



**Repositorio Institucional de la Universidad Autónoma de Madrid**

<https://repositorio.uam.es>

Este es la **versión enviada** del libro publicado en:  
This is a **submitted version** of a book published in:

Pustejovsky, James; Batiukova, Olga. The lexicon. Cambridge: Cambridge University Press, 2019.

**Copyright:** © James Pustejovsky and Olga Batiukova 2019

El acceso a la versión del editor puede requerir la suscripción del recurso

Access to the published version may require subscription

# **Lexicon: Cambridge Linguistics Textbook Series**

James Pustejovsky and Olga Batiukova

# Contents

0.1	Preface	<i>page</i> 8
0.1.1	Audience	8
0.1.2	Features of this text	8
0.1.3	Organization of this book	9
0.1.4	Conventions used in this book	10
0.2	Acknowledgments	10
<b>Part I</b>	<b>The Lexicon in Linguistic Theory</b>	<b>1</b>
<b>1</b>	<b>Introduction</b>	<b>3</b>
1.1	Overview	3
1.2	What is the Lexicon?	3
1.3	What is a word?	5
1.4	Lexeme, word form, and grammatical word	8
1.5	What is in a lexical entry?	9
1.6	The role of empirical data in lexicon research	10
1.6.1	Naturally occurring data	10
1.6.2	Naturally elicited data	11
1.6.3	Experimentally elicited data	12
1.6.4	Data in the linguistic research cycle	14
1.7	Goals of Linguistic Theory and the Notion of Grammar	15
1.8	Summary	16
1.9	Further readings	17
1.10	Exercises	17
<b>2</b>	<b>Lexicon and Syntax</b>	<b>20</b>
2.1	Overview	20
2.2	What is Syntax?	20
2.3	Syntactically relevant lexical features and lexically-dependent syntactic phenomena	25
2.3.1	Syntactic category	26
2.3.2	Semantic Features and Semantic Types	30
2.3.3	Countability	31
2.3.4	The Interaction of Lexical Features	38
2.4	Summary	38
2.5	Further Readings	39
2.6	Exercises	39

<b>3</b>	<b>Lexicon in Syntactic Frameworks</b>	41
3.1	Overview	41
3.2	The Lexicon from Aristotle to Structuralism	41
3.3	Generative Grammar	47
3.4	Head-Driven Phrase Structure Grammar (HPSG)	53
3.5	Lexical-Functional Grammar (LFG)	57
3.6	Construction Grammar	61
3.7	Lexicon in its own right: Generative Lexicon	64
3.8	Summary	73
3.9	Further Readings	73
3.10	Exercises	74
<b>4</b>	<b>Lexicon and Semantics</b>	76
4.1	Overview	76
4.2	What is Semantics?	76
4.2.1	Sentence Meaning and Inference	77
4.2.2	Word Meaning and Lexical Relations	80
4.3	Conceptual Meaning	81
4.3.1	Referential Models of Semantics	81
4.3.2	Representational Theories of Meaning	83
4.3.3	Rich Denotational Models of Semantics	85
4.4	Associative or Connotative Meaning	89
4.5	Literal and non-literal meaning	90
4.6	Summary	92
4.7	Further Readings	93
4.8	Exercises	93
<b>5</b>	<b>Lexicon in Semantic Frameworks</b>	95
5.1	Overview	95
5.2	Formal semantics	95
5.3	Conceptual Semantics	100
5.4	Cognitive Linguistics	104
5.5	Prototype theory	109
5.6	Natural Semantic Metalanguage	113
5.7	Summary	115
5.8	Further Readings	116
5.9	Exercises	117
<b>Part II</b>	<b>Lexical Structures</b>	119
<b>6</b>	<b>The Structure of a Lexical Entry</b>	121
6.1	Overview	121
6.2	Linguistic vs. Extralinguistic Knowledge in the Lexical Entry	121
6.2.1	Conventional dictionary definitions and their types	123
6.3	Linguistic Structures	124
6.3.1	Typed Feature Structure	124
6.3.2	Argument Structure and Predication	125

---

6.3.3	Event Structure	130
6.3.4	Qualia Structure	133
6.4	Conceptual Structures	135
6.4.1	Image Schemas	135
6.4.2	Frames and Scenes	137
6.4.3	Conventional Attributes	138
6.5	Properties of lexical entries	140
6.5.1	Ambiguity, polysemy, and homonymy	140
6.5.1.1	Tests of sense Distinctness	141
6.5.1.2	Polysemy and Homonymy	143
6.5.1.3	Regular Polysemy	144
6.5.2	Vagueness and Underspecification	146
6.6	Summary	147
6.7	Further readings	147
6.8	Exercises	148
<b>7</b>	<b>Semantic Typing and Decomposition</b>	<b>150</b>
7.1	Overview	150
7.2	Strategies for Lexical Decomposition	150
7.3	Semantic Types	155
7.4	Qualia Structure as Semantic Types	160
7.5	Summary	165
7.6	Further Readings	166
7.7	Exercises	166
<b>8</b>	<b>Argument Structure</b>	<b>168</b>
8.1	Overview	168
8.2	The Basics of Function-Argument Behavior	168
8.2.1	Motivating Argument Structure	168
8.2.2	Argument Structure and Lexical Meaning in the Predicate	170
8.2.3	Arguments and Adjuncts	176
8.2.4	Unexpressed Arguments	179
8.3	Argument Structure in Verbs	181
8.3.1	Semantic Roles and Related Notions	181
8.3.2	Verbal Valency	185
8.4	Argument Structure in Nouns	187
8.5	Argument Structure in Adjectives	193
8.6	Argument Structure in Prepositions	195
8.7	Summary	198
8.8	Further Readings	199
8.9	Exercises	200
<b>9</b>	<b>Lexical Aspect, Tense, and Modality</b>	<b>202</b>
9.1	Overview	202
9.2	Events as Arguments of Natural Language Predicates	202
9.3	Internal Temporal Makeup of Events: Event Structure	203
9.3.1	Perspectives on Event Decomposition and Event Structure	204

9.3.2	Event Type as a Property of Phrases and Sentences	211
9.3.3	Event Type Diagnostics	213
9.3.4	Eventive Readings of Nouns and Adjectives	217
9.4	Tense-Aspect Details	220
9.5	Modality	224
9.6	Summary	230
9.7	Further Readings	231
9.8	Exercises	232
<b>Part III</b>	<b>Lexicon as a System</b>	<b>235</b>
<b>10</b>	<b>General Architecture of the Lexicon</b>	<b>237</b>
10.1	Overview	237
10.2	Lexical Architecture	237
10.3	Syntactic Type Hierarchy	239
10.4	Semantic Type Hierarchy	241
10.5	Lexical Semantic Relations	248
10.6	Morphology and Word Structure	257
10.7	Summary	261
10.8	Further Readings	262
10.9	Exercises	263
<b>11</b>	<b>Compositionality in the Mapping from the Lexicon to Syntax</b>	<b>265</b>
11.1	Overview	265
11.2	The Basics of Compositionality	265
11.3	Apparent Violations of Compositionality	271
11.4	Main approaches to compositionality	278
11.5	Non-compositional constructions	286
11.6	The Lexicon and Grammar: Outstanding Problems	290
11.7	Summary	293
11.8	Further readings	294
11.9	Exercises	295
<b>Appendix A</b>	<b>Answers to Selected Exercises</b>	<b>297</b>
<b>Appendix B</b>	<b>Online resources</b>	<b>311</b>
<b>Appendix C</b>	<b>Glossary</b>	<b>313</b>
<b>Appendix D</b>	<b>Subject Index</b>	<b>327</b>
<b>Appendix E</b>	<b>Name Index</b>	<b>328</b>
	<i>References</i>	329

## 0.1 Preface

This book is the first textbook on the lexicon in the Cambridge Textbooks in Linguistics series. It is intended as an in-depth introduction to the theory and structure of the lexicon in linguistics and linguistic theory. This text offers a comprehensive treatment of lexical structure and design, the relation of the lexicon to grammar as a whole, and to methods of interpretation driven by the lexicon.

The present text examines the structure of lexical information within the context of both traditional and newly emerging views on the role of the lexicon in linguistic theory. No single syntactic framework in linguistics is assumed. Rather, the linguistic phenomena are observational, while the proposed mechanisms and explanations to account for these data can be seen as generally theory-neutral. Nevertheless, a strong theoretical claim is made for specific, generatively oriented, structural principles, characterizing the behavior of lexical items in relation to grammar.

### 0.1.1 Audience

This book is written for anyone interested in knowing more about the lexicon and its general design, and in using lexical data for specific tasks, both theoretical and applied. In other words, it aims at answering the following questions: (1) what is the lexicon, what does it contain, and how is it structured?; (2) what principles determine the functioning of the lexicon as a component of natural language grammar?; and (3) what role does lexical information play in linguistic theory (e.g., how is lexical information exploited by other components of grammar)? The approach taken is strongly data-oriented and has as one of its essential goals to provide the reader with a set of tools enabling work with lexical data for all kinds of purposes.

Having a linguistics background is not required, although a basic (introductory course level) knowledge of grammar will make the formal details and representations easier to follow. For this purpose, we suggest *A Student's Introduction to English Grammar* (Huddleston and Pullum 2005) and other references listed in sec. 1.9 of Chapter 1. Two more textbooks we highly recommend for acquiring additional background on different aspects of lexical theory are *The Lexicon. An Introduction* (Ježek 2016), which covers a wide range of topics related to the internal structure of the lexicon and its usage, and *Lexical Meaning* (Murphy 2010), which deals with word meaning and different approaches to its study.

This textbook can be used for both introductory and advanced courses in the study of the lexicon and for courses that touch upon different aspects of the lexicon, such as: lexical semantics, lexicography, syntax, general linguistics, computational lexicology, ontology design, etc. The book is structured in such a way that its contents are easily customizable to a specific course level, set of objectives and requirements, and instructional strategies.

### 0.1.2 Features of this text

The overall structure of the book is uniform, where each chapter has an *Overview* and a *Summary* section, which are meant to help the student by adding context and connecting the various strands of the topic. The former is intended to introduce the content covered in the chapter

and to contextualize them with respect to previously presented material. The latter sums up succinctly the main points addressed in the chapter, thus allowing the reader to reflect on what has been learnt. The *Glossary* provided in Appendix C may be used as review material, too, as it contains definitions of the key concepts introduced in the book.

Extensive problem sets offered in the Section *Exercises* of each chapter as well as questions labeled as DISCUSS, which are integrated into the exposition of different topics, ensure that the students are actively engaged with the essential content and effectively acquire the necessary knowledge and skills of the topic. The discussion points are meant to ensure that the students approach the topics presented critically and open-mindedly, and are better suited for in-class activities and group discussion. The exercises may be preferably used for individual assignments and their ultimate goal is to provide the necessary feedback on the learning process results. Answers to the exercises are provided in Appendix A.

Two more features are framed as boxes: CLUE/COMMENT and WARNING. The CLUE/COMMENT boxes contain additional comments (definitions, historical remarks, data from languages other than English, etc.). The WARNING boxes are meant to prevent common terminological misunderstandings and introduce important exceptions to the generalizations presented in the text.

The *Further Readings* sections provide lists of references on the topics covered in each chapter. *Primary references* are more appropriate for advanced students and as additional sources for the instructor, while *secondary references* are helpful for students who need to strengthen their background or look for a more detailed explanation of the contents included in the corresponding chapters. Additional resources available online are provided in Appendix B, which is structured in four sections: *General links*, *Lexical databases and lexicons*, *Modern theoretical frameworks*, and *Corpora and corpus query systems*.

The following brief cross-reference guide may be useful if the instructor plans on covering specific aspects of the lexicon in class:

- *word* and other key concepts in lexical study: ch. 1
- lexical semantics: ch. 4-7
- lexicon-syntax relations: ch. 2, 3, 8, 11.
- lexicography: ch. 1, 6
- word meaning: ch. 4-7
- lexical-semantic relations: ch. 4, 10
- lexical ontology and type system: ch. 10
- lexical morphology: sec. 10.6
- syntactically and semantically oriented approaches to the lexicon: ch. 3, 5
- lexical structures: ch. 6-9
- verbal semantics and syntax: sec. 2.2, 2.3, 6.3.2, 6.3.3; ch. 8, 9
- nominal semantics and syntax: sec. 2.3, 6.3.4; ch. 7
- lexical data and empirical methods in lexicon research: sec. 1.6

### 0.1.3 Organization of this book

A general “bottom-up” pedagogic approach has been followed in organizing the book, which we believe allows one to integrate the new ideas and topics with the preceding ones as the book proceeds.

Part I (*The Lexicon in Linguistic Theory*) contains three introductory chapters on the key concepts in lexical study (Chapter 1), the relation between lexicon and syntax (Chapter 2), and the



relation between lexicon and semantics (Chapter 4). Chapters 3 and 5 show how these concepts have been treated in different theoretical frameworks.

The component pieces of the lexical entry are dealt with in Part II (*Lexical Structures*): they are presented at a general level in Chapter 6, and are further detailed and applied to specific syntactic categories in Chapters 7, 8, and 9.

The various threads introduced in the above chapters come together in Part III (*Lexicon as a System*), in two chapters dealing with higher levels of lexical and syntactic organization: the general architecture of the lexicon (Chapter 10) and the mapping from the lexicon to syntax and its effects on compositional interpretation of complex linguistic expressions (Chapter 11).

#### 0.1.4 Conventions used in this book

The following typographical conventions are used in this book:

##### **Bold face**

Indicates new terms, followed by definitions when necessary.

##### *Italics*

Indicate previously introduced technical terms and signal a metalinguistic use of an expression (e.g., *book* used to refer to the word *book* in English rather than to the physical object this word represents).

##### SMALL CAPS

Small capital letters signal major conceptual and linguistics categories, as well as semantic types (e.g., EVENT, LOCATION, HUMAN, etc.).

##### *\*, #, ?*

When preceding a linguistic expression, these symbols signal different acceptability judgments (i.e., whether a native speaker would judge such an expression as “good” or acceptable, or not):

\* marks *grammatically* unacceptable (ungrammatical) sequences

# marks *semantically* and *pragmatically* odd expressions

?, ?? marks expressions which are not as bad as those following a star (\*), but which still are perceived as more or less odd or inadequate syntactically, semantically, and sometimes pragmatically.

##### [MAGNIFYING GLASS ICON FOR CLUE/COMMENT]

This icon signifies a general note, an additional comment, or a clue.

##### [EXCLAMATION MARK FOR WARNING]

This icon indicates a warning or caution.

## 0.2 Acknowledgments

We are very grateful to everyone at CUP who helped us see through this project: in the first place, Andrew Winnard, and also Lisa Pinto and Rosemary Crawley. Many friends and colleagues from both sides of the Atlantic gave us their feedback on different parts of the manuscript or at

---

some point discussed with us the issues it deals with: Mark Verhagen, Elena de Miguel, Annie Zaenen, Lauri Karttunen, Nicholas Asher, Pier Marco Bertinetto, and Elisabetta Ježek. We would also like to thank the anonymous CUP reviews for their valuable input. We are also in debt with our students, past and present, who we always kept in mind while writing this textbook.

James adds: I would very much like to thank my family, Sophie and Zachary, for putting up with this project for so many years. I would also like to thank Karen, for her patience and support over the past two years while we finished this book. And of course infinite thanks to Olga, for ensuring that the book would be finished at all!

Olga adds: I would like to thank my husband, Iván, for his support, encouragement, and patience in spite of all the time and energy that my work takes away from him, and also Noa for having let me finish the book and for making me the happiest person on earth with her smile. Lots of love and gratitude to my family and especially my parents Viacheslav and Valentina, who always believed in me and helped me believe in myself. And many thanks to James for having offered me the chance to undertake this project with him and for everything I learnt from him.

James Pustejovsky, Olga Batiukova  
April, 2018

## **Part I**

---

# **The Lexicon in Linguistic Theory**

# 1 Introduction

---

## 1.1 Overview

In this introductory chapter we outline the basic concepts covered and terms used in this book. We first introduce the notion of *mental lexicon* and explain how it is different from the word listings familiar from most dictionaries. The next issue we address is the definition of *word* as a basic unit of language: we present the different criteria of ‘wordhood’, and lay out a preliminary approach to the notion of *lexical entry* and its structure (dealt with in more detail in Chapter 6). In order to explain how different kinds of lexical data should be treated and how they can be used to validate theoretical claims, we offer a general typology of lexical data coupled with the research methodology usually adopted in each case. Finally, we present a general vision of the concept of *natural language grammar* and establish the role of the lexicon as one of its core modules.

## 1.2 What is the Lexicon?

Loosely speaking, the **lexicon** is a collection of words capturing the knowledge that speakers and hearers have about basic lexical expressions in a language. There is no question that our repertoire of words (what we will call our **mental lexicon**) is large, containing up to 350,000 lexical entries. This is based on fairly conservative estimates of speaker competence with **active vocabulary** (do I know how to use it?) and **passive vocabulary** (do I understand it?). For example, an average speaker’s lexicon might contain at least 5,000 different verbs, 30,000 distinct nouns, and over 5,000 adjectives. Combine this with an additional 20,000 compound forms and at least 300,000 distinct proper names, and the lexicon grows fairly large indeed. This certainly indicates that the organization of our mental lexicon has the capacity for storing large amounts of information.

Furthermore, words are retrieved from the mental lexicon surprisingly fast: when reading, it takes us less than half a second to decide whether the sequence of letters we see is a real word (e.g., *parrot*) or a non-word (e.g., *varrot*), a problem known as a **lexical decision task** in psycholinguistics. This would be impossible if words were just randomly heaped up in our mind. Rather, this suggests that the lexicon is a highly organized and very complex system.

The notion of a lexicon as a reference list of words is familiar to anyone who has used a dictionary or studied a foreign language. However, there are a number of important differences between the mental lexicon and conventional dictionaries, designed by people for specific purposes. In the words of Hanks (2000), “checklist [numbered lists] theories in their current form are at best superficial and at worst misleading. If word meanings do exist, they do not exist as a checklist.” Hanks believes that the very structure of dictionary **definitions** has given people a

false impression of how language is used, and certainly how it is organized. Most book dictionaries emulate a *sense-enumerative lexicon* strategy, which are essentially lists of words, wherein each lexical entry represents a different word, and each lexical entry is structured as a list of senses. *Homonyms* (words having the same sound and spelling but different, unrelated meanings, cf. sec. 6.5.1) are treated as different words (i.e., different lexical entries), and logically related meanings of the same acoustic and written form are treated as different senses of the same *polysemic* word within the same lexical entry. For example, the following entries from the Merriam-Webster Online Dictionary illustrate how both cases (*polysemy* and *homonymy*) are dealt with in conventional dictionaries:

- (1) <sup>1</sup>*race* *noun*
1. the act of running
  2. a strong or rapid current of water flowing through a narrow channel
  - ...
- <sup>2</sup>*race* *verb*
1. to compete in a race
  2. to go, move, or function at top speed or out of control
  - ...
- <sup>3</sup>*race* *noun*
1. a breeding stock of animals
  2. a family, tribe, people, or nation belonging to the same stock
  - ...

As we can see, there are three lexical entries corresponding to *race*, two of which are nominal and one verbal. The ‘act of running’ sense and the ‘current of water’ sense are treated as related, they are included in the same lexical entry, and so are the different submeanings included in the other two entries. The ‘act of running / water current’ meaning cluster is treated as unrelated to the other nominal sense (referring to a group of common descent), or to the verbal meanings. Is this division justified? Most speakers would probably agree that the first and third lexical entries are not logically related. But what about the first and second entries? Can we state in good faith that the act of running and the running competition are totally unrelated? Hardly: both are obviously related, and the noun *race* is even used in the definition of the verb *race*.

The lexical entries and word senses in such listed representations are *isolated* and *compartmentalized*, there is no straightforward way to establish a connection even between related word senses in the same lexical entry, let alone different lexical entries. To a large extent, this is due to the fact that the lexical meanings are presented as *atomic*: even though in each case there is a specification of the more general class to which the defined entity, property or event belong (‘act’, ‘current’, ‘stock’ in (1)), there is no systematic indication of how these classes and, consequently, the defined terms are arranged and related among themselves.

A further indication of why this is not how the mental lexicon is organized is the order of lexical entries. Alphabetical order is convenient for human search and use. However, it does not seem to reflect the characteristics or properties of everyday language use, such as frequency and semantic and morphological relatedness. For example, the proximity of one word to another in the alphabetical order seems to have little to do with how they are related to each other: *abdicate* and *accolade*, or *table* and *taboo* are relatively close in a dictionary, but this is only because they share the first letter or two, and not because they are related semantically or syntactically (cf. sec. 1.6).

Another important property of the mental lexicon is that we naturally assign words to categories and larger conceptual classes. While such groupings (referred to as *hypernyms*, see Section 10.5) are typically captured in print dictionaries, humans can easily distinguish instances of such categories – that is, typical representatives of a class – from those which are not as typical (cf. sec. 5.5). Thus, we know that an *apartment* or a *house* are more typical kinds of *housing* than, say, a *tent* or a *barrack*. This has proven to be an important distinction, giving rise to *typicality effects* in experimental psycholinguistic studies. However, the closeness of the defined term to the prototype is not accounted for in conventional dictionaries: both *apartment* and *barrack* are defined as *housing*.

**WARNING: Typicality Effects in Dictionaries**

Of course, there are exceptions to this characterization even among conventional dictionaries, for example the “Diccionario del español usual en México” (Lara Ramos, 1996). Anna Wierzbicka also advocates enriching the lexicographical entries with the information related to stereotypes and other socially and culturally relevant information in her natural semantic metalanguage proposal (Wierzbicka 1985a, see sec. 5.6).

The list of entries and senses registered in the dictionaries (even very large ones) is finite and thus incomplete for obvious reasons: only the *actual* uses of words in a language will ever appear in a dictionary, usually after they have been circulating for some time. The *potential* uses of a word (sense extensions, contextual modulations and so on) are not reflected in a dictionary, or even predictable, although we continuously witness the spontaneous creation of novel senses of existing words or even new words, which is an important source of linguistic creativity.

Finally, the information on how words function in context is very limited in book dictionaries, and it does not allow relating the lexical features of the described item to their syntactic projection. The only syntactically relevant feature provided in the example (1) is the syntactic category (verb or noun). It does not explain, for example, why the noun *race* can be the direct object of the verb *witness* or can be modified by the adjective *fast* (unlike many other nouns, such as *table*: we cannot *witness a table* and there is no such thing as *fast table*).

From our discussion above, it should be clear that conventional dictionaries are not an accurate reflection of the *mental lexicon*: print dictionaries provide an incomplete, static view of our knowledge of words and how they are used in language. By contrast, it appears that the mental lexicon is flexible, extensible, and much more richly structured.

### 1.3 What is a word?

The notion of *word* is deeply rooted in the Greco-Latin grammatical tradition: it is assumed to be a basic unit of language, which demarcates the border between morphology and syntax: morphology deals with the internal composition of words and syntax deals with the combination of words. Also, it seems easy to grasp intuitively: we know a word when we see one, so we think. When presented with the following list, a native speaker of English would: surely identify (2a) as a word; reject (2b) because she has never heard it before and because it doesn’t look like an English word; claim that (2c) is an expression composed of four words, as is (2d) (probably with a little hesitation about the status of *a*, to which we will return later).

- (2) a. orange  
 b. aeegf  
 c. Give it to me!  
 d. become a compulsive liar

#### DISCUSS

Do you agree with this? Whether or not your opinion is the same, try to motivate your answer. Use the following as guiding questions:

- What criteria did you use to decide whether or not a given sequence of letters is a word? Did you consistently use the same criteria for all the cases?
- Should we define *orange* as one or two words, depending on whether it refers to the fruit or the color? Are both senses related?
- Would equivalent linguistic expressions in other languages qualify as words, too?
- Would your answer be the same if you perceived these expressions acoustically and not visually?

As you probably realized at this point, a considerable amount of complexity is hiding behind this intuitively simple notion, especially if we try to find a more technical definition of word. To a large extent, this complexity is due to the inherently intricate nature of the word, which is a highly structured object: it has internal constituents (studied in morphology) and it is used to build bigger linguistic expressions (studied in syntax); it conveys meaning (studied in semantics), and it has graphic and acoustic identity (as studied in orthography, and phonetics and phonology, respectively). Depending on which of these perspectives on wordhood we adopt, we will end up with the following definitions:

#### (3) Orthographic word

A sequence of letters written consecutively, with no blank spaces.

In the above examples, (2a) would certainly count as a word according to this definition, which seems to confirm our initial intuitions. But so would (2b), which certainly seems counterintuitive because we cannot assign any meaning to this sequence of letters (we take up the meaning component of wordhood shortly). (2c) and (2d), in turn, have four orthographic words, but we would probably have to answer differently when dealing with other languages: the Spanish equivalent of *give it to me* is written with no spaces (*dámelo*, lit. ‘give-me-it’), and *become a compulsive liar* is expressible with a single verb in Russian: *izolgat’sja*. Does it make sense? As it turns out, there is much cross-linguistic variation in the definition of word.

#### (4) Phonological word

“A string of sounds that behaves as a unit for certain kinds of phonological processes, especially stress or accent” (Aronoff and Fudeman, 2011, 40).

The stress criterion is relevant in English and in many other languages (although there are many other phonological criteria, depending on the language), where a phonological word must have a stress. But, again, we find a counterexample in (2c): under normal circumstances, *give it to me* is pronounced with just one main stress, on *give*, which makes the whole expression one phonological word and seems to indicate that *it*, *to*, and *me* are not treated like words by the phonology. These kinds of linguistic elements, which are syntactically (and sometimes orthographically, as

in English) independent, but which cannot stand alone phonologically, are called **clitics**; they usually need to be incorporated into the prosodic structure of adjacent words.

CLUE/COMMENT[magnifying glass icon]: **Prosodic** or **supersegmental** features are stress, rhythm, pitch, volume, and intonation. They characterize strings of sounds or phonemes rather than individual sounds.

Consider the ways that stress can convey different kinds of meaning: in (a) below the pronoun *it* is used *metalinguistically* (we talk about the word *it* instead of using it to refer to a real-world entity); the preposition *to* in (b) carries contrastive stress, to highlight the opposition between *to* and *from*; finally, the personal pronoun *me* in (c) is used after a pause in an elliptical construction.

- a. What does *it* stand for in this sentence?
- b. I said I was returning *to* Madrid, not *from* Madrid.
- c. What do you think about this book? - Who, *me*?

(5) **Content words** (lexical categories)

Content words encode a rich conceptual meaning, related to the real world.

(6) **Function words** (functional categories)

Function words denote much more abstract, language-internal meaning.

The lexical vs. functional category distinction is a fundamental one in syntactic studies, and we are following the syntactic perspective on it in this section (although it is not the only one, as will be demonstrated).

Lexical categories are also called *content words* or *semantic words* because they carry meanings that denote or describe things in the world: they refer to real entities (*table, sun, book, crowd*), imaginary entities (*unicorn, horcrux, holodeck*), events (*blow, coronation; teach, explode*), and properties (*whiteness, wisdom; tired, pretty*). In most approaches, lexical categories include nouns, adjectives and verbs. The lexical categories largely overlap with the so-called “open-class lexical items”, the latter term referring to the fact that new words can be introduced into the lexicon by speakers of the language, and that they can also fall into disuse. The acquisition of open-class words is a life-long process for every speaker. It is also usually a conscious one: even young children can explain what *table* or *milk* means, and can point to the objects in the real world denoted by these words.

Functional categories, on the other hand, represent a very restricted and synchronically stable (closed) repertoire: the speaker cannot coin a new determiner or auxiliary verb voluntarily. The following syntactic classes are usually considered functional categories: prepositions (e.g., *in, to, of*), conjunctions (e.g., *and, or, until*), complementizers (*that, if, whether*), pronouns (*she, him, themselves*), determiners and quantifiers (e.g., *a, the, her; most, more, several*), and auxiliary verbs (*do, be*).

The function words are acquired for life in early childhood and their content is much less accessible consciously, which is one of the reasons why adult second language learners usually have a hard time acquiring these categories even if their vocabulary is extensive in general: how would you explain to your Czech friend what *the* or *a* means (Czech has no indefinite/definite distinction)? The meaning of these words seems to be language-internal and very abstract: e.g., *a* introduces new entities belonging to a certain class into the discourse (8a), and *the* establishes definite reference: it appears in nominal groups referring to uniquely identifiable entities, which are known from previous context (8b):



- (7) a. I saw {a/ the} cat.  
b. Viděl jsem kočku.
- (8) a. I just saw *a cat*. (in a context where there was no cat before)  
b. I just saw *the cat*. (in a context where a cat had been mentioned or alluded to previously)

Some function words, however, do have a much more transparent meaning. The semantic content of spatial prepositions (*under, on, in, between*, etc.), for example, is much easier to grasp. While the distinction between lexical and functional words is not a clear one in many cases, it has far-reaching consequences for syntactic theory and the articulation of the relationship between syntax and the lexicon: although both kinds of elements are sound-meaning pairings, roughly, function words belong to the realm of syntax, since they are instrumental in combining different words in phrases and sentences, and lexical words belong to the realm of lexicon, understood as the repository of different kinds of idiosyncratic, not uniquely linguistic, information. If we compare syntactic structures with buildings (again, following the syntactic perspective on this opposition), the lexical words would be the bricks or building blocks, and the function words would be the cement or the glue that holds the bricks together. Without the function words, the syntactic structure would fall apart. For example, the sentence (2c) above would turn into the generally uninterpretable, *Give!*, if we remove the function words.

Considering how complex and typologically heterogeneous an entity a *word* is, we might ask whether it should still be considered a linguistic technical term at all. Researchers working in different subfields of linguistics seem to opt for a positive answer to this question. Independently of which criterion of wordhood (orthographic, phonological or grammatical) prevails in any given language, there seems to be reliable psychological evidence that ‘word’ is an important *cognitive* unit. One of the proofs is the **word superiority effect** detected in psycholinguistic studies: letters are processed faster and more accurately when they are embedded in a word rather than presented alone or within a random sequence of letters, which indicates that words have some kind of access advantage as compared to non-words or single letters.

At this point, we are ready to introduce the definition of ‘word’ as adopted throughout the book. Unless otherwise noted, we assume that ‘word’ used in the context of linguistic theory has the following definition:

(9) **Word**

A “meaning-form” pairing (i.e., association of an acoustic or graphical form and meaning) used in forming a sentence in a language and intuitively recognized by native speakers as the basic unit of meaningful speech.

CLUE/COMMENT[magnifying glass icon]: This definition comes from the classical Saussurean definition of **linguistic sign**, which has been used in linguistics since the beginning of the 20th century: “the linguistic sign unites a concept [signified] and a sound-image [signifier]” (Saussure, 1966).

## 1.4 Lexeme, word form, and grammatical word

After this detailed review of all the things that *word* stands for, you may still wonder whether there is a way of referring to a word in all its richness, with all these nuances? In fact, there is one. **Lexeme** is the term used to refer to the word as an abstract linguistic unit, which represents

all the information we associate with a lexical item out of context, i.e., its inherent features. It is abstract because words are always used in context (except the *metalinguistic uses*), and because none of the words we actually hear or read are lexemes: they are (physical or acoustic) **word forms** or **grammatical words**.

We can also talk about lexemes as *types* and word forms as *tokens*. The type-token distinction is familiar to anyone who has dealt with multiple instances of the same kind of object: coins, apples, books, etc. If you buy two copies of the same book, you have two *tokens*, but just one *type*. In the actual use of linguistic utterances we make reference to linguistic types but each use of the type is a specific token. For example, in (10), the number of **tokens** of the **type** *the* is 3: i.e., # of types = 1, # of tokens = 3.

(10) **The** boy bought **the** pizza at **the** store.

In order to refer to a lexeme (e.g., in a dictionary), one of its forms is used conventionally, which is called the **lemma** or the **citation form**. For example, in most European languages the infinitive is used as the citation form for verbs (*go*, *break*), the singular masculine form is used for adjectives and participles (*green*, *broken*), and the singular is used for the nouns (*woman*, *house*).

Once the lexeme is inserted into the syntactic context, it becomes a *grammatical word* or *word form*. In the sentence, the lexeme acquires additional syntactic features. In the following example, there are two word forms corresponding to the lexeme *to be* (*were* and *was*) and two word forms corresponding to the lexeme *week* (*week* and *weeks*):

(11) **Were** you in Cape Cod last week? - Yes, I **was** there for the last two weeks.

In both cases, the verb acquires the past tense features and, in addition, it must agree in person and number with the subjects *you* and *I*, respectively. The noun, on the other hand, is realized in the singular and plural grammatical number forms (*week*, *weeks*, respectively).

## 1.5 What is in a lexical entry?

In order to understand what information needs to be represented in a **lexical entry**, imagine for a second that you are given a list of new terms in English, which you have to memorize and learn how to use in context. What kind of data would you need to include for every lexical item, in order to achieve this goal? As we will see in more detail in Chapter 6, there are at least four types of information in a lexical entry: *orthographic* (how do I write the word?); *phonological* (how do I pronounce the word?); *semantic* (what does the word mean?); and *syntactic* (what other words is this one compatible with in a phrase or a sentence?).

Let's take as an example, the word *table*. We first need to specify its spelling (*table*) and pronunciation (/ˈteɪbəl/). As we have seen, semantic information is often provided through paraphrases called **definitions** in the dictionaries. The following is the definition of *table* taken from the Merriam-Webster Online Dictionary:

(12) **table**: a piece of furniture with a flat surface that is designed to be used for a particular purpose.

Like most dictionary definitions, this one is composed of two parts: the **definiendum**, which is the word being defined; and the **definiens**, which is how it is defined. The definiens makes reference to two features: (a) the larger class which the word meaning is included (i.e., *furniture*); and (b)

the set of distinctive features which differentiates this concept from the other members of the same class (i.e., *with a flat surface and designed to be used for a particular purpose*).

As shown at the beginning of this chapter, the syntactic information provided in the dictionaries is usually limited to the **syntactic category**: e.g., *table* is a noun. This is an important piece of data, from which we can deduce (with the help of **syntactic rules**) that *table* is projected in the syntax as the **head** of the noun phrase. As such, it is compatible with certain kinds of complements (adjectival and prepositional phrases: [<sub>NP</sub> [<sub>AP</sub> red] table], [<sub>NP</sub> table [<sub>PP</sub> by the window]]), and it can be used as a complement of higher-level functional projections, for example within a determiner phrase (DP): [<sub>DP</sub> the/three [<sub>NP</sub> red tables]]. However, it says nothing about more fine-grained requirements this noun imposes on its complements. Recall the ungrammatical *\*fast table* example: if any kind of adjective was compatible with *table*, *fast* should be able to combine with it, just as well as the adjectives *red* or *nice*, but this is not the case. Also, it does not account for the interpretation of *useful table*, for example: the speakers know that it means ‘useful for a particular purpose’ (writing, cooking, etc.), but this meaning cannot be inferred from the dictionary definition.

Print dictionaries are a useful source of linguistic data, but as we will see in the following chapters the structure of the lexical entry in the mental lexicon requires a much richer and much more complex representation. Chapter 6 deals with this topic in detail and shows formally how the different kinds of information are connected in a **lexical entry** (in particular, how the word meaning components affect the syntactic behavior of the word).

## 1.6 The role of empirical data in lexicon research

Determining the appropriate kind of data is, of course, critical for the development of a theory in any empirically-oriented field of scientific research. The theory being constructed must be evaluated against the data we have chosen as relevant, in order to be validated. As we will see in this section, the very nature of the **linguistic data** determines the linguistic methodology to a great extent.

### 1.6.1 Naturally occurring data

Linguists deal with two kinds of data: finite expressions, which we can list exhaustively (at any given point in time, the set of **phonemes** and **morphemes** in a given language is stable) and potentially infinite expressions, which cannot be exhaustively enumerated (combinations of words as phrases and sentences).

- (13) **Phoneme**: an abstract unit of the phonetic system which is perceptually distinct from other sounds in the same language. Phonemes are not endowed with meaning but they can distinguish one word from another. For example, /b/ and /p/ are two English morphemes which are similar (both are plosive bilabial consonants) but are perceived as different by speakers (/b/ is voiced and /p/ voiceless) and can distinguish words, as in *bet* and *pet*.
- (14) **Morpheme**: the smallest linguistic unit with a lexical or grammatical meaning. Morphologically simple words can have just one morpheme (*sun*, *get*, *black*) and morphemes can be smaller than a word (e.g., *un-*, *believ*, and *-able* in *unbelievable*).

The first kind of data are directly observable and can be characterized, more or less, completely

for a given language. The second kind of data, however, due to the creative nature of language, is only observable in part, by sampling from available resources: (a) our own language intuitions (*naturally elicited* data); or (b) attested data that comes from linguistic *corpora* of some sort (*naturally occurring* data). Lexicographers and corpus linguists take *naturally occurring* data to be the primary source for making generalizations and theoretical statements about a language.

- (15) **Corpus:** A collection of linguistic elements (usually texts) selected and ordered according to explicit linguistic criteria in order to be used as a representative sample of the language.

CLUE/COMMENT[magnifying glass icon]: The plural of *corpus* is *corpora*.

In other words, a corpus is a finite snapshot of a natural language. In order to be a source for creating a reliable model of linguistic reality, the corpus must be *balanced*, i.e., it must contain quantitatively proportional samples of different kinds of texts, according to the medium of publication (journals, newspapers, books, brochures, etc.), genre (poetry, theater, fiction, essay, etc.), topic (biology, literature, arts, etc.), and geographical origin (e.g., American vs. British English, or European vs. Latin American Spanish). The corpora allow us to establish the existence and relative frequency of different linguistic phenomena, and they are especially useful for the study of contextual distributions of different lexical items, which is one of the central issues in lexicological and lexicographic research.

Current linguistic corpora can be very large, consisting of millions, hundreds of millions, and even several billion words; they can also be processed relatively easily for simple search and retrieval operations. They are usually *annotated* with various metadata (author, document production time, source, genre, language) and linguistic information (part of speech, word sense, and other syntactic and semantic information).

### 1.6.2 Naturally elicited data

As far as theoretical linguistics is concerned, the source and scope of the data examined will have a direct impact on the generality and breadth of the explanations that the theory makes about language. If you merely look into what is directly observable, you risk eventually coming across a new piece of data which can refute your theory. If you want to go further, you have to find a way to *elicit* (build or obtain) those data which do not occur naturally (for example, because they are infrequent or very specific).

The needed data can be elicited *naturally* or *experimentally*. *Naturally elicited data* are usually referred to as *introspective* in theoretical linguistics: linguists often exploit their native competence to generate linguistic expressions and evaluate their acceptability. *Introspection* plays a very important role in generative linguistic studies, inasmuch as the linguistic competence of *any* speaker is representative of the linguistic competence in a given language. In the words of Chomsky (1965, 3), “linguistic theory is concerned primarily with an ideal speaker-listener, in a completely homogeneous speech community, who knows its language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of the language in actual performance”.

Let us now examine, operationally, what the procedure is for generating linguistic examples in the absence of naturally occurring data. Assume that we are interested in describing the syntactic behavior of adjectives in an English corpus, particularly those that describe events,

such as *likely*, *unlikely*, and *probable*. The corpus contains many sentences containing the target adjectives, including those shown in (16).

- (16) a. It is *likely* that Mary is coming to the party.  
 b. It is *probable* that spring will arrive early.  
 c. Mary is *likely* to come to the party.

We notice a syntactic correlation between (16a) and (16c), where the subject of the embedded sentence (*Mary*) can appear as the subject of the entire sentence. However, we observe no sentences where *probable* behaves in a manner similar to *likely* in (16c), as illustrated in (17) (where NA is “not attested”).

- (17) (NA) Spring is *probable* to arrive early.

By virtue of our own **linguistic competence**, we can **introspect** regarding the acceptability of sentences that are not attested in the corpus. Namely, (17) doesn’t appear because it is ungrammatical, and this only confirms our own linguistic intuitions regarding the adjective’s grammatical behavior, giving support to a classification that separates adjectives like *probable* from those behaving like *likely*.

CLUE/COMMENT[magnifying glass icon]: Another valuable if minor source of empirical data are the **slips of the tongue**, which can either be registered by the linguist in natural speech or else elicited. They provide valuable clues on how the lexical items are generated and retrieved, and on how they are related among themselves. These speech production errors are not produced randomly, they have been shown to be highly constrained and to affect certain kinds of segments (e.g., only phonemes and phoneme clusters present in normal speech can appear in the slips of the tongue).

There are many types of speech errors, but the ones a lexicologist is most interested in are those where the morphemes within a morphologically complex word are somehow misplaced or blended ((a) and (b)), where a wrong word is retrieved from the mental lexicon (synonym, antonym, associated word, as in (c) and (d)), or a new (possible but nonexistent) word is created (as in (e)):

- a. infinity clause → infinitive clause
- b. momentaneous (blend of two synonyms, *momentary* and *instantaneous*)
- c. This room is too damn *hot - cold* (antonyms)
- d. the two *contemporary*, er- sorry, *adjacent* buildings (similar notions in the time and space dimensions)
- e. groupment → grouping

(Fromkin 1971, Fromkin 1973)

### 1.6.3 Experimentally elicited data

**Experimentally elicited data** are usually obtained as a result of a *questionnaire* or task proposed by the experimenter to a group of native speakers. The former is used in all subfields of linguistics, where the researcher might: ask the subjects explicitly about a specific issue of interest (e.g., *Which of the following words have a negative connotation for you?*); focus on the data needed in order to investigate this issue, e.g., to fill in the blanks in a **cloze test** (a fragment of text with certain words removed), rate the linguistic expressions according to their acceptability, etc.

In *psycholinguistics*, data are elicited from a wide variety of language experiments. The ultimate goal of the experiment is to establish a relationship between **dependent and independent variables**. To this end, the independent variables are manipulated and the dependent variables are measured simultaneously, while holding constant other factors (the **control variables**) which can have an impact on the dependent variable. The tested data in psycholinguistic experiments are usually controlled for frequency and length (among other variables): other things being equal, frequent and shorter words are processed faster than low-frequency and long words, and we do not want this difference to affect the results of the experiment. The following list includes some of the most common experimental setups:

- (18) a. *letter identification*: what letter is it?
- b. *picture naming, word naming*: name the picture or read aloud the word
- c. *reading*: read the following sequence
- d. **lexical decision**: is this sequence of letters a real word?
- e. **semantic decision**: does the word refer to a living or a nonliving entity? (animacy), are the two words synonymous? (synonymy), etc.

These tasks can be combined with specific experimental techniques (eye-tracking, ERP, fMRI). **Priming** is one of the most popular psycholinguistic techniques. It is based on the **priming effect**, defined as “improvement in speed or accuracy to respond to a stimulus **target**], when it is preceded by a semantically [morphologically, phonologically, orthographically, etc.] related stimulus [called **prime**] (e.g., *cat-dog*) relative to when it is preceded by a semantically unrelated stimulus (e.g., *table-dog*)” (adapted from McNamara 2004). Thus, the presence of priming is indicative of relatedness between the prime and the target in the mental lexicon of the speakers.

These effects are recorded and quantified using either *offline* (focusing on the result of processing) or *online* (focusing on the course of processing) measurement techniques. The latter includes the following strategies:

- (19) a. **Eye-tracking**: the recording of eye movements during task, based on the assumption that eyes do not fixate on visual stimuli randomly, but stop at what is being processed by the brain and only for as long as necessary;
- b. **Neuromaging techniques** (fMRI: Functional Magnetic Resonance Imaging, and PET: Positron Emission Tomography): based on changes in brain metabolism. The brain areas activated as a response to a processing task can be detected and visualized because they demand more oxygen and therefore attract more blood flow.
- c. *Neurophysiological measure* (ERP (event-related potentials): electric response of the brain to certain external events, measured using electroencephalography. Certain types of ERP components are known to be related (although not exclusively) to language processing.

It is important to recognize that both naturally occurring and elicited data have significant drawbacks. Naturally occurring data are partial, in that they do not always contain the phenomena we want to investigate: as a result, it is very difficult to control all the variables (dialect, style, register, frequency, among others) and make them compatible with a unified theoretical framework. Importantly, naturally occurring data do not contain **negative data**, i.e., unacceptable linguistic expressions which would allow us to show what is *not* well-formed in a natural language (e.g., if we do not find the expression *fast table* in a corpus, we would not know if it is not possible at all or if it is just not attested in this particular corpus). The set of elicited data, on the other hand, usually reflect the linguistic competence of a very limited number of speakers, and, hence is incomplete or unrepresentative of the larger linguistic community. This is why it



is commonly assumed in contemporary linguistics research that both kinds of data should be combined in different stages of the research cycle.

#### 1.6.4 Data in the linguistic research cycle

When formulating a linguistic hypothesis with language data, a fairly regular cycle of development is employed, summarized below.

1. Identification of the phenomenon to be analyzed and/or formulation of the problem to be solved;
2. Formulation of an initial hypothesis or outline theory, usually backed up by a limited and manageable set of *introspective (naturally elicited)* data;
3. Testing on a much larger set of *naturally occurring data (corpora)* or *experimentally elicited data*;
4. *Quantitative and qualitative data analysis*;
5. Refinement/modification of the initial hypothesis or formulation of a new one.

Stage (1) concerns the questions we ask ourselves in lexicological research. This is an important point, since the researcher's choice of method will be substantially influenced by the nature of this question. The major goals of lexicological research can be separated into the following areas:

- (20) a. *lexical semantics*: what is word meaning, how can it be represented, how can lexical ambiguity and polysemy be accounted for;
- b. *the interaction of words in context*: what syntactic and semantic constraints does a lexical item impose on its neighbors in a sentence, what lexical features are syntactically relevant, how is sentence meaning computed; and
- c. *the internal structure of the lexicon*: how are words organized in the *mental lexicon*, what is the nature of lexical relations.

Of course, the research question raised in a concrete linguistic study must be much more specific than these general goals: we can investigate the selectional requirements of the verbs of cutting, the syntactic behavior of mass and count nominals, the hypernymic relations among types of artifacts, etc.

Regarding stage (2), the hypothesis we put forward must fulfill certain basic requirements. It should be:

- (21) a. *falsifiable*: it must be refutable by linguistic data;
- b. *empirically adequate*: it must account for the actual data;
- c. *able to generate predictions*:, it must account for the kinds of linguistic expressions that are *possible*, beyond the actual data used to test the initial hypothesis.

Stage (3) states that, whenever possible, we need to test our hypothesis on large data sets to assess the robustness of the observed phenomenon and minimize the impact of random and irrelevant factors which can affect our conclusions (e.g., individual differences between speakers: age, educational level, dialectal and idiolectal specificities, etc.).

In stage (4), the quantitative data analysis refers to statistical interpretations of the obtained data. We need to check if the manipulation of independent variables affects the dependent variable and if the registered effect is statistically significant, i.e., if it is not pure chance. Qualitative data analysis relates the obtained results to the initially formulated hypothesis: do they confirm

or disconfirm it? Furthermore, how do these results compare to those obtained in similar or related studies; and what is their bearing on the research of this particular linguistic phenomenon? At stage (5), we loop back to the beginning of the cycle to refine or abandon our theoretical assumptions.

**WARNING: Interpreting Data in the Context of Theory**

Empirical data must be treated with caution, both when collecting them (choosing balanced corpora and building balanced data sets for experiments) and when interpreting them relative to a linguistic theory.

- Make sure that the data are as *ecological* as possible, i.e., that the conditions in which they are obtained are close to the natural conditions (e.g., when the speaker is not being taped or is not aware that he is being taped). For the same reason, in psycholinguistic experiments preference should be given to simple and non-invasive tasks, which minimize the chance that the tested speaker's response is due to a conscious decision (e.g., eye-movement experiments are more ecological than semantic decision tasks).
- Elicited data are the product of linguistic competence (which, by definition, cannot be directly observed), and hence can be compatible with several underlying linguistic mechanisms or models of language representation. For instance, the **slip of the tongue** (*groupment* instead of *grouping*) could have happened because the speaker could not access the existing lexeme in his or her mental lexicon (because of time constraints, for example) or because this speaker was looking for a specific meaning nuance encoded by the suffix *-ment* but not by *-ing*.
- Since we have no direct access to what the mental lexicon really is, the models of language representation we formulate are usually metaphorical in nature: we use syntactic *trees* to represent the phrase structure or **lexical networks and fields** to visualize how words are linked to one another. There is no question that some of these metaphors are very useful and can even provide us with the clues to the nature of the investigated phenomenon, but we should not forget that this is only a useful approximation to how language works, this is not necessarily how language is actually represented in the brain.

## 1.7 Goals of Linguistic Theory and the Notion of Grammar

In the next four chapters, we position the **lexicon** within the larger context of the **grammar** of a language. We begin by characterizing the different approaches to the lexicon through the way the theory accesses lexical information, in order to discuss the "use" of lexicon by the syntax and semantics. In particular, we see how information linked to individual words can have an impact on two of the main components of the grammar: **syntax** (contributing to the structure of a sentence) and **semantics** (contributing to the interpretation of words and word combinations).

Since most linguistic theories approach the study of the lexicon from a particular point of view and tend to focus on the interaction or interface of the lexicon with specific linguistic modules or sub-disciplines, we will provide an overview of the models of lexicon assumed in some of the most influential syntactically and semantically-based frameworks. Our main goal will be to present the changing view of the lexicon within linguistic theory: from a passive storage of atomic items to a complex, genuinely creative and dynamic component of the language.

The aim of linguistic theory is to characterize and explain the behavior of language as a com-



plex human activity. We can identify three goals that will figure prominently in our investigation of language and what role the lexicon plays in it:

- *Provide an adequate description of linguistic phenomena*: this constitutes the first phase of linguistic research. We *describe* the observable properties of linguistic items and structures before developing a theory which would *account* for these properties.
- *Give an explanation of these phenomena*: we design *linguistic models* which would account for the previously identified properties of language phenomena: why do these properties occur? We use the term *linguistic model* because the inner workings of the language faculty are hidden from us: although the native speakers *can* speak and understand their language, the knowledge underlying this ability is *subconscious* and they cannot explain *why* and *how* they do it. The theoretical linguistics does not concern itself with whether and how the linguistic rules and mechanisms are represented in our brain (brain physiology is the realm of neurology). Instead, it aims at providing abstract representations (i.e., models) compatible with the external manifestation of the language faculty. Recall from Section 1.6.4 that any theory or hypothesis must be *falsifiable*, *empirically adequate* and must be able to *generate predictions*.
- *Contribute to our understanding of the cognitive underpinnings of language*: natural language is a cognitive ability, and linguistic research should help unveil how it is acquired, what (language specific and/or general cognitive) mechanisms are involved in its processing, and how linguistic knowledge can be represented.

In contemporary linguistics, *grammar* is a term referring to a human's cognitive system that enables one to speak and understand language. It encompasses everything we need to know in order to create well-formed expressions in language and interpret them, and also to judge whether the expressions encountered conform to the grammatical constraints of our language. Most linguists view grammar as itself consisting of distinct modules or systems, either by cognitive design or for descriptive convenience. These areas usually include: syntax, semantics, **morphology**, phonology, and the lexicon. Knowledge of **pragmatics** and language use are not uniformly considered linguistic in nature, but we will briefly refer to the interaction between lexical knowledge and pragmatic information in the last chapter of the text (sec. 11.6). Throughout the book, we will refer to **lexical competence** as the ability to fluently recognize and use words.

**WARNING: Traditional Meaning of Grammar**

In traditional grammatical studies, *grammar* tends to refer only to syntax and morphology, since its goals are purely descriptive: listing and classifying the different kinds of word-internal (morphological) and word-external (syntactic) structures in a given language.

## 1.8 Summary

In this chapter, we have introduced the general concepts that we will examine in this book. We stressed the following points:

- The **mental lexicon** is both complex and highly structured. Print dictionaries do not reflect many of its core properties: the relatedness of lexical senses and lexical items; the impact of lexical-semantic properties on syntax; semantic flexibility; lexical creativity, and so on.

- The concept of **word** can be defined from different perspectives (orthographic, phonological, grammatical, etc.), each of which focuses on a different facet of its complex nature and singles out partially different linguistic units. In spite of these differences, the word is a cognitively substantiated unit.
- The **lexical entry** in the mental lexicon comprises all the information we need in order to be able to use words in context, which includes their form (pronunciation and spelling) as well as their semantic and syntactic features.
- **Empirical data** are crucial in lexicological research: any model of the lexicon must be evaluated relative to the data; further, the nature of the linguistic data determines the linguistic methodology. The data can be **naturally occurring** (as in linguistic **corpora**), **naturally elicited** (introspective), or **experimentally elicited** (through experimentation). The different kinds of data complement each other in linguistic research.
- The lexicon is one of the core modules of *natural language grammar* understood as a human cognitive system, that enables native speakers to speak and understand their language. **Lexical competence** is the part of linguistic competence that enables the speakers to recognize and use words.

## 1.9 Further readings

If you had trouble understanding the linguistic terminology and concepts used in this chapter, we strongly recommend strengthening your background. The following references can be helpful for this purpose:

Topic	Secondary references
Basic linguistic terminology and concepts	Denham and Lobeck (2012), Fromkin <i>et al.</i> (2018), Akmajian <i>et al.</i> (2017), Huddleston and Pullum (2005)
Introduction to the organization of the mental lexicon	Aitchison (2012) (Part 1)
Different approaches to wordhood	Dixon and Aikhenvald (2003), Aronoff and Fudeman (2011) (ch.2)
Introduction to morphological theory	Aronoff and Fudeman (2011)
Overview of the state of the art in psycholinguistic research and introduction to experimental design	Spivey <i>et al.</i> (2012), Warren (2012), Sandra (2009a), Sandra (2009b)

## 1.10 Exercises

1. The following concepts are expressed through single words in languages other than English (they have been taken from the book *They have a word for it* by Howard Rheingold, Rheingold 2000). Put to test your lexical creativity and create English words with this meaning. Say what linguistic resources you used: combination of existing morphemes (from English or other languages), phonological elements which seem to somehow evoke the meaning you need, existing words with a new meaning, borrowings from other language, etc. Think about why a language might have a word for some concepts but not for others.

- a. The prevailing mood or spirit in a society of a certain period (German: *Zeitgeist*, noun)
  - b. Mother who pushes her children into academic achievement a little too hard (Japanese: *kyoikumama*, noun)
  - c. The unspoken truth of certain social situations that everyone knows but nobody talks about directly (Kiriwina, New Guinea: *mokita*, noun)
  - d. Peace offerings for wives from guilty husbands (German: *Drachenfutter*, noun)
  - e. An extraordinarily energetic, talented, competent woman (Yiddish: *berrieh*, noun)
  - f. Excessively narrow-minded technical expert (German: *Fachidiot*, noun)
  - g. Elegantly beautiful, endowed with aesthetic value which grows over the years (Japanese: *shibui*, adjective)
  - h. Something that is all fouled up, especially as the result of an attempt to fix it (Yiddish: *farpotshket*, adjective)
  - i. To slake an emotional or spiritual thirst, to be revitalized (Thai: *sabsung*, verb)
  - j. To understand things and thus take them lightly, philosophically (Chinese: *ta*, verb)
  - k. To consciously do nothing, refrain from doing something (e.g., in politics) (Chinese: *wei-wu-wei*, verb)
2. In each sequence, identify the orthographic, phonological, and grammatical words:
- a. I won't come.
  - b. Unfrigginbelievable!
  - c. washing machine
  - d. my ex
3. Provide examples of linguistic expressions (in English and in other languages) wherein
- a. the phonological and the grammatical words coincide
  - b. a phonological word consists of more than one grammatical word
  - c. a grammatical word consists of more than one phonological word
4. We have already defined what a word is, in terms of linguistic theory. The linguist Yuen Ren Chao argues that there is another definition of 'word' that we should consider, when studying language from a socio-cultural perspective, namely the *sociological word*. He writes:
- "By the 'sociological word' I mean that type of unit, intermediate in size between a phoneme and a sentence, which the general, nonlinguistic public is conscious of, talks about, has an everyday term for, and is practically concerned with in various ways. It is the kind of thing which a child learns to say, which a teacher teaches children to read and write in school, which a writer is paid for so much per thousand, which a clerk in a telegraph office counts and charges so much per, the kind of thing one makes slips of the tongue on, and for the right or wrong use of which one is praised or blamed. Thus it has all the social features of the common small change of everyday speech which one would call a "word" in English" Chao 1968."
- Do you agree with the author?
  - In what other aspects of our life do we realize that a word is not just a linguistic unit and that its cultural significance goes beyond the scope of linguistics?
  - How does this importance manifest itself in other languages and cultures?
5. The following poem, credited to Richard Thompson, is composed of actual quotes from the former US President George W. Bush. Detect, classify and analyze the different slips of the tongue and provide a tentative account of their source.

**Make the Pie Higher**

I think we all agree, the past is over.  
 This is still a dangerous world.  
 It's a world of madmen  
 And uncertainty

And potential mental losses.  
Rarely is the question asked  
Is our children learning?  
Will the highways of the internet  
Become more few?  
How many hands have I shaken?  
They misunderestimate me.  
I am a pitbull on the pantleg of opportunity.  
I know that the human being and the fish  
Can coexist.  
Families is where our nation finds hope  
Where our wings take dream.  
Put food on your family!  
Knock down the tollbooth!  
Vulcanize society!  
Make the pie higher!  
Make the pie higher!

6. What source of linguistic data and what methodology would you use to investigate the following issues?
  - a. Do speakers perceive the following verbs as more or less related to each other: *snore, strive, doze, shiver, tremble*?
  - b. What semantic groups of nominals do the verbs *fix, mend, and repair* usually take as their direct objects?
  - c. We process words that share their roots with many other words (e.g., *word*: *wordy, wording, wordless, wordbook, etc.*) faster than words with only a few morphologically related lexical items (e.g., *lion*: *lioness*)?

## 2 Lexicon and Syntax

---

### 2.1 Overview

In this chapter, we examine the relationship between syntax and lexicon, exploring what information associated with a word can determine its specific syntactic behavior and how a word combines with other lexical units to form well-formed sentences. The aspects of a lexical item that affect its syntactic behavior are not just the properties that we consider syntactic, but also morphological and semantic attributes of a word. In this chapter we examine some of these properties, specifically: the notions of syntactic category; subcategorization (also known as selectional requirements or argument structure); countability; and semantic type.

### 2.2 What is Syntax?

In most linguistic research within the last six decades, **syntax** has been approached as a *recursive formal system*, much like a computer programming language. It operates on a limited (although quite large) set of basic elements (lexical items provided by the lexicon) by combining them in constructions of varying degrees of complexity according to a set of **well-formedness rules**. If we compare natural language to arithmetic expressions, by way of example, we can think of the integers, 0, 1, 2, . . . , as proper nouns, operations such as +, −, and \* as verbs, and equations such as  $a = b$ , as full sentences. But as we see in (1), there is an underlying syntax that directs the combination of terms, to ensure the proper interpretation of the expression.

- (1) a.  $3 = 3$   
b.  $5 - 2 = 3$   
c.  $2 * 4 - 5 = 3$

For example, there is an underlying order in how  $2 * 4 - 5$  is interpreted, which is reflected in its syntactic bracketing: i.e.,  $((2 * 4) - 5)$ . Further, it is obvious that the two terms on either side of  $=$  are structures that combine before joining together to make an equation: i.e.,  $((5 - 2) = 3)$ ,  $((2 * 4) - 5 = 3)$ . This example illustrates two points. First, lexical items can be seen as the minimal units of syntactic analysis. But not all lexical items behave the same in syntax: notice how the operators (+, −, \*, =) are lexical items that build up larger syntactic expressions from smaller ones, while integers do not.

*Syntactic rules* (referred to above as *well-formedness rules*) are abstract constraints that license certain word combinations and rule out others. There are two constraints introduced by a syntactic rule, as used in most linguistic theories: **linearity** (<) and **dominance** (*Dom*). The former is a relation determining the ordering of words in an expression, such as ‘determiners precede nouns’ in English, i.e.,  $\text{Det} < \text{N}$ . Dominance introduces a structural dependency relation of in-

clusion, such as ‘nouns are part of noun phrases’, i.e.,  $NP \text{ Dom } N$ . These two constraints are typically combined in the use of a *rewrite rule*, such as  $A \rightarrow B C$ , which specifies that  $A$  dominates both  $B$  and  $C$ , and also specifies that  $B$  precedes  $C$ . Word combinations not licensed by syntactic rules are called *ungrammatical* in generative linguistics, and we typically use the asterisk (\*) to indicate this.

**WARNING: Descriptive rules vs. Prescriptive Rules**

This use of the term *rule*, referring to ‘inherent regulating principle or generalization’, should not be confused with the other meaning of the same word: *rule* as a ‘prescribed or imposed way of conduct’. This dichotomy opposes *descriptive* and *prescriptive* approaches to grammar. For example, when dealing with the expression *I feel real good*, prescriptive grammar stipulates that it is non-standard (*real* is an adjective and it should not be used as intensifier) and should be avoided in formal language. A descriptive grammarian, by contrast, would note that this use of *real* is widespread in many varieties of English and, therefore, it conforms to the English grammar and should be studied accordingly.

As mentioned above, syntactic rules generate word combinations from a limited set of words. The number of expressions resulting from the application of syntactic rules is potentially infinite, which is why syntax is often considered to be the creative or generative core of the language faculty. Two important properties underlying the generative nature of syntactic rules are *productivity* and *recursion*. *Productivity* is the capacity of a rule or mechanism to be applied automatically whenever the relevant conditions are met. For example, placing an adjective ( $A$ ) before a noun ( $N$ ) is a productive syntactic rule in English, where a phrase ( $N'$ ) “rewrites” to  $A$  followed by  $N$ : i.e.,  $N' \rightarrow A N$ :

- (2) {big/ red/ American/ ... } {truck/ car/ refrigerator/ ... }

*Recursion*, in turn, allows an expression to contain an instance of itself, thus contributing to the generation of potentially infinite word chains. Embedded clauses are one kind of recursion, an example of which is shown in (3a), where a sentence structure is embedded within another sentence. Such embeddings can occur within embeddings as well, as shown in (3b). This is typically accounted for by having a Verb Phrase ( $VP$ ) rule rewrite to a Verb ( $V$ ) followed by a sentence ( $S$ ), i.e.,  $VP \rightarrow V S$ . So, together with the main  $S$  rule, which rewrites to a subject Noun Phrase ( $NP$ ) and a predicate  $VP$  ( $S \rightarrow NP VP$ ), we have a two-step recursion (the derivation creates a recursion in two rules or steps), as shown in (3c) below.

- (3) a. [<sub>S</sub> I thought that [<sub>S</sub> you forgot my birthday]].  
 b. [<sub>S</sub> I thought that [<sub>S</sub> you forgot that [<sub>S</sub> we were reminded yesterday that [<sub>S</sub> the exam is next Friday]]]].  
 c.  $S \rightarrow NP VP$   
 $VP \rightarrow V \text{ that } S$

**WARNING: Nominal Phrases and Determiner Phrases**

We will be using the terms *nominal phrase*, *nominal group* and the abbreviation  $NP$  in order to refer to this syntactic group in a very informal and theory-neutral way. The term *determiner phrase* ( $DP$ ), on the other hand, will be used specifically for nominal groups headed by proper names and for nouns combined with determiners and quantifiers.

As will become apparent in the following sections, current syntactic theories differ greatly with respect to their goals and even the basic tenets (for example, the units of analysis). However, the structural parameters we are about to review are acknowledged by most of them, namely: **word order**, **grammatical relations**, and **constituent structure**.

**Word order** in a language can play an important role in determining the meaning of a sentence. In English, for example, the sentences below have obviously different meanings, where word order determines which DP refers to ‘the one who loves’ and which one to ‘the one who is loved’.

- (4) a. The woman loves the child.  
b. The child loves the woman.

Furthermore, the structural or **grammatical relation** each of these DPs establishes with the verb *love* is different: e.g., when we change the grammatical number of the preverbal DP in (4a), the verb adopts the same number (*The women love the child*) although, from the semantic perspective, the notion of plurality is not applicable to events in the same sense as it is to nouns (think of *The students performed a musical*, where there are several performers but just one performance event). However, when the same modification is applied to the postverbal DP, the verbal form remains unchanged: *The woman loves the children*. We know that this is due to the different grammatical relations holding between the verb and each DP: in (4a), *the woman* is the subject and *the child* is the direct object. Grammatical relations include traditional notions such as *subject* and *object* (direct and indirect), and also a number of other relations, such as *modifier* and *modified*. English has a subject-verb-object word order. In many languages, however, the basic word order is subject-object-verb (Lakhota), or verb-object-subject (Toba Batak).

Word order can be more or less fixed in different languages. Under normal circumstances (neutral, non-emphatic reading) the preverbal DP is the grammatical subject in English, and word order is the only explicit clue that allows differentiating the subject and the object. In many other languages, however, words holding a particular grammatical relation with the verbal predicate (and some other sentential elements) are assigned a specific marker, called **grammatical case**, which makes them identifiable and less dependent on the linear order within the sentence. In the following German examples, for example, the direct object *ihren Sohn* ‘her son’ is marked with accusative case and the sentence is interpreted the same way with either word order.

- (5) a. Die Frau liebt ihren Sohn.  
b. Ihren Sohn liebt die Frau.  
‘The woman loves her son’

While linearity is obviously an important structural principle, even with the relative flexibility enabled with grammatical case assignment, it is not the only relation determining syntactic structure in a phrase. As we saw above in (3), words in linear sequence can be grouped into phrases, illustrating the second constraint characterizing syntactic structure, namely dominance, usually referred to as **constituent structure**. Let us illustrate this relation with the example shown in (6).

- (6) The studio recorded the singer with the microphone.

This sentence has at least two interpretations: (1) the studio used a microphone to record the singer; and (2) the singer with the microphone is the person whom the studio recorded. This

kind of **ambiguity** (called **structural ambiguity**) arises when the same linear sequence of lexical items corresponds to two different syntactic structures, with different dominance relations: that is, they are grouped differently in terms of constituent structure. **Constituents** are groups of words that function as a single syntactic unit within a bigger structure and are sensitive to certain syntactic operations. **Phrases** are constituents built up around a lexical item belonging to a particular syntactic category, such as nominal phrase, verbal phrase, etc.; **clauses** are also constituents that are sentence-like units embedded in a bigger sentence. The following constituent structures, corresponding to the example (6), show that, in the first case, the constituents *the singer* and *with the microphone* are independent, and in the second case the constituent *with the microphone* is part of the larger constituent headed by *the singer*:

- (7) a. The studio recorded [<sub>DP</sub> the singer] [<sub>PP</sub> with the microphone].  
 b. The studio recorded [<sub>DP</sub> the singer [<sub>PP</sub> with the microphone] ].

We can determine which interpretation (and bracketing) is appropriate in a given context with the use of *constituency tests* (diagnostics), that are sensitive to certain syntactic operations. For example, constituents can be replaced with a single word (a pronoun in (8a)), moved from their original position in the sentence (for example, preposed, as in (8b)) or used to answer a question (8c). In the following sentences, the constituents are bracketed; the first sentence in each pair corresponds to the constituent structure in (7a) and the second one to the structure in (7b).

- (8) a. The studio recorded [him] [with the microphone] (*him* = 'the singer') / The studio recorded [him] (*him* = 'the singer with the microphone').  
 b. [The singer] was who the studio recorded [with the microphone] / [The singer with the microphone] was who the studio recorded.  
 c. Who was recorded by the studio? - [The singer] / [The singer with the microphone].

This approach to syntactic structure offers a principled account of grammatical relations: for example, the element bearing the closest relation to the verb within the VP is this verb's direct object (they form a constituent), and the subject is external to this minimal constituent and is added after both elements have been combined: [SUBJECT [V DO]]. (9a,b,d) confirm that *recorded the singer* is a constituent, and so is *the studio recorded the singer* in (9e). By contrast, when we apply the constituency tests to the combination of the verb and the subject, leaving out the direct object (*the studio recorded* in (9c)), they fail. (We ignore the phrase *with the microphone* here):

- (9) a. The studio did [this] (*this* = 'recorded the singer').  
 b. [Recording the singer] was what the studio did.  
 c. \*[The studio recorded] was what the studio did to the singer.  
 d. What did the studio do? - [Record the singer].  
 e. What happened? - [The studio recorded the singer].

The relatedness of different elements within constituents is guaranteed through various mechanisms, many of which have explicit **grammatical markers**. We already came across two such markers: word order and **grammatical case**. **Agreement** is a mechanism whereby syntactically related words share certain syntactic features. When discussing the example (4a) above, we noted that when the subject changes its number from singular to plural the verb undergoes the same kind of change: *The woman loves the child* / *The women love the child*. This is an instance of subject-predicate agreement: the subject and the verbal predicate must agree in number and also in person (*The woman loves the child* / *I love the child*). The following examples illustrate further kinds of agreement in Spanish (10) and Russian (11), which have richer inflectional morphology



than English: the determiner agrees with the noun in gender and number in Spanish; in Russian, the noun agrees with its adjectival modifier in case, gender and number:

- (10) a. la hija [FEM.SG.] - las hijas [FEM.PL.]  
       'the daughter - the daughters'  
       b. el ladrillo [MASC.SG.] - los ladrillos [MASC.PL.]  
       'the brick - the bricks'
- (11) a. Ona umnaja studentka [NOM.FEM.SG.] - Ja znaju umnuju studentku [ACC.FEM.SG.]  
       'She is a smart female student - I know a smart female student'  
       b. On umnyj student [NOM.MASC.SG.] - Ja znajuumnogo studenta [ACC.MASC.SG.]  
       'He is a smart male student - I know a smart male student'

It must be noted that this is a purely formal process: the "shared" feature may tell us something about the semantic content of the word which initially had it, but for the word which acquired it through agreement this is just a syntactic mark. In terms of the minimalist framework, we would say that the gender and number features are *interpretable* on the Ns in (10a) and (11a,b), but they are *uninterpretable* on the determiner in (10a,b) (the determiner is a functional element, whose main purpose is relating the NP with the things it refers to) or on the adjectives in (11a,b) (the adjectives encode properties, which cannot be specified for biological gender or quantity).

Traditional grammar often associated grammatical relations with specific semantic meanings: roughly, the subjects are the "doers", who exert some kind of impact on the objects, which are the "undergoers". Although this is often the case, this approach blurs the distinction between two kinds of relations lexical items establish in a sentence: the structural ones (encoded as **grammatical relations** properly defined) and the semantic ones. The latter are termed **semantic relations/ roles** or **thematic roles** (and abbreviated as ' $\theta$ -roles'), we will use the former term throughout this book as it is more general. The inventory of semantic roles typically includes the following relations.

- (12) a. **Agent**: animate and volitional (but not necessarily intentional) initiator or doer of an action: *The boy* broke the watch.  
       b. **Patient/ Theme**: entity undergoing the action and somehow affected by it (brought into existence, destroyed, moved, modified, etc.). A useful distinction we are going to adopt is *affected* objects (e.g., *The boy broke the watch*) vs. *effected* or *created* objects (e.g., *The boy baked cakes*).  
       c. **Experiencer**: entity psychologically or emotionally affected by the event: *I love you/ We witnessed the accident*.  
       d. **Benefactive**: entity that benefits from the event: *You can't suit everyone*.  
       e. **Location**: place where the event takes place: *Amber lives in Boston*.  
       f. **Source**: the entity or location from which a motion event takes place: *We leave the US/ The librarian handed me a book*.  
       g. **Goal**: the entity or location towards which a motion event takes place: *We landed in Barajas/ The librarian handed me a book*.  
       h. **Instrument**: the entity used to perform an action: *The boy broke the watch with a toy hammer*.  
       i. **Cause**: non-volitional initiator of an action: *The storm destroyed the hut*.  
       j. **Measure**: temporal or spatial extent of events and entities: *Our enthusiasm lasted one day*.

- k. **Possessor:** entity owning something: Grandma, what big eyes *you* have!
- l. **Manner:** the way an action is performed: The kids behaved *well*.

**WARNING: Grammatical Relations vs. Semantic Relations**

It is important to not confuse these two relation types. They must be seen as distinct because the same grammatical relation can be associated with different semantic roles and vice versa. Notice how in both (a) and (b), the DP *the watch* is the “entity subject to change” (has the semantic role of *Patient* or *Undergoer*), although it is the syntactic subject in (b) and the object in (a).

- a. The boy broke *the watch*.
- b. *The watch* broke.

Different semantic roles are introduced by particular lexical items, and such information plays an important part in analyzing the linguistic behavior of words in the grammar. We examine these in detail in Chapter 8. Before delving deeper into the relationship between syntax and lexicon, let us sum up their fundamental differences in Table 2.1.

	SYNTAX	LEXICON
Acquisition	Syntax is acquired in early childhood in a fast, ordered and subconscious fashion (there is no explicit teaching or learning process involved), and it is retained for life.	Lexicon acquisition is a life-long and conscious process: the vocabulary must be memorized.
Uniformity within the same language	Yes: the speakers of a given language share the same syntax, with minor variations.	No: no two native speakers share the same vocabulary.
Dependence on language-external environment	No: syntax reflects much more abstract notions and relations.	Yes: the lexicon inevitably reflects the physical and social environment.
Relatedness to the general cognitive abilities of the speakers and their acquired knowledge	No, for adult competent speakers.	Yes: function words aside, the vocabulary of a person (its size, level of formality, specificity and precision) depends on her/his general culture and lifestyle.

**Table 2.1** Differences between syntax and lexicon

## 2.3 Syntactically relevant lexical features and lexically-dependent syntactic phenomena

Syntax is the linguistic level responsible for combining words into phrases and sentences, and it is by definition productive and usually assumed to be recursive. However, we know that some words just don't go together, which means that syntactic rules must be constrained in order not to *overgenerate*, i.e., yield unacceptable word combinations. We will view the lexicon as the main source of such constraints.

### 2.3.1 Syntactic category

Recall from Section 1.5, that one of the things we know about a lexical item, as speakers of a language, is what other words it is compatible with in a sentence. While we obviously cannot include a full list of such items, we can specify some constraints on what kinds of words (and phrases) can cooccur with a lexical item. We will call these specifications **selectional requirements**, and the lexical structure integrating them **argument structure** (to be studied in depth in Chapter 8). To illustrate this point, consider the following ungrammatical sentences in English.

- (13) a. \*John hates.  
 b. \*John arrives the zoo.  
 c. \*John put.

A speaker of English will recognize that each sentence is ungrammatical because the verb is not provided the arguments it requires or typically accepts. To capture this lexical dependency imposed by the verb, let us try to formalize the argument structure for each of the verbs above, as shown in (14).

- (14) a. *hate*(arg<sub>1</sub>, arg<sub>2</sub>)  
 b. *arrive*(arg<sub>1</sub>, arg<sub>2</sub>)  
 c. *put*(arg<sub>1</sub>, arg<sub>2</sub>, arg<sub>3</sub>)

*Hate* is a transitive verb, taking a subject and a direct object, while *put* requires a subject, direct object, and an argument denoting the final location of the moved entity. On the other hand, while *arrive* seems to be a transitive verb like *hate*, its arg<sub>2</sub> is a goal argument, which requires a PP as its syntactic realization (i.e., *at the zoo*).

#### DISCUSS

We just said that *arrive* needs a PP to encode the Goal argument. Or does it? Can you think of a bare NP (a nominal group without a determiner) following *arrive*? Put forward your own hypothesis to account for these cases (are they exceptional?, what enables these NPs to appear in this context?) and discuss it with your classmates.

As we will see, *lexical* syntactic categories are usually combined with different *functional* syntactic categories in context, in the form of **phrasal categories**. For instance, nouns (lexical categories) are usually combined with determiners (functional categories) within the noun phrase (NP) or determiner phrase (DP), as in ‘a professional accountant’: similarly, prepositions (functional categories) combine with a DP within the prepositional phrase (e.g., ‘in the office/ in winter’). Without these functional elements, the lexical categories cannot be used in a sentence: (15a) is ungrammatical because the subject needs a determiner and the preposition *in* needs a nominal complement, as represented by the blank positions, \_\_\_\_.

- (15) a. \* \_\_\_\_ Accountant arrived in \_\_\_\_.  
 b. The accountant arrived in the office.

For this reason, we will specify the *phrasal category* rather than just the *syntactic category* in the argument structure representations. Let us add the categorial information (introduced by the *cat* feature) to our argument structure representation:

- (16) a. *hate*(arg<sub>1</sub>[cat=DP], arg<sub>2</sub>[cat=DP])  
 b. *arrive*(arg<sub>1</sub>[cat=DP], arg<sub>2</sub>[cat=PP])  
 c. *put*(arg<sub>1</sub>[cat=DP], arg<sub>2</sub>[cat=DP], arg<sub>3</sub>[cat=PP])

While these additional constraints help rule out the sentences in (13), they do not prevent the generation of many other constructions, which conform to the argument structures in (16), but are nevertheless ungrammatical, as shown in (17).

- (17) a. \*The happiness hates John.  
 b. \*John arrives at the book.  
 c. \*John put the hunt on the table.

Before delving into why these sentences are still unacceptable, let us consider in more detail the notion of **syntactic category**. We defined it above as “a group of lexical items presenting morphological, syntactic and semantic similarities”. Indeed, semantic, syntactic, and morphological criteria have each been suggested as ways to differentiate between word classes. Historically, the oldest technique used for distinguishing word classes is based on **semantic criteria**: it goes back to Aristotle’s philosophy and has been generally adopted in traditional grammar. It represents an approach which associates words with the extralinguistic notions they stand for: roughly, verbs denote events (*break, enter, love*), nouns denote entities (*house, cat, John*), adjectives denote states or qualities (*white, smart, political, hungry*), and adverbs denote manners of action (*well, nicely, safely*). However, it would not take us long to come up with counterexamples: *decency* and *whiteness* refer to qualities although they are both nouns and not adjectives; *strike* and *birth* are nouns, too, but they refer to events; *harsh* is an adjective in *harsh critic*, but it refers to the way the critic performs his function rather than just encoding a quality. These and many other mismatches suggest that the semantic criterion of “relatedness to extralinguistic conceptual notions”, when considered alone, must be rejected. To illustrate this point even more clearly, consider the nonsense sentence below in (18).

- (18) The virocious prolection prondled foribly on these dranards.

This expression is obviously meaningless, and the only real English words are the determiners *the* and *these*, and the preposition *on*. Still, we can easily determine the syntactic category of all the other words: *virocious* behaves like an adjective, *prolection* and *dranards* are noun-like, *prondled* appears to be a verb and *foribly* looks like an adverb. How did we do it? We made use of **morphological** and **distributional criteria**.

**WARNING: Linguistically relevant semantic distinctions**

The reader should be aware that these counterexamples and mismatches associated to the semantic criterion do not mean that it is not pertinent *at all* in identifying the syntactic categories. As will be shown in the remainder of this section, *language-internal* semantic features (such as semantic type, reference, quantification, predication, etc.) can and must be taken into account in these and other aspects of linguistic analysis.

There are two kinds of morphological criteria that can be used to determine syntactic category. In the first place, different *grammatical words* or *word forms* instantiating the same *lexeme* (recall Section 1.4) are derived through *inflectional morphology*. For example, our pseudo-noun *dranards* carries the plural inflection *-s*, as most English nouns. The verb *prondled*, on the other hand, is formed with the *-ed* ending, which derives simple past forms. In the second place, morphology is used to derive a new lexeme from an existing one through *derivational morphemes*. Thus, we can safely assume that *virocious* is an adjective because the suffix *-ous* is used to derive adjectives from nouns (think of the English adjectives *mysterious*, *poisonous* and *victorious*). By the same token, the suffix *-tion* indicates that *prolection* is a deverbal noun (similar to *adoption*, *irritation* or

*stimulation*), and the suffix *-ly* marks the deadjectival adverb *foribly* (same as *adequately*, *cordially* or *promptly*).

Note, again, that some of these inflectional and derivational morphemes are category-specific: only nouns in English are formed with the suffix *-(a)tion* and derive the plural form through the ending *-s*, and only adjectives can have the *-ous* suffix. Other morphemes, however, have more than one use, especially in morphologically poor languages. Although most English words ending in *-ly* are adverbs, we can also think of quite a few adjectives (e.g. *friendly*, *costly*), and even words that can be classified as an adverb or an adjective depending on the context (*You play lovely* vs. *You are a lovely player*). The ending *-ed*, on the other hand, can appear on simple past verbs (*I answered*), past participles (*I have answered*) and also the so-called adjectival participles (*the answered question*).

#### DISCUSS

Are there any derivational morphological markers which allow us to differentiate adverbs and adjectives in *-ly*, and the verbal and adjectival forms in *-ed*?

These and other mismatches suggest that we should supplement evidence from morphological markers with other criteria. The *distributional criterion* has been used to identify word classes for many decades, with variations. The term *distribution* refers to how different items are arranged syntagmatically (i.e., in the surface form of the language). In its simplest version, the distributional criterion relates syntactic categories to specific “gaps” in word sequences:

- (19) a. I like \_\_\_\_.  
       b. Chris \_\_\_\_ Mary.  
       c. Your kid behaves \_\_\_\_.  
       d. This condo is \_\_\_\_.

By this reasoning, any word occurring in the gap in (19a) is a noun (*I like {summer/ grapes/ John}*), the gap in (19b) is expected to be filled in by a verb (*Chris {likes/ teaches/ drives} Mary*), and the slots in (19c) and (19d) correspond to adverbs (*Your kid behaves {well/ terribly}*) and adjectives (*This condo is {huge/ inexpensive/ bright}*), respectively. Note, however, that these syntactic positions are defined linearly and not hierarchically, which, as established in the previous section, gives rise to a number of problems. For instance, it can be objected that the empty spots in (19a) and (19c) can be occupied by clauses: *I like living in Boston* / *Your kid behaves as if he was the one in charge*. Should we assume, consequently, that these clausal structures are nouns or NPs? The only valid answer seems to be ‘no’: if *I like living in Boston* was an NP, it should be compatible with other verbs that can be followed by NPs, but this is not what we find (*I saw {grapes/John/\*living in Boston}*). Similarly, the word between *Chris* and *Mary* in (19b) can be a conjunction, for example (*Chris and Mary*), and it would be unreasonable assimilating it to a verb.

These issues can only be solved if we take into account the position of the lexical item in a hierarchical syntactic structure, i.e., how it is related to other words within the constituent structure of the sentence, reflecting the underlying dominance relations. Let us return to our nonce word example, repeated below as (20):

- (20) The virocious prolection prondled foribly on these dranards.

As mentioned above, English words ending in *-ly* can be adverbs or adjectives: what is *foribly* then? We can tell that it forms a constituent with *prondled*, because it can be used as an answer to a question: *What did the virocious prolection do?* - [*Prondle foribly*]. As we know, only a few English

verbs are compatible with adjectival complements (*be, become, feel, get, look, seem, smell, sound*), all the others take adverbial modifiers, which suggests that *foribly* is probably an adverb. Another constituent is formed by *these* and *dranards*, as evidenced by the fact that it can be moved from its original position: [*These dranards*] *is where the virocious prolection prondled foribly*. In this case, the plural marker is shared by the determiner and the word it is grouped with, which confirms our initial claim about *dranards* being a noun (think of similar examples: *a pen - two pens, this tree - these trees*). Note that without explicit morphological markers and function words, this kind of analysis would have been impossible: in (21) there are neither determiners nor prepositions, and the “verb” could just as soon be a noun (*prondle*):

(21) Virocious prolection prondle dranards.

The syntactic principle behind these and other manifestations of syntactic relatedness within a constituent is called **headedness**: every syntactic structure (a phrase or a sentence) is organized around a central unit (the **head**), which *projects* this structure and determines the phrase’s syntactic and semantic properties. Thanks to headedness, we can determine the syntactic category of a word by looking at the syntactic and semantic properties of the structure it projects. In (22a), the adjective *proud* is the head of the adjectival phrase *very proud of him*: it selects the PP *of him* as a complement and is quantified by *very*, which indicates the degree of the property denoted by *proud*. The head of the embedded PP, in turn, is the preposition *of*, which selects the pronoun *he* as a complement and assigns the oblique case (*him*) to it. Another case-assigning category includes the verbs: in (22b), the verb *warned* projects an event-denoting phrase and assigns the accusative case to the direct object *me*. The adverbial phrase *very far from her parents* in (22c) is very similar to the AP in (22a): the head adverbial *far* selects a PP as a complement (*from her parents*) and is quantized by *very*.

- (22) a. I am [<sub>AP</sub> very proud [<sub>PP</sub> of him]].  
 b. He [<sub>VP</sub> warned me].  
 c. Lisa lives [<sub>AdvP</sub> very far [<sub>PP</sub> from her parents]].

It is important to remark here that a **category** can **function** in more than one way. For instance, the following Spanish examples show that the element functioning as the modifier of a noun does not necessarily need to be an adjective.

- (23) a. Tengo [<sub>DP</sub> una [<sub>NP</sub> camisa [<sub>AP</sub> azul]]].  
 ‘I have a blue shirt.’  
 b. Tengo [<sub>DP</sub> dos [<sub>NP</sub> camisas [<sub>AP</sub> azules]]].  
 ‘I have two blue shirts.’  
 c. Tengo [<sub>DP</sub> varias [<sub>NP</sub> camisas [[<sub>AP</sub> azules] y [<sub>AP</sub> rojas]]]].  
 ‘I have several blue and red shirts.’
- (24) a. Tengo [<sub>DP</sub> una [<sub>NP</sub> camisa [<sub>NP</sub> azul marino]]].  
 ‘I have a navy blue shirt.’  
 b. Tengo [<sub>DP</sub> dos [<sub>NP</sub> camisas [<sub>NP</sub> azul marino]]].  
 ‘I have two navy blue shirts.’  
 c.. \*Tengo [<sub>DP</sub> varias [<sub>NP</sub> camisas [[<sub>NP</sub> azul marino] y [<sub>AP</sub> rojas]]]].  
 ‘I have several navy blue and red shirts.’

In (23), *azul* is an adjective, because it agrees in number with the head of the NP (in (23a,b): *camisa azul* ‘blue shirt’ - *camisas azules* ‘blue shirts’) and it can be coordinated with another adjective (in

(23c): *camisas azules y rojas* ‘blue and red shirts’). In (24), the same word still modifies the head noun, but its syntactic category is different: it is a noun and as such it does not agree in number with the head (as in (24a,b)), and it cannot be coordinated with an adjective (as in (24c)):

As explained in Section 1.3, there are several basic distinctions according to which the syntactic categories are classified.

- 1 The first one is the kind of content they express: the **lexical categories** (nouns, verbs and adjectives) encode conceptual meanings related to the real world, and the **functional categories** (prepositions, conjunctions, complementizers, pronouns, determiners, quantifiers, and auxiliary verbs) lack descriptive content and encode language-internal semantic features, such as reference, definiteness, quantification, predication, etc.
- 2 The second distinction separates those words that can be introduced into the language by its speakers at any point in time (the **open-class items**, largely overlapping with the lexical categories), from those representing a much more restricted and synchronically stable set (**closed-class items**, largely overlapping with the functional categories).
- 3 A third distinction not mentioned thus far pertains to the capacity of a word to be associated with inflectional features and participate in agreement operations: syntactic categories having such capacity are called **variable categories** (in English, nouns, verbs, adjectives, determiners, and pronouns) and those not having it **invariable categories** (adverbs, prepositions, conjunctions, complementizers, and interjections). In agreement processes, a grammatical feature is “inherent” on one of the agreeing words and is “matched” or “copied” by the other word. The inherent features are often *interpretable* (they play a role in semantic interpretation, cf. Section 2.2), but when they are matched they are always uninterpretable.

The following table sums up some of the inflectional features of the main variable syntactic categories in English:

GRAMMATICAL FEATURES	INHERENT TO	MATCHED ON
Number	nouns, pronouns	verbs, determiners
Gender	some nouns and pronouns	determiners
Person	pronouns	verbs
Tense, aspect, mood	verbs	

**Table 2.2** *Grammatical features*

### 2.3.2 Semantic Features and Semantic Types

Let us now see what other selectional requirements are imposed by a lexical item. As pointed out with regard to the examples in (17), repeated below as (25), the arguments in each of these sentences apparently satisfy the categorial requirements of their respective verbal predicates but still result in unacceptable expressions:

- (25) a. \*The happiness hates John.  
 b. \*John arrives at the book.  
 c. \*John put the hunt on the table.

Sentence (25a) is ungrammatical because the subject of *hate* does not fulfill a **semantic selectional requirement**: namely, it is expected to be animate, i.e., to be positively specified for the feature of **animacy** (unlike the subject of *arrive*, for example: *The train just arrived*).

The **animacy** feature is relevant in a number of syntactic phenomena. In English, the possessive *-s'*-construction is preferred over the prepositional *of*-construction when the possessor is animate (as in (26a)), while the passive construction is preferred over the active one when one of the arguments of a Theme-Experiencer verb (such as *thrill* in (26b)) is animate and the other one is inanimate (Ferreira, 1994).

- (26) a. John's house / house of John  
 b. *match/boxer/thrilled*: The boxer was thrilled by the match / The match thrilled the boxer.

The latter phenomenon has to do with the correlation between animacy and semantic role assignment: as confirmed by a wide array of typological data, "agent-like arguments are normally animate or human, while patient-like arguments may, but need not, be animate or human" (Van Valin and LaPolla, 1997: 305-306).

Animacy is also an important component of agency and dynamicity, and it often affects the aspectual interpretation of the predicate. For example, the sentences in (27) differ only with respect to the animacy of their syntactic subjects, but this not only affects the semantic role assignment (the subject *the police* in (27a) is an Agent and *the fence* in (27b) is a Theme) but also the aspectual classification of both predicates: (27a) denotes a dynamic resultative event (an *accomplishment*, cf. Chapter 9) and (27b) denotes a non-dynamic non-resultative event (a *state*).

- (27) a. The police surrounded the park.  
 b. The fence surrounded the park.

Now let us turn to the ungrammaticality of sentences (25b,c) above. As it happens, these also contain violations of semantic selectional constraints: the PP-complement of *arrive* must have the **semantic type** LOCATION (e.g., *arrive at the {zoo/school/square}*), not PHYSICAL OBJECT like *book*; and the direct object of *put* must be a PHYSICAL OBJECT, not an EVENT (although metaphoric use seems to allow this: *Put your divorce behind you*). Semantic type indicates the sort of entity denoted by the lexical item. Semantic types and features are discussed in detail in Chapter 7.

Given the role that semantic features seem to play in the selectional behavior of verbs, we can further enrich the argument structures for our three verbs, *hate*, *arrive*, and *put*, to reflect the semantic information we just introduced.

- (28) a. *hate*(arg<sub>1</sub>[cat=DP, animacy=+], arg<sub>2</sub>[cat=DP])  
 b. *arrive*(arg<sub>1</sub>[cat=DP], arg<sub>2</sub>[cat=PP, sem type = LOCATION])  
 c. *put*(arg<sub>1</sub>[cat=DP, animacy=+], arg<sub>2</sub>[cat=DP, sem type = PHYSICAL OBJECT], arg<sub>3</sub>[cat=PP, sem type = LOCATION])

### 2.3.3 Countability

Another syntactically relevant lexical-semantic feature (or rather set of features) is related to the concept of **countability**. Consider the following examples in (29).

- (29) a. The coach gathered {the boys/ the team/ the cash/ information}.  
 b. The police dispersed {the fans/ the crowd/ toxic gas/ the demonstration}.



Apparently, the verbs *gather* and *disperse* look for complements somehow associated with plurality, although the only arguments marked with the grammatical plural number are *the boys* and *the fans*. All the other direct objects appear in singular, but we still can relate them to plurality: *the team* and *the crowd* refer to *groups* composed of many individuals, *demonstration* is an event (usually) involving more than one person, and *the cash* and *gas* refer to what we usually call “stuff” or “substance”, composed of many homogeneous instances of the same matter. *Information* is an abstract entity, but it is very similar to physical substances in this respect. The co-occurrence of these nouns with a number of (not necessarily semantically similar) verbs (such as *meet*, *conspire*, *agree*, *assemble*, etc.) seems to indicate that they form a natural class as far as selectional constraints are concerned.

The singular and plural marker (along with other formal properties we are about to discuss) allows us to establish two classes of nouns with differentiated morphosyntactic behavior: **mass nouns** and **count nouns**. These classes are usually recognized by the following criteria.

(30) **Count Nouns:**

- a. can occur in the plural:  
*girl-girls, fan-fans, class-classes*
- b. as a rule, cannot occur in the singular without a determiner:  
*\*Elephant is big./ \*I saw {girl/ class}./ \*This is {elephant/ girl/ class}.*
- c. are quantifiable by cardinal numerals:  
*twenty girls, two classes of '90*
- d. are quantifiable by ‘how many’ quantifiers: (a) *few, each, many, several*  
*{A few/ many/ several} fans sneaked backstage.*

(31) **Mass Nouns:**

- a. cannot occur in the plural at all, or acquire a derived (‘standard portion of’, ‘a kind of’, etc.) interpretation:  
*my money - public monies* (‘pecuniary sums / budget’), *beer - Czech beers* (‘kinds of beer’)  
*- The bartender brought our beers* (‘{glasses/ cans} of beer’)
- b. can occur in the singular without a determiner:  
*{Natural gas/ gold} is a fossil./ I want water./ This is {gas/ gold}.*
- c. are not quantifiable by numerals at all, or acquire a derived interpretation:  
*\*five moneys/ Two bears, please!* (‘glasses of beer’)/ *These are our three top beers.* (‘kinds of beer’)
- d. are quantifiable by ‘how much’ quantifiers: (a) *little, much*  
*A little gas leaked from the pipe./ I do not drink much milk.*

Semantically, count nouns refer to **individuals**, understood in linguistic terminology as discrete, bounded entities. Mass nouns, on the other hand, refer to unindividuated ‘stuff’. The notion of *individual* has been mainly analyzed from a mereological and topological perspective in modern linguistics, i.e., by looking at what properties the parts of an entity have and how it is related to other entities in space. Some of the major contributions to this topic are Quine (1960b), Parsons (1970), Pelletier (1974), Link (1983), Bunt (1985) (the Ensemble Theory), and Krifka (1989). A significant part of subsequent work on individuation (and the present discussion) rely heavily on their proposals. In this overview, we will adopt the mereological approach taken in Jackendoff (1991), for reasons of exposition.

There are two features underlying the count-mass distinction (and parallel distinctions in the verbal domain, to which we return later): [ $\pm$ **bounded**] and [ $\pm$ **internal structure**]. Entities

with the [+bounded] property are *non-divisive* and *non-cumulative*. *Non-divisive* means that an entity has no smaller (i.e., *proper*) parts which would qualify as the same kind of thing: no part of the entity referred to by *girl* or *fan* qualifies as a girl or a fan. *Non-cumulative* means that an entity made up by two or more instances of the same individual does not qualify as this individual: *two girls* or *many fans* are not the same kind of entity as *a girl* or *a fan*. Entities with the [-bounded] property, on the other hand, are *divisive* and *cumulative*: any part of *water* can be properly described as *water* (up to the minimal part of the substance, the H<sub>2</sub>O molecule) and by adding water to more water we still get an entity definable as *water*. The other mereological feature, [ $\pm$ internal structure], has a positive value when the entity referred to by the noun is composed of separate, distinguishable individuals. *Crowd*, *class* and the plurals *girls* and *fans* are [+internal structure] because they refer to pluralities of individuals. *Girl* and *fan*, or *gas* and *water*, by contrast, are [-internal structure] because they are not made up of distinguishable individuals (internal organs and molecules, notwithstanding).

The combination of these two features predicts the existence of four classes of entities or, in terms of Clausen *et al.* (2010), *individuation types* ([b] stands for ‘bounded’ and [i] for ‘internal structure’):

- (32) a. [+b, -i]: individual (*a girl, a fan, a table*)  
       b. [+b, +i]: group (*a class, a committee*)  
       c. [-b, -i]: substance (*gas, water*)  
       d. [-b, +i]: aggregate (*rice, cattle, girls, tables*)

These four classes clearly contrast with the traditional two-way count-mass distinction: in addition to *individuals* (which are typically count) and *substances* (which are typically mass), we have two intermediate categories. *Groups* are like individuals in being [+b], but they are [+i], i.e., composed of discernible individuals. *Aggregates*, on the other hand, are like substances with respect to boundedness ([-b]) but, like groups, they have internal structure ([+i]).

If this analysis is on the right track, the conclusion seems to be the following: the two noun classes with different morphosyntactic properties (count and mass) are distinguished based on the semantic [ $\pm$ b] feature: individuals and groups are both [+b], and they belong to the morphosyntactic count-class, whereas substances and aggregates are [-b], and they belong to the morphosyntactic mass-class.

This does not mean that the [ $\pm$ i] feature has no syntactic impact. In fact, the following examples show that English syntax *is*, at least sometimes, sensitive to the presence of distinguishable individuals in the noun denotation. Group (also called *collective*) nouns in English sometimes allow for plural verbal agreement, as in (33a), arguably because the verb can “detect” the plurality inherent in this noun’s denotation, which we formalized as [+i]. The adjective *large* is polysemous, and it only refers to the cardinality of the modified noun (i.e., is roughly equivalent to *numerous*) when combined with group nouns, such as *family*, *community* or *committee*. With nouns of individuals (e.g., *apartment*) and aggregates (both plural and singular forms: *apartments* and *cattle*) it refers to the size of *each* individual, even when the noun denotes a plurality of individuals. The combination of *large* with substance nouns (*mud* in (33b)) is ungrammatical. One more piece of evidence confirming the syntactic visibility of the [ $\pm$ i] feature is that groups and aggregates often have dedicated *unitizers*, i.e., expressions singling out individuals of which they are composed, as shown in (33c).

- (33) a. The Dutch team {were/was} coached by Louis van Gaal.

- b. Large {family/ community/ committee}/ large apartment(s)/ \*large mud/ large cattle  
 c. a grain of rice, a member of the {family/ committee}, a head of {cabbage/ cattle}

The feature structure in (32a) defines the notion of individual as [+b, -i]. **Individuation** is the process whereby we identify an entity and distinguish it from other entities. It is a complex psychological mechanism that involves dividing the surrounding flow of reality, which is continuous and non-discrete, into more or less coherent and “manageable” chunks. Individuation is a prerequisite for counting, which explains why mass nouns reject plural marker and cardinal quantifiers: in order to be able to count them, we first have to turn them into [+b] (by assigning them ‘a portion of’ or ‘a kind of’ interpretation, recall *two beers* and other similar examples just discussed).

Since the individuation of real-world objects and phenomena seems to have an impact on language, should we assume that real-world attributes of the denoted entities determine in a unique way how these are encoded in language? This does not seem to be the case, at least as far as the count-mass distinction is concerned. First of all, if extralinguistic reality was the only determining factor, we would expect the same kind of objects to be uniformly represented in *all* languages, which obviously does not hold. For instance, in English the names of berries are count (see *blueberry* and *blueberries* in (34a)), whereas in Russian they are mass: the morphologically simple, unmarked form is *černika*, and if we want to refer to individual blueberries we have to use *černičina* or *černičinka*, derived from *černika* by adding the singulative suffix *-in(k)*:

- (34) a. There {was one blueberry/ were two blueberries/ were many blueberries} on the plate.  
 b. Na tarelke {byla odna černičina/ bylo dve černičiny/ bylo mnogo černiki}.

A particularly striking example of cross-linguistic differences is provided by classifier languages (Chinese, Japanese, Korean, Vietnamese, etc.). In Mandarin, for example, nouns cannot combine with a numeral quantifier unless accompanied by an appropriate morpheme, called *classifier*: the noun *shu* ‘book’ in (35a), without a classifier, is ambiguous between singular and plural. The fact that this is mandatory for both mass and (arguably) count nouns (as in (35b) and (35c)) is often used to argue that *all* Chinese nouns are basically mass (cf. Chierchia 1998 and Borer 2005a). What is uncontroversial is that we do need a classifier if we want to refer to individuated, countable units.

- (35) a. Hufei maishu    qu le  
       Hufei buy-book go sentence-final-particle  
       ‘Hufei went to buy a book/books’  
 b. san-ben        shu  
    three-CL<sup>volume</sup> book  
    ‘three books’  
 c. yi-wan        tang  
    one-CL<sup>bowl</sup> soup  
    ‘a/one bowl of soup’  
    (Cheng and Sybesma, 2005)

Additional evidence suggesting that the count-mass distinction cannot be fully accounted for by the properties of the denoted entities is that, even within a language, the same kind of entity can be referred to with a count and a mass noun: in the pairs shown in (36), the first member is a count noun and the second is mass.

- (36) a. leaves-foliage  
       b. coins-change  
       c. knives-cutlery  
       d. shoes-footwear

These data can make us wonder whether the count-mass distinction has any connection at all with the properties of the entities denoted by both noun classes and, inasmuch as the meaning of the lexical items reflects some of these properties, with lexical semantics. If there is no such connection, then this distinction can be rightfully considered as purely grammatical or syntactic. Indeed, we often observe how, in certain syntactic contexts, count nouns become mass (as in (37a)) and vice versa (as in (37b)): in linguistic theory, cases of the former are regarded as the outcome of a **Universal Grinder** mechanism, and the latter are associated with a **Universal Packager**:

- (37) a. There was {blueberry all over the kid's face/ apple in the salad}.  
       b. Two {beers/ wines}, please!

The syntactic encoding of the count-mass distinction is argued for in Borer (2005a). In short, it is claimed that all nouns are interpreted as mass, by default, and that the count interpretation emerges when they are inserted into syntactic structure composed of two functional projections: a CIP (Classifier Phrase, responsible for dividing, i.e., individuating) and a #P (Quantity Phrase, responsible for counting). In English, the CIP is headed by the plural inflection or the singular indefinite determiner *a*: Borer argues that the former is just a divider, and that the latter is both a divider and a counter. The simplified structure in (38a) represents a determinerless mass NP (with neither CIP nor #P), (38b) a determinerless plural (with CIP but no #P), (38c) a quantity plural (with the numeral *three* in the #P and the plural feature in the CIP), and (38d) an indefinite singular DP (with the indefinite determiner *a* in both the CIP and the #P).

- (38) a. *salt*: [<sub>DP</sub> [<sub>NP</sub> salt]]  
       b. *boys*: [<sub>DP</sub> [<sub>CIP</sub> boy [<sub>NP</sub> boy]]]  
       c. *three boys*: [<sub>DP</sub> [<sub>#P</sub> three [<sub>CIP</sub> boy [<sub>NP</sub> boy]]]]  
       d. *a boy*: [<sub>DP</sub> [<sub>#P</sub> a [<sub>CIP</sub> a [<sub>NP</sub> boy]]]]

The bottom line of this approach is that the count-mass features are not lexically encoded and, consequently, *any* noun can be interpreted as mass or count depending on the syntactic structure. Under this view, any conflict arising from the combination of a lexical item with the syntactic structure is basically due to the extralinguistic content expressed by this lexical item. Despite the numerous advantages of this approach (foremost, its cross-linguistic reach and uniformity), the mismatches that result from combining any word with any kind of structure turn out to be too many and too systematic to be disregarded.

Thus, many authors have argued against one of the main arguments in favor of the structural approach, the Universal Grinder, by showing that, in reality, it is not unrestricted or truly universal. For instance, Djalali *et al.* (2011) report the results of an experiment where the participants were asked to grade (from 1 to 7) the acceptability of different noun classes when inserted into three grinder constructions: *There is NOUN all over the {floor/ highway}*, *There is NOUN in the {bread/ concrete}*, and *{A robot/ a termite} eats NOUN*. They found that the mean acceptability of grinder constructions is significantly lower than the acceptability of non-grinder constructions: 2.33 vs. 5.68. Moreover, most noun types were rejected by the participants in grinder constructions: group terms (*fleet, committee*), complex artifacts (*computer, toaster, car*), shape names (*tube*,

*sphere, cone*), simple artifacts (*hammer, towel, pencil*) and individual group members (*ship, person*). The only noun classes which made relatively felicitous combinations were foodstuff (*steak, apple, cracker*) and animals (*squirrel, snake, pig*).

This outcome is hardly surprising: in our everyday life we deal with animals and plants both as individuals and as edible substance. At a more general level, the conclusion seems to be that count-mass features are not determined exclusively by real-world entities and their attributes, nor by language-specific (or language-internal) properties alone. Rather, they have to do with how speakers of a given language *conceptualize* the denoted entities, i.e., how they interpret them or what idea they form of them in their mind. This view implies that we can have multiple perspectives on the same object and highlight its different facets by different nouns, which would explain, for example, the existence of the pairs in (36) above.

In an exhaustive study of different groups of nouns, Wierzbicka (1985b) distinguishes the following factors affecting their encoding as mass or count in different languages:

- **Size** (the *perceived* size, especially with respect to other entities of the same class): stuff consisting of bigger, easier identifiable individual entities is more likely to be viewed as a plurality and be referred to by a plural noun than stuff consisting of smaller particles: compare English *pea(s)* vs. *rice*, or Russian *gorox* ‘mass-pea’ vs. *bob(y)* ‘bean(s)’. According to Wierzbicka, the fact that Russian uses mass nouns for the aggregate entities named by count nouns in other languages (recall also the *blueberry* example in (34)) suggests that in this language the average size of countable entities must be bigger.
- **Contiguity**: lots of small things occurring together are usually mass (*hair, clover*). They are used as count sometimes, when “even one of these things that usually occur together can be potentially significant to human beings”, especially when they occur in small numbers: *Look, you have three grey hairs!* / *\*Look, you have a hundred grey hairs!*. *Physically joint* pairs of individuals jointly performing a function (*scissors/ a pair of scissors*) are not used in singular (*\*a scissor*) while physically separated pairs can be used in singular (*eyes/ pair of eyes/ an eye*). In addition to spatial contiguity, contiguity in time applies to collective supercategories such as *contents* (“groupings of different kinds of things which happen to be in one place at one time, and often for the same reason”: *contents of this purse*) or *dishes*, which “used as plurale tantum refers to a heterogeneous collection of objects which are gathered together in one place after a meal [i.e., at the same time] and which have to be washed because they have been used in connection with a meal”.
- **Standard way of handling and function** of the entity: how we usually handle things and with what purpose determines whether we encode them in language as count or mass. For example, individual peas can be eaten one by one (*Come on, Sophie, three more peas and you get dessert!*) and in English *pea* is a count noun (although it mostly occurs in plural: peas are served in portions involving more than one pea), but a grain of rice is too small to pay attention to or be eaten individually, hence *rice* is mass. *Cabbage* is mass, too, but for a different reason: a cabbage head is too big to be eaten whole, individually. Collective categories (*mail, furniture, luggage*) are not homogeneous as far as their composition is concerned (*jewelry* includes earrings, pendants, necklaces, and even piercings) but they are uniform with respect to function: they all are meant to be worn on the body for personal adornment.
- **Fixed configuration**: count nouns refer to entities whose parts cannot be separated without jeopardizing these entities’ function or even existence, whereas mass nouns can be freely divided in arbitrary parts or portions (recall the *divisiveness* property defined above).
- **Taxonomic heterogeneity**: collective supercategories made up of different kinds cannot be

counted because one can only count objects conceptualized as belonging to the same kind (*\*three kitchenwares, \*four furnitures*), unless it is clear that what is being counted are different kinds, and not individual objects: *I had three vegetables for lunch: carrots, beets and broccoli*.

With this in mind, we can conclude (with Wierzbicka 1985b, Clausen *et al.* 2010 and Grimm 2012) that the locus of typological variability resides in: (1) which conceptually-rooted individuation classes correspond to which morphosyntactic noun classes; and (2) what unmarked form a given language uses to refer to individuation classes. As mentioned above, English has two morphosyntactic classes:

- (39) a. Nouns allowing plural marking (traditionally called *count*): individuals ([+b, -i]: *table(s), girl(s)*) and groups ([+b, +i]: *famili(es), team(s)*). The singular form in the unmarked one.  
 b. Nouns typically having only one form (traditionally called *mass*): mass ([-b, -i]: *beer, gas*) and aggregates ([-b, +i]: *sugar, rice*).

Welsh, on the other hand, according to Clausen *et al.* (2010) and Grimm (2012), has three morphosyntactic noun classes. One class allowing plural marking includes just individuals, and a second class only having one form is limited to mass (liquids and substances). The third class is made up of [+i] nouns, which refer to groups and aggregates in the unmarked form, and which can be combined with a singulative suffix (*-en/-yn*) to refer to separate individuals (recall similar Russian examples in (34b)). *Col.* stands for ‘collective’ and *sgl.* for ‘singulative’:

- (40) a. *dail* ‘foliage’ → *deil-en* ‘leaf’, *afan* ‘raspberry-col.’ → *afan-en* ‘raspberry-sgl.’  
 b. *gwenyn* ‘bee-col.’ → *gwenyn-en* ‘bee-sgl.’, *pysgod/pysg* ‘fish-col.’ → *pysgod-yn* ‘fish-sgl.’  
 (Stolz, 2001)

Not surprisingly, the clearly countable individuation class (individuals) and the clearly non-countable individuation type (mass) show the same morphosyntactic behavior in both languages, and there is much more variation in the classes combining properties of individuals and masses, i.e., groups and aggregates.

So far we have only been talking about individuation of physical entities and countability of nouns. However, both these notions, as well as the lexical features involved in their encoding, can be straightforwardly applied to analyze events and verbal semantics, as well. The predicates in (41) are classified in terms of the [±bounded] and [±internal structure] features: an event is bounded when it has a temporal limit, and it has internal structure when it is composed of other individual events. Thus, (41a) is a bounded event without discernible identical parts or phases (just like the individuals *a girl* or *a table*); (41b) is a bounded iterative event, composed of many instances of the *bounce* event (it is similar to groups, e.g., *a class* or *a committee*); (41c) is an unbounded homogeneous event (like *water* or *mud* substances in the nominal domain); (41d) is an unbounded iterative event (similar to aggregates and plurals: *girls, rice, cattle*, etc.):

- (41) a. [+b, -i]: *John built a house*.  
 b. [+b, +i]: *The ball bounced till I caught it*.  
 c. [-b, -i]: *John is sleeping*.  
 d. [-b, +i]: *The ball is bouncing*.

If we assume that countability and related features are lexically encoded, we still need to account for cases of regular polysemy, where the lexical features are modified in context, for example in the Universal Grinder and Universal Packager constructions encountered above in (37). In order

to account for these transformations, we could assume that packaging and grinding functions can apply, taking as an argument, one individuation type and returning a different one. The functions are paired such that each pair has a function that includes the denoted entity into a larger one, and a function that extracts a part from an entity.

#### 2.3.4 The Interaction of Lexical Features

As stressed above, different types of lexical features are not independent. Rather, they form an intricate network, within which they interact with one another in complex ways. Above, we have shown how animacy affects semantic role assignment and the aspectual classification of predicates (see the examples in (27)), and how the latter is related to countability through the [ $\pm$ bounded] and [ $\pm$ internal structure] features. Another interesting case of features interacting is provided by the interplay of animacy and countability.

Smith-Stark (1974) develops a scale of “likelihood of participation in the speech event”, based mainly on animacy as the organizing principle (in (42)), and demonstrates that the higher a noun is in the hierarchy, the more individuated the denoted entity is and the more likely it is to show the singular-plural distinction.

- (42) animate < human < rational < kin < addressee < speaker  
(Smith-Stark, 1974)

As far as the collective-singulative marking is concerned, Grimm (2012) argues that, above the level of prototypical mass-nouns (i.e., liquids and substances, which do not usually show the collective-singulative distinction), the inverse tendency holds: the more individuated an entity is, the less likely it is to be viewed as occurring collectively, therefore higher positions in the animacy hierarchy are less likely to be occupied by collective nouns.

- (43) [liquid/substance] < granular aggregate < inanimate collective aggregate < lower animate < higher animate < human  
(Grimm, 2012)

Lexical features related to how situations unfold in time (often brought together under the terms of **event structure** and **verbal aspect**) have only been mentioned in passing in this section for reasons of space, although they deserve much more attention. Chapter 9 reviews their impact on other components of grammar and their role in current linguistic theories.

## 2.4 Summary

In this chapter, we focused on the relationship of the lexicon with syntax.

- We demarcated the role of syntax within grammar, understood as a human cognitive system enabling native speakers to produce and understand utterances in their language;
- We reviewed some of the main syntactic concepts crucially involved in how words are combined within phrases and sentences: *word order*, *grammatical relation*, *agreement*, and *constituent structure*.
- Finally, some of the most important lexical features (syntactic category, semantic type, and countability) were reviewed. We showed how they affect various syntactic phenomena, and demonstrated that most of these features are transcategorical, thus overcoming the limits of traditional word classifications.

## 2.5 Further Readings

The following textbooks on syntax contain general discussion of different approaches to grammatical study and deal with basic syntactic notions framed within the generative tradition:

Topic	Secondary references
Basic generative syntactic terminology and concepts	Radford (2004) (ch.1-3), Carnie (2002) (Part 1), O'Grady (2005), Hornstein <i>et al.</i> (2005), Den Dikken (2013), Bosque and Gutiérrez-Rexach (2009) (ch.1-4), Gabriel and Müller (2013)
Lexicon in generative grammar and minimalism	Carnie (2002) (ch. 7), Bosque and Gutiérrez-Rexach (2009) (ch.5), van Gelderen (2017) (ch.1-2)

## 2.6 Exercises

1. Compare the following sentences. Are the word sequences in italics syntactic constituents? Use the constituency tests in Section 2.2.

- a. She wrote *a letter in ten minutes*.
- b. She promised *Mary a letter*.
- c. She wrote *a letter to Mary*.
- d. She promised him *a book of proverbs*.

2. One of the criteria used in traditional grammars to identify the syntactic category of a lexical item is its grammatical function, i.e., the structural relation it establishes with other words in the sentence. This criterion would presumably predict the following correspondences:

- a. Nouns are words that can be the subject or the object of the verb.
- b. The adjective is the modifier of the noun.
- c. The adverb is the modifier of the verb.

Explore whether this criterion is correct or whether it is too strong. That is, are there cases where nouns do not satisfy this criterion, and likewise for adjectives and adverbs?

3. The following is a piece of Vogon poetry (Vogons are a fictional alien race from Douglas Adams' series *The Hitchhiker's Guide to the Galaxy*, Adams 2012). Read the verse: as you will see, the Vogons are making use of many English morphosyntactic elements. Try to determine the syntactic category of underlined words based on morphological and syntactic clues:

Oh freddled gruntbuggly! Thy micturations are to me  
 As plurdled gabbleblotchits on a lurgid bee.  
 Groop, I implore thee, my foonting turlingdromes,  
 And hooptiously drangle me with crinkly bindle werdles,  
 For otherwise I will rend thee in the gobberwarts with  
 My blurglecruncheon, see if I don't.

4. Identify all the lexical categories and all the functional categories in this passage (from D. Bowie and S. Critchley, *Bowie*). What criteria did you use (semantic, syntactic, morphological)?

This was very early in the morning, and there was something so still and primal about what I was looking at outside and there were tears running down my face as I was writing this thing. It was just extraordinary.



5. Basic count-mass tests can be found in Section 2.3.3 of this chapter. Complete that battery of tests based on the following pairs: pay particular attention to syntactic, semantic and phonological clues.
  - a. We have enough {soup/ volunteers}.
  - b. Get me some {soup/ chairs}.
  - c. I did not get any {soup/ chairs}.
  - d. A great {amount of soup/ quantity of money/ number of tents} was provided.
6. Classify the following Ns with respect to the features [ $\pm$ bounded] and [ $\pm$ internal structure]. Apply the tests introduced in Section 2.3.3:  
leaves, foliage, sect, grass, poultry, fowl, flock, underwear, barley
7. Which of the individuation factors put forward by Wierzbicka (1985b) (see Section 2.3.3) account for the different conceptualization of the entity or entities denoted by the following doublets?
  - a. leaves-foliage
  - b. dishes-crockery
  - c. letters-mail

## 3 Lexicon in Syntactic Frameworks

---

### 3.1 Overview

In this chapter, we characterize the different syntactic frameworks in terms of how they make use of lexical information. We will frame our discussion in terms of two extreme positions: (a) the lexicon is a passive resource for the needs of syntax and syntactic rules; and (b) the lexicon drives the derivation of all syntactic forms. We begin by presenting theories that adhere to the first approach, since this is the position that has been assumed (although not always explicitly) in most linguistic frameworks since at least the 19th century: traditionally, the role of the lexicon has been that of a listing of those idiosyncrasies that are not predictable or cannot be accounted for by syntactic rules. We then move towards the second approach, which gives the lexicon a more active role. Although the lexicon is still viewed as the most passive module of grammar, we will see that different linguistic theories have progressively increased the amount and, more importantly, the complexity of information associated with lexical items. We conclude with a discussion of theories arguing that the lexicon is a dynamic module of grammar, incorporating as well as dictating essential components of syntactic and semantic interpretation.

### 3.2 The Lexicon from Aristotle to Structuralism

Until the early 20th century, the study of lexicon (and of natural languages in general) was limited to what we referred to in section 1.7 as the first goal of linguistic theory: *to provide an adequate description of linguistic data*. It is also important to bear in mind that, as a rule, no clear distinction was made between linguistic factors that are structural in nature and those that are psychological, philosophical, or socio-cultural.

Aristotelian logic and metaphysics laid the foundation for the philosophical study of language until at least the 19th century, and many of his insights still form an integral part of contemporary linguistic theory: e.g., he organized the linguistic units within a compositional hierarchy, from single words to propositions and syllogisms (combinations of propositions), and defended a bipartite division of sentences (propositions) into a subject and a predicate. Furthermore, he proposed a classification of thoughts and the words that convey them using a systematic set of four dimensions called *aitia* ('causes'): material, formal, efficient, and final cause. Applied to verbs and their corresponding events, this allows us to distinguish between two classes based on the attainment of a final goal (goal-completive *telic* events and non-goal completive *atelic* events). This has influenced work in lexical aspect within linguistics, as well as provided much of the conceptual background for the Generative Lexicon's *Qualia Structure* (see section 3.7).

Most of the research from the Middle Ages to Enlightenment was focused on etymology:

“Assuming that words are essentialist descriptions of the things they name, but at the same time taking for granted that the superficial form of the word as it has come down to us may hide its original constitution, etymological analysis takes the form of looking for the hidden original meaning of words” (Geeraerts 2010: 2). *Speculative etymology*, mainly interested in the meaning connections between words of the same language and oblivious to the highly constrained mechanisms and relations connecting the form of the words, eventually gave way to an empirically-based etymology and comparative philological studies in the 19th century, reflected in large monolingual historical dictionaries, e.g., James Murray’s *Oxford English Dictionary*. On the other hand, the art of rhetoric contributed a varied repertoire of *rhetorical tropes* (i.e., figures of speech), among which *metaphor* and *metonymy* came to be identified in subsequent periods, as robust mechanisms driving semantic and lexical change.

Much of the early work in the 19th century focused on the role words played in substantiating researchers’ claims regarding diachronic change in phonology, word inflection, and word meaning. Unlike the etymological studies of the previous periods, which regarded language change as a process of progressive deterioration of what was once the “perfect” language of the classical literatures, a number of 19th century scholars claimed that change is inherent to language and that its patterns and mechanisms should be studied comprehensively: “the progress of language consists in being freed without violence from its origins. Speech would cease if all words had to be restored to the exact meaning which they possessed in the beginning” (Bréal 1900: 120-121).

Semanticists in France and Germany in the late 19th century began focusing on word meaning from a psychological perspective, looking at the relation between word meaning and concepts. In France, Bréal considered *polysemy* (a word which he coined) to be a necessary creative component of language, and argued that this phenomenon better than most in semantics illustrates the cognitive and conceptualizing force of the human species (Bréal 1897). He analyzed and illustrated in detail, the causes of polysemy and its consequences for language as a system.

For Erdmann (1900), too, polysemy is a necessary part of the functioning of language. The “Vieldeutigkeit” of a word can refer either to a constructional ambiguity, such as inheres in the modal distinction of the meaning of *play* in “Mary played the violin” (between the actual activity of playing a violin and the ability to perform that action), or to the polysemy of an expression which alters its meaning in context, as with adjectives such as *good* and *fast* (see the examples in sections 3.7, 7.4, and 8.5). The early theories of *semasiology* (i.e., study of lexical meaning which takes the linguistic form as a starting point, nowadays largely assimilated to *semantics*) attempted to account for meaning shifts in language and, in particular, for how an expression changes its meaning in context in definite and definable ways. Erdmann’s discussion of metonymy, for example, is similar to the view expounded here on how the meaning, and with it the referential potential of an expression, changes in a context in specific ways. Relating to this distinction, Paul (1891) termed the meaning of uncombined words *usual signification*, and the meaning of word combinations acquired in context, *occasional signification*.

In the 20th century, the focus of linguistic research shifted from studying diachronic issues (how things change over time) to synchronic phenomena (how language components relate to one another at one time), and from mere description to the development of a sound and theoretically grounded discipline. To this end, the European Structuralists first conceived of natural language as a *symbolic system* or a *system of signs*.

- (1) **Linguistic sign:** An arbitrary conjunction of acoustic form (i.e., sounds) and conceptual meaning.

**WARNING: On the Arbitrariness of Linguistic Signs**

*Arbitrary* doesn't mean that individual speakers can freely choose what form to combine with what meaning: once a given combination of form and meaning is accepted in a linguistic community, it becomes fixed or conventionalized. Rather, *arbitrary* refers to the fact that there is no natural link between form and meaning. This is how Ferdinand de Saussure, the father of the European Structuralism, explains it: "The idea of 'sister' is not linked by any inner relationship to the succession of sounds *s-ö-r* which serves as its signifier [i.e., acoustic form] in French." In other words, it could be equally represented as any other *arbitrary* sequence. (Saussure 1959)

Words are signs, and so are morphemes (e.g., the suffix *-ful*, which has the same meaning in *painful* and *delightful*) and word combinations which function as a single word (e.g., *red herring*, among many other word combinations called *multi-word expressions* in current linguistic theory, see sections 3.6 and 11.5). A crucial property of any system is that its components interact and are interdependent. Thus, in addition to meaning, each sign has a **value**, which can only be determined within language as a system by the relations it holds with other signs. Saussure uses the chess metaphor to illustrate this idea: the piece representing the knight, for instance, only has value as an element of the game and means nothing outside the chess board, and it can be easily substituted for another one having no physical resemblance to it whatsoever.

Structuralists distinguished two basic kinds of relations between linguistic units: syntagmatic and paradigmatic. **Syntagmatic relations** are acquired by linguistic elements when "chained together" in a word or a phrase: they are also called "horizontal". **Paradigmatic relations** (also called "vertical"), on the other hand, are based on similarity and refer to the relations holding between elements compatible with the same linguistic context and mutually replaceable in that context. The examples in (2) illustrate both kinds of relationships between morphemes in a derived word, and between words in a sentence. In (2a), the prefix *mis-* establishes a syntagmatic relation with the words *adventure*, *conduct*, and *diagnosis*. The relation between the latter three stems is paradigmatic: they "compete" for the same spot in the derived word. In (2b), the paradigmatic relation holds between the nouns *misadventure*, *misconduct* and *misdiagnosis*, which occupy the same position in the sentence and are related syntagmatically with the neighboring elements, the determiner *his* in the first place.

- (2) a.  $\text{mis-} \left\{ \begin{array}{l} \text{adventure} \\ \text{conduct} \\ \text{diagnosis} \end{array} \right\}$
- b. John told us about his  $\left\{ \begin{array}{l} \text{misadventure} \\ \text{misconduct} \\ \text{misdiagnosis} \end{array} \right\}.$

It should be mentioned that proponents of classical structuralism (both European and American, as we will see right away) did not view the lexicon as a separate component of grammar. Saussure, for instance, criticized the traditional division of grammar into morphology and syntax, to the exclusion of lexicon. His main argument was that grammar and lexicon are often functionally equivalent, i.e., the same linguistic distinction may be encoded grammatically or lexically. He used the following pairs of Russian verbs to show that the distinction between imperfective forms (denoting incomplete, ongoing events) and perfective forms (denoting completed events) can be encoded grammatically (as in (3a), where both forms are solely distinguished by the suffix *-iva*) as well as lexically (as in (3b), where they are morphologically distinct).

- (3) a. spros-i-t<sup>P</sup> / spraš-iva-t<sup>I</sup> 'ask'  
 b. govor-i-t<sup>I</sup> / skaz-a-t<sup>P</sup> 'say'

The tendency of equating the lexicon with “arbitrary” or “unmotivated” and grammar with “(partially) motivated” is already common in Saussure, and it is even more prominent in the writings of Bloomfield, the leading figure of American Structuralism. For him, lexicon is the complete inventory of morphemes of a language, a morpheme being the smallest meaningful linguistic unit. Grammar and morphology are responsible for any regularity in the construction of words into phrases, and it is the responsibility of the lexicon to list the morphemes as well as any morphemic combinations whose properties are not predictable through grammar. Hence the famous view of the lexicon as a “list of basic irregularities” (Bloomfield, 1933).

However, structuralism did make several significant contributions to the study of the lexicon, which had far-reaching consequences and were adopted within numerous subsequent theoretical frameworks. In what follows we review two of these contributions, which are closely related: the notion of **lexical field** and the method of **componential analysis**.

A **lexical field** is a way of representing paradigmatically related lexical units: words related in meaning are represented as occupying specific slots within the conceptual or semantic domain they share, forming a kind of mosaic (a metaphor used in Trier 1931) wherein each small piece carves out a specific portion of semantic content and the position of each piece with respect to its neighbors determines its value. Importantly, lexical fields and other structured representations of the lexicon defy the “ragtag collection of words” conception of our mental dictionary.

Many different implementations of the notion of lexical field have been put forward (other related terms used in the literature are *semantic field*, *word field* and *conceptual field*). There is, however, a common thread running through most of them (at least since Weisgerber 1927): in order to identify the relations between words, we first need to identify a set of dimensions along which they may be established and compared. Most field representations refer explicitly to the intrinsic dimensions along which the lexical items are compared, and are based on the **componential analysis** of lexical meaning, a kind of **lexical decomposition**. Lexical decomposition emerges from recognizing that lexical meaning is complex, and as such it can be broken down into smaller components which can be studied independently from each other. Lexical decomposition will be dealt with in chapter 7.

The notion of componential analysis of lexical meaning was imported from structuralist phonology, where different phonemes (the smallest units of sound capable of conveying a distinction in meaning) were distinguished on the basis of distinctive binary features belonging to a set of contrastive dimensions. The simplified matrix in table 3.1 reproduces the distinctive features of the English phonemes /p/, /t/, /k/, and /b/ following the distinctive feature set put forward in Jakobson *et al.* (1963).

	/p/	/t/	/k/	/b/
Consonant / Non-consonant	+	+	+	+
Compact / Diffuse	-	-	+	-
Grave / Acute	+	-		+
Nasal / Oral	-	-	-	-
Tense / Lax	+	+	+	-
Continuant / Interrupted	-	-	-	-

**Table 3.1** *Distinctive features in phonology*

Each dimension is defined by a Boolean feature: the positive value corresponds to the first member of each set of features and the negative value to the second member. When a certain dimension is not applicable to a phoneme, the cell is left blank, e.g. 'grave-acute' for /k/. The four phonemes share the features [+consonant], [-nasal] (i.e., [+oral]) and [-continuant] (i.e., [+interrupted]). /p/ and /t/ are opposed to /k/ in being [-compact], and contrast with each other with respect to the 'grave-acute' dimension: /p/ is [+grave] and /t/ is [-grave]. Further, /p/ and /b/ are identical except for one feature value, i.e., Tense/ Lax. These features are *distinctive* in English because they correlate with change in meaning: the words *pan* (/paen/), *tan* (/taen/) and *can* (/kaen/) have the same acoustic form except for the three morphemes just analyzed, and differ in meaning.

Applied to the study of lexical fields, this approach lets us establish what features are shared by words within the same field and which differentiate them. This view is adopted by another prominent European structuralist, Eugenio Coseriu, whose definition of lexical field we adopt:

- (4) **Lexical field:** A group of lexemes which share generalizing semantic content and which are mutually opposed by means of minimal distinctive features (Coseriu, 1977). The set of features shared by all the lexemes in a lexical field, or an actual word presenting these features, is called a **archilexeme**.

As an example of this strategy applied to word meaning, consider the domain of cooking terms as defined by distinctive semantic features (cf. Lehrer (1974)). The archilexeme of this field is *cook*, which comprises the features [Process: irreversible], [Instrument: Heat] and [Purpose: Make food desirable, nutritious, digestible]. The sign '\*' means that a component is not applicable, and blank cells correspond to information that, in principle, can be filled in but which do not belong to the word definition (e.g., the cooking speed can be fast or slow for *bake*, but this information is not distinguishing).

	Water	Oil or fat	Vapor	Liquid amount	Heat source	Cooking action	Special utensil	Added purpose	Cooking speed
<i>boil</i> <sub>1</sub>	+	-	-						
<i>boil</i> <sub>2</sub>	+	-	-			[Vigorous]			
<i>stew</i>	+	-	-			[Gentle]		[To soften]	[Slow]
<i>steam</i>	+	-	+				(Rack, sieve)		
<i>fry</i>	-	+	*				(Frying pan)		
<i>sauté</i>	-	+	*	[Small]					[Fast]
<i>broil</i>	-	-	*	*	[Radiant]	*			
<i>grill</i>	-	-	*	*	[Radiant]	*	(Grill, griddle)		
<i>barbecue charcoal</i>	-	-	*	*	[Radiant (Hot coals)]	*			
<i>bake</i>	-	-	*	*	[Conducted]	*	(Oven)		
<i>roast</i>	-	-	*	*	[Radiant or conducted]	*			

**Table 3.2** *Lexical field of cooking words, componential analysis, Lehrer (1974)*

One important property shared by phonological and lexical-semantic features is the existence of *gaps*: a priori legitimate combinations of features which are not realized in language. For example, there are presently no English verbs meaning ‘cook something in a large amount of fat on an open fire for a long time’ or ‘cook something gently in water on a pan for a short time’, i.e., there are **lexical gaps** in this lexical field.

That said, a number of important differences between phonological and lexical-semantic features stand out if we compare tables 3.2 and 3.1:

- (5) a. Binary features are expressive enough to classify the set of phonemes, but in the case of lexical meaning for words, it would seem that binary features will not be adequate for giving a reasonably complete meaning description;
- b. Phonological features can be shared by different phonemes but they never overlap, unlike the senses of different lexemes. For example, *broil* and *bake* differ in the kind of heat applied to the food, while *roast* is compatible with both kinds of heat.
- c. No two phonemes share the same features: by contrast, at the word level it is not uncommon that two lexemes have the same semantic features (i.e., are synonymous), e.g., *barbecue* and *charcoal*.
- d. Phonological features identify elements which each have equal status in the category, while lexical-semantic features define categories that contain either central or peripheral members within the field. For example, *fry* and *stew* are certainly more typical ways of cooking than *steam* or *sauté*.

These and other mismatches would appear to challenge the appropriateness of feature-based charts for representing lexical meaning (recall the highly irregular shape of table 3.2). As shown in Sections 5.4 and 5.5, prototype-based models of meaning address some of these issues.

Research on lexical fields raised yet another question: **is there any connection between paradigmatic and syntagmatic relations?** In particular, **do semantically related words show similar syntactic behavior?** From our definition of paradigmatic relations it follows that paradigmatically related words share syntactic similarities, inasmuch as they are expected to appear in the same context. The assumption that the meaning components demarcating different elements of a lexical field can also determine their syntactic behavior is adopted later in the book, when we see how semantics is mapped to surface syntactic structure (see chapters 8, 10, and 11).

Cooking verbs seem to confirm this thesis (Lehrer 1974, Atkins *et al.* 1988): they are all used in transitive constructions, with variations. For example, (6a) is a typical transitive sentence with an Agent subject and a Theme direct object, while in (6b), the subject has the semantic role of Instrument.

- (6) a. The host is {grilling / roasting / boiling} the meat.
- b. This broiler cooks chops, fish and steaks very fast.

Notice that these verbs can also be used intransitively.

- (7) a. The meat is {grilling / roasting / boiling}.
- b. The pork chops broiled very fast.
- c. The chef is {cooking/baking/\*roasting/\*sautéing}.

The syntactic subjects in (7a) and (7b) belong to the same class as the direct objects in (6): they refer to the cooked material and have the semantic role of Theme. The intransitive sentence (7c) differs from the other two because the syntactic subject has the same properties as the syntactic subjects in (6): it denotes the Agent and there is no Theme. Note that this kind of construction

(called *unergative*) is available, almost exclusively, with the two basic verbs of cooking, *cook* and *bake*. Different types of intransitive predicates will be reviewed in chapter 8.

### 3.3 Generative Grammar

While the model of syntax as developed within generative linguistics differs substantially from structuralist approaches, it is interesting that its conception of the lexicon is taken directly from Bloomfield's notion that it is no more than "an appendix of the grammar, a basic list of irregularities". This is not surprising, given that generative linguistics aims at unveiling and formalizing the generic or universal properties underlying all human language, while separating these properties from the so-called "residue", i.e., irregular information that cannot be derived through any general principle. On this view, different components of grammar are treated unequally: namely, syntax necessarily plays a central role since it drives the linguistic computation (cf. section 2.2); it is also regular and easier to model; the idiosyncratic lexicon is left in the background, acting in the service of more dynamic components, such as syntax, morphology, and possibly semantics.

This being said, it should be acknowledged that the six decades of the generative history have witnessed a progressive revaluation of the role of the lexicon in the model of language. In this brief review, we single out the following stages of this steady progress:

- Grammar without a dedicated lexical component (Chomsky 1957)
- Lexicon as a part of grammar separated from syntax; lexical entry as a structured set of nothing but irregularities (Chomsky 1965)
- The *Lexicalist Hypothesis*: regularities in the lexicon (Chomsky 1970)
- *Principles and Parameters Theory* (Government and Binding model): the *Projection Principle* (syntactic structures are projected from the lexicon)
- *Principles and Parameters Theory* (Minimalism): properties of abstract lexical features trigger syntactic phenomena

Chomsky's *Syntactic Structures* (Chomsky, 1957), the work that laid the foundations of the generative enterprise, does not include the lexicon as a linguistic level, in contrast to phrase structure (i.e., syntax), morphology, or phonology. Lexical items are treated as vocabulary elements on the morphological level of analysis, alongside forms that are not conventional lexical units. A specific kind of phrase structure rule, the *preterminal rule*, makes reference to these items and embeds them within a derivation that may include the addition of inflection or derivational endings. The following adapted representation includes the phrase structure rules used to derive the phrase *the balls*:

- (8) a. the balls  
       b.  $NP_{pl} \rightarrow D + N + -s$   
       c.  $D \rightarrow the$   
       d.  $N \rightarrow ball$

The rule (8b) specifies that a plural NP is formed by concatenating a determiner, a noun and the plural ending *-s*. The rules (8c) and (8d) are pre-terminal: they insert the lexical items *the* and *ball* into the derivation.

In *Aspects of the theory of Syntax* (Chomsky, 1965), two important steps are made towards elevating the status of the lexicon. In the first place, Chomsky introduces the lexicon as a distinct (albeit passive) component of the grammar, a repository of words. The main reason for doing so



was that it did not seem appropriate to overload the syntactic rules with non-syntactic information, such as selectional constraints. Recall from section 2.3 that these constraints comprise two types of information: the syntactic category and its semantic features. Categorial information affects syntax in a straightforward fashion. Notice that sentence (9a) contains a categorial violation and is clearly ungrammatical, while (9b) contains a semantic violation and can be labeled as semantically odd.

- (9) a. \*The boy hates *around the corner*.  
 b. ?*Happiness* hates the boy.

The second major advance is that a significant amount of systematicity is encoded in individual lexical entries, which are structured as feature matrices. In addition to the phonological description, each entry contains a collection of syntactically-relevant features. For instance, the words *boy*, *happiness* and *hate* would have the following entries (which are similar to the argument structure constraints in section 2.3, example (28)):

- (10) a. (*boy*, [+N, +D\_\_\_, +Common, +Count, +Animate, +Human])  
 b. (*happiness*, [+N, +D\_\_\_, -Count, +Abstract])  
 c. (*hate*, [+V, +[+Animate] \_\_\_ NP])

The features in (10a), for example, specify that the lexical item *boy* is identified as: a common noun (+Common, +N) that can follow a determiner (+D\_\_\_), and refers to a countable (+Count) human (+Animate, +Human). Since the selectional constraints are encoded in the lexicon, the pre-terminal rules (e.g., (8c,d)) can be dispensed with. A unique *lexical insertion rule* makes sure that *boy* can be inserted in the syntactic structure as the subject of *hate*, because it meets the categorial and semantic requirements imposed by the verb. *Happiness*, on the other hand, will be rejected as the subject because it is [+Abstract] and not [+Animate].

Because there are few useful “generic” lexical items (as there are syntactic rules), lexical entries were viewed as containing irregularities, since their behavior does not follow without the stipulations encoded in their features. Hence, this corresponds to the strongest interpretation of the “lexicon as a repository of irregularities”. The only exception is made for the **redundancy rules**, which specify which features are predictable given others. For example, if we assume that [+Human] presupposes [+Animate] (redundancy rule (11a)) and that [+Common] presupposes [+N] (rule (11b)), the features [+Animate] and [+N] can be safely removed from the lexical entry due to their redundancy, and the lexical entry can be abbreviated as in (11c):

- (11) a. [+Animate] → [±Human]  
 b. [+N] → [±Common]  
 c. (*boy*, [+D\_\_\_, +Common, +Count, +Human])

“Remarks on Nominalization” (Chomsky, 1970) is the foundational work of the *lexicalist* view of syntax, which separates word derivation and word formation rules from the syntax. This shift was significant, in that the lexicon became a more interesting place, and took up some of the responsibility that was previously carried out by syntax. One major shift is that deverbal and de-adjectival nominalizations should be derived in the lexicon and not in syntax, despite exhibiting significant regularity in languages, as argued below.

1. There is limited productivity of derived nominals: e.g., *eagerness*, *easiness* and *difficulty* are derived from adjectives *eager*, *easy*, and *difficult*, but only *eagerness* is acceptable in NPs mirroring the structure of full sentences:

- (12) a. John is eager to please / John's eagerness to please  
 b. John is {easy/difficult} to please / \*John's {easiness/difficulty} to please
2. There are idiosyncratic semantic relationships between derived noun and base: *ignore-ignorance* ('state or property related to V'), *reside-residence* ('place of V/ act of V'), *construct-construction* ('act or result of V'), etc.
3. The derived nominals have the internal structure of NPs and not VPs (or APs): unlike verbal forms, they are compatible with preposed adjectival modifiers (13a), determiners (13b), and have neither aspect nor time:
- (13) a. John's unmotivated criticism of the book / \*John's unmotivated criticizing the book.  
 b. John's three buildings / {Many/some} of John's buildings.

In order to account for the partial regularities detected in derivational morphology, a set of **lexical redundancy rules** (similar to those in syntax and phonology) is introduced. The following rule states that an NP with a *-ble* adjective can be derived only from transitive verbs and only when the modified noun is the direct object of the base verb:

- (14) a.  $[_{VP} V NP] \rightarrow [_{NP} [_{AP} V\text{-}ble] N]$ .  
 b. \*John is believable '=[John believes'/ This claim is believable '=The claim can be believed'.

This approach to the relationship between syntax and lexicon is known as the **Lexicalist Hypothesis**. In limiting the access of syntactic rules to already formed lexical items, it assumes that morphology is a lexical phenomenon. Over the years, the Lexicalist Hypothesis obtained manifold interpretations in morphological and syntactic literature, the main sticking point being the status of inflectional morphology. The Weak Lexical Hypothesis holds that derivational morphology is a lexical phenomenon, while inflection is syntactic in nature (as defended in Jackendoff 1975, Aronoff 1976, Anderson 1982, Booij 1996, etc.). The Strong Lexicalist Hypothesis states that both derivation and inflection operate within the lexicon (cf. Lieber 1980, Selkirk 1982, Di Sciullo and Williams 1982, among others).

The next major revision of the generative model, usually referred to as the *Principles and Parameters Model*, dispenses with the complex system made up by numerous phrase structure rules and transformational rules, and sets out to capture the general properties of natural languages in the form of a limited set of innate principles of Universal Grammar (UG). Among these, the **Projection Principle** assumes that the lexicon plays a central role in the grammar: it stipulates that syntactic structures are projected from the lexicon and that lexical features must be preserved at every syntactic level, including Logical Form (the semantic representation determined by grammar) (Chomsky 1981).

As in previous approaches, the lexical features dealt with are those involved in selectional constraints. The argument structure and related constraints are *projected* by the lexical items, and the argument structure representation is enriched with **thematic roles** ( $\theta$ -roles), which refer to the semantic relations between the predicate and its arguments (a notion first introduced in Section 2.2). For the purpose of this overview, it should be noted that equivalent or similar notions to thematic roles have been proposed and developed in the context of different linguistic frameworks. We will discuss these proposals in more detail in chapter 8.

In the Principles and Parameters theory, there are two kinds of information represented by a language: vocabulary and **parameters**. Parameters represent variable or language-specific aspects of the grammar. One of them is the *Head Direction Parameter*. Assuming, for simplicity,

that the phrase structure of all natural languages conforms to the X-bar format, as in (15), a complement (YP) will attach either to the left or the right of the head,  $X^0$ .

- (15) [XP [Specifier- $X'$   $X'$ [(YP)  $X^0$  (YP)]]]

Languages differ in how they fix the value of this parameter. For example, Japanese, Turkish, and Korean set this variable to head-final, while English and Italian assume a head-initial setting. In (16a,b), for example, the head of the PP *in Japan* / *in Giappone*, the preposition *in*, precedes its complement, and in (16c) the order is reversed (*ni* is a *postposition*):

- (16) a. English: *in Japan*  
       b. Italian: *in Giappone*  
       c. Japanese: *nihon ni*

Such parameter choices act to distinguish and cluster natural languages in a multi-dimensional space of possible language settings.

The most recent model of generative linguistics that we review here is that known as **Minimalism**. The Minimalist Program (Chomsky 1995, Chomsky 2005) imposes a requirement on linguistic representations, known as the **Full Interpretation principle**: in order to be usable, they must be interpretable by the cognitive module (the *conceptual-intentional* performance system) and the articulatory-perceptual (also called *sensory-motor*) performance system, responsible for speech perception and production. Both performance systems are external to mechanisms computing linguistic structure (i.e., syntax), but communicate with them.

Strict combinatoric requirements result in extremely austere, non-redundant syntactic representations (hence the term *Minimalism*) and force the researchers to dispense with a great deal of descriptive mechanisms developed in previous frameworks: the X-bar levels, indices, traces, and so on. Although the lexicon is still viewed as “an optimal encoding of exceptions”, its role is reinforced in the Minimalist framework: syntax is only allowed to rearrange “what you’ve already got”, which are the lexical properties, and no new objects may be added in the course of syntactic computation, something known as the **Inclusiveness Condition**.

Within minimalism, the derivation of a linguistic expression is accomplished in three stages: lexicalization, combination, and externalization. **Lexicalization** is basically the process of turning concepts or linguistic features related to an utterance into words. It is done in two steps: (1) Select a set of features [F] from the universal feature set F; (2) assemble the features from [F] into the appropriate lexicon for the utterance.

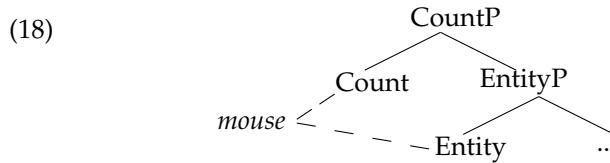
Some minimalist approaches to the definition of word (e.g., Distributed Morphology and Nanosyntax) reject the lexicalist hypothesis mentioned above, and propose a kind of syntactically-based decomposition underlying the mechanisms of feature assembly into lexical items (hence the term *l-syntax*, ‘lexical syntax’, introduced in Hale and Keyser (1993) to refer to the part of syntactic structure where the content of the lexical entry is projected, and where certain word formation processes take place). On this view, syntax manipulates morphosyntactic feature bundles, devoid of phonological form, and the vocabulary as such (as a list of meaning-form pairings, words and morphemes) emerges post-syntactically by matching fragments of the syntactic tree with phonological form. In approaches with only one, post-syntactic, lexicon (as in Nanosyntax), syntax can no longer be claimed to be projected from the lexicon since there is no lexicon before syntax.

To illustrate how this works, consider the relatively simple operation of building an NP around the noun *mouse*. Within a conventional generative model, such as Principles and Param-

eters, the lexical item *mouse* exists pre-syntactically and it is inserted under the terminal head node, N; this then projects to N' and then NP, as illustrated in (17).

$$(17) \text{ [NP[N' [N mouse ]N]N']NP}$$

In the nanosyntax model, there is no N node as such. Rather, the notion of N is decomposed into the relevant sublexical (viz., below the word level) functional projections: in this case, *mouse* spans two functional projections, *entity* and *count*. Recall that we classified these functional projections as *semantic features* or *types* in section 2.3.2.



(Based on Starke 2014)

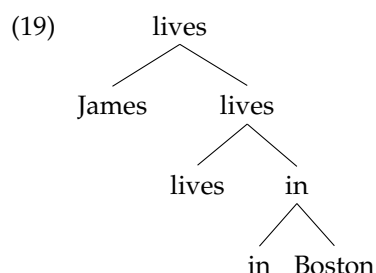
#### WARNING: Against Lexical Decomposition in the Syntax

One of the main arguments raised against the “lexicon in the syntax” approach is that the mechanisms by which sublexical features combine into word meaning are not the same as the mechanisms by which words meanings combine into phrase and sentence meanings. Jackendoff (2002), for instance, argues that “even if the sublexical units composing a word meaning could themselves be expressed as words, no phrase composed of those words could express what the original word expresses”. This argument is further elaborated upon in chapter 7.

The next stage of syntactic derivation in this model corresponds to **combination**, the recursive mechanism responsible for building syntactic structures from lexical items. Within this stage, there are two parts: (1) Select the set of relevant lexical items from the Lexicon, called the lexical array (LA); (2) Map the LA to a linguistic expression, with no recourse to [F] for narrow syntax (i.e., syntax can only access lexical items and their features).

The basic syntactic operation generating linguistic expressions from words is **Merge**: it combines two syntactic objects,  $SO_i$  and  $SO_j$ , in order to create a new syntactic object,  $SO_{i/j}$ . The first application of Merge combines two lexical items from the lexical array, and subsequent cycles add one word at a time to the syntactic object under construction. In principle, Merge is symmetrical: it applies to an unordered pair  $\{SO_i, SO_j\}$ , and the resulting syntactic object can have the properties of either of the combined elements. Usually, the head of the new expression is the object that needs to have its selectional requirements satisfied (here is where an asymmetry arises): Merge is triggered in order to provide it with a complement or a specifier.

To illustrate this procedure, let us do a schematic derivation of the sentence *James lives in Boston*. Merge proceeds recursively, in a bottom-up fashion. The first two elements to combine are the preposition *in* and the DP *Boston*. The preposition needs a complement, and the DP can take on this role, resulting in the object  $\{in, \{in, Boston\}\}$ , headed by *in* (we will explain shortly why we dispense with categorial labels in these representations). At a subsequent step, the verb *lives* is introduced, which enters into a head-complement relation with the PP *in Boston*. Finally, the DP *James* is merged with the verbal projection obtained in the previous step by virtue of the specifier-head relation. The resulting tree, called a *bare phrase structure (BPS)*, is shown below.



These differ from X-bar representations in several crucial respects: there are no X-bar levels to distinguish projection levels; configurational relations are not pre-determined prior to the derivation; categorial labels may be dispensed with, too, since this information is contained in the lexical entry of the inserted lexical item.

In Minimalism, the properties of abstract lexical features trigger syntactic phenomena. Features are usually divided along three lines: *interpretable* vs. *uninterpretable*, *valued* vs. *unvalued*, and *weak* vs. *strong*. Here we touch briefly on the notion of interpretability. The ultimate reason for applying syntactic operations derives from the fact that some lexical items come with features that cannot be processed at the semantic and/or phonetic interface. Semantically **uninterpretable** features cannot be processed at the semantic interface (LF), and they must be *deleted* (in the sense ‘made invisible to the semantic component, but not to syntax or the phonetic component’) before the expression reaches the semantic interface. One example of an uninterpretable feature is *case*, which is inherent on nouns and pronouns and does not encode semantic content regardless of the category (unlike other features, which are usually interpretable on some categories and uninterpretable on others, recall section 2.3).

An uninterpretable feature, *F*, of a head category, *K*, (called the *probe*) can only be deleted if it matches (i.e., is compatible with) an interpretable feature, *F'* (or an *unvalued* feature, whose value is determined in the course of the derivation), of the category, *K'* (called the *goal*). Feature matching (or *feature checking*) is only possible if both the probe and the goal are active, i.e., if they have uninterpretable features that need to be checked, and if the goal is accessible to a given probe: the probe must c-command the goal (the goal must be contained in the sister node of the probe), and there must be no intervening element matching the probe.

From this brief overview of the role of the lexicon in Generative Grammar, it follows that one of the main goals of current syntactic research consists of discovering what semantic (i.e., interpretable) features of lexical items and what features of the functional categories associated with them determine the properties of the syntactic structure. This can be seen as constituting significant progress compared to earlier models of generative linguistics, as it opens the way to exploring systematic relationships between syntax and lexical semantics. It might seem that many of the generative approaches dispense with the lexicon altogether, integrating its most productive and regular parts into syntax and ignoring the rest. However, very few (if any) recent generative syntactic frameworks actually deny that lexical categories encode a rich conceptual content, which is not always visible to grammar. It is usually not included in syntactic and formal-semantic representations of lexical items, but, as we will see henceforth (especially in chapters 5 and 6), it is crucial for differentiating between syntactically identical lexical items.

As far as the syntax-lexicon relationship is concerned, we will make a point in differentiating, as cleanly as possible, between elements of lexical and syntactic knowledge. In particular, we believe that the fact that many lexical features have an impact on syntax does not make them syntactic, it merely indicates that these features are syntactically-relevant.

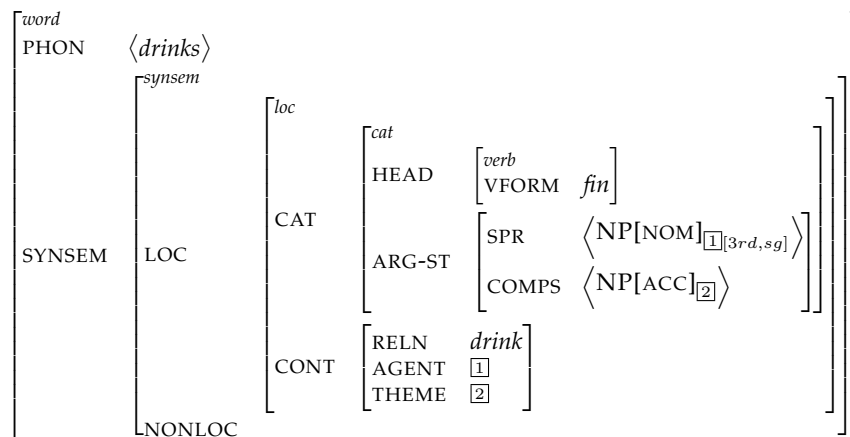
### 3.4 Head-Driven Phrase Structure Grammar (HPSG)

HPSG is a phrase structure grammar formalism where the role of the lexicon in creating syntactic forms is very prominent. For this reason, it is referred to as a *lexicalized grammar*. Linguistic objects are represented as *typed feature structures*, which we will examine in detail shortly. The range of acceptable feature structures is constrained by a set of universal, as well as language-specific principles, encoded in the system components listed below. Feature structures not ruled out explicitly by these constraints are allowed.

- (20) a. Linguistic ontology: inventory of available types of linguistic entities;
- b. Schemata or rules: a small inventory of available phrase types;
- c. Principles constraining well-formed phrases;
- d. Lexicon: a system of rich, highly structured lexical entries.

The lexicon in HPSG is much more than just a list of entries registering idiosyncratic and non-generalizable aspects of the lexemes. As we will see, there is a significant amount of regularity in the way lexical entries are structured. Moreover, the lexicon as a whole is viewed as a system, and the relationships between lexical entries are captured by means of multiple inheritance hierarchies and lexical rules. To get a better understanding of what a feature structure is and how a lexical entry is structured, consider the inflected verb form *drinks*, as in ‘Anna drinks tea’, shown in (21).

(21) *drinks*:



This lexical entry is formalized through a feature structure called an **attribute value matrix (AVM)**. This is actually a very general way of indicating what values are associated with a particular attribute (or property) for an object. For example, attributes for a PERSON might include: LAST\_NAME, FIRST\_NAME, GENDER, and so on.

In HPSG, the feature structures that correspond to different kinds of linguistic objects are typed, as represented in the labels in small italics above, e.g., *word*, *synsem*, *cat*, and so on. Any given kind of feature structure has a fixed set of attributes. For instance, the feature structure of type *word*, as in (21), has the attributes PHON and SYNSEM: the former stands for PHONOLOGY, the phonological representation of the word, which can also refer to the orthographic form; SYNSEM refers to SYNTAX-SEMANTICS, which includes semantic and syntactic information relevant for combinatorial purposes, i.e., features that can be selected for by other words or syntactic

constituents within the same structure. The PHON feature is *atomic*: its value is not decomposable. The SYNSEM feature, on the other hand, is *complex*, meaning that it takes other features (LOC and NONLOC), with their respective values, as its value. LOC (LOCAL) refers to locally-relevant features, which typically affect categorial selection, head-complement agreement, case and semantic role assignment, etc. NONLOC (NON-LOCAL) information is relevant in non-local dependencies, to relate the original position of a moved constituent to its final (i.e., ‘surface’) position, as in *wh*-phrases and other constructions, e.g., ‘Where<sub>i</sub> do you come from \_\_<sub>i</sub>?’.

The syntactic label CAT (CATEGORY) subsumes the features HEAD and ARG-ST (ARGUMENT STRUCTURE). HEAD includes the information shared between the lexical item and its syntactic projection or, in HPSG terms, between the *head daughter* and the *head mother*. In our case, this information is the categorial attribute VFORM (VERBAL FORM), which is valued as *fin* (*finite*), since *drinks* is a tensed verbal form. The ARGUMENT-STRUCTURE feature specifies what kind of arguments *drinks* must be combined with: more precisely their syntactic category, grammatical case, and person and number for the subject (note that the PHON feature is missing from the description of the arguments, because phonological information is not selected for by the selector). As we can see, the verbal arguments are mapped onto two lists: the SPR (SPECIFIER) feature introduces verbal subjects (as well as determiners of noun phrases), and the COMPS (COMPLEMENTS) feature encodes all the other subcategorized arguments. The arguments are represented as lists (rather than unordered sets) to obtain the correct word order in a sentence.

The semantic label CONT (content) essentially expresses thematic relations in the predicate: it refers to the fact that the verb *drinks* encodes a ‘drink’ relation between the Agent, which refers to the same entity as the subject argument (both are tagged with the index [1]), and the Theme, which is coreferential with the direct object (tagged as [2]). HPSG makes wide use of boxed indices to signal instances of structure sharing (or **reentrancy**, see section 6.3.1), when two or more features have the same value: to signal that the referent of two nominals is the same, to ensure identity of agreement features in subject-verb and determiner-noun structures, etc.

Since AVMs are used for modeling full syntactic phrases as well as lexical items, there needs to be a mechanism for combining lexical AVMs. This is accomplished through an operation called **unification**. This is a kind of substitution mechanism which ensures that syntactic and semantic constraints, as encoded in the feature structure, are satisfied when two AVMs are combined. In particular, two or more feature structures can be unified (i.e., combined in a single, larger feature structure), if the resulting feature structure is consistent (it does not contain conflicting feature types): e.g., a feature structure with a HEAD value *verb* cannot be unified with the feature CASE, because it is not appropriate for this type of feature structure -verbs are not marked for case) or different values for the same feature (e.g., a verb requiring a first complement valued as NP cannot be combined with a PP instead). Hence, in HPSG, all grammatical constraints are satisfied simultaneously: in other words there is no ‘movement’ or ‘rule derivation’, as in most generative theories such as Minimalism.

Phrases also have the attribute DAUGHTERS (DTRS), which encodes the constituent structure of a phrase. The value of DTRS is the type *constituent structure* (*con-struc*), and there are several *con-struc* subtypes. The most frequent one is *headed structure* (*head-struc*), which includes the attributes HEAD-DAUGHTER, SPECIFIER-DAUGHTER, COMPLEMENT-DAUGHTERS, and ADJUNCT-DAUGHTERS. A headed structure must have a head (just one), can have a specifier (usually one), and can have (no or several) complements and adjuncts, which essentially follows the approach to headedness we sketched in section 2.3.1.

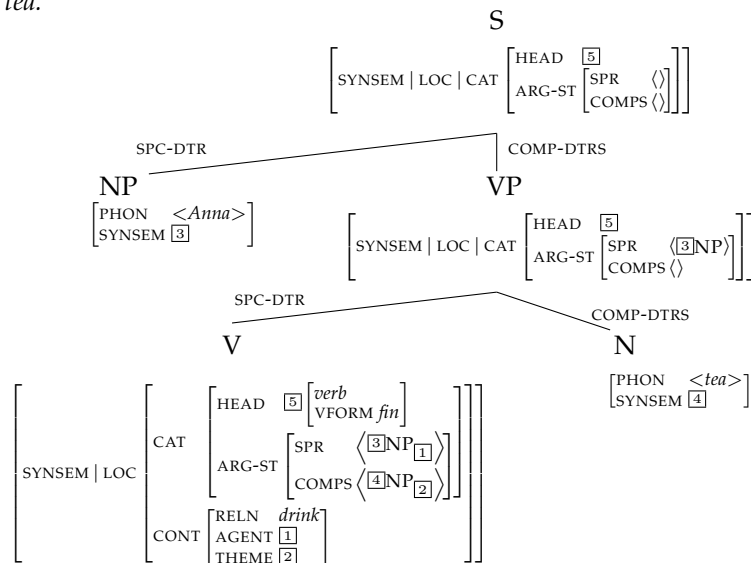
To ensure that the features of the head are passed up along the head projection and that the

arguments satisfy the selectional requirements of the head, two principles have been postulated in HPSG, the *Head Feature Principle* and the *Valence Principle*, which are shown in (22).

- (22) a. *Head Feature Principle*: In any headed phrase, the HEAD value of the mother and the HEAD value of the daughter are identical.  
 b. *Valence Principle*: Unless the rule says otherwise, the mother's SPR and COMPS values are identical to those of the head daughter (Sag *et al.*, 1999).

Now let's see how all of this machinery plays out in the construction of a full sentence. The representation below corresponds to the sentence *Anna drinks tea*, which is an instance of a headed structure. We combine the AVM formalism within a tree structure for visualization purposes:

(23) *Anna drinks tea.*



After the elements from the SPR and the COMPS lists of the head daughter are combined with the head, they are cancelled off the respective list (similarly to how features are checked and deleted in Minimalism), and all unrealized ARG-STR requirements of the head daughter are handed on to the mother. For example, the Theme complement of the head daughter V does not appear in the list of complements of the head mother VP. The Agent argument, on the other hand, stays on the SPR list until the COMP list of the lexical head is empty and the VP is formed (by virtue of the Head-Specifier Rule). It is erased from the SPR list at the level of S, after the subject is combined with the VP.

As we just pointed out, the relationships between lexical entries are captured in HPSG by means of **lexical rules** and **multiple inheritance hierarchies**. **Lexical rules** are used, in particular, to model different phenomena of derivational and inflectional morphology: they derive lexical entries of morphologically complex (prefixed, suffixed, compound) words from those of simpler lexical items, and map lexemes into their inflected forms (which we called *word forms* or *grammatical words* in section 1.4).

Lexical rules have the general format ' $X \Rightarrow Y$ ': "for any lexical entry that is consistent with the description in X, there is another lexical entry that includes the description in Y" (Sag *et al.* 1999: 185). For instance, the rule in Figure 3.1 derives Agent nominals ending in *-er* (*swimmer*, *destroyer*, etc.) from verbal bases:



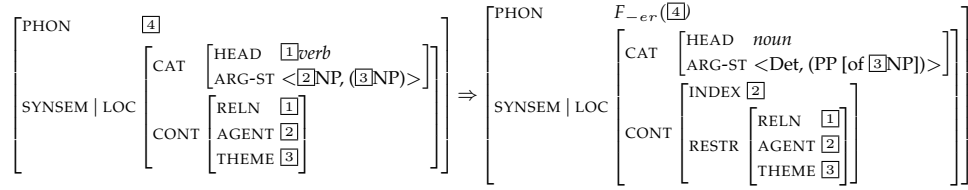


Figure 3.1 Agent nominalization lexical rule

The left-hand side of this rule specifies that it applies to verbal lexemes that take one or two NP arguments (the parentheses around the second argument indicate optionality). This explains why nominals such as *depend* or *insert* do not exist: *depend* requires a subject NP and a PP complement (e.g., *Mary depends on her brother*), and *insert* selects for an NP subject and two complements, an NP and a PP (*Mary inserted a coin in the slot*). (Note, however, that this generalization might not be fine-grained enough. Nominals such as *believer* do exist although the verbal base selects for a PP complement: *I believe in karma* – *I am a firm believer in karma*). The output of the rule is a noun suffixed with *-er*, which has the same semantic tag as the subject of the base verb (i.e., the INDEX attribute refers to the Agent of the relation denoted by the verb, captured in the RESTR attribute), and which may inherit the Theme argument of the base verb as its PP complement introduced by the preposition *of* (e.g., *the owner of a company*).

Recall that in HPSG the feature structures corresponding to different kinds of linguistic objects are typed and each type has a fixed set of attributes. Furthermore, types are organized into hierarchies, with more specific types (*subtypes*) positioned under more general types (*supertypes*). Each subtype *inherits* the constraints (in terms of features and their values) of its respective supertype, eliminating a lot of redundancy from the lexical entries.

To illustrate this, consider how subtypes of lexemes inherit information from their supertype. For example, the type CAT is the supertype for the parts of speech in a language, e.g., *verb-lxm*, *adj-lxm*, and so forth, while ARG-ST is the type that identifies the arguments to a predicate. All verbal lexemes have a *verb* value of the HEAD feature and have (by default) an NP as the only element of the SPR list. In addition, the different kinds of verbs are distinguished as subtypes of ARG-ST, specifying the nature of the complements they take: for example, I (intransitive) covers verbs such as *arrive* and *die*; ST (strict transitive) for verbs such as *kill* and *read*; P (prepositional) for verbs such as *depend* and *rely*; and PT (prepositional transitive) for verbs such as *put*. Similar remarks hold for *adjective* lexemes, which are also differentiated by argument structure: I for adjectives such as *long* and *tall*; P for *proud* and *jealous*, and so forth. Hence, the lexical types in (24a) and (24b) are subtypes of CAT, while (24c) and (24d) are subtypes of ARG-ST.

- (24) a.  $\left[ \begin{array}{c} \text{verb-lxm} \\ \text{SYNSEM} \left[ \begin{array}{c} \text{HEAD } \text{verb} \\ \text{ARG-ST} \left[ \begin{array}{c} \text{SPR } \langle \text{NP} \rangle \\ \text{COMPS } \langle \dots \rangle \end{array} \right] \end{array} \right] \end{array} \right]$  b.  $\left[ \begin{array}{c} \text{adj-lxm} \\ \text{SYNSEM} \left[ \begin{array}{c} \text{HEAD } \text{adjective} \\ \text{ARG-ST} \left[ \begin{array}{c} \text{SPR } \langle \dots \rangle \\ \text{COMPS } \langle \dots \rangle \end{array} \right] \end{array} \right] \end{array} \right]$
- c.  $\left[ \begin{array}{c} \text{p-lxm} \\ \text{SYNSEM} \left[ \begin{array}{c} \text{HEAD } \text{verb/adjective} \\ \text{ARG-ST} \left[ \begin{array}{c} \text{SPR } \langle \dots \rangle \\ \text{COMPS } \langle \dots, \text{PP} \rangle \end{array} \right] \end{array} \right] \end{array} \right]$  d.  $\left[ \begin{array}{c} \text{i-lxm} \\ \text{SYNSEM} \left[ \begin{array}{c} \text{HEAD } \text{verb} \\ \text{ARG-ST} \left[ \begin{array}{c} \text{SPR } \langle \text{NP} \rangle \\ \text{COMPS } \langle \dots \rangle \end{array} \right] \end{array} \right] \end{array} \right]$

Using this notion of inheritance, let's try to assign types to specific lexical items. Lexical items such as *kill* and *depend* are subtypes of *verb-lxm*, while *proud* and *long* are subtypes of *adj-lxm*. But now notice something peculiar: both the adjective *proud* and the verb *depend* inherit from the ARGUMENT SELECTION node P: that is, we have *proud of her mother* as well as *depend on*

*her brother*; in the same way, both *long* and *die* inherit from the ARGUMENT SELECTION node I, in that they each take only one argument. This creates a “tangled hierarchy” with **multiple inheritance**, which is allowed in HPSG. Lexical items can be classified along several different dimensions, i.e., if each subtype is allowed to have more than one immediate supertype. In Figure 3.2, following the strategy put forward in Sag *et al.* (1999), the argument structure properties are category-neutral, and each lexeme is classified according to its syntactic category and its argument structure properties.

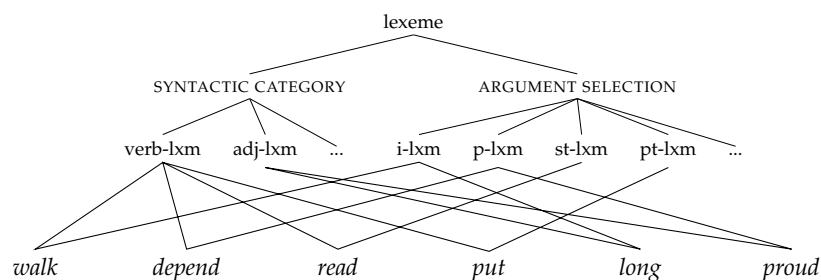


Figure 3.2 Multiple inheritance hierarchy

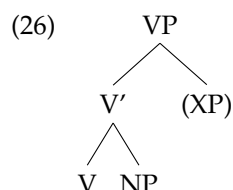
Lexical rules and type hierarchies allow for the expression of regularities in the lexicon and this reduces the amount of information that needs to be put into the lexical entries. If we have a rule that can derive one lexical entry from another, we can predict what derived words can exist instead of listing them all in the lexicon (recall the example of Agent nominals in Figure 3.1). Likewise, if we know that a given lexical entry is a subtype of another one, we can refer to the supertype entry to retrieve their common attributes and values instead of specifying them explicitly (see also chapters 10 and 11).

### 3.5 Lexical-Functional Grammar (LFG)

Lexical-Functional Grammar (LFG) is another linguistic formalism where the lexicon plays an important role in constructing both the syntactic and semantic interpretation of linguistic expressions in language. The two main levels of structure in LFG are: the representation of syntactic constituents (*c-structure*); and the representation of grammatical functions (*f-structure*). As in most generative syntactic frameworks, *c-structure* is a constituent-based, structural representation for the sentences of a language. Unlike in other frameworks, however, *c-structure* encodes only the two configurational constraints of *linearity* and *dominance* (as described in Section 2.2): other structural properties of the phrase, such as headedness, are not inherently part of *c-structure*. This can be seen, for example, in two of the *c-structure* representations defining the VP in English.

- (25) a.  $VP \rightarrow V' \quad (XP)$   
       b.  $V' \rightarrow V \quad NP$

The VP node dominates its two daughter constituents,  $V'$  and  $XP$ , while the  $V'$ , in turn, dominates  $V$  and  $NP$ . Within the VP, a linearity constraint specifies that  $V'$  precedes an  $XP$ , while within  $V'$ , it is specified that  $V$  precedes an  $NP$ . This results in the structure below.



As its name indicates, however, the main driving forces in this framework are the lexicon and the functional nature of grammatical information. This includes the *grammatical functions*, which we have been referring to as *grammatical relations*. Unlike mainstream generative grammar (cf. Section 2.2), where grammatical relations are determined directly from the syntactic structure (e.g., the sister node of the verb is its *direct object*; and the *subject* is external to this minimal constituent, viz. [SUBJECT [V DO]]), LFG treats grammatical relations as primitive notions which are encoded in the **functional structure** (*f-structure*).

We can think of f-structure as a representation that specifies any constraints that hold in the sentence beyond linearity and dominance, which are defined by c-structure. This includes:

- (27) a. Formal relations between one syntactic node and another (e.g., headedness);  
 b. Grammatical relations between a predicate and its argument (e.g., SUBJECT, OBJECT);  
 c. Functional relations between one syntactic node and another (e.g., tense, agreement).

The basic information in an f-structure consists of attribute value pairs, packaged into matrices (AVMs, cf. Section 3.4). For example, consider the sentence in (28).

(28) The man feeds Fido.

Part of the f-structure for this sentence is represented below: in (29a), the TENSE attribute carries the value 'present'; and in (29b), the OBJ attribute has the complex value of '[PRED 'John']'.

- (29) a. [ TENSE present ]  
 b. [ OBJ [ PRED 'Fido' ] ]

The task of the grammar is to associate the attribute-value pairs of the f-structure with the backbone of the c-structure, in a compositional and comprehensive fashion. This is accomplished in two steps: (a) the lexical entries of a language are made *functional*, e.g., they can refer to features of the larger expression they are part of; and (b) a set of correspondence rules called *functional equations* is introduced to mediate the mapping between c-structure and f-structure. Functional equations are formalized constraints on acceptable f-structures and control the way information is communicated within the c-structure, and between the syntax and the f-structure. They have the form  $(f_n \text{ ATT}) = \text{VAL}$ , meaning: 'within the f-structure  $f_n$ , the attribute ATT has the value VAL'. We can think of functional equations as annotations on particular nodes within the c-structure for a sentence.

With the use of a restricted *metavariable*,  $\uparrow$ , the specific variable  $f_n$  in the functional equation above can be replaced, resulting in:  $(\uparrow \text{ ATT}) = \text{VAL}$ , meaning: 'in the node above me, the attribute ATT has the value VAL'. Another metavariable,  $\downarrow$ , makes reference to the current node, and is usually used to indicate where the value of a specific attribute is coming. For example, if a node B is annotated with the functional equation,  $(\uparrow \text{ ATT}) = \downarrow$ , then this specifies that the ATT attribute on the node above B will take as its value the content of the present node, B. However, if this equation were to make no mention of a particular attribute, as in  $\uparrow = \downarrow$ , then this would state that all of the attributes of the current node, B, also belong to the node above B.

Since syntactic nodes can be annotated with functional equations, we can also annotate our c-structure rules to make reference to the functional behavior of the content of the constituents. For example, the two VP rules we discussed above in (25) can now be augmented with functional annotations, as illustrated below.

- (30) a.  $VP \rightarrow V' \quad (XP)$   
 $\uparrow = \downarrow$   
 b.  $V' \rightarrow V \quad NP$   
 $\uparrow = \downarrow \quad (\uparrow OBJ) = \downarrow$

The annotated rule in (30a) specifies that all of the features on  $V'$  will be inherited by the VP node; rule (30b) also passes along the attributes from the V node to its mother,  $V'$ , thereby encoding the notion of “head” and the inheritance of head-based features. The second functional equation in (30b) states that the OBJ attribute on the  $V'$  node will take the value from the current node, i.e., NP.

As mentioned above, there are two factors determining how f-structures can be mapped to c-structures: namely, functional equations and the lexicon itself. As it happens, metavariables play an important role in the representation of a lexical item, encoding much of the information that is subsequently represented in the f-structure of a sentence. Consider the lexical entries associated with the sentence mentioned above in (28), *The man feeds Fido*. Verbs encode a variety of information regarding their argument structure, such as specifying the grammatical function for each argument; the values of agreement, tense, aspect; case assignment properties; and so on. The way this information is encoded, however, determines how the features are integrated into the c-structure of the sentence, along with the larger f-structure associated with it. For example, the lexical entry of *feeds* in (31) specifies that *feeds* takes two arguments (a 3rd person singular subject and an object) and that it is a present tense form. Every attribute-value pair in this entry makes use of the metavariable  $\uparrow$ , which ensures that the lexical content is inserted into the dominating node’s f-structure in the tree.

- (31) *feeds*:  $V \quad (\uparrow PRED) = \text{'feed'}$   
 $(\uparrow TENSE) = \text{present}$   
 $(\uparrow SUBJ CASE) = \text{NOM}$   
 $(\uparrow OBJ CASE) = \text{ACC}$   
 $(\uparrow SUBJ NUM) = \text{sg}$   
 $(\uparrow SUBJ PERS) = 3$

In fact, proper names, common nouns, adjectives, and determiners all make use of functional constraints on the attribute-value pairs. For example, consider the lexical entries below.

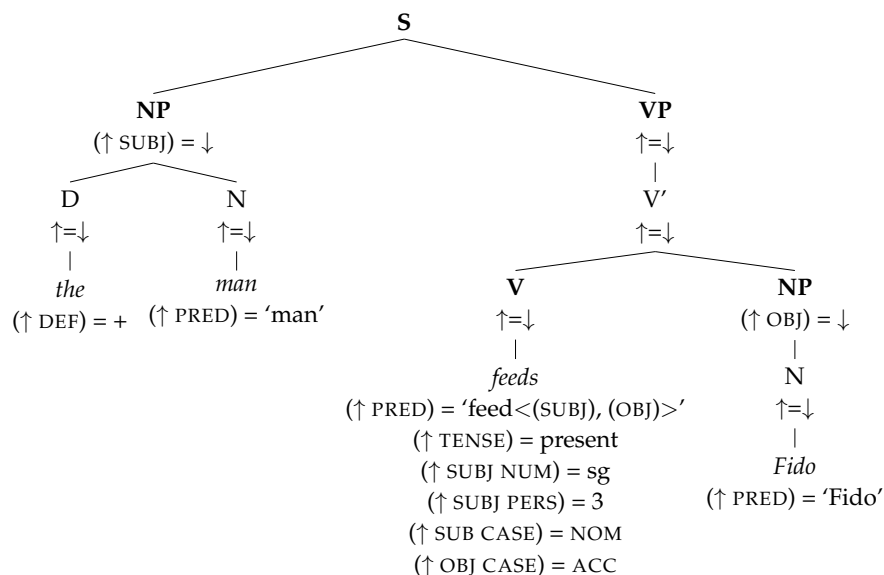
- (32) a. *Fido*  $N \quad (\uparrow PRED) = \text{'Fido'}$   
 b. *man*  $N \quad (\uparrow PRED) = \text{'man'}$   
 c. *the*  $D \quad (\uparrow DEF) = +$

The lexical entry for *Fido* in (32a) first indicates that it is a noun: it then specifies that the terminal node that it will fill has the PRED value of ‘Fido’. Similarly, *man* in (32b) is also a noun, with a PRED value of ‘man’. Finally, the lexical entry for the determiner *the* specifies that the terminal node it fills has a DEF value of +, i.e., it introduces definiteness to c-structure it is part of.

With the lexical entries in (31) and (32), and with annotated c-structure rules, such as those

in (30), we can now see how the structure and interpretation of a sentence is formed compositionally. We illustrate this with the annotated c-structure for the sentence *The man feeds Fido* below.

(33)



Each lexical entry in the tree passes its attribute-value information up to the embedding node above it, where, if it is the head of a phrase,  $(\uparrow = \downarrow)$  it is recursively passed up the tree. One attribute specific constraint,  $(\uparrow \text{OBJ}) = \downarrow$ , specifies that the OBJ attribute on the dominating node (**V'**) takes as its the value the entire feature structure of the NP; similar remarks hold for the subject NP, which has the constraint  $(\uparrow \text{SUBJ}) = \downarrow$ . Because of the  $(\uparrow = \downarrow)$  annotation on the VP node, the root node **S** will carry the resulting f-structure for the entire sentence. Hence, the result of this composition is a single f-structure for the sentence *The man feeds Fido*, as illustrated below.

$$(34) \left[ \begin{array}{ll} \text{PRED} & \text{'feed<SUBJ, OBJ>} \\ \text{TENSE} & \text{present} \\ \text{SUBJ} & \left[ \begin{array}{ll} \text{DEF} & + \\ \text{NUM} & \text{sg} \\ \text{CASE} & \text{NOM} \end{array} \right] \\ \text{OBJ} & \left[ \begin{array}{ll} \text{PRED} & \text{'Fido'} \\ \text{CASE} & \text{ACC} \end{array} \right] \end{array} \right]$$

One of the essential features of LFG is that most structure changing rules can be handled as lexical operations over grammatical functions. For example, *passive* is simply a change associated with passive morphology and a lexical mapping that indicates how the grammatical functions are to be expressed in syntax. Similarly, the sharing of feature structures can model the effects of phrasal movement, e.g., in what is classically known as *wh*-movement, as invoked in questions and relative clauses.

## 3.6 Construction Grammar

The frameworks reviewed so far assume, either explicitly or implicitly, the existence of the lexicon as a core linguistic component, however impoverished in certain models (e.g., nanosyntax and distributed morphology), or complex in others (e.g., HPSG). Furthermore, a clear distinction is made between lexicon and syntax: the lexicon gathers all the information that cannot be deduced from other linguistic components and principles, and the syntax combines the lexical items through regular and productive mechanisms that follow the properties of the combined constituents. Crucially, all conceptual content is provided by lexical items and syntactic rules cannot alter (modify, augment or reduce) this content. **Construction Grammar** (CG) challenges this widely accepted view, and argues that many (or even all) word combinations have specific properties associated with the construction as a whole, rather than with the meaning that is contributed by individual components alone.

To better understand what motivates this view, let us look at some examples in (35), that are usually classified as *multiword expressions* (MWEs) or *idioms*.

- (35) a. That's it, *end of story*. - End of (\*this beautiful) story  
 b. He knows how to *push* {my/her} *buttons* = 'He knows how to annoy or manipulate {me/her}'  
 c. All this talk about productivity is just a (\*very) *red herring* = 'purposefully distracting action or piece of information'

For some of these expressions, the meaning is semantically transparent but the syntax is irregular: *end of story* in (35a), for example, does not admit determiners or adjectival modifiers before *story*, although, syntactically, it is an NP. Other expressions have a regular syntax but are semantically unpredictable: the action denoted by *push one's buttons* in (35b) has nothing to do with anybody's buttons or the physical act of pushing them; rather, it refers to the manipulation of someone's feelings. The prototypical idiom in (35c) is, of course, an extreme case, since it is semantically and syntactically irregular. Because of the apparently unpredictable (*non-compositional*) behavior of these expressions, Construction Grammar extends the scope of a linguistic sign to what is called a **construction**, defined as follows:

(36) *Construction*

C is a *construction* iff C is a form-meaning pair ⟨F, S⟩ such that some aspect of F or some aspect of S is not strictly predictable from C's component parts or from other previously established constructions.

*Construction Grammar* in fact refers to a family of frameworks rather than to one unified theory. Shared by all these frameworks is the assumption that language is a part of the human conceptual system and *all* its properties can be accounted for by general, language-independent cognitive principles (conceptualization, categorization, schematization, etc.) and constraints (e.g., memory limitations and attentional biases).

All levels of linguistic knowledge (morphology, lexicon and syntax) can be modeled as constructions. Different kinds of constructions vary according to their size, as well as their degree of complexity and schematicity, as shown in table 3.3. The *complexity* parameter allows distinguishing between atomic or non-decomposable constructions (all the morphemes and morphologically simple words) and complex constructions, which can be subdivided into smaller components (this would be the case of complex words and idioms). *Schematicity*, on the other hand, has to do with phonological fixedness of a construction: some constructions are totally fixed and

do not allow variations (morphemes, simple words, and idioms like *end of story* or *red herring*) while others have open slots, which can be filled in by elements of the appropriate type (e.g., the *push one's buttons* construction or the *way* construction):

LINGUISTIC UNIT	EXAMPLE	COMPLEXITY	SCHEMATICITY
Morpheme	<i>un-, post-, -al</i>	atomic	fixed
Word	<i>sun, live, in</i>	atomic	fixed
Word	N-s ( <i>socks, apples</i> ), un-Adj ( <i>unethical, uneven</i> )	complex	partially fixed
Idiom	<i>end of story, red herring</i>	complex	fixed
Idiom	<i>X push Y's buttons</i>	complex	partially fixed
The <i>way</i> construction: [DP <sub>i</sub> [V [Poss <sub>i</sub> <i>way</i> ] PP]]	<i>She laughed her way into his heart</i>	complex	minimally fixed

**Table 3.3** *Types of constructions in CG*

This approach inevitably leads to the revision of the very nature of the lexicon and of its relationships with other linguistic components. Since every construction is a pairing of form and meaning, lexical items can no longer be claimed to be special in this respect. And since this pairing is idiosyncratic in all constructions, words cannot be the only ones that need to be listed and memorized, and the result is that there is no distinction between grammar and the lexicon. This extended version of the lexicon is called a **constructicon**, where all syntactic rules of a language are constructions endowed with meaning, independently of the words they combine.

On this view, basic clause constructions (such as the passive construction, the transitive and ditransitive construction, the caused-motion construction, etc.) are themselves meaningful, and are associated with 'basic scenes of human experience' or basic event types, such as 'someone did something to someone', 'something moved', 'someone experienced something', 'someone possessed something', much like the general-meaning verbs *do*, *give*, *get* and others. These meaning components are syntactically-relevant because they determine the syntactic expression of arguments. The fact that they are regarded as constructional meanings implies that the lexical items are stripped of the 'privilege' of encoding them.

Specific lexical meaning is linked to specific *scenes* or *frames*, which represent the typical properties of an action or an object, and its spatial, temporal and functional interaction with things usually associated with it. The creation meaning of the verb *paint*, for example, is associated with the following frame from FrameNet, based on Fillmore's *frame semantics*:

- (37) *paint* frame: A **creator** produces a physical **object** which is to serve as a **representation** of an actual or imagined **entity** or **event**.

To illustrate how verbal semantics and constructional meaning work together, consider the interpretation of the sentence in (38).

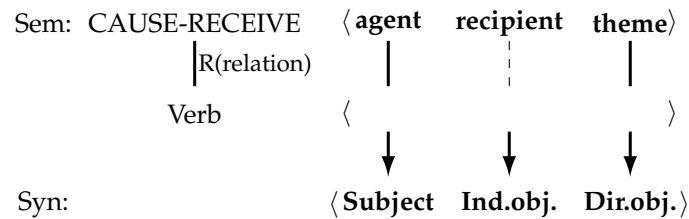
- (38) Ethan painted his mother a portrait.

The frame-semantic meaning of *paint* encodes specific participant roles:

- (39) *paint* ⟨**painter** **painted-theme**⟩

The construction that embeds this lexical item encodes the more general roles called *argument*

roles (agent, patient, theme, goal, etc.), while the verb's semantics includes the frame-specific *participant roles* given in (39). The construction where *paint* is inserted is the ditransitive construction, represented in figure 3.3. It takes three argument roles: agent, theme and recipient, which are syntactically expressed as subject, direct object, and indirect or oblique object. The solid line between the argument roles and the participant roles indicates that the agent and theme arguments have to be *fused* obligatorily with profiled participant roles of the verb. The dashed line beginning at the recipient argument indicates that this argument role does not need to be fused with a verb's participant role, which means that it can be contributed by the construction. 'R(relation)' refers to the semantic relation holding between the verb and the construction.



**Figure 3.3** Ditransitive construction. Adapted from Goldberg (2006)

The resulting composite structure binds *paint* as the verb, and the frame-specific values to each of the construction-based argument roles (Verb  $\mapsto$  paint, agent  $\mapsto$  painter, theme  $\mapsto$  painted-theme). The recipient is not specified by *paint*, so it keeps its general value as in the original construction.

Since the information encoded in lexical-specific roles (e.g., for *paint* or *eat*) is distinguished from the possible constructions they may enter into, CG has a principled account of argument structure alternations, such as those shown in (40).

- (40) a. He painted a portrait.  
 b. He painted his mother a portrait.  
 c. He painted the portrait black and white.  
 d. He painted his way to fame and fortune.

Approaches claiming that the verb meaning determines the argument structure properties are forced to introduce derived verb senses and alternative argument structure frames in cases like these, when the verbal semantics seems to be affected by context to a bigger or lesser extent. The constructionist treatments avoid this by allowing the constructions to augment the verbal argument structure. Note, however, that, unlike the neoconstructionist models framed within minimalist syntax (e.g., Borer 2005a and Borer 2005b), Construction Grammar does not allow syntactic structure to blindly force itself onto “unsuspecting words” (as Goldberg puts it). CG combines the top-down and bottom-up approaches by requiring that the meaning of lexical items and the constructions containing them be *integrated* following a restricted set of principles. As we will see in section 11.4, this approach to the combination of constructional and lexical meaning has interesting and far-reaching consequences for the treatment of *type-shifting* or *coercion*, which arise when the combinatorial requirements imposed by one of the combined words are not directly satisfied by the other word and yet the whole construction turns out to be acceptable.

One important property of constructions is that they are systematically linked into networks of inheritance, where the properties of one construction can be predicted based on the properties of other constructions in the network. Inheritance links have the status of typed objects in



CG: they are assumed to have internal structure and to be related hierarchically as types and subtypes. The following types of inheritance links have been proposed in CG:

- (41) a. **Polysemy links** ( $I_P$ ) capture the relation between a particular sense of a construction and the extensions of this sense. For example, the meaning 'X INTENDS TO CAUSE Y TO RECEIVE Z' of the ditransitive construction (as in *Ethan painted his mother a portrait*) is related by a polysemy link to the central meaning of the construction, 'X CAUSES Y TO RECEIVE Z' (as in *Ethan gave his mother a portrait*).
- b. **Subpart links** ( $I_S$ ) relate one construction with another construction, which is its proper part and may exist independently. For instance, the intransitive resultative construction (e.g., *The lemonade froze solid*) is a subpart of the resultative construction (e.g., *We froze the lemonade solid*).
- c. **Instance links** ( $I_I$ ) relate a construction with its particular instances, where a lexical item fills in one of the open slots of the construction: e.g., the '*drive someone* {crazy/ insane/ nuts/ mad/ bananas}' construction in an instance of the general resultative construction, i.e., 'X [agent] CAUSES Y [patient] TO BECOME Z [result-goal]'.
- d. **Metaphorical extension links** ( $I_M$ ) are posited when a metaphor is used to specify the relation between two constructions. For example, in an approach where spatial notions and events are regarded as the conceptual point of departure for the construal of all other events, the resultative construction (e.g., *John knocked Dan unconscious*) is a metaphorical extension of the caused-motion construction 'X [agent] CAUSES Y [theme] TO MOVE to Z [goal]' (e.g., *John knocked Dan to the ground*). The metaphorical link between both constructions would be 'CHANGE-OF-STATE AS CHANGE-OF-LOCATION': the latter represents a change of location and the former a change of state, which is more abstract than change of location.

Most constructionist frameworks acknowledge the importance of usage-based factors in linguistic analysis: in particular, frequency of use is the most important usage factor, as it determines whether or not a certain construction becomes conventional or, in other words, whether or not the link between the form and meaning within a certain linguistic sign is fixed.

From this review, we see that CG provides a quite different interpretation of the role of the lexicon, to the one assumed in standard generative models. In subsequent chapters involving the projection of lexical information into larger semantic expressions, we will return to some of these distinctions.

### 3.7 Lexicon in its own right: Generative Lexicon

Generative Lexicon Theory (GL) emerged in the 1990s, partly in reaction to the simplistic models of the lexicon adopted by most linguistic theories at the time, as well as by traditional lexicographic models of word description. Recall from section 1.2, the discussion of word entries as found in conventional dictionaries. This approach to defining word meaning results in something we termed a *sense-enumerative lexicon*: that is, the lexicon is represented as a list of words where each lexical entry corresponds to a different word, and each lexical entry comprises a list of senses. The lexical entries in such representations are *isolated*, *compartmentalized*, *static*, and *atomic* (i.e., undecomposable and unanalyzable beyond the word level), properties that make it difficult to explore some of the basic issues dealt with by lexical theory. These include:

- Modeling the connection between related senses of the same word (*polysemy*);
- Representing the relations between lexical entries in the lexicon (in terms of lexical fields, inheritance hierarchies and webs, metaphorical extensions, etc.);
- Describing how the new meanings that words acquire often depend on context (e.g., the alternations discussed in (40) in the previous section);
- Explaining the new uses and meanings a given word develop over time (semantic extension, lexical loss, neologisms).

Note that, despite the obvious differences, a very similar perspective on the lexicon is largely adopted by the mainstream generative grammar: it incorporates the description of word meaning into a formal model of grammar (which is an accomplishment in itself), but syntax is still the only truly generative component of the language. As shown in section 3.3 of this chapter, those frameworks consider the lexicon to be a passive resource of elements used in other grammatical processes: hence, the lack of any interest in digging into the structure and functioning of the lexicon beyond lexical features that are immediately useful to syntax.

GL is meant to be an encompassing model of the lexicon in its own right, not as a mere appendix of other linguistic components (such as syntax, semantics or pragmatics). Although GL is a generatively-rooted framework, what sets it apart from the other theories originating within the generative tradition is that it views the lexicon as the main source of the generative power of human language and of its creative potential. There are at least two senses in which the lexicon is considered to be properly *generative* in this framework:

- (42) a. The internal functioning of the lexical component is generative: specific lexical mechanisms derive a potentially infinite number of word senses from a finite number of meaning elements encoded in different lexical structures. These mechanisms determine, to a great extent, the functioning of synonymy, antonymy, polysemy, and metonymy (see chapters 6, 10, and 11). Hence the previously unfamiliar term: *generative lexicon*.
- b. The lexicon incorporates as well as dictates essential components of other linguistic levels: syntax and semantics. In this respect, GL is a fundamentally projectionist framework.

Because many of these principles are incorporated into our model of the lexicon in this book, several components of GL will be reviewed in Part II and III. In this section we present GL's approach on the main issues concerning the nature of the lexicon and its relationship with syntax and semantics.

The most distinctive aspect of GL is the view that the lexicon is itself a complex linguistic component comprising several levels of representation. As part of this architecture, GL adopts a *componential* (also known as *decompositional*) approach to lexical analysis, first introduced in classical structuralist linguistics (see section 3.2 of this chapter) and further developed by proponents of Generative Semantics (see Further Readings). As discussed in chapter 7, breaking lexical meaning down into smaller, *sublexical* components allows us to represent the internal structure of word meaning, account for the combinatorial properties of words and, most importantly, reduce lexical variability to a list of basic meaning components and dimensions, on which relevant generalizations regarding lexical acquisition and organization can be based.

It is important to bear in mind, however, that looking for increasingly smaller linguistic primitives is not a goal in itself for GL. Decomposition (or componential analysis) is only justified as long as it helps to identify groups of words with homogeneous semantic and syntactic properties, and thus to discern *compositional* or *relational* aspects of lexical semantics. For example,

decomposing predicates that refer to events or situations into identifiable “phases” is justified because their syntactic behavior varies depending on which and how many phases they are made up of (the structure of events it dealt with in section 6.3.3 and in chapter 9). To illustrate this point, consider a simple example in (43), involving how the adverbial *almost* can be interpreted when modifying different verbs.

- (43) a. John almost quit his singing career.  
b. John almost recorded an album.

There is only one interpretation for the event denoted in (43a), that it did not happen. In (43b), however, there are two possible ways in which the event was not fulfilled: (i) John recorded some songs, but never packaged them into an album; or (ii) John came close to starting an album, but never did any recording. These kinds of interpretations with adverbials such as *almost* reveal what phases an event has. Events with just one phase (such as *quit*) have only one interpretation: an instantaneous change of state from ‘being a singer’ to ‘not being a singer’, in this case. Events that have more than one phase (such as *record*) may have two different interpretations, depending on which of the phases of the complex event is modified by *almost*. Namely, *record an album* refers to a process of recording followed by a new state wherein a new album exists.

Another illustrative example of the componential technique employed in GL involves the relatively unassuming class of *evaluative* adjectives that includes *faulty*, *good* and *efficient*, among others. Some of the nouns these adjectives typically modify are illustrated in (44a-b) below, while the examples in (44c) are clearly odd, requiring some additional interpretive effort to process.

- (44) a. {useful/faulty/reliable} {knife/watch/umbrella}  
b. {faulty/good/efficient} {furnace/brakes/appliance}  
c. ??{faulty/good/efficient} {pigeon/tree/oxygen}

This example reveals a fundamental type distinction in the class of nouns, namely the semantic differences between “functional” and “non-functional” noun meanings, which emerges from their syntagmatic or distributional behavior in the language. Namely, functional nominals such as *furnace*, *brakes*, *knife*, *watch*, and so on, denote objects that have a purpose or function, and can therefore be evaluated relative to that event or activity. Non-functional nominals (also called *natural*), on the other hand, such as *pigeon*, *tree* and *oxygen*, do not have conventional functions or purposes, and therefore do not readily combine with such modifiers. Notice, however, that they might be reinterpreted as functional entities: *good pigeon* as ‘efficient messenger pigeon’, *good tree* as ‘fertile fruit tree’, and *good oxygen* as ‘healthy oxygen to breathe in’ or something similar.

Having briefly examined how GL approaches componential analysis of word meaning, we now introduce the major structures that comprise a lexical entry. Every lexical entry is made up of four separate levels of representation in GL: the **Argument Structure** (AS), the **Event Structure** (ES), the **Qualia Structure** (QS), and the **Lexical Inheritance Structure**. Here we discuss very briefly the first three structures (chapter 6 deals with them in more detail), while typed inheritance structure is presented in chapter 10.

As standardly assumed in generative frameworks, the **argument structure** specifies the number and type (both semantic and syntactic) of the arguments to a predicate. In GL, the AS is seen as a minimal specification of a word’s lexical semantics. The major innovation of GL consists in putting forward a rich argument typology, beyond the classical argument-adjunct distinction, and, most importantly, in explicitly relating argument selection to the sublexical components

of the predicate and the arguments. The details of this conception of AS will be examined in section 6.3.2 and in chapter 8, for now we just include an example of verbal AS.

As we can see in (46), GL uses typed feature structures (first introduced in section 3.4 of this chapter in connection with HPSG) to formalize lexical entries and their parts. As an example, consider the English verb *build*, as used in (45) below.

- (45) a. Mary built a house (from bricks).  
b. Sophie built a bookshelf (out of wood).

Notice that, while both the subjects and direct objects in (45) are obligatory, the PP object is optional, and the lexical entry for the verb in (46) reflects this distinction.

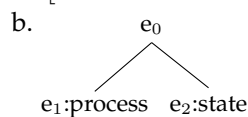
$$(46) \left[ \begin{array}{l} \text{build} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = x : \text{animate} \\ \text{ARG}_2 = y : \text{phys.obj} \\ \text{D-ARG}_1 = w : \text{phys.obj} \end{array} \right] \end{array} \right]$$

Namely, *build* is represented as having three arguments: the first two, ARG<sub>1</sub> and ARG<sub>2</sub>, semantically typed as [ANIMATE] and [PHYSICAL OBJECT], are **true arguments**, meaning that they are obligatorily realized in syntax. The third argument (D-ARG<sub>1</sub>) refers to the material used for building (brick, wood, etc.) and it is a **default argument**: it is semantically incorporated into the verb and the argument, as will shall see, but it may only be expressed syntactically when certain conditions are met (in particular, when its semantic contribution is informative in the context of the predicate, see section 8.2.4 for details).

The next level we examine is called the **event structure**. This subsumes various types of information related to the internal temporal constitution of the situation denoted by the predicate. As will be explained in section 6.3.3 of chapter 6 and in chapter 9, the ES defines the overall event type of the predicate based on a set of basic aspectual features, identifies the relevant parts (*phases* or *subevents*) of an event, and also specifies how these event parts are ordered and which ones are more prominent than others. The subeventual approach to event structure is one of the major contributions of GL to the study of aspect: prior to its introduction, events were mostly seen as atomic and undecomposable entities and not as a complex and structured components of linguistic description. Enriching the ES with temporal information tied to every subevent and to the argument(s) affected within each subevent allowed developing a more complex ES representation (termed **Dynamic Event Structure**, DES), which permits tracking the modification of a given argument and its properties over time and thus accounting for the scalar properties of both events and their nominal arguments. The DES will be dealt with in chapter 9.

The ES of the verb *build* is represented as a feature structure in (47a) and as a tree structure in (47b). The event denoted by *build* is complex. Just like *record* in (43b), it comprises two subevents: the first subevent is a process (the process of building with something), and the second subevent is a state indicating the result of this process, namely the existence (creation) of a new artifact.

$$(47) \text{ a. } \left[ \begin{array}{l} \text{build} \\ \text{ES} = \left[ \begin{array}{l} E_0 = e_0 : \text{transition} \\ E_1 = e_1 : \text{process} \\ E_2 = e_2 : \text{state} \end{array} \right] \end{array} \right]$$



Now let us turn to the **qualia structure**, which is perhaps the most innovative as well as the most controversial contribution of GL to the study of lexical semantics and the lexicon as a whole. Taking the arguments from AS and the events from ES, the qualia structure (QS) binds them into a componential representation of the verb. The QS is made up of four *qualia roles*, which are used to decompose the lexical meaning of words along the following dimensions:

- (48) a. FORMAL (F): basic semantic typing (the **is-a** relation, e.g., *fence* is a kind of 'barrier'); features that distinguish the object within a larger domain (orientation, shape, dimensionality).  
 b. AGENTIVE (A): factors involved in the origin of an object (e.g., 'build' for *fence*).  
 c. TELIC (T): purpose or function of the object (e.g., 'separate/ prevent from entering or leaving' for *fence*).  
 d. CONSTITUTIVE (C): relation between an object and its proper parts (e.g., 'wood/metal' for *fence*), or between an object and what it is a part of.

It is clear that this kind of information goes far beyond the lexical features traditionally assumed in syntactically-oriented approaches and, as a matter of fact, they have been labeled as 'hyper-specific' or even 'encyclopedic' by many scholars. Indeed, as will be detailed in section 6.3.4, the qualia were adopted from the Aristotelian 'modes of explanation', meant to account for how we understand the world, rather than to define a repertoire of lexical features. However, GL's conception of qualia is strictly linguistic, and its linguistic appropriateness has been tested on a number of semantic and syntactic phenomena.

Below is the QS representation for the verb *build* that we have been discussing. Notice that the first subevent,  $e_1$ , is associated with the Agentive role, and expresses that the argument  $x$  is acting on  $w$  in a "building manner". The second subevent,  $e_2$ , is associated with the Formal role, and expresses that the argument  $y$  exists and is predicated as being built.

$$(49) \left[ \begin{array}{l} \text{build} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{be\_built}(e_2, y) \\ \text{AGENTIVE} = \text{build\_act}(e_1, x, w) \end{array} \right] \end{array} \right]$$

In the structure in (50), the three levels of representation (AS, ES, and QS) are now integrated to show the complete entry for the verb *build*.

$$(50) \left[ \begin{array}{l} \text{build} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = x: \text{animate} \\ \text{ARG}_2 = y: \text{phys\_obj} \\ \text{D-ARG}_1 = w: \text{phys\_obj} \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} E_0 = e_0: \text{transition} \\ E_1 = e_1: \text{process} \\ E_2 = e_2: \text{state} \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{be\_built}(e_2, y) \\ \text{AGENTIVE} = \text{build\_act}(e_1, x, w) \end{array} \right] \end{array} \right]$$

The process subevent of the ES is identified in the QS as an agentive activity involving the syntactic subject  $x$  ( $\text{ARG}_1$ ) and the default argument  $w$  ( $\text{D-ARG}_1$ ). The formal role expresses the resultant state of there being a built object,  $y$  ( $\text{ARG}_2$ ). The QS, in turn, informs the AS: the general semantic constraints on the arguments required by *build* are specified as semantic types in the formal role of the three arguments: [ANIMATE], [PHYS-OBJ] and [PHYS-OBJ], respectively. Lastly, the ES and the AS necessarily interact inasmuch as different arguments are involved in different parts of the event in different ways: the subject is usually the event causer or initiator, therefore it figures prominently in the initial subevent; the object, by contrast, is more strongly associated to the resulting subevent, since it bears the consequences of the event.

Having reviewed the basic levels of representation in GL, we can now discuss the other major innovation in the theory, namely the mechanisms that allow semantic composition to become dynamic. Lexical meaning is notoriously flexible. As we saw already in (40), the verb *paint* can refer to a creation event (*He painted a portrait*), but it can also denote a manner-of-action event (*He painted his way to fame and fortune*). In some cases, it would seem that the meaning of the word is solely determined by its context. This is especially the case with general-meaning words, such as the adjective *good* in (44) above, the verb *finish* in (51), or the adjective *easy* in (52).

- (51) a. Mary finished her beer (= 'finished drinking her beer')
- b. Mary finished the draft (= 'finished writing/reading the draft')
- c. Mary finished high school (= 'finished studying at high school')
- (52) a. easy recipe (= 'a recipe that is easy to cook')
- b. easy answer (= 'an answer for a question that is easy to give')
- c. easy question (= 'a question that is easy to answer')
- d. easy prey (= 'prey that is easy to catch')

*Finish* and *easy* seem to be interpreted relative to an event associated with the noun they modify ('study' for *school*, 'write' or 'read' for *draft*, 'catch' for *prey*, etc.). Interestingly, notice that (52b) and (52c) are dependent in their meanings: you can't have an easy question if there isn't an easy answer for it.

We already know how other syntactically-oriented frameworks would address this issue. For neoconstructionist minimalist theories (recall section 3.3), these cases ultimately prove that the lexicon is subordinated to syntax: that is, lexical meaning will always try to match the rigid interpretational constraints imposed by syntactic structure. This account, however, raises serious doubts as to the limits of lexical malleability: can any word fit into any syntactic structure? The obvious answer is no: even if we are willing to admit that these limitations are due to the rich conceptual content of words, a significant part of it can be proven to be syntactically relevant and cannot be dispensed with as 'non-linguistic', 'pragmatic' or 'encyclopedic'. In Construction Grammar (section 3.6), syntactic constructions have their own meaning, too, but the approach is not exclusively top-down: the interaction of word meaning and constructional meaning goes in both directions and is determined by a set of principles.

GL adopts a different approach to this issue: it claims that no constructional meaning need be postulated in addition to the lexical meaning. Word meaning is flexible because it is inherently **underspecified** and because the meanings of different words interact, when combined in a sentence, through a set of **compositional mechanisms**.

**Underspecification** can be defined as the "absence of specification of linguistic signs that enables them to participate in different syntactic structures and, as a consequence, in different operations of semantic composition" (Pustejovsky, 1995). The ES representation of *build* in (47), for example, is underspecified with respect to event headedness: out of context, we do not know whether the initial processual phase or the final resultant-state phase is prominent. Similarly, contextual elements enrich such underspecified representations: in (53a), the present continuous makes the initial subevent more prominent, and in (53b) the time-frame adverbial *in a matter of hours* focuses on the whole event, the resultant state of 'there existing a portrait' included.

- (53) a. Sophie is painting a portrait.
- b. Sophie painted a portrait in a matter of hours.

Underspecified lexical entries and word definitions (also referred to as *minimal*, cf. Bosque and Mairal 2012 and Batiukova and de Miguel 2013) have the advantage of being compatible with

different syntactic contexts and thus eliminate the need for postulating multiple word senses for contextual meaning variations (see section 6.5.2 for more discussion on underspecification).

With this in mind, how does GL account for the actual meaning that words demonstrate in different contexts? As mentioned above, a set of generative devices operates on the different structures within the lexical entry when words are combined, to ensure that the selectional requirements are met and the resulting word combination is acceptable. These devices or mechanisms will be reviewed in chapter 11. For now we will just say that they function in a three-way fashion:

1. They license word combinations wherein one word satisfies the selectional requirements of another word in a straightforward fashion, as in *John painted the fence*, where the verb needs a direct object typed as PHYSICAL\_OBJ and the noun *fence* satisfies this requirement.
2. They rescue (in principle) unacceptable word combinations by looking for the needed licensing elements inside the lexical entry. *Mary finished her beer* would be a case in point: in principle, *finish* selects for event-denoting complements (*finish the meeting*, *finish drinking the beer*), but *beer* refers to a SUBSTANCE. The compositional mechanisms are able to rescue this word combination because the lexical entry of *beer* (the TELIC quale, to be precise) includes mention of an event typically associated with *beer*, which is *drink*.
3. They reject word combinations that cannot be salvaged (unless used in highly metaphorical contexts or in poetic speech): \*‘paint the absence’, \*‘finish the blue’, etc.

While arguing for a rich lexicon, GL maintains a formal separation between language-specific knowledge on the one hand, and general encyclopedic and pragmatic knowledge on the other hand. As seen above, however, GL introduces lexical representations and mechanisms that other generative frameworks would already consider as too rich, encoding real-world knowledge in the lexicon. At the same time, GL argues that lexical structures are language-specific in identifiable ways and offers syntactic motivation to prove it: lexical features shown to affect the syntactic behavior are considered to be properly linguistic. Recall, for instance, how we showed that events composed of more than one subevent behave differently from single-phased events when combined with adverbial modifiers (cf. (43)), or how nominals referring to functional objects (artifacts) are compatible with adjectival modifiers which natural (i.e., non-functional) nominals reject (as in (44)).

On the other hand, this framework does not deny that words express rich conceptual and commonsense knowledge, and that encyclopedic and pragmatic information interacts with lexical knowledge to play a major role in disambiguating and fully determining the semantics of words in context. Let us consider a few examples of how real-world knowledge imposes a bias on lexically-determined interpretations.

As noted above, the sentence in (51b), repeated below as (54a), is ambiguous because the noun *draft* may be associated with two events: the event of writing and the event of reading. However, if we change the syntactic subject from *Mary* to *Stephen King*, we will be strongly inclined to choose the interpretation ‘finished writing the draft’ (although we probably would not reject the other interpretation altogether). This certainly has to do with our world knowledge: we know that there is a Stephen King who is an American novelist, and novelists are typically engaged in writing.

- (54) a. Mary finished the draft. (= ‘finished writing/reading the draft’)  
       b. Stephen King finished the draft. (= ‘finished writing the draft’)

Furthermore, discourse can often override lexically-specified preferences. For example, notice

how the verb *enjoy* in (55c) selects for events just like *finish* in (54): we typically enjoy interacting with the objects in a way compatible with their functionality (e.g., lying on the sofa). However, this would not be the only interpretation of (55c) if (55b) holds:

- (55) a. Lisa is Olga's friend who loves chilling out on the new sofa.  
 b. Lisa is Olga's cat who loves scratching furniture.  
 c. Lisa enjoys the new sofa.

Hence, the interpretation of how Lisa enjoys something is provided by our contextualized knowledge that: (a) Lisa refers to a cat; and (b) this cat likes scratching furniture.

The final aspect of GL that we touch on here is the manner in which lexical items determine their syntactic realization. In this respect, it is essentially a *projectionist* framework (see Section 3.3 on the Projection Principle): namely, the properties of lexical items determine the properties of the syntactic structure they make up, in a bottom-up fashion, and the argument structure of a word is seen as a minimal specification of its lexical semantics. However, unlike classical projectionist models (Levin 1993, Levin and Hovav 2005, Pinker 2013), which regard verbs, deverbal nominals, and other event-denoting words as the prototypical relational arguments around which predicates are built, GL claims the importance of non-verbal components of the predicate towards determining the semantic shifts and alternations in sentence composition (see Batiukova and Pustejovsky 2013).

The qualia structure roles associated with the nouns constituting arguments and adjuncts in the sentence can be regarded as similar in many respects to the argument structure for verbs. In a fashion similar to argument structure realization, the qualia roles do not need to be expressed overtly in order to be accessible for interpretation. Just as the verb *paint* presupposes that its direct object denote a kind of physical object, even when not overtly expressed (*What is your brother doing? - He is painting*), the artifactual nouns *fence* and *portrait* encode the event which brought them about and the activity they are meant for: 'building' and 'enclosing' for *fence*, and 'painting' and 'depicting' for *portrait*, respectively:

- (56) a. 
$$\left[ \begin{array}{l} \text{fence} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{phys.obj}(x) \\ \text{TELIC} = \text{enclose}(x,y) \\ \text{AGENTIVE} = \text{build}(w,x) \end{array} \right] \end{array} \right]$$
  
 b. 
$$\left[ \begin{array}{l} \text{portrait} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{phys.obj}(x) \\ \text{TELIC} = \text{depict}(x,y) \\ \text{AGENTIVE} = \text{paint}(w,x) \end{array} \right] \end{array} \right]$$

These relational parameters affect compositional processes in ways that verb-centric approaches have difficulty accounting for. The example in (57) is a case in point.

- (57) a. Sophie painted a fence.  
 b. Sophie painted a portrait.

Both (57a) and (57b) are framed around the verb *paint* as the syntactic predicate, and yet their interpretations are very different: (57a) is a change-of-state predicate ('as a consequence of the action performed by the agent *Sophie* on the pre-existing object *fence*, the fence becomes painted'), and (57b) is a creation predicate ('as a consequence of the action performed by the agent *Sophie*, a new object *portrait* comes into being').

These and other examples show that it cannot be the semantics of the verb alone that drives the semantic interpretation of a sentence, and that the syntactic predicate does not license its



complement more than the complement licenses the syntactic head: that is, we are dealing with **mutual licensing**. As will be discussed in section 11.4, this particular compositional mechanism (termed *co-composition*) is activated when some QS values of the selecting predicate and its complement are identical: *paint a portrait* is a creation predicate because the agentive value of the direct object *portrait* is precisely ‘paint’. Note that *all* the semantic information we need in order to interpret the predicate stems from the lexical entries of the components of the predicate: the features of lexical items create the syntactic structure and its semantic interpretation by mutually influencing each other. Hence, there is no need to postulate a construction that would determine the properties of the word combination (as is done in constructional approaches).

The final aspect of GL that should be noted is that, in addition to being a formal componential theory of semantics, GL was intended to be implemented as a computational lexicon for natural language processing (NLP) systems. Computational lexicons can be defined as lexicographical resources meant to be used in NLP applications rather than destined for human consumption. They need to represent lexical units in much more detail than conventional dictionaries, given that computers cannot rely on the linguistic competence which natural language speakers develop at a very young age. Each lexical entry in a computational dictionary must be exhaustively structured and every lexical feature must be explicitly formalized.

For these (and other) reasons, the highly-specific lexical structures put forward by GL have been made use of in several computational lexicons (see Batiukova 2009a for a detailed review): SIMPLE (Semantic Information for Multipurpose Plurilingual Lexicons), EuroWordNet, and BSO (Brandeis Semantic Ontology). The following lexical entry (modeled following Lenci *et al.* 2000a) shows how the noun *school* is not only defined through a traditional lexicographical paraphrase (‘gloss’ in figure 3.4) but is also analyzed with respect to the four qualia parameters (FORMAL, AGENTIVE, CONSTITUTIVE, and TELIC), which make this entry truly relational:

Use:	<school>
Template type:	[Building]
Domain:	Architecture
Semantic class:	<i>Building</i>
Gloss:	Public building that hosts a school
Formal:	<i>isa</i> (<building>)
Agentive:	<i>created by</i> (<build>)
Constitutive:	<i>has a part</i> (<classroom>)
Telic:	<i>used for</i> (<teach>)

**Figure 3.4** Lexical entry of ‘school’

Aspects of GL have been integrated into very different linguistic frameworks. The qualia, for instance, have been productively exploited in the Role and Reference Grammar (Van Valin 2005, Van Valin 2013), Conceptual Semantics (Jackendoff 1997, Jackendoff 2002, Jackendoff 2007), cognitive semantics (Cruse 2000), Construction Grammar (Kaschak and Glenberg 2000), and minimalist syntax and morphology (Fábregas 2014).

### 3.8 Summary

In this chapter, we have described the major syntactic frameworks through the way they use lexical information, and along the way, we have shown how the lexicon evolved from being viewed as the most passive component of grammar to being a dynamic module incorporating, as well as driving, essential components of syntactic and semantic interpretation. Table 3.4 sums up the stance adopted by the reviewed linguistic theories on the core issues pertaining to the lexicon-syntax interface.

	CLASSICAL STRUCTURAL- ISM	GENERATIVE GRAMMAR	HPSG	CONSTRUCTION GRAMMAR	GENERATIVE LEXICON
Clear separation of lexicon and syntax	no	yes	yes	no	yes
Top-down or bottom-up approach to word combination	both	bottom-up in projectionist models and top-down in the neoconstructionist approach	essentially bottom-up	both	bottom-up
Demarcation of linguistic and encyclopedic knowledge	yes	yes	yes	no	yes
Inclusion of regularities and productive processes into the lexicon	Saussure, Bloomfield:no Coseriu, Trier:yes	no: all systematic aspects of lexical meaning are considered to be syntactic	yes	no: all systematic aspects of lexical meaning are considered to be constructional	yes

**Table 3.4** *Lexicon-syntax relationship in syntactic theories*

### 3.9 Further Readings

This chapter contains multiple pointers to textbooks and research literature dealing with the lexicon-syntax relationship. In this section we provide some additional references for further clarification and a more advanced self-study.

Whenever possible and appropriate, in describing the different theories we use theory-neutral terminology as well as concepts coming from previously introduced frameworks. We do so to facilitate understanding as well as comparison of the different theories. Note, however, that sometimes this may result in analogies that these models' practitioners might disagree with. We refer the reader to the first-hand sources for a more exhaustive explanation.

Topic	Primary references
Generative Grammar and Minimalism	Chomsky (1995), Chomsky and McGilvray (2012), Ramchand (1997) (on <i>lexical determinism</i> ), Starke (2010), Starke (2011)
Generative Semantics	McCawley (1968), Morgan (1969), Lakoff (1970)
HPSG	Pollard and Sag (1994), Sag <i>et al.</i> (1999)
LFG	Kaplan <i>et al.</i> (1982), Zaenen <i>et al.</i> (1985), Kaplan and Zaenen (1995)
Construction Grammar	Lakoff (1987), Fillmore <i>et al.</i> (1988), Goldberg (1995), Goldberg (2006)
Generative Lexicon	Pustejovsky (1995), Pustejovsky <i>et al.</i> (2013)

Topic	Secondary references
Overview of major theoretical trends in lexical semantics	Geeraerts (2010), Allan (2013) (ch. 8, 19, 20, 24), De Miguel Aparicio (2009) (Part 3), De Miguel (2016),
Generative Grammar	Boeckx (2011) (ch.2,23)
HPSG	Levine and Meurers (2006), Müller (2013)
LFG	Bresnan <i>et al.</i> (2015), Dalrymple (2001), Falk (2011)
Construction Grammar	Hoffmann and Trousdale (2013) (ch.1,2,4)
Generative Lexicon	Pustejovsky (2009), De Miguel (2009)

### 3.10 Exercises

1. What relation holds between the following elements, *syntagmatic* or *paradigmatic*?
  - a. The relation between the verb and the adverbs:  
*She works {well/fast}.*
  - b. The relation between *a* and *the*:  
*I passed {a/the} student.*
  - c. The relation between the noun and the determiner:  
*I got myself a jacket.*
  - d. The relation between color-denoting adjectives:  
*Black, yellow, blue, red, green*
2. What syntactic frameworks make the following assumptions regarding the nature of the lexicon? Provide a reasoned answer to the following questions:
  - 2.1. When there is a conflict between the conceptual meaning conveyed by the word and the interpretation imposed by the syntactic structure, the latter will always prevail and make the lexical-semantic meaning stretch as much as possible to match the syntactic constraints.

- 
- a. European Structuralism  
b. Generative Grammar (Minimalism)
- c. Lexical-Functional Grammar  
d. HPSG
- 2.2. Lexicon plays a central role in the grammar: syntactic structures are projected from the lexicon and lexical features must be preserved at every syntactic level (Projection Principle).
- a. Generative Grammar (Government and Binding model)  
b. Distributed Morphology
- c. American Structuralism  
d. Construction grammar
- 2.3. Sublexical features are combined into words by the same mechanisms that combine words into phrases.
- a. Aristotle  
b. HPSG
- c. Construction grammar  
d. Nanosyntax, Distributed Morphology
- 2.4. Lexical entries are formalized as attribute-value matrices. Lexical regularities are captured through lexical rules and type inheritance hierarchies.
- a. HPSG  
b. The lexicalist hypothesis (Generative Grammar)
- c. Lexical-Functional Grammar  
d. American Structuralism
- 2.5. Syntax and lexicon are not fundamentally distinct. Any unpredictable form-meaning pairing (be it a word, a morpheme, an idiom, or a basic clause construction) needs to be listed somehow and memorized.
- a. Generative Grammar (Minimalism)  
b. Aristotle
- c. Construction grammar  
d. Generative Lexicon
- 2.6. Groups of words standing in a paradigmatic relationship are represented as *lexical fields*, wherein some lexical features are shared by all lexemes and other features make them mutually opposed.
- a. Generative Grammar  
b. European Structuralism
- c. American Structuralism  
d. HPSG
- 2.7. Lexical information drives syntactic derivation. Lexical entries are made up by underspecified levels of representation that are acted upon by compositional mechanisms, yielding the meaning words express in context.
- a. European Structuralism  
b. Aristotle
- c. Generative Lexicon  
d. HPSG
- 2.8. Grammatical relations are assumed to be primitive rather than derived from the syntactic structure of the sentence.
- a. Construction Grammar  
b. Lexical-Functional Grammar
- c. Generative Grammar  
d. Aristotle

# 4 Lexicon and Semantics

---

## 4.1 Overview

In this chapter, we look at the relation between words and meaning. Words are said to convey meanings, but how much of this is *linguistic meaning*? This chapter focuses on three basic aspects of the study of meaning and its relation to the lexicon: (1) the main perspectives on the study of meaning, which relate linguistic meaning with the real world and abstract concepts; (2) the kinds of meaning encoded by words and sentences; (3) the kinds of reasoning that allow us to establish logical relations between linguistic expressions.

## 4.2 What is Semantics?

**Semantics** is the study of meaning, and in linguistic studies it is one of the modules of the cognitive system that enables humans to speak and understand their language (we have been referring to this system as *grammar*). In particular, linguistic semantics studies the meaning expressed by words and complex linguistic expressions (phrases and sentences). The central questions addressed in semantics are the following:

1. What is meaning and how is it conveyed at different linguistic levels, e.g. words, phrases, sentences?
2. How is meaning represented (cognitively, computationally, socially)?
3. How are linguistic meanings related to the world they represent and to the speaker's mind?
4. How do the meanings of words combine to yield the meanings of sentences?
5. What meaning relations exist between words, phrases and sentences?

### WARNING: Semantic Meaning vs. Pragmatic knowledge

In formal linguistic theories, semantic meaning is abstracted away from factors contributed by the speaker (their intentions, socio-cultural background, etc.), the hearer, and the particular situation and environment where the speech act takes place. For example, if we hear someone ask "Do you know what time it is?", we know that we are not supposed to interpret it literally, as a yes-no question ('Yes, I know what time it is' is not the answer that the person asking expects). Rather, we interpret it as a request for specific information about the time: 'Tell me what time it is'. These are some of the aspects of meaning studied by *pragmatics*. The view adopted here is that pragmatic knowledge enriches (specifies, disambiguates, etc.) compositionally derived semantic interpretation. We briefly return to this topic in Chapter 11, when we discuss how the lexicon interacts with pragmatics.

Many dictionaries define *meaning* as ‘the thing that is conveyed by language’. Informally, we could say that we use language to convey knowledge about the world, our ideas and sensations directly related to the real world, or just somehow imagined or felt regardless of what is going on in the world. Given the list of questions above, let’s try to identify the different kinds of meaning associated with language and use. When we use language to communicate our ideas, intentions, and beliefs, there are two basic sources of semantic interpretation that can be differentiated from each other: (1) **conceptual meaning**; and (2) **connotative** or **associative meaning**. The former identifies the core aspect of a word or phrase, while the latter conveys additional aspects of interpretation, such as *affective* and *social meaning*.

On this view, semantics is about the representation of information in a way such that it can be used to perform **inferences**, e.g., reasoning and drawing conclusions from the meaning of linguistic expressions, as described below. Two things are needed for this: a compositional representation and component (syntax); and a clear way to define important inferential relations, such as synonymy, equivalence, and entailment. Conceptual meaning helps govern the way we put linguistic expressions together to form a basic interpretation, while associative meaning embeds and contextualizes the meaning of this expression, adding aspects to the interpretation that extend to non-linguistic facets of meaning.

#### 4.2.1 Sentence Meaning and Inference

As mentioned above, the representation of meaning is important because it is the semantics of linguistic expressions that drives inference. **Inference** is a process of reasoning where a conclusion is formed on the basis of the evidence or knowledge one has available to hand. Language-based inference is inference where the evidence and the conclusion are packaged as linguistic expressions. Hence, the meaning of words and phrases is directly relevant to this problem. While we will not dive too deeply into the problems of logical inference here, there are three concepts to discuss that are critical to an understanding of the role that language plays in this process: they are (a) proposition; (b) truth condition; and (c) entailment.

Briefly, we can think of language-based inference as mediated through linguistic expressions by virtue of these three notions: an inference represents the logical consequence that results from combining sentences considered as **propositions**, to determine the **truth condition** of the resulting combination, i.e., the condition under which a sentence (as a proposition) is true. Along the same lines, an **entailment** is a relation that holds between two sentences, defined as follows:

- (1) **Entailment:** Given two sentences,  $S_1$  and  $S_2$ ,  $S_1$  entails sentence  $S_2$  if and only if, whenever  $S_1$  is true,  $S_2$  is also true.

So, while inference in general involves drawing conclusions from the meaning of sentences, an entailment is a specific kind of inference we can make from one sentence to another sentence, based on their truth conditions. Entailments can be used by linguists to determine whether (and when) two sentences are semantically related to each other (or unrelated or even identical).

When determining the semantic relations between sentences, it is more common to speak in terms of how the “meaning” of a sentence is semantically related to the “meaning” of another sentence. The conventional designation for sentence meaning is the *proposition*, mentioned above. So, assume that  $S_1$  denotes the proposition **P**, and that  $S_2$  denotes the proposition **Q**. Then, we can spell out the conditions for entailment defined above in (1) as below (*T* stands for ‘true’ and *F* for ‘false’).

P		Q
T	$\Rightarrow$	T
F	$\Rightarrow$	T or F
F	$\Leftarrow$	F
T or F	$\Leftarrow$	T

Table 4.1 Entailment

Let's look at some examples to make this clearer. Linguistic expressions (e.g., words, phrases, and sentences) have meaning by virtue of how they "connect" to the world and our conception of it. For example, if I know that (2a) is true, then I can infer that (2b) is also true.

- (2) a. [Karen drove a blue car]<sub>S<sub>1</sub></sub> and [James drove a green car]<sub>S<sub>2</sub></sub>.  
 b.  $\Rightarrow$  [Karen drove a blue car]<sub>S<sub>1</sub></sub>.

This kind of inference exploits the fact that if a sentence containing two conjuncts,  $S_1$  and  $S_2$ , is true, then each sentence will also be independently true. On this view, a sentence refers to a proposition, and it is a proposition that has a truth value, i.e., whether it is true or false. The reasoning demonstrated in (2) is called a *structural inference* rule, and can be represented schematically as in (3).

- (3) a. [ $S_1$  and  $S_2$ ]  $\Rightarrow S_1$   
 b. [ $S_1$  and  $S_2$ ]  $\Rightarrow S_2$

This is a consequence of the truth table associated with propositional conjunction (*and*), shown below:

P	Q	P and Q
T	T	T
F	T	F
T	F	F
F	F	F

Table 4.2 Logical Conjunction

Each column conveys the possible truth values options (two: T or F), given the number of sentences being combined,  $n$ . This creates a table with  $2^n$  rows. For two sentences, the number of possible combinations is 4. Reading off each row tells us that, for example, when **P** has truth value *T* and **Q** has truth value *T*, then combining them to **P and Q** also produces *T*. Every other situation is *F*.

Note that **proposition** is a logical term used to refer to the information conveyed by a sentence, and which can be judged as true or false. Although related, the terms **sentence** and **proposition** do not mean the same thing. Simplifying somewhat, we can say that proposition is what we get after assigning reference to all the referring expressions in a sentence and filtering out those elements that do not affect the truth conditions of the sentence. In fact, the same proposition may be expressed by more than one sentence. For example, the passive sentence in (4) conveys the same propositional content as the active form we encountered in (2a).

- (4) A blue car was driven by Karen.

So we can say that both (2a) and (4) refer to the same proposition, namely that there was some "Karen driving a blue car" situation that was true. Hence, we say that they are **equivalent** truth-conditionally. On the other hand, it should be obvious that the two sentences in (2a) are semantically **independent** of each other: James driving a green car does not seem to affect the truth condition of Karen driving a blue car, from what we know about the world.

Entailments can come in many forms in language. We saw a fairly simple structural inference in (2). Other kinds of entailment structures include generalizing from a descriptive NP, as in (5), and reasoning through class hierarchies in the language, as in (6).

- (5) a. Karen drives a blue car.  
b.  $\Rightarrow$  Karen drives a car.
- (6) a. Karen drives a car.  
b.  $\Rightarrow$  Karen drives a vehicle.

The sentence in (5a) is said to “entail” that in (5b), while (6a) entails (6b).

To summarize, by using entailment as a diagnostic, we can distinguish three kinds of semantic relations between two sentences,  $S_1$  and  $S_2$ , shown in Table 4.3, where  $\Rightarrow$  indicates entailment.

When	Sentences	Truth-conditionally
<b>either</b>	$S_1 \Rightarrow S_2$ <b>or</b> $S_2 \Rightarrow S_1$	related
<b>neither</b>	$S_1 \Rightarrow S_2$ <b>nor</b> $S_2 \Rightarrow S_1$	independent
<b>both</b>	$S_1 \Rightarrow S_2$ <b>and</b> $S_2 \Rightarrow S_1$	equivalent

**Table 4.3** *Logical Relations through Entailment*

Not all semantic relations between sentences, however, can be characterized as entailments. There is another semantic relation, called **presupposition**, that is similar in many respects to entailment, but is logically distinct. To demonstrate this distinction, consider the pair of sentences below.

- (7) a. Karen’s car is blue.  
b.  $\Rightarrow$  Karen has a car.

This appears to be an entailment inference as the one we saw in (5) above: it is the case that (7b) is true when (7a) is true. But notice something strange, illustrated in (8).

- (8) a. Karen’s car is not blue.  
b.  $\Rightarrow$  Karen has a car.

Namely, even when (8a) is not true, there is something about the construction that allows the inference to go through. It is mainly this behavior that characterizes presupposition.

- (9) a. Sophie stopped talking on the phone.  
b.  $\Rightarrow$  Sophie was talking on the phone.
- (10) a. Sophie didn’t stop talking on the phone.  
b.  $\Rightarrow$  Sophie was talking on the phone.

As with the previous example, the inference goes through (i.e., is licensed) under either condition, e.g., affirmation or negation. For the present discussion, we will define presupposition as follows:

- (11) **Presupposition:** Given two sentences,  $S_1$  and  $S_2$ ,  $S_1$  presupposes  $S_2$  if both  $S_1$  and the negation of  $S_1$  entail  $S_2$ .

Similar to the interpretation of entailment in Table 4.1 above, we can spell out the conditions defined by presupposition in the table below.



P		Q
T	$\Rightarrow$	T
F	$\Rightarrow$	T

Table 4.4 *P presupposes Q*

Unlike the truth tables, this one has two lines stating the conditions that must hold for the presupposition to be satisfied.

- (12) a. If “Karen’s car is blue” is true, then “Karen has a car” is true.  
 b. If “Karen’s car is blue” is false, then “Karen has a car” is true.

There are various diverse syntactic contexts that are associated with licensing presupposition, including a special class of *lexical presupposition triggers*. These are lexical items that, when used in a sentence, will allow that sentence to trigger a specific presupposition. We already encountered some of these above in (7)-(10). Other examples include the verbs *regret* and *know*, which presuppose the meaning of their sentential complement, as in (13):

- (13) John {regrets/ knows} that he didn’t win the scholarship.  
 $\Rightarrow$  John didn’t win the scholarship.

See further readings for some excellent discussion of these phenomena, as well as an elaboration on the various diverse syntactic contexts and lexical triggers associated with licensing presupposition.

#### 4.2.2 Word Meaning and Lexical Relations

While the previous section examined the logical relations that inhere between the meanings of sentences, here we discuss the semantic relations that exist between the words in a language, an area called **lexical semantics**. Here are just some of the topics that lexical semantics deals with:

1. **The description of word meaning:** what its nature is and how it can be described and formalized. We present three perspectives on word meaning below (referential, representational, and denotational) in sections 4.3.1, 4.3.2, and 4.3.3 of this chapter. Chapter 5 provides a more detailed overview of the approaches adopted within different semantic frameworks.
2. **Identification and analysis of word classes sharing meaning components:** The reader is already familiar with the notion of *lexical field*, which was introduced in section 3.2. Further approaches to lexical-semantic word classes will be reviewed in chapter 7.
3. **Meaning relations between words** (i.e., paradigmatic lexical-semantic relations): these include, among others, synonymy, antonymy, hyponymy and meronymy (cf. chapter 10).
4. **Contextual variations of lexical meaning:** Quite obviously, the meaning of a word may vary depending on the properties of its syntactic neighbors. As seen before, the adjective *easy*, for example, encodes different attributes when combined with *recipe*, *answer*, and *prey*, but the speakers have no trouble interpreting these expressions. As will be shown in chapter 11, this variation is systematic and not arbitrary in many cases, and it can be accounted for by the lexical properties of the combined lexical items.
5. **The relationship between the meaning of words and their syntactic properties:** In particular, lexical semantics must establish if there is such a relationship and, if the answer is yes, it must find out to what extent the syntactic behavior of words is determined by their meaning. Recall, for instance, that we asked ourselves in section 3.7 if nominals denoting artifacts and natural

entities behave differently when combined with certain adjectival modifiers (*good, efficient, faulty*).

From a general theoretical perspective, one of the most important areas of study within lexical semantics is how word meaning contributes to the meaning of complex expressions. When words are combined within a syntactic structure, we can still recognize their lexical meaning and, in addition, we can identify the structural meaning associated with the syntactic structure. Having the knowledge of both (the lexical meaning and the structural meaning) guarantees that, even if we have never heard a phrase or a sentence before, we will still be able to understand it or use it. This is very important because syntactic rules are recursive and productive (recall section 2.2), and the number of word combinations they can generate is potentially infinite. This property of the meaning of complex expressions is called **compositionality**. The meaning of a complex expression is **compositional** if it is determined by the meanings of its component parts and their syntactic arrangement. We return to this topic in more detail in Chapter 11.

## 4.3 Conceptual Meaning

Conceptual Meaning (sometimes called *cognitive meaning*) can be thought of as that component of semantics that governs the way we interpret language. To this end, it is best thought of as expressing those aspects of linguistic meaning that are used in the service of forming inferences and reasoning with language, as mentioned in the previous section. It is also distinguished from connotative and affective aspects of meaning, which we cover in section 4.4 below. We can think of referential meaning as that component of semantics which takes the expression outside of language itself, and “grounds” it in something else, such as the world. This being said, there are two very different approaches to modeling the conceptual meaning of linguistic expressions: (a) “referential theories of semantics”, which establish a link between linguistic expressions and the things, properties, and situations in the real world that they *refer to*; and (b) “representational theories of semantics”, which establish a link between linguistic expressions and concepts in the mind that they *represent*. Most contemporary semantic theories are actually hybrid models, combining both referential and representational components, as we will see below in section 4.3.3, entitled “Rich Denotational Models of Semantics.” As we shall see, the denotational approach provides the means with which to perform the kinds of inferences we discussed in the previous section.

### 4.3.1 Referential Models of Semantics

The central idea underlying the referential theory of meaning is that linguistic expressions stand for things or objects in reality. So on this view, words in a language are merely *labels* for things that are “out there in the world”. Similarly, full sentences are just *macro-labels* for referring to situations (or states of affairs) in the world. The specific thing designated or referred to in the world by a linguistic expression is usually called its **extension**. Table 4.5 gives some of the major correspondences between types of linguistic expressions and their extension in the world:

LINGUISTIC EXPRESSION	ITS EXTENSION
Noun	set of objects
Verb	activity
Adjective	attribute
Proper Name	individual
Sentence	situation

**Table 4.5** *Extension of different types of linguistic expressions*

To illustrate how a direct reference theory works, consider the sentences in (14).

- (14) a. Billy petted a black cat.  
       b. The sun is shining.  
       c. The Senator drinks green tea.

These sentences refer to situations in the world, but they do so through the use of different kinds of linguistic expressions, as listed in the table above. For example, proper names, such as Bill or Lucy, have very little semantic content: when asked “What is *Lucy*”, most English speakers would probably answer “It is a name”, if they are not provided with additional contextual information. They can be seen as labels attached to real-world entities: *Lucy*, for example, can be the name of a blonde girl with blue eyes, of an elderly green-eyed brunette, of a hurricane, or even a guitar (this is, in fact, what George Harrison called his red Gibson). Referring expressions such as “the sun” and “the Senator” also refer to real world individuals, but in very different ways. From our experience, there is only one sun, and hence this is a unique definite description. But there are many Senators, and picking out the right one is more involved.

Let’s see how this theory works out in a bit more detail. In sentence (14a), the subject NP “Billy” refers to a specific individual in the world, **Billy**, notated with  $\mapsto$ , a *referential mapping relation*: that is, “Billy”  $\mapsto$  **Billy**. Since there are many individuals named Billy, to make this unique, we will need to assign an index, e.g., **Billy598**, so that we pick out the intended individual in the world. The NP object “a black cat” is similarly analyzed, with the additional referential constraint imposed by the adjective “black” on the set of potential cats. Hence, a direct referential mapping for this NP would be: “a black cat”  $\mapsto$  **cat209**. The verb “petted” refers directly to the observable set of activities in the world of **pettings**. This composes with **cat209** and then **Billy598**, to give the the following mapping: “Billy petted a black cat”  $\mapsto$  **situation289:pettings(Billy598,cat209)**.

While this approach has a kind of commonsense appeal, there are some obvious problems with it as a comprehensive theory of language meaning. The first difficulty is when the strict ‘linguistic expression - real world’ correspondence it is based on does not hold, which is fairly often. The following list provides the most typical instances of words with an “empty extension” (i.e., words that do not have clear correspondences in the real world):

1. Some words (known as *abstract*) denote things that may be real but which cannot be defined by pointing at their referents: *freedom, belief, speed, surprise; lucky, imaginative; relaxation, degradation*.
2. Some words denote nonexistent things which, however, may be deeply rooted in the collective imagination. Think of *Hydra, jedi, goblin*, and other creatures from myths and movies.
3. The function words (*the, every, which, although*, etc.) only have grammatical meaning, they do not refer to entities, properties or situations per se.

In terms of the referential theory, all these words have an empty extension, but would it be fair to say that they do not have meaning? Probably not: we talk all the time about things that do not exist in the real world or are intangible, and we know exactly what these words mean. We (most of us anyway) know that a *jedi* is a warrior monk from the *Star Wars* movie series, that ‘a house’ is not the same as ‘the house’ or ‘every house’, etc.

Furthermore, because there is only one aspect to what a linguistic expression can mean (i.e., its reference in the world), then any two or more expressions that refer to the same thing in the world will mean, by definition, *the same thing*. But this seems too restrictive. Consider the sentence below in (15).

- (15) John Smith is *Mary’s father*, *the high school football coach*, and *the Chair of Computer Science Department*.

Obviously, we use different expressions to refer to the same real-world entity. In (15), the expressions ‘John Smith’, ‘Mary’s father’, ‘the high school football coach’ and ‘the Chair of Computer Science Department’ refer to the same person (i.e., have the same extension), but they obviously do not have the same meaning. These considerations suggest that, while reference is an important aspect of what a linguistic expression means, it is not the entire meaning. Something else is needed to account for how two referring expressions can mean different things while referring to the same entity.

#### 4.3.2 Representational Theories of Meaning

While referential semantics states that a linguistic expression is a label for something in the real world, *mentalist theories* relate linguistic expressions to mental states of the users of language. The difference, as Speaks (2016) states, is in what kinds of mental states are taken to be relevant to the determination of meaning. We can distinguish three views on this question: (a) the Gricean view, where meaning is explained in terms of how utterances relate to the communicative intentions of the users of language; (b) the meaning-as-convention view, where language meaning is determined by “conventions which pair sentences with certain beliefs”; and (c) the representational view, where meanings are interpreted as abstract mental representations, framed within a sort of language of thought. In this section, we will briefly explore the last approach, and return to aspects of the first two approaches in Chapter 11.

We can think of representational models of meaning as analyzing one kind of representation in terms of another kind of representation, namely, going from linguistic expressions to concepts. A **concept** is a generalization or an abstraction from a specific part of our experience. It is a mental representation consisting of any number of diverse types, from propositions to bundles of similarities we extract from instances of entities, events and properties that we have encountered in our experience. Conceptualizing something means coming up with a mental representation that allows us to categorize similar but not identical elements of experience as belonging to the same class.

Consider the images in figure 4.1. The pictures in the top row represent different instances of flowers that we might see. The image in the bottom row is an abstract visual representation of the concept FLOWER that can be seen as encompassing all of these instances and categorizing them as the same kind of thing. As we can see, conceptualization assumes some sort of categorization, which itself is a grouping or clustering of instances by virtue of shared features. In figure 4.1, this is represented by the presence of petals arranged in a circle, where we should consider the size, shape, and number of petals as underspecified.

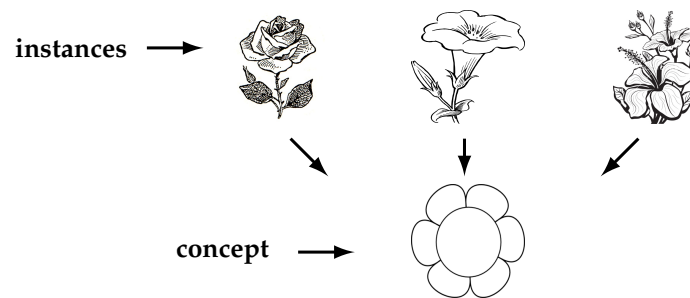


Figure 4.1 Concept FLOWER

Note that, as a matter of fact, such a ‘folk’ conceptualization of FLOWER is scientifically incorrect: many kinds of flowers have no petals but they all have stamens and pistils, which are not included in the generic image below. Furthermore, the “concept” of FLOWER given in the figure above has a specific number of petals, with determined shape and size. How do we interpret this representation as a generic flower?

It should be pointed out that not every concept can be represented as an image or graphical representation: abstract concepts cannot be easily associated with a specific image, nor can concepts expressed by function words, such as tense, definiteness, possession, and so on. This is not really a problem, however, since most representational theories assume that concepts are mentalistic constructs, and are not privy to “visual examination”.

In mentalist theories of meaning, linguistic expressions refer to concepts. But what is the procedure by which we attach words and phrases to concepts in our mind? There are essentially two steps in this procedure: (a) concept lexicalization; and (b) concept composition.

**WARNING: Why we do not have a word for every concept**

Not all the concepts in any given language are lexicalized. Recall from exercise 1 in Chapter 1 that German has a special word (*Drachenfutter*) for the concept ‘peace offerings for wives from guilty husbands’, which other languages lack. Clearly, such a concept could be “packaged into” a word in other languages, but lexicalization within a language is subject to cultural and conventional factors in a speech community. Other concepts are so rare or have so little use that naming them would be uneconomical as far as linguistic resources are concerned: this explains why there are no words for “all the things a woman puts into her gym bag”, “the action of petting a recently found kitten”, or “the property of being able to throw linguini at a wall and making it stick”.

Words are the labels we attach to concepts and the process of turning concepts into words is called **lexicalization**. Putting concepts together is a process called **concept composition**, where larger conceptual units are formed from basic concepts, until, in the case of a sentence, we have a *situational concept*. To illustrate how the representational theory of meaning handles the interpretation of different linguistic expressions, we return to the example from the previous section. As with the referential theory of meaning, table 4.6 identifies some of the major correspondences between types of linguistic expressions and their concepts in the mind. Concepts associated with expressions are illustrated in “all caps”.

LINGUISTIC EXPRESSION	ITS CONCEPT
Noun	THING
Verb	ACTIVITY
Adjective	PROPERTY
Proper Name	INDIVIDUAL
Sentence	Situation concept

**Table 4.6** *Concepts of different types of linguistic expressions*

Consider again the sentence in (16).

(16) Billy petted a black cat.

Here, the subject NP “Billy” represents an individual mental concept, BILLY. We notate this *conceptual mapping relation* with  $\dashrightarrow$ , hence “Billy”  $\dashrightarrow$  BILLY. As with the referential theory, we most likely have many Billy concepts, so we need to uniquely identify this Billy concept, e.g., “Billy”  $\dashrightarrow$  BILLY598. The NP “a black cat” can be seen as the lexicalization of an entity concept, a property concept, and a quantifier concept for “a”: “cat”  $\dashrightarrow$  CAT; “black”  $\dashrightarrow$  BLACK; and “a”  $\dashrightarrow$  SOME. Concept composition can be seen as the glue that puts these all together, so as to make a coherent complex concept: that is, “a black cat”  $\dashrightarrow$  SOME(BLACK(CAT)). Finally, with the activity concept associated with “petted”, we can compose a full situation concept, as shown below.

(17) “Billy petted a black cat”  $\dashrightarrow$  PET(BILLY598,SOME(BLACK(CAT)))

Just as the referential theory of meaning has a commonsense appeal, the mentalist approach to representing meaning has a psychological plausibility that is also appealing. There are, however, several problems with purely mentalist interpretations of language meaning. The major drawback is that it fails to address the way in which language users are able to communicate with one another, in order to share and exchange thoughts and beliefs about the objects and events in the real world. More specifically, although each speaker of a language is able to form a mental representation of an object, activity, or a situation, through what means is she able to associate the mental representation that is the **sense** of a linguistic expression, to a potential or actual referent, the **extension** of that expression? In the next section, we answer this question with what is called a **rich denotational** theory of meaning.

### 4.3.3 Rich Denotational Models of Semantics

In this section, we introduce the view of semantics that is most commonly assumed in linguistics today, namely what we will call the **rich denotational** theory of meaning. This combines aspects of both the approaches we examined above, integrating the conceptual complexity of representational theories with the extensional directness of referential theories. There are three key aspects of this theory, stated below.

- (18) a. Every linguistic expression has a meaning composed of both a **sense** (or **intension**) and a **reference** (or **extension**); however, in some cases, one or the other of these might be empty, as seen in section 4.3.1;  
 b. There is a formal link (i.e., a function) between a linguistic expression and its meaning called the **interpretation function**;

- c. The meaning of a linguistic expression is built up **compositionally** from the meanings of all of its parts.

One of the innovations introduced in (18) is the distinction between the sense and reference of a linguistic expression. That is, there is both a connection between a word (or phrase) and a concept in the mind, as well as a connection between a word (or phrase) and what it denotes in the world. How does this work? Consider the following example to illustrate this distinction.

- (19) a. John, Mary, and Fred are meeting in a conference room.  
 b. John is 6'0" in height.  
 c. Mary is 5'6" in height.  
 d. Fred is 5'4" in height.

Now, imagine you say the following sentence:

- (20) John is *the tallest person in the room*.

The NP *the tallest person in the room* denotes one individual, John, in this situation. We might be tempted to even say that this expression *means* John, but that is incorrect. Notice that if John leaves the room, the following sentence is now true.

- (21) Mary is *the tallest person in the room*.

Hence, the NP *the tallest person in the room* now denotes Mary, not John. While this is obvious and somewhat trivial, it does point out that there is more to meaning than mere reference. In fact, the *sense* of this expression is actually what allows us to appropriately refer to the right individual in the first place. That is, the sense (or intension) includes those properties and attributes that help us determine the satisfaction conditions for the expression: namely, nobody else in the room can be taller than this person. Hence, while the denotation of the NP *the tallest person in the room* is different for sentences (20) and (21), the sense of *the tallest person in the room* stays exactly the same in both cases.

Let us turn this situation on its head, where we consider how two NPs with different senses can refer to the same individual. In fact, we already encountered this in the example in (15) above, repeated in (22).

- (22) John Smith is *Mary's father*, *the high school football coach*, and *the Chair of Computer Science Department*.

Here the NPs *Mary's father* and *the Chair of Computer Science Department* both denote John Smith, while having very different senses with very different satisfaction conditions on each one. For example, *Mary's father* has an intension that takes the kinship relation of *father-of*, binds it to Mary, and then creates a sense for the unique individual that would satisfy these properties, and it so happens that John is Mary's father. Similarly, for the other two referring expressions, the sense is respectively defined by the conditions that will allow one to pick out the appropriate unique individual.

Consider now the interpretation function introduced in (18b). To demonstrate how this operates, recall the example sentence from the two previous sections, "Billy petted a black cat". As with the referential and representational theories of meaning, we identify the major correspondences between linguistic expressions and their meanings. Notice that each expression is given both a sense and a denotation (or extension), as shown in table 4.7.

LINGUISTIC EXPRESSION	INTENSION	EXTENSION
Noun	THING	set of objects
Verb	ACTIVITY	activity
Adjective	PROPERTY	attribute
Proper Name	INDIVIDUAL	individual
Sentence	Situation concept (Proposition)	situation (truth-value)

**Table 4.7** *Denotational Semantic Meanings of different types of linguistic expressions*

We will use double brackets ( $\llbracket \cdot \rrbracket$ ) to indicate the interpretation function applied to a linguistic expression: e.g.,  $\llbracket \text{a cat} \rrbracket$  expresses the semantic interpretation of “a cat”. We can think of this function as being a sort of “overloaded function”, one that allows us to further specify just the intension or just the denotation of an expression. In the case of  $\llbracket \text{a cat} \rrbracket$ , we will introduce two notations for this very distinction, shown in (23).

- (23) a.  $\llbracket \text{a cat} \rrbracket_{\rightarrow} =$  the intension of cat; i.e., all the concepts and features characteristic of cats, as a particular kind of animal that purrs, that people typically have as pets, etc.  
 b.  $\llbracket \text{a cat} \rrbracket_{\mapsto} =$  a specific cat, **cat209**

Similarly,  $\llbracket \text{Billy} \rrbracket$  should have both an extensional meaning,  $\llbracket \text{Billy} \rrbracket_{\mapsto}$ , which refers to the actual person in the real world, **Billy598**, as well as an intensional meaning, which includes all the properties and relations that are identifiable with the word “Billy”. But proper names really don’t have much to offer in this respect, and typically we think of the intension of a proper name as being null; hence,  $\llbracket \text{Billy} \rrbracket_{\rightarrow} = \emptyset$ .

These expressions are now put together following the strategy mentioned above in (18c), which we encountered in section 4.2.2 as the *Principle of Compositionality*. The meaning of the verb “pet” can be seen as a relation between individuals, and the interpretation can be illustrated as in (24) below.

- (24) a.  $\llbracket \text{pet} \rrbracket_{\rightarrow} =$  “the set of pairs of concept HUMAN and concept ANIMAL”  
 b.  $\llbracket \text{pet} \rrbracket_{\mapsto} =$  “the set of pairs of individual humans and animals”

The idea behind the principle of compositionality is that the particular meaning associated with the utterance “Billy petted a cat” is build up systematically following the syntax of the sentence, step by step (compositionally), using only the interpretations of the subparts of a phrase to create the interpretation of the larger phrase.



CLUE/COMMENT[magnifying glass icon]: **Sense vs. Reference.**

Gotlob Frege was a logician and philosopher working at the turn of the 20th century, who introduced the distinction between an expression's **sense** and its **reference** or **denotation**. He also made the first formal attempt to formulate how language expressions are combined to make larger units of meaning, called the **principle of compositionality**.

From a separate tradition within linguistics, Ferdinand de Saussure made a similar distinction in the way we define what a word or expression means. He thought of words as links between three different domains: concepts, sounds, and referents, illustrated below:

- 1 the signified - the concept or idea that a sign evokes.
- 2 the signifier - the "sound image" or string of letters on a page that one recognizes as a sign.
- 3 the referent - the actual thing or set of things a sign refers to.

Let us clarify some of the compositional processes at work here. Most words may not be used to refer to just *any* kind of entity in the world: we do not use the words *professor* or *store* to refer to a specific kind of coffee or music style, for example, because this is not what these words describe. Common nouns (*professor*, *store*, *stone*), adjectives (*blue*, *soft*, *young*) and verbs (*work*, *crawl*, *act*) are *semantic predicates*. They have as their extension the set of *all* the entities in the world which they describe (all the stones, all the blue things, all the crawling things, etc.).

Semantic predicates do not identify their referents without further specification: we do not know which stone or professor the speaker is referring to unless she uses the nouns *stone* and *professor* as a part of a **referring expression**. A noun can turn into a referring expression if it becomes a part of a DP, which identifies the entity or entities we are talking about. DPs with definite determiners (such as *the* in (25a) and *his* in (25c)) identify their referent unequivocally or uniquely: there is just one entity of the kind 'stone' or one 'acting' event which is relevant in this particular situation.

- (25) a.  $\llbracket \text{the stone} \rrbracket$  = the unique stone relevant in this particular situation  
 b.  $\llbracket \text{a professor} \rrbracket$  (as in *I just saw a professor*) = one of the set of professors, the one that the speaker happened to see  
 c.  $\llbracket \text{his acting} \rrbracket$  (as in *His acting yesterday was excellent*) = the particular instance of the acting event performed by someone

Declarative sentences are the kind of sentence we use, in order to make statements, or more technically, convey **propositions**. Knowing what a declarative sentence means implies knowing what situation it refers to and being able to judge whether or not this situation occurs in the real world. If the sentence describes accurately the state of affairs in the real world, it is true, otherwise it is false. **True** and **false** are the **truth values** of a given sentence, in formal semantics the denotation and extension of a given statement is its truth value. The conditions that must be met for a sentence to be true are the **truth conditions**, which we cover in detail in Chapter 5.

Table 4.7 describes the relation between a linguistic expression and its intension and extension, respectively. But how are intensions and extensions related to each other? The standard view on this is that the intension of a linguistic expression determines its extension or denotation: that is, the features included in the intension determine what real-world entities, properties and events this expression can denote. This is sometimes referred to as the **denotation function**.

To sum up, we can say that the denotational and representational perspectives on word meaning are related and are complementary. Most words can be defined using both of them, and for some words only one kind of definition is available (e.g., the extensional definition for proper

names or the intensional definition for words denoting abstract concepts). The representational perspective will be prominent in subsequent chapters, because we are interested in the cognitive underpinnings of the lexicon and, therefore, in the links between words and concepts.

## 4.4 Associative or Connotative Meaning

So far we have been talking about the **conceptual meanings** of words, which allow us to identify certain entities, properties and events in the real world (if we follow the denotational perspective) or certain concepts associated with the words (if we follow the representational perspective). However, there seems to be more to word meaning than just its denotation or its sense. Remember the following sentences, which we mentioned at the beginning of this chapter:

- (26) a. *Mother-in-law* means ‘the mother of someone’s husband or wife’.  
 b. *Mother-in-law* means ‘a pain in the neck’.

Sentence (26a) provides the definition of the word *mother-in-law*, i.e., its sense strictly speaking. It is objective and any speaker of English would agree with it. Then what is referred to by *mean* in (26b)? We could say that ‘pain in the neck’ sums up a whole set of subjective judgments that some (or even many, but certainly not all) speakers associate with the word *mother-in-law*.

This kind of subtle, and often subjective and variable semantic nuances are called **connotations**. Connotation allows us to convey our emotional attitude towards the entity denoted by the lexical item or our evaluation of it. Let us consider, for example, some of the (sometimes controversial) terms used in American English to refer to an adult female:

- (27) **adult human female:** woman, girl, lady, sister, gal, babe

Most speakers would agree that *woman* has a generally neutral connotation, and is conventionally the term used for making reference to an adult female in most polite discourse and written contexts. As it happens, *girl* is still commonly used in place of *woman*, but carries distinct connotations. Depending on context, speaker, and hearer, it can take on either a pejorative and derogatory connotation or endearing and bonding sentiments, as seen in (28).

- (28) a. **Male speaker and hearer:** Find yourself a nice *girl* and settle down.  
 b. **Female speaker and hearer:** The *girls* and I are going skiing later.

The term *lady*, on the other hand, was previously used as a means of describing a women of high social status, or a refined and polite women (as in (29a)). Currently, however, a more common use of the term is as a neutral description to someone you do not know, often in a public or chance encounter (as in (29b)):

- (29) a. **Previous:** Jane is such a *lady*, I doubt she’ll say anything about your dirty kitchen.  
 b. **Current:** *Lady*, I don’t know how you’re going to get out of this ditch.

Similar remarks hold for the other words in (27), and these are good examples of how connotation is related to the different dimensions of language variation. Words such as *gal* and *babe*, for example, may be used as colloquial terms with a neutral connotation, but more commonly would carry negative (i.e., pejorative) connotations. Both words are marked with respect to the **social circumstances** of their use, in particular the **register**: they are limited to informal communicative settings. *Gal* may be classified as another colloquial equivalent of *woman*, but it is a marked term: many speakers nowadays perceive it as archaic, mostly used by older speakers.

This is an instance of **sociolinguistic variation** if we classify it with respect to the social group of speakers using it, and an instance of **diachronic variation** if we classify it within a specific historical stage.

CLUE/COMMENT[magnifying glass icon]: **Sociolinguistic variation** studies the interaction of linguistic structures and properties (pronunciation, vocabulary, morphosyntax) with specific social parameters of the speakers in a given language community: age, race and ethnicity, sex, level of education, and others. The study of **diachronic variation** focuses on how and why languages and groups of languages change in time. **Historical linguistics** deals with this and other issues. **Etymology** is the study of the origin and history of words.

## 4.5 Literal and non-literal meaning

There is a longstanding distinction made in linguistics and lexicography between a word's literal (or "actual") meaning and when it is used "non-literally". Our discussion thus far in this chapter has focused on the former: **literal meaning** can be interpreted in strict correspondence to what every element within an expression means within a neutral setting, as in (30).

(30) I want very much to see you.

**Non-literal meaning** emerges when the literal interpretation is either impossible, simply false, or when the speaker wishes to convey something beyond the mere compositional interpretation of her words. To illustrate this phenomenon, consider the sentences in (31), where the meaning of each sentence is non-literal: the interpretation is provided in parentheses.

- (31) a. I am dying to see you.  
 (= 'I want very much to see you')
- b. The green shirt behind you is making me nervous.  
 (= 'The person in the green shirt behind you is making me nervous')
- c. Your words are music to my ears.  
 (= 'Your words make me happy')
- d. He spent hours wandering through the forest of his memories.  
 (= 'He spent hours remembering things')
- e. His first novel came out in 1978.  
 (= 'His first novel was published in 1978')
- f. A: I was the best in my class! - B: Sure, and I am the Duke of Edinburgh!  
 (= 'I don't believe you')

Each of these sentences illustrates a different kind of non-literal expression. For example, (31a) contains a figure of speech known as **hyperbole**: the desire to see someone can hardly be a cause of death, but the speaker exaggerates for the sake of greater expressiveness. 'The green shirt' in (31b) is a **metonymy**, another figure of speech. Metonymy allows the speaker use the name of one entity to refer to another entity, if both entities are somehow related. 'The green shirt' is a salient attribute of a person, and it is used by the speaker to refer to that person.

(31c) and (31d) contain **metaphors**, in both cases terms belonging to one domain are replaced with terms coming from another domain, such that both domains are regarded as related. In (31c), 'to be music to my ears' stands for 'make me happy', and the positive connotation of harmony and enjoyment associated with *music* is used to convey the idea of happiness. The

metaphor ‘memories are a forest’ in (31d) is based on the similarity between both notions: both invoke complex entities made up of many unordered elements, where one can get easily lost. The difference between (31c) and (31d) is that the former is based on a **conventionalized metaphor**, which has lost part of its expressive power as a consequence of repeated use, while the latter is a **novel literary metaphor** with a much stronger effect.

The sentence in (31e) also contains a metaphor, even though we may not perceive it as such. If we assume that the basic meaning of ‘come out’ is spatial (‘to move from inside to outside’), then its use in this sentence is clearly non-literal: the metaphor establishes a link between the domain of motion and the domain of existence (‘being inside’ is ‘not to exist/ be hidden’ and ‘be outside’ is ‘exist/ manifest itself’). Cases such as these are ubiquitous in neutral everyday speech, and they show that metaphor is much more than just a literary device, and that human language and cognition are metaphorical in nature. Metonymy and metaphor are dealt with in chapter 11 in relation to the role of the lexicon in compositionality.

The last example (in (31f)) is different from the others in that its interpretation is strongly dependent on the context. In particular, the reply of speaker B implies that she knows that what speaker A is saying is false (i.e., A was not the best student in his class), and that she responds with another untrue statement (‘I am the Duke of Edinburgh’) in order to let her interlocutor know that she does not agree with him. This is an **irony**: a figure of speech in which the intended meaning is very different from (and quite often opposed to) the literal meaning. This contrast results in a humorous effect, as in this case. Irony and other meaning variations related to extralinguistic context are studied by pragmatics.

As these examples show, distinguishing between literal and non-literal expressions is not always an easy task. Sentences such as (31e), for instance, are very common and do not have the exotic or literary flavor we expect to find in figurative expressions. As argued in Cruse (2000), the criteria used for pinning down this distinction are all objectionable, often yield different results and therefore cannot be regarded as the ultimate test. For example, often it is said that the earliest recorded use of the word is the literal one. In fact, within a speaker’s mental lexicon and the larger community of speakers of a language, there is little reason to think that historical precedence has any bearing on how a word is interpreted.

Alternatively, one might say that the sense of a word that has the highest frequency is the literal meaning. While such a quantitative approach may seem, *a priori*, more sound and less amenable to subjective judgment, it means that what is literal will change merely as a function of the use of the word. Consider, for example, verbs of perception, such as *hear* and *see*, when they are used to refer to cognitive processes. *Hear* encodes acoustic perception (‘He could hear me from afar’) but is also used to acknowledge someone’s opinion or complaint (as in ‘I hear you, but there’s nothing I can do about it’). The first use is more frequent than the second one, and speakers would probably agree that it is more basic. However, the perception verb (*to see*) seems to display the opposite pattern: the abstract meaning ‘to understand’ (as in ‘Now I see why you resent linguists’) is almost as frequent as the basic meaning ‘to perceive by the eye’ (as in ‘I saw a car in the lot’). Regardless of their relative frequency, we probably want to say that the perception sense is the literal meaning.

Finally, we might think that those senses more closely related to basic human experience are the literal ones. According to this criterion, physical or tangible experiences related to the body and its immediate environment form the conceptual basis from which more abstract extensions are derived. Spatial notions are especially important in this respect. Recall, for instance, (31e), where the motion verb *come* is used to encode a much more abstract meaning, ‘appear, begin to exist’. However, if an abstract meaning of the word is frequent enough and if it was the first

one acquired by the speakers, they may feel that it is more basic. For instance, if the meaning of *lame* was acquired in contexts favoring the reading ‘dull, socially awkward’ (as in *lame* {*excuse/apology/ joke*}), the ‘physical’ meaning ‘unable to walk normally’ may be perceived as derived and even non-literal.

The perspective adopted in this textbook on the literal vs. non-literal distinction goes far beyond the question of whether a given linguistic expression is literal or not, which we take to be of secondary importance. From the perspective of the lexicon, what is essential is to reveal the systematic correspondences between the different uses of a word and to identify the mechanisms responsible for their emergence. Once these mechanisms are established, the non-literal or figurative uses can no longer be regarded as instances of expressive extravagance. Rather, they must be seen as products of regular (productive or semi-productive) lexical-semantic and syntactic operations (see chapter 11).

## 4.6 Summary

In this chapter, we briefly introduced semantic notions immediately relevant for the study of the lexicon. We differentiated two basic sources of linguistic interpretation:

- *conceptual meaning*: this identifies the core aspect of a linguistic expression and governs the way we put linguistic expressions together to form a basic interpretation;
- *connotative meaning*: this conveys additional aspects of interpretation related to the emotional attitude of the speaker, her subjective evaluation, the social circumstances of the use of a word, etc.

We established the distinction between *sentence meaning* and *lexical meaning*, and defined the following notions:

- *Inference*: process of reasoning where a conclusion is formed on the basis of the evidence or knowledge one has available to hand. We introduced two basic types of language-based inference, *entailment* and *presupposition*, and used entailment to define three kinds of semantic relations between sentences: *independence*, *equivalence*, and *relatedness*.
- *Proposition*: statement conveyed by a declarative sentence, which can be judged as true or false depending on whether its *truth conditions* are met.

We further presented the three main perspectives on the study of meaning and the semantic notions involved in the three-way relationship between words, the real world, and concepts, namely: *denotation*, *intension*, and *extension* along with a specific *reference*:

- *Referential model*: this establishes a direct link between linguistic expressions and the things, properties, and situations these expressions stand for;
- *Representational model*: this represents linguistic meaning in terms of mental representations or concepts;
- *Rich denotational model*: this combines both previous perspectives as complementary and provides both a *sense* and a *reference* for linguistic expressions through the *interpretation function*.

Also, we emphasized that *non-literal linguistic expressions* generically classified as literary devices (first and foremost, the metonymy and the metaphor) are pervasive in neutral everyday speech, and should be regarded as the product of regular lexical-semantic and syntactic mechanisms. We further elaborate on this idea in chapter 11.

## 4.7 Further Readings

This chapter presented just a few of the basic semantic notions directly related to the study of the lexicon. A number of more comprehensive introductions to semantics are available, some of which are listed in the following table.

Topic	Secondary references
Comprehensive introduction to semantics	Saeed (2003), Riemer (2010), Pafel and Reich (2016)
Less formal and more cognitively-oriented introduction, includes a broader overview of meaning-related syntactic and pragmatic phenomena	Cruse (2000)
Introduction to semantics, theories of meaning	Cann <i>et al.</i> (2009), Bunnin and Yu (2008), Davis and Gillon (2004), Lycan (2012), Pinkal (1995)
Lexical semantics	Murphy (2010), Escandell Vidal (2007), Cruse (1986)

## 4.8 Exercises

- Provide examples of:
  - linguistic expressions that have sense and an empty reference;
  - linguistic expressions that have reference but no sense.
- Which of the nominal expressions in *italics* are used referentially? Keep in mind that some expressions may be interpreted as both referential and non-referential.
  - My cake* was delicious.
  - Chocolate cake* is the best antidepressant there is!
  - I would like to order *a cake for my son's birthday*.
  - My colleagues got me *a cake*.
  - I know you worked hard, but that looks nothing like *cake*.
- Which of the lexical items in each series has a larger extension and broader intension? Define both (intension and extension) for every word following the format adopted in section 4.3.3.
  - horse - stallion - foal
  - book - novel - dictionary
  - walk - saunter - move
- What logical relations hold between the propositions expressed by the two sentences in each example: *presupposition* or *entailment*?
  - Obama was reelected for president. - Obama was elected for president before.
  - Juan's Picasso will be sold this summer. - Juan's Picasso exists.
  - Nero set Rome on fire. - Rome burnt.
  - I did not realize that John fell asleep. - John fell asleep.
  - John is swimming. - John is moving.
  - This object is a book. - This object is meant to be read.
  - I am surprised that you got married. - You got married.

5. Specify separately the sense and the connotation of the following words. For each case, provide a synonym with a neutral connotation (rather than a socially charged and potentially insensitive connotation) and, whenever possible, a synonym with an oppositely oriented connotation.
- Nouns: mutt, cop, slum
  - Verbs: to pass away, to fire (someone)
  - Adjectives: lackadaisical, crippled, youthful, vocal

## 5 Lexicon in Semantic Frameworks

---

### 5.1 Overview

The question of what a word means must be dealt with in any semantic framework. In fact, without properly defining the meaning of a lexical item, none of the goals of semantic theory can be pursued. Two issues in particular are intimately tied to what assumptions the theory makes about a word's meaning: (a) explaining what meaning relations hold between words in the lexicon; and (b) accounting for how sentence meaning is built up out of word meaning. In this chapter, we discuss how different frameworks address the following questions: (1) Should lexical meaning be defined following the referential, representational, or denotational perspective? (2) Is lexical meaning atomic or can it be decomposed into smaller elements? (3) If we assume that lexical meaning can be decomposed, what would be its smallest elements (i.e., the *primitives*) and how can they be formalized? (4) Is the nature of these minimal meaning components strictly linguistic (belonging exclusively to 'lexical knowledge') or rather conceptual (belonging to a more general 'commonsense knowledge')?

### 5.2 Formal semantics

Formal semantics starts with the assumption that natural language can be modeled as a formal system, much like the domain of and representations for logic and computer science. The tradition of making use of logical descriptions to account for natural language meaning goes back to at least Aristotelian logic and syllogistic schemata. The mutual influence of linguistics and logic is only natural given that logic focuses on the patterns of human reasoning, while one of the main functions of natural language is to convey thoughts in an explicit manner.

The interest in formal languages and their potential for explaining the properties of natural languages was shared from the beginning of contemporary linguistics by proponents of both generative grammar and formal semantics, but the focus of their interests has been quite different. Generative linguistics (as promoted by Chomsky) is still primarily interested in syntax, where semantics is, roughly, an interface through which syntax communicates with the cognitive module (*conceptual-intentional system* in the Minimalist framework, see section 3.3). Formal semantics, by contrast, has placed more emphasis on the semantic interpretation of linguistic expressions, with syntax being responsible for building sequences of meaningful elements and providing the structural scaffolding for their compositional interpretation, and nothing else. Hence, the famous (rather extreme) quote of Richard Montague, one of the founders of modern formal semantics: "I fail to see any interest in syntax except as a preliminary to semantics" (Montague, 1970).

As mentioned in 4.2, when looking at language meaning from the perspective of reasoning



and inference, it is important to have an explicit and formal representation for the semantics of sentences and how they combine: for this we introduced **propositional logic**. Recall that this formalism treats sentences as whole units without any internal structure, as illustrated in (1):

- (1) a. If [ it's raining]<sub>S<sub>1</sub></sub>, then [ it's wet outside]<sub>S<sub>2</sub></sub>. ( $S_1 \rightarrow S_2$ )  
 b. [ Mary likes John]<sub>S<sub>1</sub></sub> and [ John is happy]<sub>S<sub>2</sub></sub>. ( $S_1 \wedge S_2$ )

With propositional logic, there is no way to even represent the common argument (John) seen in the two sentences in (1b). But when examining the internal meaning of sentences, we need to have data structures that correspond to the syntactic units we have already encountered in language, such as verbs and their arguments, e.g., NPs. To do this, we introduce a first-order logic called **predicate calculus**. It is called "first-order" because we have the ability to mention (or quantify) first-order individuals (or things), which we couldn't do in propositional logic. Once a sentence is "translated" into first-order logic, it can then be interpreted in a *model* (i.e., a simplified but formal representation of real-world situations), where it can be judged as true or false.

Let's now look at the syntax of predicate calculus to see what goes into making a well-formed expression. The syntax of first-order logic includes both a **vocabulary** (the equivalent of the natural-language lexicon) and a set of **rules**, specifying what combinations of vocabulary items are legitimate *formulas*, i.e., representations of propositions that can be true or false. The vocabulary includes:

- (2) a. Individual constant symbols, which represent specific individuals (objects, persons, etc.):  $a, b, c$ , etc.  
 b. Individual variable symbols, which are placeholders used when the exact identity of the individuals they represent is not relevant or is unknown:  $x, y, z$ , and other letters from the end of the alphabet. Individual constants and variables are called **terms**.  
 c. Predicate symbols, which represent  $n$ -place relations between individuals:  $A, B, R$ , etc.  
 d. Logical connectives:  $\neg$  (not),  $\wedge$  (and),  $\vee$  (or),  $\rightarrow$  (if ... then),  $\leftrightarrow$  (if and only if).  
 e. Quantifiers, which allow making statements about sets of individuals rather than single individuals: ' $\forall$ ' stands for the universal quantifier 'every' and ' $\exists$ ' for the existential quantifier 'some'.

Now consider the rules that are used to build up well-formed formulas:

- (3) a. If  $A$  is an  $n$ -place predicate and  $t_1 \dots t_n$  are terms, then  $A(t_1 \dots t_n)$  is a formula.  
 b. If  $\phi$  is a formula, then  $\neg \phi$  is a formula.  
 c. If  $\phi$  and  $\psi$  are formulas, then  $(\phi \wedge \psi)$ ,  $(\phi \vee \psi)$ ,  $(\phi \rightarrow \psi)$ , and  $(\phi \leftrightarrow \psi)$  are formulas.  
 d. If  $\phi$  is a formula and  $x$  is a variable, then  $\forall x \phi$  and  $\exists x \phi$  are formulas.

To illustrate how the vocabulary and rules work together, let's translate some sentences from English into predicate calculus. We will use a Star Wars theme for illustration.

- |                                 |                           |
|---------------------------------|---------------------------|
| (4) a. Chewbacca is a Wookiee.  | d. Han Solo is not hairy. |
| b. Chewbacca protects Han Solo. | e. Someone is hairy.      |
| c. Chewbacca is hairy.          | f. All Wookies are hairy. |

First we need to express the relevant vocabulary items for our little Star Wars domain.

- (5) a. **Individuals:** Chewbacca:  $c$ , Han Solo:  $h$ , Luke:  $l$

b. **Predicates:** is a Wookiee:  $W$ , is hairy:  $H$ , protects:  $P$ , loves:  $L$ , speaks English:  $E$   
Now we can translate the sentences from (4) into first-order logic, as shown below.

- |               |  |
|---------------|--|
| (6) a. $W(c)$ | d. $\neg H(h)$                         |
| b. $P(c,h)$   | e. $\exists x H(x)$                    |
| c. $H(c)$     | f. $\forall x (W(x) \rightarrow H(x))$ |

One of the main themes in formal approaches to the semantics of language is the notion of compositionality, which we encountered above in 4.2.2. This is a strategy for building up utterance meanings from the smaller component parts of a phrase or sentence. That is, well-formed formulas are assigned an interpretation in a compositional fashion, by first interpreting the smallest expressions and then deriving the meaning of larger expressions containing them based on the way they are combined syntactically and semantically.

A major feature that differentiates formal semantics from most other semantic frameworks (including those developed within the generative tradition) is that it requires linguistic expressions to have an interpretation in a **model**. A model is a structured image (or copy) of the world, where we are able to check the truth or falsity of linguistic expressions, after they have been translated into a suitably expressive logic, such as the predicate calculus introduced above. Since we cannot directly put our finger on all of the extralinguistic reality we constantly refer to and take for granted, the interpreted model provides a simplified version of it, that reflects the linguistically relevant aspects of the situations referred to by words and sentences. Theories of meaning that follow this approach are often called **model-theoretical semantics**.

As we saw in section 4.3.3, linguistic expressions carry both an intension and an extension. While the intension refers to the conceptual core of a word or phrase, the extension points to something specific in the model (and the world). For example, the *extensions* of proper names (*Louvre*, *Boston*, *Bill*) and other referring expressions (*the teacher*, *a teacher*, *this teacher*) are the entities in the actual world they stand for, as determined in the context of use. Similarly, the extension of a predicate (*stone*, *blue*, *crawl*) is the set of all the entities in the world characterized by the property encoded by this predicate: e.g., the set of all the stones, all the blue things, all the crawling things, etc. Finally, the extension of a declarative sentence is its truth value: for example, we interpret the sentence *I am tired* as true if the speaker belongs to the set of ‘tired things’ when she utters this sentence, and as false otherwise.

We will assume that a semantic model ( $M$ ) has two parts: a **domain of discourse**,  $U$ , which is the set of all the entities or individuals included in our modeled situation; and an **interpretation function**,  $F$ , which we introduced in 4.3.3 as  $\llbracket \cdot \rrbracket$ . This ensures that the translation of every linguistic expression is matched with the appropriate element(s) in the domain of discourse. When  $\llbracket \cdot \rrbracket$  is applied to the interpretation of a variable, we refer to it as an **assignment function**,  $\llbracket \cdot \rrbracket_g$ , as we show below.

Let us build a toy model of a possible world (which we call  $M_1$ ) based on the plot of *Star Wars* to see how different semantic objects may be formally represented and how the truth value of a sentence is calculated relative to this model. Our domain of discourse is specified in (7):

- (7)  $U_1 = \{\textbf{Luke}, \textbf{Leia}, \textbf{Darth Vader}, \textbf{Han Solo}, \textbf{Chewbacca}\}$

It is important to note that the elements in (7) are entities in the model, not lexical items, and this is why they are bold-faced. Words are introduced into the model by logical constants and variables. Our discourse only has individual constants so far in (8):  $l$ ,  $d$ ,  $h$ ,  $c$ , and  $j$  (since  $l$  already stands for “Luke”), which refer to individuals in the model. In (8), the interpretation function  $F$  returns the appropriate entity in the domain when applied to each of these logical constants.

- (8) a.  $\llbracket l \rrbracket = \text{Luke}$  d.  $\llbracket h \rrbracket = \text{Han Solo}$   
 b.  $\llbracket j \rrbracket = \text{Leia}$  e.  $\llbracket c \rrbracket = \text{Chewbacca}$   
 c.  $\llbracket d \rrbracket = \text{Darth Vader}$

When applied to predicates, the interpretation function returns the set of individuals having a certain property, pairs of individuals standing in a two-place relation, and triples of individuals standing in a three-place relation. Recall that we use upper-case letters for predicate constants:

- (9) a.  $\llbracket H \rrbracket = \text{is hairy} = \{\text{Chewbacca}\}$   
 b.  $\llbracket E \rrbracket = \text{speaks English} = \{\text{Luke, Leia, Darth Vader, Han Solo}\}$   
 c.  $\llbracket J \rrbracket = \text{is a jedi} = \{\text{Luke}\}$   
 d.  $\llbracket S \rrbracket = \text{is a sibling of} = \{\langle \text{Luke, Leia} \rangle, \langle \text{Leia, Luke} \rangle\}$   
 e.  $\llbracket L \rrbracket = \text{is in love with} = \{\langle \text{Luke, Leia} \rangle, \langle \text{Han Solo, Leia} \rangle, \langle \text{Leia, Han Solo} \rangle\}$   
 f.  $\llbracket P \rrbracket = \text{prefers} = \{\langle \text{Leia, Han Solo, Luke} \rangle\}$

Let us spell out this notation. The predicates in (9a-c) denote properties and take just one argument (the entity that has the property). (9a) states that the extension of *H* ‘is hairy’ in the model  $M_1$  is the set with just one element, Chewbacca (in other words, the only entity in the domain of discourse that has the property of being hairy is Chewbacca). According to (9b), the entities that have the property of speaking English are Luke, Leia, Darth Vader, and Han Solo. The extension of the predicate *J* ‘is a jedi’ includes just Luke, as in (9c). (9d) and (9e) contain predicates taking two arguments. The relation *S* ‘is a sibling of’ holds in the pairs  $\langle \text{Luke, Leia} \rangle$  and  $\langle \text{Leia, Luke} \rangle$ , because it is symmetrical: Luke is the sibling of Leia and Leia is the sibling of Luke. The relation *L* ‘is in love with’ holds between Luke and Leia, Han Solo and Leia, and Leia and Han Solo. Finally, the extension of the predicate *P* ‘prefers’ includes a triple: Leia prefers Han Solo to Luke.

The truth value of the sentences or propositions that we may generate are determined compositionally based on this model: a proposition is true if its denotation is included in the model and false otherwise. Let us consider the sentences in (10):

- (10) a.  $E(h) = \text{Han Solo speaks English.}$   
 b.  $L(l, j) = \text{Luke is in love with Leia.}$   
 c.  $H(d) = \text{Darth Vader is hairy.}$

(10a) and (10b) are true because their extension is included in the model  $M_1$ : (10a) is true because the extension of *Han Solo* is included in the set with the property *speaks English* in the model  $M_1$ ; and (10b) is true because the extension of the ordered pair  $\langle \text{Luke, Leia} \rangle$  is included in the set defined by *is in love with* in the model  $M_1$ . (10c), by contrast, is false: the extension of *Darth Vader* is not included in the set with the property *is hairy*:

- (11) a.  $\llbracket E(h) \rrbracket^{M_1} = 1$  because  $\llbracket h \rrbracket^{M_1} \in \llbracket E \rrbracket^{M_1}$   
 b.  $\llbracket L(l, j) \rrbracket^{M_1} = 1$  because  $\langle \llbracket l \rrbracket^{M_1}, \llbracket j \rrbracket^{M_1} \rangle \in \llbracket L \rrbracket^{M_1}$   
 c.  $\llbracket H(d) \rrbracket^{M_1} = 0$  because  $\llbracket d \rrbracket^{M_1} \notin \llbracket H \rrbracket^{M_1}$

Now consider a slightly more complex example (12a), whose logic translation is provided and informally paraphrased in (12b):

- (12) a. Someone is in love with Leia.  
 b.  $\exists x [L(x, j)]$  ‘There is some  $x$ , where  $x$  is in love with Leia.’

This sentence contains the **existential quantifier** *some*, symbolized as ' $\exists$ ', and the variable  $x$  (recall that variables are placeholders used when the exact identity of the individuals they represent is not relevant or is unknown, as in this case). For (12a) to be true, 'is in love with Leia' must be true for some value of  $x$  in the model  $M_1$ , i.e., some entity included in the domain of discourse must be in love with Leia. This is what the assignment function,  $\llbracket \cdot \rrbracket_g$ , does: it assigns interpretations to variables in the context of a quantifier. If we inspect the interpretation for the predicate *is in love with* from (9e), we see that there are in fact two candidates, **Luke** and **Han Solo**, who fit the bill. So this sentence is true. A similar procedure is applied for determining the assignments of the variable when a **universal quantifier** (such as *every person*) is used, but the predicate has to hold for all the individuals in the domain, for a particular restriction.

As these simplified examples show, building up a truth-conditional semantics can be formally straightforward. All the complexities related to human perception and linguistic performance are avoided because the speaker is not in the picture: all that matters are the correspondences between linguistic expressions on the one hand, and the way they are abstracted and represented in a model of the world, on the other hand. This is one of the characteristics that differentiates formal from cognitive linguistics (as seen in sections 5.3-5.6).

The main focus within formal semantics is on sentence meaning and how it is derived compositionally. As a result, the meaning of words is often seen as uninteresting, as long as the word's behavior in syntax is accounted for formally. Therefore, the main areas of interest of formal semantics as regards lexical meaning are the very same that are at the core of syntactically-oriented frameworks (as shown in Chapter 3), such as the functional categories crucially involved in the building and interpretation of syntactic constructions (quantifiers, conjunctions, negation words, deictic elements), argument structure, and event structure (cf. Chapters 6, 8, and 9).

There is, however, a formal way to characterize semantic relations that exist between words in a language, namely through the use of **lexical axioms** (or **meaning postulates**). A meaning postulate is a specification of some formal association that holds between one term in the language and another, typically consisting of two propositions related by lexical entailment. Most **lexical relations** can be accounted for formally through meaning postulates, as demonstrated in (13d).

- (13) a. **Hyponymy**: a hyponym is a special subclass or kind of something else, called its *hypernym*. For example, Fords and BMWs are different kinds of cars, hence they are hyponyms of *car*. Similarly, a daisy is a kind of flower, and since every daisy is a flower, we can represent this as follows:  
 $\forall x[daisy(x) \rightarrow flower(x)]$
- b. **Synonymy**: synonyms are equivalent or mutually entail each other. The symbol ' $\leftrightarrow$ ' represents equivalence or mutual entailment.  
 $\forall x[calm(x) \leftrightarrow serene(x)]$
- c. **Opposition or antonymy**: the assertion of one of the binary antonyms (i.e., *contradictories*) entails the negation of the other one.  
 $\forall x[even(x) \rightarrow \neg odd(x)]$
- d. **Converseness** is a lexical relation wherein both words describe the same situation seen from two different perspectives (it will be examined in detail in section 10.5). Pairs of terms such as *parent-offspring*, *in front of-behind* or *sell-buy* are typical converses.  
 a.  $\forall x \forall y[in.front.of(x, y) \rightarrow behind(y, x)]$   
 b.  $\forall x \forall y[in.front.of(x, y) \rightarrow \neg behind(x, y)]$

In addition to lexical semantic relations, meaning postulates can be used to encode lexical-semantic features of words, and provide a way of performing a kind of lexical decomposition (recall sections 3.2 and 3.7, and see also Chapter 7). The meaning postulates in (14) contain two such features: [INANIMATE] and [HUMAN]. These rules indicate that *daisy* is inanimate and *bachelor* is human.

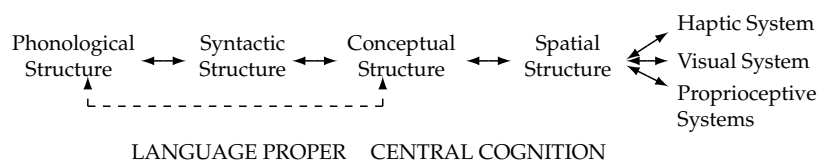
- (14) a.  $\forall x[\text{daisy}(x) \rightarrow \text{inanimate}(x)]$   
 b.  $\forall x[\text{bachelor}(x) \rightarrow \text{human}(x)]$

The difference between compositional approaches and formal semantics as regards the meaning components is that the latter does not claim that any of them are primitive. This issue is simply irrelevant for formal-semantic research due to its focus on the compositional aspects of meaning. Further, since no meaning component is considered to be primitive, there is also no way of deciding which meanings are basic or primary and which ones are secondary or derived. As a consequence, *a word is defined relationally*, i.e., by the relations it has with the other words in the lexicon, but no account is provided as to why these relations hold.

### 5.3 Conceptual Semantics

Conceptual Semantics is a generatively-rooted approach to natural language meaning developed by Jackendoff and colleagues, and it shares a number of assumptions with mainstream generative grammar, Cognitive Linguistics, Construction Grammar, and Generative Lexicon. Conceptual Semantics is a *mentalist* theory of natural language. As discussed in Section 4.3.2, this approach is different from formal semantics in that it focuses on semantics as a conceptualization interface between the world and language users. This conceptualization can be triggered by direct contact with reality (through direct perception), by memory, by other people's utterances, or it may be arrived at through logical inference.

Conceptual Semantics assumes a model of language called *the Parallel Architecture*, where the three major linguistic systems (syntax, semantics, and phonology) are equally generative. The three systems communicate with each other through interface levels: syntax-phonology interface, syntax-semantics interface, and semantics-phonology interface. In the following diagram from Jackendoff (2010), the linguistic systems are embedded within a general architecture of the mind: phonology interfaces with hearing and speaking, and the two structures encoding semantic information (Conceptual Structure and Spatial Structure) interface with both action and different kinds of perception (vision, touch, bodily self-awareness).



**Figure 5.1** *The Parallel Architecture of the language faculty*, Jackendoff (2010) by permission of Oxford University Press

Within Conceptual Semantics, the lexicon plays the role of long-term memory for linguistic structures of many different sorts. The notion of *lexical item* is very similar to the conception of *construction* in Construction Grammar (Section 3.6), and includes a wide range of linguistic expressions varying in size and degree of fixedness: e.g., morphemes, simple words, derived

words, idioms, constructional idioms, argument structure patterns, phrase structure rules, etc. They all need to be memorized, and the only difference is that some are bigger than others (constructional idioms and phrase structure rules are bigger than words and morphemes), and that some are totally fixed (morphemes, words, fixed expressions such as *for the record*) while others have open slots for variables (all phrase structure rules, the argument structure of the verbs, idioms such as *push someone's buttons*). Table 3.3 in Chapter 3 illustrates many of the possible combinations.

Lexical items may be fully specified for the three components making up the Parallel Architecture or may lack one of them, as table 5.1 illustrates. The word *cat* is fully specified: it has its phonology (here we use the orthographic representation for convenience), semantics (*cat* is an object-denoting word), and syntax (it is a singular form of a count noun). Interjections lack syntax: they can be used by themselves as meaningful utterances and cannot be combined with other words into phrases or sentences. Certain functional words (expletive *it*, the preposition *of*, or the support *do*) lack conceptual content. Syntactic constructions (e.g., the causative resultative construction in table 5.1) have syntactic structure and semantic structure (note that the indices establish appropriate links between the constituents of the syntactic and the semantic structure), but lack phonology. Phrase structure rules are also construed as schematic constructions.

LEXICAL ITEM	PHONOLOGY	SEMANTICS	SYNTAX
[lexical word] <i>cat</i>	cat	[ <i>Object</i> CAT]	[N; sing; count]
[interjections] <i>wow, oops, aha</i>	wow, oops, aha	expression of surprise/ apology / triumph	—
[functional words] <i>it</i> (in <i>It rains</i> ), <i>of</i> (in <i>destruction of a temple</i> ) <i>do</i> (in <i>Do you remember?</i> )	it, of, do	—	Pronoun, P, V
[syntactic construction] causative-resultative constr.	—	X <sub>1</sub> CAUSE [Y <sub>2</sub> BECOME Z <sub>3</sub> ] MEANS: EVENT <sub>4</sub>	NP <sub>1</sub> V <sub>4</sub> NP <sub>2</sub> AP/PP <sub>3</sub>
[phrase structure rule] VP → V NP	—	—	[ <sub>VP</sub> V NP]

**Table 5.1** Full-blown and defective lexical items in the Parallel Architecture

Even though not strictly linguistic, the Conceptual Structure is the part of human cognition that embraces all the grammatically relevant aspects of meaning: quantification (*how much of X there is?*), predicate-argument structures (*predicate X takes arguments Y and Z of the appropriate type*), taxonomic categorization or category membership (*X is an instance of Y*), temporal and causal relations (*X is in the past/future, X caused/prevented Y*), social relations (*X is the farther/boss of Y*), etc. As we will see, the representations in Conceptual Structure are logical in nature and are built up from discrete features and functions.

However, not all aspects of meaning can be represented as discrete linguistic features, since meaning will be determined in part by non-linguistic modalities as well. This is where the cognitive capacity **Spatial Structure** plays a role. As shown in figure 5.1, Spatial Structure interfaces with Conceptual Structure on the one hand, and with perception and the sensorimotor system on the other hand. It encodes a great deal of *perceptual* information related to how we understand the physical world, which is far too specific for the Conceptual Structure and which must be encoded in a different (*geometric* or *topological*) format: typical shape, texture, internal constituency and motion of the objects, and how these may vary in time. Such information is claimed to be yet another part of lexical meaning, and to complement the representations provided by Con-

ceptual Structure. In order to identify an object, we need to use both. To categorize something as a *cat*, for example, we need to know that it belongs to the class of animals and that it is typically a pet (all these presumably encoded in the Conceptual Structure), and to be familiar with its shape, color and way of moving (encoded in the Spatial Structure). See the lexical entry below:

- (15) Lexical entry of *cat*  
 Phonology: /kæt/  
 Syntax: [N; singular; count]  
 Conceptual Structure: [*Object* CAT, TYPE OF ANIMAL, TYPICAL FUNCTION: PET]  
 Spatial Structure:



Spatial Structure is the locus of various aspects of verbal semantics such as the manner of motion, which can be hard to define in terms of logical representations, when it involves bodily sensations and spatial schemas rather than discrete conceptual features. For example, verbs such as *walk*, *jog*, *run*, *sprint*, and many others belonging to this group, have identical grammatical behavior because their syntactic structure and Conceptual Structure are the same, but they would be differentiated by information encoded in the Spatial Structure.

Conceptual Structure classifies linguistic expressions according to their conceptual category and a function-argument pairing if there is one, as illustrated in (16).

- (16) a. **Conceptual Categories:** Object, Event, State, Action, Place, Path, Property, Sound, Information, Quantity, Manner, etc.  
 b. **Function-argument pairing:** [<sub>Category</sub> FUNCTION (*Arg*<sub>1</sub>, ... , *Arg*<sub>*x*</sub>)]

The basic spatial use of the verb *to go* ('move somewhere'), for instance, has the following Conceptual Structure:

- (17) *to go*: [<sub>Event</sub> GO ([<sub>Object</sub> *x*], [<sub>Path</sub> *y*])]

The general conceptual category of this meaning is *Event* and it contains the function GO, which takes two arguments: one of category *Object* (the moving entity) and another one of category *Path* (the trajectory of the moving entity). The same function is a part of the meaning of the verb *rise* (among many others verbs, which is why their meanings may be related), but in this case the path argument is specified as UPWARD (Jackendoff 1983):

- (18) *to rise*: [<sub>Event</sub> GO ([<sub>Object</sub> *x*], [<sub>Path</sub> UPWARD <*y*>])]

The Conceptual Structure of phrases and sentences is built similarly. (19) represents the syntax and semantics of the sentence 'John went into the room' (Jackendoff 2002):

- (19) a. Syntax:  
 [[*John*]<sub>i</sub> [*went*]<sub>j</sub> [*into*]<sub>k</sub> [*the room*]<sub>m</sub>]]  
 b. Conceptual Structure:  
 [<sub>Event</sub> GO ([<sub>Object</sub> *John*]<sub>i</sub>, [<sub>Path</sub> TO ([<sub>Place</sub> IN ([<sub>Object</sub> *room*]<sub>m</sub>))]<sub>k</sub>)]<sub>j</sub>]

The second argument of the function GO (the path TO) has a complex structure: it is a function that takes as its argument the function IN (of category Place), which in turn is combined with the Object argument *room*. Thus the meaning of the preposition *into* is translated, roughly, as 'to in'. As the indices on syntactic and semantic constituents show, the syntactic heads map onto conceptual functions (e.g., *went* → GO), and their complements into these functions' arguments (e.g., syntactic subject *John* → Object *John*, first argument of GO).

As we can see, the Conceptual Structure formulas are rather coarse-grained or underspecified: recall that they encode the part of conceptual meaning that is amenable to being defined in discrete logical terms, and that interfaces with the syntactic structure.

GO is one of the *core functions*, around which situations (States and Events) are built. The other core functions are BE, STAY, EXT, and ORIENT. BE and STAY conceptualize static configurations that can be located in time, the difference being that BE is a State and STAY is an Event (see (20) and (21), respectively). EXT and ORIENT (in (22) and (23)) express static configurations, as well: in EXT, different parts of  $x$  occupy different parts of the Path at the same time; in ORIENT,  $x$  is oriented along the Path, but it neither moves through the Path nor occupies it. GO, as we said, conceptualizes the Event of Object  $x$  moving along the Path or Trajectory  $y$  (as in (24)).

- (20) a. John is at the cinema.  
       b. [State BE ([Object John], [Place IN ([Object cinema])])]
- (21) a. John {stayed/continued} at home.  
       b. [Event STAY ([Object John], [Place IN ([Object home])])]
- (22) a. The railway goes uphill.  
       b. [State EXT ([Object railway], [Path uphill])]
- (23) a. The telescope points to Venus.  
       b. [State ORIENT ([Object telescope], [Path TO ([Object Venus])])]
- (24) a. John went around the lake.  
       b. [Event GO ([Object John], [Path AROUND ([Object lake])])]

Two more groups of functions are meant to represent the internal structure of situations: the *aspectual functions* and the *causative functions*. The aspectual function INCH (inchoative) denotes the initiation of States: the sentence in (25b) can be paraphrased as ‘the object door started to be open as a consequence of the opening event’. The function PERF (perfective) has an opposite effect: it takes as its argument an Event (which would be the event of the moon rising in (26b)) and maps it onto the State of that Event being complete (the state of the moon having risen or being up).

- (25) a. [Event INCH (State  $x$ )]  
       b. The door opened.  
       c. [Event INCH ([State BE ([Object door], [Place AT ([Property open])])])]
- (26) a. [State PERF (Event  $x$ )]  
       b. The moon has risen.  
       c. [State PERF ([Event GO ([Object moon], [Path UPWARD])])]

(27) illustrates the causative function CAUSE, which takes three arguments when combined with transitive verbs: the causer (which can be an object or an event), the patient, and the caused event. Note how the representation of ‘John opened the door’ in (27c) embeds the three meanings of *open*: 1) the adjectival property ‘open’ (<sub>Property</sub> open); 2) the intransitive verbal meaning ‘become open’ introduced by the function INCH, as in (25b); 3) the transitive verbal meaning ‘cause something to be open’, introduced by the function CAUSE.



- (27) a. [Event CAUSE ([Object/Event x], [Object y], [Event z])]  
 b. John opened the door.  
 c. [Event CAUSE ([Object John], [Object door], [Event INCH ([State BE ([Object door] [Place AT ([Property open])])])])]]

The same set of precise abstract underlying conceptual patterns is applied to many different semantic fields. This means that the same abstract schemas can be used to analyze the domains of space, possession, time, property, change, causation, and so on. The conceptual structures of the following sentences, for example, are all based on the function BE, although they describe different conceptual domains: The function BE is supplemented with a suitable *semantic field* feature in each case: Loc, Temp, Poss, and Ident.

- (28) a. The book is in the drawer.  
 (Spatial location) [State BE<sub>Loc</sub> ([Object book], [Place IN ([Object drawer])])]  
 b. The meeting is on Thursday.  
 (Temporal location) [State BE<sub>Temp</sub> ([Object meeting], [Place AT ([Object Thursday])])]  
 c. The book is John's.  
 (Possession) [State BE<sub>Poss</sub> ([Object book], [Place AT ([Object John])])]  
 d. The book is red.  
 (Ascription of property) [State BE<sub>Ident</sub> ([Object book], [Place AT ([property red])])]

In cognitive linguistics, this parallelism is believed to show that spatial notions (e.g., the spatial use of the BE function, paraphrasable as 'to be located somewhere') are exploited as the basis for the analysis and structuring of non-spatial domains (this view is known as the *localistic approach*). Jackendoff, by contrast, argues that these similarities are due to their common source: the conceptual pattern underlying the organization of different semantic domains. It just so happens that the spatial domain is more prominent than the others, for a number of reasons. Many of the significant contributions of Conceptual Semantics to the study of lexicon will be discussed in more detail as we proceed.

## 5.4 Cognitive Linguistics

*Cognitive Linguistics* views language as just one manifestation of a more general, language-independent cognitive system, one which enables conceptualization, categorization, schematization, and other processes, along with access to and constraints over memory. One such framework within this approach, Construction Grammar, was discussed in section 3.6. CG focuses on the semantic and syntactic properties of *constructions* understood as form-meaning pairings. Theories adopting this approach do not accept generative linguistics' usual assumptions of innate specificity or uniqueness of linguistic knowledge. In this section, we introduce two additional frameworks within Cognitive Linguistics, *Cognitive Grammar* and *Radical Construction Grammar*.

Unlike formal semantics, Cognitive Linguistics (as well as Conceptual Semantics) claims that there is more to meaning than mere denotation: meaning is the product of the human mind and it does not exist independently from the human mind. Meaning emerges in our mind when our body comes into contact with the environment through perception. Consequently, semantic notions such as reference and truth cannot be defined without delving into the conceptual structures that result from the contact of the speaker with the real world. The importance of human

perception and conceptualization places the speaker and speaker-conditioned linguistic factors at the very core of language study, including the social and cultural facets of language, actual linguistic performance and language use (as opposed to abstract models of linguistic competence, strongly favored by generative linguistics), and linguistic variation (diachronic, sociological, geographical, and otherwise).

In Cognitive Linguistics, the lexicon is seen not as an independent component of grammar, but rather as a set of different types of constructions along a continuum, within which the degree of lexical and syntactic specificity can vary greatly. Since every linguistic unit has meaning and form, *all* constructions are assumed to be inherently meaningful (including function words, abstract syntactic schemas and phrase structure rules). There are, however, some interesting differences in what is understood by *meaning* and *form*, and in how the lexicon-grammar relations are treated. While Construction Grammar defines a clear distinction between constructional and lexical meaning, neither Cognitive Grammar nor Radical Construction Grammar assumes that a clear separation between ‘constructional’ and ‘lexical’ facets of meaning can be identified.

Unlike most generative approaches to the lexicon, Cognitive Linguistics believes it is not possible to separate the linguistically-relevant information from general encyclopedic knowledge associated with words, or with language more broadly. Such knowledge is complex, multifaceted, and it usually involves many different but related conceptual domains. For example, while the nouns *dog* and *hound* are considered synonyms, they have distinct speech situations and conventions associated with their use: *hound* connotes the activity of hunting and retrieving; *dog* is not only a more generic term, but also permits of negative use in metaphors and similes, e.g., *He smells like a dog*.

While there is a vast amount of encyclopedic knowledge associated with a word or a linguistic expression, it cannot be accessed every time it is used. When describing a situation, a speaker chooses one of the many perspectives on this knowledge, employing a strategy that Cognitive Linguistics calls *semantic construal*. The main types of construal are summarized below.

- (29) **Specificity:** the level of granularity used to describe an object, activity, or attribute in a situation: For example, do we refer to a MacBook, laptop, personal computer, artifact, or thing? Does it cost \$1,969.00, about \$2,000, or a fortune?
- (30) **Focusing:** the “viewing frame” (or *scope*) that demarcates the conceptual content of an expression. For example, consider the choice between saying *A finger is part of the hand* vs. *A finger is part of your body*.
- (31) **Prominence:** the elements we pay most attention to in an expression. This includes *profiling* and *trajector-landmark alignment*. The *trajector* (or *figure*) is the most prominent participant or the *primary focus* within the profiled relationship, and “is the entity construed as being located, evaluated, or described”. The *landmark* (or *ground*) is the participant that is made prominent as a ‘secondary focus’. For example, *parent* and *child* involve the same immediate conceptual base but impose different profilings over it. The latter has to do with the prominence of participants in a profiled relationship. The relationships ‘have a parent’ and ‘have a child’ have the same conceptual base and the same profile but differ in meaning because of their opposite alignments. In 5.2, the uppermost circles represent the parents, the lower circles the child, and ‘R’ is the reference individual, with respect to whom the person is a parent or a child. The thick lines mark the profiled individuals and relationships.

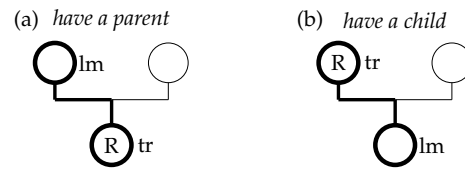


Figure 5.2 Trajector-landmark alignment, Langacker (2013)

- (32) **Perspective:** the point from which we view the situation: e.g., the pair of expressions *in front of* and *behind* introduce two vantage points (VP) that describe the same situation, as shown below:

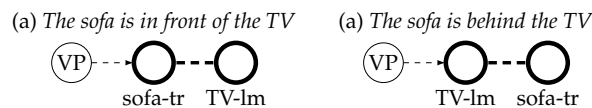


Figure 5.3 Vantage point, adapted from Langacker (2013)

Construal can be seen as a set of strategies available to a language speaker/hearer, enabling her to navigate the conceptual core associated with a linguistic expression.

Another major difference between Cognitive Linguistics and other frameworks is the way in which conceptual structures are given lexical and grammatical form. What category a given concept is realized as is a function of how it is construed and profiled in a particular context. In this view, **nouns profile things** and **verbs profile processes**, but the terms *thing* and *process* must be understood in the specific sense assigned to them in Cognitive Linguistics. Both are kinds of *entities*, an entity being any component of the conceptual structure. Figure 5.4 presents the hierarchy of conceptual types, whose relation to syntactic categories we will look into later:

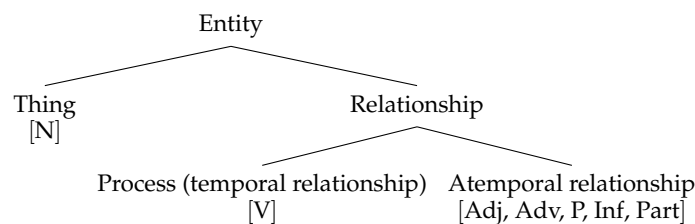


Figure 5.4 Types of entities in Cognitive Linguistics

A *thing* is a product of two basic cognitive abilities: *grouping* and *reification*. Grouping consists of clustering similar and/or contiguous entities and reification is the capacity to perceive a group as a unitary entity. For example, we perceive as a group the peas on our plate and can refer to them as a single entity when asked what side dish we are having with our steak. The same strategy applies to other kinds of things: a *laptop* is a unitary entity composed of interconnected parts (screen, keyboard, processor, etc.), *water* also represents an entity grouped and reified based on the qualitative identity of its parts and instances, and so forth.

*Relationships* are classified into processes and atemporal relations: the former are characterized as developing over time, while for the latter, temporal progression is irrelevant. Finite verb forms (referred to as *V* in figure 5.4) instantiate *processes*, defined as temporal relationships

scanned sequentially. Non-finite verbal forms (infinitives and participles), and also adjectives, adverbs, and prepositions encode atemporal relationships.

In Radical Construction Grammar, both syntactic categories and grammatical relations are defined with respect to their role in a particular construction of a particular language and the semantic relations they establish within that construction. This approach is called *non-reductionist*, because the basic entities (i.e., the constructions) are complex rather than atomic, as in classical compositional approaches. Syntactic categories are instantiations of the semantic classes that we use to structure the elements of the scene we describe. There are three basic ways to perform such a structuring, called *propositional act constructions*: **reference** (what we are talking about), **predication** (what is being said about the referred to entity) and **modification** (what we add to the description of the entity referred to). The semantic classes that may play a role in these three constructions and the syntactic categories instantiating them are defined in terms of prototypes, as summed up in table 5.2: prototypical objects are used for reference and are expressed as nouns; prototypical properties are used for modification and are expressed as adjectives; and prototypical actions are used for predication and are expressed as verbs.

Propositional act construction	Reference	Predication	Modification
Prototypical semantic class	Object	Action	Property
Prototypical syntactic category	Noun	Verb	Adjective

**Table 5.2** *Syntactic categories as correlation of semantic class and propositional act function in Radical Construction Grammar* (adapted from Croft 1990)

Prototypical semantic classes and syntactic categories are usually *morphologically unmarked*: they do not need any specific morphemes to express their prototypical function. In the sentence *I liked the blue shirt*, the object-denoting noun *shirt* is part of the referring construction ‘the blue shirt’ and it is morphologically simple. The property-denoting adjective *blue* is also morphologically unmarked. Finally, the action-predicating verbal form *liked* only has the inherent verbal tense morphology (the *-ed* ending). The existence of a prototype does not exclude the possibility of there being more *peripheral* or less central members of a category, as shown in table 5.3 for the three syntactic categories we have been looking at. Property-denoting deadjectival nouns (*sadness*, *acidity*), action-denoting deverbal nominals (*discovery*, *collection*), and non-finite verbal forms (as in *Hydrating is healthy*) can be used for reference; object-denoting words can participate in the modification construction when combined with prepositions (*the car in the yard*), the genitive *’s* marker (*John’s watch*), or adjectival morphology (*childish*); nouns and adjectives can be used as predicates when combined with a copula (*This is a dog*; *The dog is huge*), etc. Note that peripheral semantic groups within each propositional act construction are marked: they need extra morphosyntactic machinery (marked in bold face) in order to fit into these constructions.

	Reference	Modification	Predication
<b>Objects</b>	UNMARKED NOUNS	genitive ( <i>John's watch</i> ), adjectivalizations ( <i>childish</i> ), PPs on Ns ( <i>the car in the yard</i> )	predicate nominals, copulas ( <i>This is a dog</i> )
<b>Properties</b>	deadjectival nouns ( <i>sadness, acidity</i> )	UNMARKED ADJECTIVES	predicate adjectives, copulas ( <i>The dog is huge</i> )
<b>Actions</b>	action nominals ( <i>discovery, collection</i> ), complements, infinitives, gerunds ( <i>Hydrating is healthy</i> )	Participles ( <i>the cat lying on the pillow</i> ), relative clauses	UNMARKED VERBS

**Table 5.3** *Marked and unmarked coding of propositional act constructions in Radical Construction Grammar* (adapted from Croft 2001)

The traditional grammatical relations (subject, object, etc.) are explicitly excluded from syntactic structure in Radical Construction Grammar: the elements of a construction are only defined by their syntactic role with respect to the construction as a whole, and the only relations posited between the elements of the same construction are the semantic ones. One of the main reasons there are no grammatical relations in this theory is their syntactic and semantic heterogeneity. That is, the same event participant (Patient, Theme or Experiencer) can be expressed in different grammatical relations, as in (33).

- (33) a. She froze *the milk*.  
b. *The milk* froze.

Of course, it could be argued that what all the phrases share are the syntactic properties of the subject: in English, the subject always appears in nominative case (e.g., *she* in (33a) and *he* in (33b)). But this does not hold for all languages: in the languages called *ergative* (e.g., Basque, Mayan, Tibetan, Georgian, Dyirbal, etc.), the subject of a transitive verb (e.g., *she* in (33a)) is assigned the ergative case, and the subject of an intransitive verb (*the milk* in (33b)) and the object of a transitive verb (*the milk* in (33a)) are assigned the absolutive case. Hence, we can't provide a purely syntactic definition of subjecthood.

Since grammatical relations are only defined with respect to a particular construction in a particular language in Radical Construction Grammar, the name of the language and the construction are always appended to the label of each unit in the construction: the parts of the English transitive construction are a Transitive Subject, a Transitive Verb and a Transitive Object, and the parts of the English intransitive construction are an Intransitive Subject and an Intransitive Verb. Of course, this emphasis on the specificity of grammatical roles with respect to a construction does not mean that different constructions are not somehow related in the speaker's mind, their relatedness is just of a more limited kind than is usually assumed. For instance, the transitive and intransitive construction are related because they both contain a verb that has tense/aspect/agreement morphology.

Several of the most significant contributions of cognitive linguistics will be introduced or taken up elsewhere in this book: the conceptual structures are dealt with in section 6.4 and the crucial role of the metaphor in the processes of extension of lexical meaning is discussed in section 11.5.

## 5.5 Prototype theory

**Prototypicality** is a property associated with the act of categorization, i.e., how we group similar (but not identical) objects as belonging to the same class, and this concept forms the basis of the framework known as *prototype theory*. This theory is a cognitively-inspired and usage-based alternative to the classical Aristotelian categorization model of necessary and sufficient conditions, which we presented in section 3.2. On this view, categories have a very clearly defined set of properties. They are: discrete (different units are neatly demarcated and do not overlap); defined through a set of necessary and sufficient features (a member of a category must have all and only the features required for this category); and have neither “good” nor “bad” members of a category, they all fulfill the same conditions of membership.

Some of the drawbacks of this categorization model when applied to lexical semantics (in particular, to the structure of lexical fields) are the following: there are meaning gaps and overlaps between lexical concepts that are supposed to be co-hyponyms (i.e., be contrasted by one lexical feature within the same taxonomic level of a lexically-defined category), binary features often prove to be insufficient to account for the rich lexical meaning, etc. To illustrate this, consider a simple example of the dictionary definition for the word *parrot*.

(34) **parrot:** bright-colored tropical bird having a strong curved bill and clawed zygodactyl feet.

As with many things in the world, there are exceptions, but how do we handle real-world entities that don’t “check off all the boxes” in the definition of *parrot*? Consider the situations below.

- (35) a. an ill-formed or damaged parrot that lost its vivid coloring;  
 b. a new, genetically modified parrot that has a straight beak;  
 c. a robot that looks exactly like a parrot and can imitate human speech.

Does an entity stop being a parrot even though one of its distinctive features is lost or modified? Can we no longer refer to such a creature as a parrot? The answer seems to be no, which indicates that the concepts and words we use to refer to concepts are more than just a set of necessary and sufficient features.

### DISCUSS

Try to put together a list of necessary and sufficient conditions for the categories DOG, STAR, BOAT, and TOY. Which difficulties did you come across?

The research on prototype-based categorization is associated with the name of the psychologist Eleanor Rosch, who studied “what we have in mind when we use words which refer to categories” (Rosch, 1973b). In one of her most famous experiments, students were asked to judge how good an example of a category different instances are. A total of 10 categories were tested, all representing common concrete objects: FRUIT, BIRD, VEHICLE, VEGETABLE, SPORT, TOOL, TOY, FURNITURE, WEAPON, and CLOTHING. The results of this experiment showed a very high degree of agreement between participants: for 9 out of 10 categories, 95% of participants gave the highest score to the same member of the category (on a scale from 1-7). Table 5.4 contains a brief sample of the **goodness of example** (GOE) or **typicality rating**.

Category	Best members GOE		Moderate-fit members GOE		Worst members GOE	
FURNITURE	chair	1.04	buffet	2.89	ashtray	6.35
	sofa	1.04	lamp	2.94	fan	6.49
	couch	1.10	stool	3.13	telephone	6.68
FRUIT	orange	1.07	lime	2.45	olive	6.21
	apple	1.08	tangelo	2.50	pickle	6.34
	banana	1.15	papaya	2.58	squash	6.55
BIRD	robin	1.02	hawk	1.99	emu	4.38
	sparrow	1.18	raven	2.01	penguin	4.53
	bluejay	1.29	goldfinch	2.06	bat	6.15
SPORT	football	1.03	ice skating	2.29	checkers	5.64
	baseball	1.05	jai alai	2.30	cards	5.79
	basketball	1.12	skating	2.39	sunbathing	6.75

**Table 5.4** *Goodness-of-example ratings of concrete categories* (adapted from Rosch 1975)

The two basic conclusions of these and other experiments are:

- (36) a. In at least some categories, membership is a matter of degree: some members are better representatives of the category than others.
- b. In at least some categories, the boundaries are fuzzy rather than clear-cut, but the central part of the category is clear: for these categories, speakers have no difficulty identifying the most salient members, but it is not always easy or possible to say if something belongs to the category or not.

Since its emergence in the literature, there has been an intense debate regarding what exactly a prototype is and what role it plays in lexical meaning. Some researchers argue that prototypes represent, in themselves, a model of conceptual processing: others regard them as superficial effects of deeper cognitive structures and processes. We will not delve into this issue here, but we merely present some of the most common interpretations of the notion of prototype.

- **Typical examples.** The prototype is the most prominent or central member of the category: for example, *apple* or *orange* are the prototype of the category FRUIT. The likelihood of something being included into a category is computed based on its similarity with the central member(s). Category members ranked with highest GOE would be prototypes within their category.
- **Salient examples.** We use salient (familiar, memorable, and otherwise) examples that we have previously encountered to structure the category; for example, the building we each grew up in may be the prototype of the category HOUSE.
- **Set of prototypical features.** The prototype is the category member that has all or most of the features that define the category. In order to decide whether something is a good member of a category we check its properties against the features of the prototype. It is important to emphasize that prototypical features ARE NOT sufficient or necessary. As a matter of fact, if we only consider the features shared by all the members of a prototype-based category, there might very well be too few or too generic to distinguish this category from others. Some of these features are more significant than others: necessary vs. optional, or weighted differently with respect to their contribution to the prototype.
- **Family resemblance.** This notion has been productively applied to analyze categories whose members have no or few elements shared by all of them, but where each member has at least one element in common with at least one other member. This kind of relationship takes the form AB-BC-CD-DE, each letter representing a semantic feature and each combination of

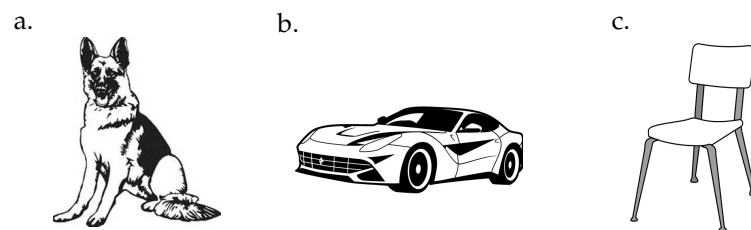
letters representing a category member. In such categories, the prototypical member is the one with most attributes overlapping with other members of that category and with least attributes in common with the members of other categories (Rosch and Mervis 1975).

Table 5.5 shows how family resemblance manifests itself in the category FRUIT: there is not one feature shared by all the members of the category, but the same features are differently combined for different kinds of fruit. The most typical fruit (orange) has the greatest number of features and the least typical (olive) has only one of them:

	<i>orange</i>	<i>banana</i>	<i>grapefruit</i>	<i>pineapple</i>	<i>tomato</i>	<i>olive</i>
grows on a tree or a bush	+	+	+	-	+	+
is juicy	+	-	+	-	+	-
is sweet	+	+	-	+	-	-
the edible part is brightly colored	+	-	+	+	+	-
is used for desert	+	+	+	+	-	-

**Table 5.5** Family resemblances in the category FRUIT

The prototype effect manifest itself not only at the horizontal level (among different members of the same category or *co-hyponyms*) but also ‘vertically’, making some taxonomic levels or levels of abstraction more salient than others. To illustrate this effect, first look at the pictures below. Now give a name to each of the objects represented.



**Figure 5.5** Naming preferences and basic level categories

How did you name the pictures? You probably used *dog* for picture (a), *car* for picture (b), and *chair* for picture (c), but there are other choices available. Note that *any* of the words in (37a-c) (and probably more) can be used to refer to these objects.

- (37) a. animal > mammal > **dog** > German shepherd  
 b. vehicle > **car** > sports car  
 c. furniture > **chair** > kitchen chair

Some of them are more specific than the ones you chose (to the right of the marked term), others are more general (to the left of the marked term). In everyday speech, we would not normally use the more specific terms (*German shepherd*, *sports car*, *kitchen chair*) even if we know what kind of dog, car or chair we are dealing with. And we would not use the more generic terms either. Why did we choose the words in bold rather than the others? The term used to describe this ‘privileged’ taxonomic level is **basic level category**. This level of categorization has been claimed to be more salient because it is information-rich (Rosch and Mervis 1975): the members of these categories have many attributes in common and at the same time share very few attributes with the members of other categories of the same taxonomic level, which



makes them easily distinguishable. For instance, all the dogs are very similar (despite obvious differences) and at the same time they can be easily differentiated from cats, giraffes, kangaroos, and other mammals. If we go one level up, we see that the members of the category MAMMAL share very few attributes: cats, giraffes, and kangaroos do not have much in common. And if we go one level down (to the category GERMAN SHEPHERD), its members cannot be easily differentiated from other categories of the same level (German shepherds have a lot in common with akitas, huskies, and even pomeranians).

Prototype theory has a number of relevant implications for lexical semantics. First, notice that basic level categories and the words denoting them have an interesting set of properties, listed in (38d):

- (38) a. Similarity in shape and overall look: most CHAIRS look similar; different items of FURNITURE look very different; different KITCHEN CHAIRS cannot be easily distinguished.  
 b. Similarity of sensory-motor interaction with the objects: CHAIRS are sat on and moved around very similarly; different items of FURNITURE are manipulated differently; different kitchen chairs are interacted with the same way.  
 c. Early categorization development and language acquisition: the basic categories are the first ones to be categorized and named by the children (e.g., CHAIR/*chair* before FURNITURE/*furniture* and KITCHEN CHAIR/*kitchen chair*).  
 d. Morphological simplicity: *chair* is a simple word composed of just one morpheme; *furniture* was borrowed from French (*fourniture* 'act of furnishing'), where it was derived from *fournire* 'to furnish'; *kitchen chair* has two words.

Broadly, there are three areas of the lexicon impacted by prototype theory: (1) the relation between prototypicality and the flexibility of word meaning; (2) the consequences for word definitions; and (3) the treatment of polysemy in terms of radial categories. Word meanings, like real-world categories, can have fuzzy boundaries, and reference to prototypes accounts for semantic flexibility and vagueness and for the fact that words may be used to describe things, properties and events that may not be directly related to the central or more basic word meaning.

As far as word definitions are concerned, recall that we have been saying that dictionaries usually follow the Aristotelian model (see section 6.2.1). This is usually the case, but it is also true that the prototype effects can be accommodated in a dictionary definition. In the definition from the Merriam-Webster Online Dictionary in (39a), the semantic features of the word *bird* are listed in order of importance: the first one ('lays eggs') is shared by all birds; the second and third one ('has wings', 'has a body covered with feathers') either have exceptions (the moas did not have wings), or are not clearly identifiable on all birds (kiwis only have vestigial wings, and the kiwis and penguins have very unusual feathers). In the definition of *fruit* in (39b), the terms 'usually', 'often', and the open-ended enumeration in parenthesis also signal what is typical or representative, without being necessary.

- (39) a. *bird*: an animal that lays eggs and has wings and a body covered with feathers.  
 b. *fruit*: a usually soft and juicy plant part (as rhubarb, a strawberry, or an orange) that is often eaten as a dessert.

Several scholars working within the cognitive-linguistic framework claim that the prototype theory provides a valid model for the treatment of lexical polysemy (Brugman and Lakoff 1988, Geeraerts 1990, Tyler and Evans 2001). On this view, polysemous words have a basic or primary sense (having the greatest number of salient features), and a set of less central senses related to

the basic one and to one another. Geeraerts (2010), for instance, proposes the following ordering of the senses of *fruit*, from the basic one in (40a) to the most peripheral one in (40f):

(40) *fruit*:

- a. being sweet, juicy, commonly used as dessert (apples, oranges, etc.)
- b. being the seed-bearing part of a plant
- c. being the edible result of a vegetable process ('fruits of the earth')
- d. being the positive outcome of a process or activity (advantage, profit)
- e. being the outcome of a process or activity

The senses (40d-e) are related to the basic sense (40a) by metaphoric links from a more concrete, biological meaning (in (40a)) to the abstract ones of 'outcome, result' (in (40d-e)). The senses (40b,c), in turn, are derived from (40a) by generalization: from the typical fruits to the biological function of all fruits (40b), and to their function for the humans (40c).

Before we close this section, it should be mentioned that prototypicality is a very complex phenomenon. On the one hand, many categories can be represented as either discrete or prototype-based. As Cruse (1990) shows, the notions *inside/outside* can be conceived as non-gradable (so that 'being in the {living-room/entry hall}' qualifies as *inside* and 'being {on the door steps/at the garden gate}' qualifies as *outside*) or gradable, admitting a borderline area (wherein 'being at the door steps' could qualify as *inside*, and it could be argued that someone being in the living room is '*more inside*' than someone being in the entry hall). Even the categories of ODD NUMBERS and EVEN NUMBERS have been found to display prototype effects (7 and 4 having higher typicality ratings than 501 and 106, respectively) despite being obviously discrete (Armstrong *et al.* 1983).

On the other hand, defining the features of a prototype and ranking them in order of importance is a complex task; we usually need to know what category the word belongs to in order to be able to define these features, which makes the feature identification for a given category prototype circular. Furthermore, making these features work in a semantic definition, based on which the compositional meaning of sentences can be defined, is technically challenging.

## 5.6 Natural Semantic Metalanguage

The last framework we review in this chapter is called *Natural Semantic Metalanguage* (NSM). Like most theories presented here, NSM is based on lexical decompositional principles (Wierzbicka 1985a). However, the view of decomposition, along with the set of semantic primitives assumed in this framework, differs in significant ways, illustrated below.

- (41) a. Complex word meanings are defined through a **reductive paraphrase** or **explanation**, which only contains **semantic primitives** (or previously defined combinations of primitives). These paraphrases have the form of actual natural language sentences rather than abstract formulas, and they represent the concepts that speakers have in mind rather than objective attributes of real-world entities.
- b. Semantic primitives are basic concepts expressible in all or most languages.
- c. Natural language words are used as the semantic metalanguage. Semantic primitives are represented by actual lexical items that are regarded as elementary and undefinable (in their most basic meaning, although they may have other, non-primitive senses, as shown below).

- d. Although the semantic primitives are universal, their **lexical exponents** (i.e., the words that lexicalize them) are language-specific.

Goddard and Wierzbicka (2013) list 65 semantic primes, grouped into categories. Similar lists have been proposed for other languages: Arabic, Chinese, Danish, Finnish, French, Japanese, Korean, Polish, Russian, Spanish, etc. Table 5.6 lists the English semantic primes.

CATEGORY	PRIMES
Substantives	I-ME, YOU, SOMEONE, SOMETHING-THING, PEOPLE, BODY
Relational substantives	KIND, PARTS
Determiners	THIS, THE SAME, OTHER-ELSE
Quantifiers	ONE, TWO, SOME, ALL, MUCH-MANY, LITTLE-FEW
Evaluators	GOOD, BAD
Descriptors	BIG, SMALL
Mental predicates	KNOW, THINK, WANT, DON'T WANT, FEEL, SEE, HEAR
Speech	SAY, WORDS, TRUE
Actions, events, movement, contact	BE (SOMEWHERE), THERE IS, BE (SOMEONE)'S, BE (SOMEONE/SOMETHING)
Life and death	LIVE, DIE
Time	WHEN-TIME, NOW, BEFORE, AFTER, A LONG TIME, A SHORT TIME, FOR SOME TIME, MOMENT
Space	WHERE-PLACE, HERE, ABOVE, BELOW, FAR, NEAR, SIDE, INSIDE
Logical concepts	NOT, MAYBE, CAN, BECAUSE, IF
Intensifier, augmentor	VERY, MORE
Similarity	LIKE-WAY-AS

**Table 5.6** *NSM semantic primitives (English exponents)*, Goddard and Wierzbicka (2013)

To illustrate this methodology, let us examine three NSM-style definitions: (42) defines the noun *sky*, (43) defines the adjective *ill*, and (44) defines the verb *apologize*:

(42) *sky*

- a. something very big
- b. people can see it
- c. people can think like this about this something:
  - it is a place
  - it is above all other places
  - it is far from people

(43) *She was ill.*

- a. something bad was happening to her body for some time
- b. because of this, she felt something bad in her body during this time
- c. because of this, she couldn't do many things during this time like she could at other times

- (44) *I apologize (for doing A).*
- a. I say this to you now:
 

“I feel something bad now because I think like this:  
‘I did something (A) before, you can feel something bad because of it’”
  - b. I know that you can feel something bad towards me now
  - c. I don’t want this

These definitions are quite obviously longer and more complex than standard dictionary definitions. They introduce the context or scenario within which the defined concept is embedded and provide a number of causal and temporal links between the different elements (‘I feel something bad *because of it*’, ‘something bad was happening to her body *for some time*’, etc.).

The scenarios are invariably articulated around the individuals (rather than the objective properties of entities and events, as we already noted), especially in their capacity of speakers and hearers. This happens even when natural objects (e.g. *sky* in (42)) are defined. These components are meant to “reflect the inherent subjectivity and anthropocentrism of ordinary language” (Goddard and Wierzbicka, 2013), and also its social and cultural underpinnings. The anthropocentrism and the incorporation of prototypical properties of the defined concepts align the NSM theory with cognitive-linguistic approaches.

One of the obvious advantages of the NSM definitions is that they are both very detailed and easy to interpret, even if very complex concepts are defined. On the other hand, their practical utility is affected by their length: for instance, the definition of *mice* in Wierzbicka (1996) is almost two pages long. On the theoretical side, the most questioned claims concern the primitiveness and the universality of the semantic primes, and also the use of natural-language words to express them. Are the NSM semantic primitives actually primitive? The fact that they are non-definable does not necessarily mean that they are conceptually and/or linguistically simple. It has also been called into question whether the primitives are actually present in all languages (Bohnenmeyer 1998, Bohnemeyer 2004). In those languages that do lexicalize them, it is often the case that their content must be disentangled from other senses of the same word (e.g., *move* in its basic meaning ‘to change location’ and in the sense ‘to change residence’).

## 5.7 Summary

This chapter reviewed the contributions of the major semantic frameworks regarding the study of word meaning. Based on this brief overview it can be established that, despite the lack of agreement on several crucial issues related to the nature and structure of the lexicon, the different frameworks attach great importance to the research of word meaning, its components and its role in the meaning of different types of linguistic expressions. Most of these theories resort to semantic decomposition of some kind in order to account for lexical meaning. The following list summarizes the positions adopted by their proponents on the core issues pertaining to lexical meaning.

- **FORMAL SEMANTICS:** This is a rich denotational approach to semantics, with no lexical decomposition of expressions, but one which makes use of the syntax (machinery) of a logic, along with its interpretation into a model.
- **CONCEPTUAL SEMANTICS:** This is a representational approach to meaning, utilizing rich lexical decomposition of terms. The minimal components of Conceptual Structure are more linguistic in nature than conceptual.

- **COGNITIVE LINGUISTICS AND THE PROTOTYPE THEORY:** These are both representational approaches to meaning, which also employ rich lexical decomposition. Construction Grammar further assumes that meaning is encoded through constructional structures as well. The smallest units of meaning include prototypical features (for prototype theory) and general conceptual components (for Cognitive Linguistics).
- **NATURAL SEMANTIC METALANGUAGE:** This is a representational approach that assumes a relatively small number of semantic primitives, which form the building blocks for any possible language meaning. It is a conceptually anchored theory, where semantic primitives are expressed by natural language words.

## 5.8 Further Readings

The following references can be useful for a more in-depth study of the theoretical frameworks presented in this chapter. We first list original research papers and monographs and then suggest some further explorations with introductory chapters and textbooks in the area.

Topic	Primary references
Influential monography on verbal meaning framed within Montague's formal semantics	Dowty (1979)
Comprehensive presentation of Conceptual Semantics (in its different versions) and its positioning among other linguistic frameworks	Jackendoff (2002), Jackendoff (1990), Jackendoff (1997), Jackendoff (1983), Jackendoff (1972)
Presentation of specific aspects of Conceptual Semantics	Jackendoff (2013), Jackendoff (2008), Jackendoff (1991)
Cognitively-framed analysis of verbal semantics	Croft (2012)
Original research on prototype-based categorization	Rosch (1973a), Rosch (1975), Rosch and Mervis (1975)
Foundational research in NSM	Wierzbicka (1987), Wierzbicka (1996), Goddard and Wierzbicka (2013), Goddard and Wierzbicka (2007)

Topic	Secondary references
Textbooks on formal semantics	Heim and Kratzer (1998), Cann <i>et al.</i> (2009)
Introduction to formal semantics, oriented from the perspective of generative grammar	Chierchia and McConnell-Ginet (2000)
Textbook focused specifically on how the meaning of complex expressions is built	Jacobson (2014)
Introductory chapter on Conceptual Semantics	Jackendoff (2011)
Textbook covering a wide array of issues addressed by cognitive-linguistic frameworks. Part II is devoted specifically to lexical semantics	Croft and Cruse (2004)
Introductory chapters on Cognitive Linguistics (in particular, on Cognitive Grammar and Radical Construction Grammar)	Langacker (2007), Broccias (2013), Croft (2013)
Introduction to Prototype Theory	Riemer (2010) (sec. 7.1.)
Introductory chapter on NSM	Goddard (2010)

## 5.9 Exercises

- Formulate meaning postulates representing the semantic relations between the words in each pair. For example, for *sibling* - *sister*, we would have:  
 $\forall x \forall y [\text{sibling}(x, y) \wedge \text{female}(x)] \leftrightarrow \text{sister}(x, y)$ .
  - nephew - uncle
  - remember something - something be true  
(this involves lexical presupposition)
  - be inside - be outside
  - dead - alive
  - huge - enormous
- Provide Conceptual Semantics-style conceptual structures for the following sentences:
  - John is in love.
  - The snow covers the valley.
  - The hotel faces the sea.
  - The cake fell onto the floor.
  - John buttered the toast.
  - The scandal forced John into retirement.
- Do the same with the following sentences. Pay attention to the compositional aspects of meaning: which fragments of conceptual structure recur in semantically related sentences?
  - John became a celebrity.
  - Mike made John a celebrity.
  - John remained a celebrity.
  - The flower is yellow.
  - The flower yellowed.
  - The craftsman yellowed the glass.
  - Mary has a doll.
  - Mary received a doll.
  - Mary kept the doll.
- Contrast the following groups of expressions in terms of *construal* as defined in Cognitive Grammar. What role do the lexical items in each sentence play in determining a specific kind of construal? Try to provide diagrams to illustrate your answer whenever possible. Recall that entities of the *thing* kind are represented by circles or ellipses, relationships are depicted by lines or arrows connecting the relevant entities, and profiled components of the expression are marked with thick lines.

- |                                  |   |
|----------------------------------|---|
| a1. John met Mary.               | c1. The professor is examining the students.          |
| a2. Mary met John.               | c2. The students are being examined by the professor. |
| a3. Mary and John met.           | d1. Grandparent                                       |
| b1. It is drizzling outside.     | d2. Grandchild  |
| b2. It is drizzling in Sarasota. |   |
5. List ten members for each of the following categories: MUSICAL INSTRUMENT, HOBBY, BUILDING, HOUSEHOLD APPLIANCE, TO LOOK and TO DECEIVE. Suggest a set of prototype features for these categories and rank their members according to their closeness to the prototype.
  6. Which of these categories are better represented through the classical categorization model and which ones through the prototype-based model: BOAT, COMPUTER, LIVESTOCK, MOLECULE, PLANET, RED, STUDENT? Can any of them be conceptualized as both discrete and prototype-based? Provide sets of features (either prototypical, or necessary and sufficient) and examples of category members to illustrate your answer.
  7. Provide NSM-style definitions for the following English words: (a) *mother* (begin with 'X is Y's mother'), (b) *unhappy* (begin with 'X is unhappy'), (c) *(to) order* (begin with 'I order you to do this'). Remember that you can only use the semantic primitives, listed in table 5.6.

## **Part II**

---

# **Lexical Structures**



## 6 The Structure of a Lexical Entry

---

### 6.1 Overview

As pointed out in Chapter 1, there is a lot we know when we use a word properly. At the very least, we exploit the following information: phonological (how it's pronounced); semantic (what the word means); syntactic (what other words it is compatible with in a phrase or a sentence); and (if it's written) orthographic (how it is written). This chapter discusses the formal structure of words in the lexicon, focusing on aspects of the semantic component of the lexical entry. The relationship between a lexical entry and word meaning is *not* a dictionary-style definition. Dictionaries and word definitions are human-constructed artifacts meant to be used as an aid for connecting words (the defined word with the words used in the definition), and not as a theoretical representation of the mental structures that are associated with the word meaning (see Section 1.2 on the differences between conventional dictionaries and the mental lexicon). Hence, we can say that a dictionary entry *relates* words to other words, while a theoretical lexicon *structures* the content of a word's meaning. Reflecting on what kinds of structures these might be is precisely the aim of this chapter.

### 6.2 Linguistic vs. Extralinguistic Knowledge in the Lexical Entry

Words are vehicles of thought and knowledge, and they encode concepts. That much we do know. But can all the information that words express be considered as linguistic just because it is somehow associated with words? This is a long-debated question of whether there is a **linguistic knowledge** associated with words that should be distinguished from **extralinguistic knowledge** (also called encyclopedic, real-world, or commonsense knowledge). A detailed discussion of how different linguistic frameworks settle this question is included in Chapters 3 and 5, and summed up in table 3.4 and summary 5.7. Here we briefly review the two main approaches to this topic and set out the position adopted in this book.

**Position 1:** Linguistic knowledge and extralinguistic knowledge are not fundamentally distinct. Cognitive-linguistic approaches, for instance, claim that there is just one kind of knowledge (conceptual), and that establishing a separation between its linguistic and extralinguistic domains is not possible or at least is very challenging because both kinds of information form a continuum with no clear boundaries.

**Position 2:** Linguistic knowledge and extralinguistic knowledge are fundamentally distinct. The proponents of this approach put forward different criteria for how both kinds of knowledge can be differentiated.

While sympathetic to the first position, we will adopt a view closer to the second approach

here and argue that a portion of conceptual information can be considered “linguistic” if it can be shown to significantly affect other modules of grammar, most importantly syntax and morphology (because its impact on syntax and morphology is directly observable). As far as semantics is concerned, the linguistic relevance of conceptual features can be verified by their role in the compositional behavior of the words and the expressions composing them. Hence, while our neural implementation of word meaning might not structurally differentiate linguistic from non-linguistic knowledge, it could still reflect preferences in connectivity for linguistically salient knowledge. Operationally, we adopt this view because very useful theoretical and descriptive observations can be made based on this dichotomy.

Let us illustrate the approach formulated in Position 2 with a few examples. Different languages may grammaticalize different sets of conceptual features, such that a certain feature may be “grammatically visible” and hence linguistically relevant in some languages but not in others. For instance, we know that the count-mass distinction is linguistically relevant in English (among many other languages) because both groups are compatible with different kinds of quantifiers and behave differently in plural (cf. Section 2.3.3).

- (1) a. {*a few/ many/ several*} toys
- b. *five* toys
- c. {*a little/ much*} milk
- d. ??*five* milks

Similarly, the distinction between nouns denoting natural kinds and nouns denoting artifacts is supported by their compatibility (or lack thereof) with phase verbs (*begin, finish*, etc.). Artifact nominals can be combined with these verbs, and the resulting interpretation always involves the event typically associated with the noun (like the event of ‘painting’ for *portrait* in (2a)). By contrast, nouns referring to natural kinds reject them: (2b) is only acceptable if we assume that the tree is either some kind of artifact (a painting, a sculpture, etc.) or that the activity is salient from the context. See Sections 3.7, 7.3, and 7.4 for additional justification of this distinction.

- (2) a. John started the portrait. = ‘John started painting the portrait.’
- b. ??John started the tree. = ‘John started {trimming/ decorating/ planting} the tree.’

What about the non-linguistic knowledge associated with lexical entries? As it happens, most conventional linguistics books only discuss the linguistic aspects of the lexical entry. This is unfortunate because a significant amount of psycholinguistics work involves both information that is linguistic and non-linguistic. The fact that we assume a linguistic-extralinguistic dichotomy does not imply that we believe that non-linguistic information associated with lexical entries should or can be ignored in linguistic research. As a result, we will present a lexical entry that has the following components: a well-defined level of linguistic structure, as well as a well-articulated conceptual domain, with areas that are typically non-linguistic. This will include views that link linguistic and non-linguistic data, such as image schemas, prototypes, frames, etc.

As we will see in what follows, the demarcation of both domains and the representation language used to describe them depends not only on the nature of the phenomena analyzed but also on the theoretical inclinations of the linguist: generative linguists tend to focus on primarily linguistic data and use propositional (logical, algebraic) languages to account for them, whereas cognitive linguists usually aim at covering both linguistic and arguably non-linguistic knowledge, and resort to imagistic devices (depictive, geometric, topological, and otherwise).

### 6.2.1 Conventional dictionary definitions and their types

Before we move on to the different structures comprising a lexical entry, let us take a quick detour to discuss how words are defined in dictionaries. Our reason for doing this is two-fold. First, we are all familiar with dictionary definitions, and most of us turn to dictionaries at some point to find or 'prove' what a word means. Secondly, for several decades, lexicographical practice has been progressively incorporating theoretical advances in lexical semantics, corpus linguistics, the lexicon-syntax interface, and other areas of linguistic research. Currently, many dictionaries (most notably, *computational lexicons*, dictionaries meant for computers and used in natural language processing applications) are not just alphabetized repositories of words. Rather, they are structured as lexical databases, whose design is flexible and dynamic, and which allow access to many kinds of information associated with words. In such a database, lexical entries are not self-contained units isolated from each other; they are actual points of convergence of all the relationships (morphological, semantic, syntactic) that a given word establishes with the rest of the lexicon.

The **definition** is the core of the dictionary entry, being the explanation of the meaning of a word. When a word has more than one meaning (i.e., is *polysemous*), each one of these meanings is called a **sense**. Different senses are separated in a dictionary and are given distinct definitions. The most frequently used types of definition are shown below.

1. **Definition by genus proximum et differentia specifica** (also called **Aristotelian** or **hypernymic**): the defined word is located in a broader class (the *genus*) and is subsequently differentiated from the other members of this class by listing its distinguishing features (the *differentiae*). In the following definition of *chair*, the genus is 'a sit' and the differentiae are associated with its specific function ('for one person') and internal constituency ('with a back and four legs'):

**chair**: a sit for one person, usually with a back and four legs.

2. **Definition by synonym**: the word is defined through one more of its synonyms, which can be supplemented by information on selectional constraints (e.g. 'of persons or animals' for *stubborn*).

**stubborn**: Of persons or animals: Pertinacious or dogged in refusing obedience or compliance; unyielding, inflexible, obstinate: chiefly in bad sense, unreasonably obstinate.

3. **Definition by antonym and negation**: the word is defined (fully or partially) through its opposite combined with negation. One of the senses of *decline* is defined through its antonyms *consent* and *agree*, preceded by 'not to'.

**unhappy**, *adj.*: Not happy; not satisfied or pleased with.

4. **Definition by extension**: the word is defined by listing all the objects that belong to the category it denotes. The definition of *halogen* contains two lists of substances that are classified as halogens: 'chlorine, fluorine, bromine, iodine, and the compound cyanogen', and 'fluorine, chlorine, bromine, iodine, and astatine'.

**halogen**: An element or substance which forms a salt by direct union with a metal. The halogens are chlorine, fluorine, bromine, iodine, and the compound cyanogen. In mod. use, any of the elements of group 7 of the periodic table, viz. fluorine, chlorine, bromine, iodine, and astatine.

#### WARNING: Intensional and Extensional Definitions

All the other kinds of definition mentioned so far are *intensional*: they list the conditions that an entity, property, or event, must meet in order to be denoted by the word.

5. **Definition by ostension:** the word is defined by pointing out real-world examples of entities denoted by this word. The definition of *green* contains an ostensive component: ‘of the color of grass, foliage, an emerald’.

**green:** Of a color intermediate between blue and yellow in the spectrum; of the color of grass, foliage, an emerald, etc.

6. **Definition by context:** the word is defined through the typical context wherein it occurs, such that its meaning can be inferred from its relations with other elements of the context. In addition to providing clues about the word meaning, this definition illustrates its usage and selectional restrictions, for instance the combination of *disciple* with a genitive phrase or a prepositional phrase referring to the mentor.

**disciple:** If you are someone’s disciple, you are influenced by their teachings and try to follow their example. ...*a disciple of Freud*.

Choosing the type of definition for a word depends on many factors, among them the type of the word and the needs of the dictionary user. Thus, the hypernymic (super-type) definition can be appropriate for adult native speakers, but certainly less so for children and second language learners, who would find ostensive definitions more helpful. The classical definition works well with nouns with a specific meaning, but it is less suitable for general-meaning nouns (*object*, *property*, *thing*, etc.), and also adverbials and adjectives. For the latter, the synonymic definition is better suited.

## 6.3 Linguistic Structures

### 6.3.1 Typed Feature Structure

An important component of the representation language we will adopt for lexical information is that of *typed feature structures*, already encountered in Section 3.4, when discussing HPSG. This provides us with a kind of metalanguage that we can use to describe natural language data. The reasons for using a metalanguage for linguistic analysis (rather than the natural language itself) are discussed in Section 7.2. A feature structure is a way of identifying any kind of object as having different **attributes**, each of which has a distinct **value**. Commonly, feature structures are represented through a data structure called **attribute-value matrix** (AVM). Consider, for example, the property of **SIZE** for a physical object *box*. The following AVM says that the value of the attribute *size* for the object *box* is ‘small’:

$$(3) \left[ \begin{array}{l} box \\ SIZE \end{array} = \text{small} \right]$$

The feature value ‘small’ in (3) is **atomic**: its value is unstructured. The **SIZE** attribute can also be represented as having a **complex feature value**, such that it takes other attributes (**WIDTH**, **HEIGHT**, and **DEPTH**), with their respective values, as its overall value:

$$(4) \left[ \begin{array}{l} box \\ SIZE \end{array} = \left[ \begin{array}{l} WIDTH = 20.0cm \\ HEIGHT = 10.0cm \\ DEPTH = 15.0cm \end{array} \right] \right]$$

The properties of linguistic expressions can also be described through typed features. The AVM in (5), for instance, is a partial lexical entry of the noun *cat*. It specifies how the word is

pronounced (/kæt/), its syntactic category ('count noun'), and a partial definition of its meaning (through the semantic type [ANIMATE]).

$$(5) \left[ \begin{array}{ll} \text{cat} & \\ \text{PHON} & = /kæt/ \\ \text{CAT} & = \text{count-N} \\ \text{SEM} & = \text{ANIMATE} \end{array} \right]$$

Similarly, the AVM in (6) is a partial lexical entry of the verb *put*. As with *cat*, we provide the phonetic information (which we will be omitting from the lexical entries henceforth), the syntactic category ('verb'), and a partial definition of the semantic features (through the general meaning 'to place in a location'). In addition, *put* has an argument structure, which specifies the syntactic category and semantic type of its three compulsory arguments: 'somebody (ANIMATE DP) *puts* something (PHYSICAL OBJECT DP) in some place (LOCATION PP)'.

$$(6) \left[ \begin{array}{ll} \text{put} & \\ \text{PHON} & = /pʊt/ \\ \text{CAT} & = \text{V} \\ \text{SEM} & = \text{to place in a location} \\ \text{ARG-STR} & = \left[ \begin{array}{ll} \text{ARG1} & = \left[ \begin{array}{ll} \text{CAT} & = \text{DP} \\ \text{SEM-TYPE} & = \text{ANIMATE} \end{array} \right] \\ \text{ARG2} & = \left[ \begin{array}{ll} \text{CAT} & = \text{DP} \\ \text{SEM-TYPE} & = \text{PHYSICAL OBJECT} \end{array} \right] \\ \text{ARG3} & = \left[ \begin{array}{ll} \text{CAT} & = \text{PP} \\ \text{SEM-TYPE} & = \text{LOCATION} \end{array} \right] \end{array} \right] \end{array} \right]$$

Sometimes two or more attributes may share the same value. This property of feature structures is called *reentrancy* and the shared value is called *reentrant* (cf. also Section 3.4). In the reflexive sentence *The cat licks itself*, for instance, the value of the attributes ARG1 and ARG2 is the same: the cat who does the licking is the cat being licked. In the first mention of the shared value, an index is assigned to it, 1, and in the further mentions of the same value this index is repeated:

$$(7) \left[ \begin{array}{ll} \text{The cat licks itself} & \\ \text{PHON} & = \dots \\ \text{CAT} & = \text{S(entence)} \\ \text{SEM} & = \dots \\ \text{ARG-STR} & = \left[ \begin{array}{ll} \text{ARG1} & = \left[ \begin{array}{l} \text{1} \\ \text{cat} \end{array} \right] \\ \text{ARG2} & = \left[ \begin{array}{l} \text{1} \end{array} \right] \end{array} \right] \end{array} \right]$$

To summarize, the basic formal components and properties of typed feature structures (as AVMs) used in this chapter are the following:

- (8) a. A **feature structure** is a list of features (attributes), each having a value;
- b. An **attribute**, *A*: this is a property description of the linguistic element;
- c. A **value**, *V*, for the attribute: this can be *simple* (or atomic) or *complex* (making reference to another AVM);
- d. Values for attributes can be **reentrant**; this means that a value is "shared" between at least two attributes in the structure.

### 6.3.2 Argument Structure and Predication

One important component of a lexical entry is a specification of its **selectional requirements**, which is an encoding of the context it keeps in a sentence. Earlier we referred to the lexical

structure encoding such requirements as its **argument structure** (cf. Section 2.3.1). But why is it that some words seem to require surrounding context while other words do just fine by themselves? Consider the verbs in the examples in (9) and their translations into Spanish in (10).

- (9) a. John **hates** \*(spinach).  
 b. Mary **ate** (fish/ a pizza).  
 c. \*(Have you) **eaten**?  
 d. \*(Let us) sing!
- (10) a. John **odia** \*(espinacas).  
 b. Mary ha **comido** (pescado/ pizza).  
 c. ¿Has **comido**?  
 d. ¡**Cantemos**!

Notice in (9a) and (10a), that both English *hates* and Spanish *odia* cannot appear without their direct objects. However, both languages allow the verbs *ate/ha comido* to drop their direct object (as seen in (9b) and (10b)). The sentences in (9c-d) and (10c-d) show how Spanish can “drop the subject” argument in certain contexts, while English cannot. What these examples illustrate is that verbs can require specific arguments to appear in syntax or allow them to be optional. As we will see, this is a result of the way argument structure is encoded in lexical items.

Interestingly, the same phenomenon occurs with nouns and the contexts they appear in. Consider the answers to the following questions:

- (11) a. Who did you visit? - John/ the nurse.  
 b. Who is John? - The cook/ \*(Mary’s) father/ \*(Mary’s) neighbor.

(11a) illustrates how *John* and *the nurse* can be used, in the absence of other elements, as an answer to the question ‘Who did you see?’. On the other hand, in (11b), *the cook* is an acceptable answer, while both *father* and *neighbor* require the mention of another person (with respect to whom John is defined as *father* or *neighbor*). The main difference between nouns that are ‘self-sufficient’ (such as *John*, *the nurse*, and *the cook*) and nouns such as *father* and *neighbor*, is that the former refer to **individuals** and have no relational force, while the latter encode **relations** between entities or individuals (and also **properties of individuals**, as we will see below).

**WARNING: Two Uses of the Term *Individual***

Note that we have been using the term **individual** with two different meanings so far, which are not totally orthogonal but which are not to be confused. In the context of the count-mass opposition, *individual* is a bounded entity that has no separate entities as its parts (see Section 2.3.3). In formal logic, *individual* is a specific and uniquely identifiable entity (object, person, etc., see Section 5.2). The latter meaning is relevant in this part of the discussion. For example, the DP ‘the girls’ is an example of a mismatch between interpretations of this term: that is, it is an *individual* in the sense of ‘a specific entity’ composed of several independent girls; but since it is a “group” entity, it has separate entities as its parts (girls), and is not a “single” individual.

The semantic notion of **predication** is of essence in order to associate relations and properties with individuals, and we will define it here as follows:

- (12) **Predication**: semantic operation of applying a property to an individual or establishing a relation between individuals.

Consequently, we will refer to the linguistic expression that encodes properties or relations between arguments the **predicate** of those arguments. As we saw above, words show up in very different contexts syntactically: the verbs *hate* and *odiar* require two arguments, *eat* requires a subject but not an object, and *comer* can do without either, in the appropriate context; similarly, the noun *father* requires one argument, while *cook* does not, and so on. That is, these words have very different ways of *predicating*.

In order to better understand this notion, let us look at the predicates in the above example. As noticed before, there is difference in the required number of arguments associated with distinct predicates. This is something we will refer to as the predicate's **valence** or **arity**. For example, verbs having just one argument (the syntactic subject) are called **intransitive** (13) and verbs having more than one argument are called **transitive** (14). We illustrate the predicative structure after each sentence.

- (13) a. The ball **rolled**.  
           **roll**(the\_ball)  
       b. Mary **fell**.  
           **fall**(Mary)  
       c. The glass **broke**.  
           **break**(the\_glass)
- (14) a. The girl **broke** the glass.  
           **break**(the\_girl,the\_glass)  
       b. Mary **hugged** her daughter.  
           **hug**(Mary,her\_daughter)  
       c. John **ate** the cookie.  
           **eat**(John,the\_cookie)

But valence is not a property of verbs alone, but also distinguishes the behavior and semantics of both nouns and adjectives. As it happens, the majority of nouns in most languages identify a class of things or concepts. These include natural kinds such as *dog*, *tiger*, and *tree*, as well as many occupational and artifact denoting nouns, such as *professor*, *cook*, *desk*, *book*, *phone*, and so on. We will call such nouns *class predicates*, where they have only one argument. The predication of such nouns to a subject, as in (15), essentially applies this property to the individual.

- (15) a. John is a **cook**.  
       b. Mary is a **professor**.

Nouns such as *father* and *mother*, on the other hand, refer to *functional* concepts, where there is a unique value after applying the predication: e.g., in (16), **father**(Mary) can only have one value, John, while **boss**(Bill) has the unique value, Mary.

- (16) a. John is Mary's **father**.  
       b. Mary is Bill's **boss**.

Finally, some nouns refer to concepts that are inherently *relational*, such as kinship terms (*sister*, *uncle*), body parts (*arm*, *finger*), and other terms (e.g., *neighbor*). Unlike functional nouns, predication involving relational nouns can refer to multiple individuals: that is, Mary can have many neighbors, including John; a person has typically two arms, and so on.

- (17) a. John is Mary's **neighbor**.  
 b. Mary is Fred's **sister**.

As a result of this distinction, these nouns types have different predicative representations, as shown in (18).

- (18) a. CLASS PREDICATES:  
**cook**(John)  
 b. FUNCTIONAL PREDICATES:  
 John = **father**(Mary)  
 c. RELATIONAL PREDICATES:  
**neighbor**(John,Mary)

**WARNING: The Terms *Subject* and *Predicate* in Traditional Grammar**

In traditional grammar and in many school grammar books, the sentence is analyzed as having two main parts: the subject and the predicate, the latter conveying something about the subject. Under this conception, all components of the sentence other than the subject are included in the predicate. While obviously related to the notion of 'predicate' discussed here, we will not be adopt this definition.

Finally, consider how adjectives can also be differentiated in terms of valence. As with verbs and nouns, adjectives can be characterized as having either one or two arguments. Consider the examples below, where the adjectives in (19) can predicate of an individual by itself, while those in (20) require a relational predication.

- (19) a. John is **tall**.  
 b. Mary is **happy**.  
 c. a **long** table
- (20) a. Bill is **proud** of his daughter.  
 b. Your house is **similar** to mine.  
 c. He is **jealous** of her success.

As with nouns, adjective types have distinct predicative representations, as seen in (21).

- (21) a. SIMPLE PREDICATES:  
**tall**(John)  
 b. RELATIONAL PREDICATES:  
**proud**(Bill,his\_daughter)

In sum, we can see that valence plays an important role in differentiating lexical types across categories, and is therefore a critical aspect of argument structure. However, as mentioned in Section 2.3.1, the notion of argument structure is more than a just a listing of the number of arguments a predicate takes. In addition, it encodes what *kind of* arguments are required, both in terms of their syntactic category as well as their semantic type. For example, consider the two sentences in (22) below, where information about the syntactic category has been listed for each argument (with DP and PP standing for Determiner Phrase and Prepositional Phrase, respectively).



- (22) a. Mary ate a cookie.  
       **eat**(arg<sub>1</sub>[cat=DP],arg<sub>2</sub>[cat=DP])  
       b. John put his watch on the table.  
       **put**(arg<sub>1</sub>[cat=DP],arg<sub>2</sub>[cat=DP],arg<sub>3</sub>[cat=PP])

Such information is, of course, needed to ensure that a verb not only has the right number of arguments, but that they have the appropriate syntactic form as well. Argument structure can also reference semantic features or types, such as ANIMATE, LOCATION, EVENT, PHYS.OBJECT, and so forth. In fact, the lexical entry for the verb *put* shown above in (6) already encodes the semantic typing information for each argument, as illustrated below.

- (23) a. Mary put an apple in the bag.  
       b. **put**(arg<sub>1</sub>[sem=animate],arg<sub>2</sub>[sem=phys.obj],arg<sub>3</sub>[sem=location])

As we will see in Chapter 11, semantic typing can distinguish between related but distinct lexical items. Consider the verbs *kill* and *murder*, for example. While both verbs allow HUMAN arguments as their subject, *murder* actually requires it. Further, *kill* permits a broader range of subject semantic types than does *murder*.

- (24) a. Mary **killed** the flower.  
       b. The insects **killed** the flower.  
       c. The drought **killed** the flower.  
       (25) a. Bill **murdered** his neighbor.  
       b. \*The storm/ drought **murdered** the man.

Semantic typing captures this distinction by restricting the subject of *murder*, while allowing that of *kill* to select for either an animate or event type:

- (26) a. **kill**(arg<sub>1</sub>[sem={animate,human,event}],arg<sub>2</sub>[animate])  
       b. **murder**(arg<sub>1</sub>[sem=human],arg<sub>2</sub>[animate])

One final type of information that is often associated with the argument structure of verbs and deverbal nominals is the notion of **semantic role**. As pointed out in Section 2.2, semantic roles can be seen as encoding the specific relationship played by each participant in an event. For example, in (27a), each argument plays a different part in the event, as labeled by its semantic role, e.g., Agent, Patient, Instrument.

- (27) a. Mary **ate** the soup with a spoon.  
       **eat**(arg<sub>1</sub>[role=Agent],arg<sub>2</sub>[role=Patient],arg<sub>3</sub>[role=Instrument])  
       b. The glass broke.  
       **break**(arg<sub>1</sub>[role=Patient])  
       c. John broke the glass.  
       **break**(arg<sub>1</sub>[role=Agent],arg<sub>2</sub>[role=Patient])

Notice from these examples that the same grammatical relation can be associated with different semantic roles, and verbs denoting similar events can assign different semantic roles to their arguments: the subject in (27b) plays the role of the Patient, while the subject in (27c) is an Agent. Similarly, some verb pairs, such as *fear* and *frighten*, have identical semantic roles (as in (29)), but in “reverse” order expressed syntactically, as in (28) below.

- (28) a. Mary **fears** snakes.  
 b. Snakes **frighten** Mary.

- (29) a. **fear**(arg<sub>1</sub>[role=Experiencer],arg<sub>2</sub>[role=Cause],)  
 b. **frighten**(arg<sub>1</sub>[role=Cause],arg<sub>2</sub>[role=Experiencer])

One question that arises at this point concerns the predictability of argument structure from the meaning of individual words. This is, in fact, one of the most important themes when studying the lexicon: namely, to establish how and to what extent lexical information determines the syntactic expression of words. Here we will argue that there exists an explicit relation between argument selection and sublexical components of the predicate and its arguments, although we will not go as far as to claim that lexical semantics alone is enough to determine *all* the properties of word combinations. In Chapter 8, we will show how that, in many cases, very fine-grained lexical distinctions must be invoked in order to account for selectional differences between semantically similar words.

### 6.3.3 Event Structure

Another important domain of lexical information pertains to events and their participants. But what is an event? Informally, an **event** is any kind of situation or happening denoted by a predicate. While the argument structure represents the participants of the situation (who does what to whom), it says nothing about the temporal or structural properties of events, which are also very important: if something is an event, it must take place in time. There are at least two kinds of time-related information that are needed to interpret a sentence: these are known as *tense* and *aspect*, which we describe below.

First, when we describe a situation, it is important for us to know **when** something happens (is it happening now?, did it happen in the past?, will it happen in the future?). There are a number of ways we can make it clear, for instance through temporal adverbials ('I am leaving *tomorrow*' / 'See you *in a week*'). In many languages this information is grammaticalized as **verbal tense**, a linguistic category that locates events in time and relative to other events and time points, usually through tense morphemes and auxiliary verbs. In English, we have specific verbal forms and combinations of verbs referring to the present ('He *works*' / 'He *is working*'), the past ('He *worked*' / 'He *was working*'), and the future ('He *will work*' / 'He *will be working*'). Some verbal forms help us order the relevant events: when we hear 'He *had left* when I arrived', we know that both 'leaving' and 'arriving' took place in the past, and also that the event of leaving happened before the event of arriving. We will be dealing with tense in more detail in Section 9.4.

There is more to the temporal meaning of a sentence, however, than just identifying the tense of the verb. The fact is that the same tense can be associated with different temporal interpretations. For example, the sentences *He is smoking* and *He smokes* both occur in the present tense, but they denote different sorts of events: the former describes an ongoing event in the present, while the latter expresses a habit or disposition that presently holds. Not only can the nature of the tense vary, as in the previous example, but the same tense form can refer to different temporal interpretations. Consider the pair *He wants a cup of coffee* versus *He leaves in the morning*. The former is a true present tense interpretation (somebody wants a cup of coffee *while* the speaker is uttering this sentence) while the latter is an imminent future event interpretation (the event of leaving will take place some time after the speaker has uttered the sentence). As we will see,

this difference stems from a lexical semantic distinction in the verbs *want* and *leave* called **lexical aspect** or **Aktionsart**. This is another facet of the temporal dimension of events having to do with their internal temporal structure or distribution. As we will see, different lexical aspects can be encoded as distinct **event types**. Some of the basic aspectual properties are shown below.

- **Durativity**: Does the event last for some time (e.g., *Mike built the house*) or is it instantaneous (e.g., *Mike exploded the balloon*)?
- **Boundedness**: Does the event come to an end (e.g., *Mike built the house* / *Mike built the house for two years*) or does it last indefinitely within the relevant time period (*Mike was building the house* / *Mike is in Boston*)?
- **Dynamicity**: Does the event involve some kind of change or not? *Stative events* do not involve change, e.g., *know, love, be tall, be sick*. *Dynamic events*, on the other hand, are perceived and described as changing in time: e.g., *John {ran/was running}* (John's location in time changes), *John is working*, etc.
- **Telicity**: Does the event reach a natural culmination? Events that involve change may have a built-in endpoint (their *telos*) or not. For instance, the event denoted by *John read* does not have a natural result (i.e., is *atelic*), but that denoted by *John read the book* does (i.e., when the book has been read through) and it is therefore *telic*.
- **Iteration**: Is the event composed of several distinct events (e.g., *The ball bounced along the road* or *Mike visited his parents every Sunday*) or just one single event (e.g., *The baby sneezed once*)?
- **Intensity**: What degree of force does the event have? For instance, if we compare *He burned himself* and *The building burned down*, the latter expresses a higher intensity event: the building was completely destroyed by burning.

As with many other linguistic features, aspect can be realized differently in different languages: some languages grammaticalize aspectual meanings and convey them through explicit grammatical markers, while others make use of other means. In the former case, we talk about **grammatical aspect**, which is usually encoded in the verbal inflection. Meaning components expressed by grammatical aspect are usually related to a particular perspective on the event (Comrie 1976, Smith 1991), and allow one to focus on different subparts of the event or the event as a whole. When we 'zoom out' on the event or look at it from a distance, we get a full view, including the initial and final endpoints. When we 'zoom in' on the event, we can observe its intermediate stages, but we lose sight of the beginning and the end. These two viewpoints are expressed through the **perfective** and **imperfective** grammatical aspect, respectively.

Such viewpoint aspect allows us to represent the same situation in alternative ways: in (30a), for example, with the verb in simple past, the event 'to build the house' is viewed in its entirety and the speaker knows that it was completed; in (30b), with the verb in progressive form, there is no such entailment, however, and we just know that the event was in progress at some point. Note that this is independent of the overt tense marking, since both sentences are in past tense.

- (30) a. PERFECTIVE: Mike built the house.  
       b. IMPERFECTIVE: Mike was building the house

This distinction in grammaticalized aspect is encoded in some languages directly in the verb's morphology, as with the Slavic aspectual system. In Russian, for example, all verbal forms have grammatical –perfective or imperfective– aspect, and most verbs have a perfective and an imperfective form. For instance, the perfective forms (P) *vybrosit'* ('discard') and *dat'* ('give') in (31a) and (31b) portray these events as completed, while the imperfective forms (I) *vybrasyvat'* and *dat'* express them as incomplete, by either focusing on their progress ('throwing away', 'giving')

or by expressing them as multiple occurrences of the same kind of event ('throw away/ give repeatedly or habitually').

- (31) a. PERFECTIVE: **vybrosit'**<sup>P</sup> 'throw away'  
 IMPERFECTIVE: **vybras-yva-t'**<sup>I</sup> 'be in the process of throwing away repeatedly or habitually'  
 b. PERFECTIVE: **dat'**<sup>P</sup> 'give'  
 IMPERFECTIVE: **da-va-t'**<sup>I</sup> 'be giving, give repeatedly or habitually'

The imperfective form in (31a) is derived with the suffix *-yva-*, and the one in (31b) with the suffix *-va-*. Note that this aspectual difference does not affect the lexical meaning of the verbs, which is identical for each pair.

In Germanic and Romance, by contrast, tense and grammatical aspect are usually expressed through the same morphological markers. The Spanish past imperfect inflection (the *-aba* ending of 'trabajaba' in (32a)), for instance, encodes both the past tense and the imperfective aspect, and the simple past perfect inflection (the *-ó* ending of 'trabajó' in (32b)) amalgamates past tense and perfective aspect.

- (32) a. Juan trabaj-a-ba en el campo.  
 'Juan was working the land.'  
 b. Juan trabaj-ó en el campo.  
 'Juan worked the land.'

While these examples demonstrate how lexical and morphosyntactic components of a language allow grammatical aspectual distinctions to be made, let us look at the features that contribute to distinguishing the basic Aktionsarten (or **event types**) that we find in language. The most widely used classification of event types is that proposed by Zeno Vendler (Vendler 1967), although the first known contribution to this topic goes as far back as Aristotle's *Metaphysics* (Aristotle 1998, cf. Section 3.2). Vendler identified four basic event types (**states**, **activities**, **accomplishments**, and **achievements**). In addition, most researchers now acknowledge an additional class, the **semelfactives**. We represent these in table 6.1 through combinations of three of the aspectual oppositions that we discussed above: *dynamicity* (dynamic/stative), *durativity* (durative/instantaneous), and *telicity* (telic-atelic), followed with descriptions of each event type in (33).

	Durativity	Dynamicity	Telicity
State	+	-	-
Activity	+	+	-
Accomplishment	+	+	+
Achievement	-	+	-
Semelfactive	-	+	-

**Table 6.1** Core event types

- (33) a. **States** are stative, durative, atelic events. They last in time but don't involve change and therefore don't culminate; e.g., *love*, *resemble*, *know*, *be sad*.  
 b. **Activities** are durative and atelic, but unlike states they are dynamic. Although they express change, they have no built-in culmination. When we say that somebody {*worked*/

*will work*}, we do not have any specific endpoint in mind. However, this does not mean that activities are unable to just stop in time and be **bounded**, as in *John worked for three hours*, which is bounded and atelic. *Work, run, drag, read, and dance* are also activities.

- c. **Accomplishments** are durative and dynamic, like the activities, but they do have an inherent culminating point. The culmination is usually defined relative to the entity somehow affected by the action denoted by the verb: *Mike built a house* (the result is a new house), *The water froze* (the water becomes frozen), etc.
- d. **Achievements** are dynamic and telic, like accomplishments, but the change of state that they involve is instantaneous: e.g., *arrive, reach the summit, sit down, die, faint*.
- e. **Semelfactives** are instantaneous and dynamic, like achievements, but they do not have a telos. They usually express a single occurrence of events that tend to happen in sequences: e.g., *blink, cough, tap, knock*.

We will return to these distinctions in Chapter 9, where we examine how the lexical and grammatical encoding of aspect is treated compositionally in the grammar.

#### 6.3.4 Qualia Structure

The Qualia Structure is a level of semantic interpretation first introduced by Generative Lexicon theory to the study of lexical meaning. The qualia were adopted from the Aristotelian *modes of explanation* (or *aitia*), which were originally meant to account for how we understand the world (see Moravcsik 1975, Moravcsik 1991). In particular, they were designed to represent the basic nature of processes, objects, and propositions, and the attributes that make them what they are: what e.g., it means to be a house, a rock, a hurricane, a riot.

We can think of the Qualia Structure (QS) as a formal linguistic projection of the *aitia*, a relational semantic system whose parameters allow us to decompose word meaning in a principled way, accounting for what other concepts and words it can be associated with in different contexts, based on its meaning. The core notion of qualia structure is that there are four aspects that make up our knowledge of a word: the class of entities it denotes (the **formal role** or **quale**), how the denoted entity was created (the **agentive role**), the intended function of this entity (the **telic role**), and the internal makeup of this entity (the **constitutive role**). Here is a more formal definition (Pustejovsky 1995):

- (34) a. **Formal role (F)**: basic semantic type, including features that distinguish the object within a larger domain (orientation, shape, dimensionality, color). E.g., a *violin* is a MUSICAL INSTRUMENT.
- b. **Agentive role (A)**: factors involved in the origin or 'bringing about' of an object, such as creator, artifact, causal chain, etc. E.g., the violin is created through the event of BUILDING or, more generally, CREATING.
- c. **Telic role (T)**: purpose or function of the object, the purpose that an agent has in performing an act, or the built-in function or aim of certain activities. The violin is created for PRODUCING MUSICAL SOUND.
- d. **Constitutive (C)**: relation between an object and its proper parts (i.e., its material and component elements), or between an object and the whole it is a part of. E.g., WATER is major constituent of *coffee*; and a *finger* is part of a HAND.

As an illustration, consider the qualia structure for the noun *violin*, expressed as the Attribute Value Matrix (AVM) in (35).

$$(35) \left[ \begin{array}{c} violin(x) \\ QS \end{array} \right] = \left[ \begin{array}{lcl} F & = & musical\_instrument(x) \\ A & = & build(y,x) \\ T & = & produce\_music\_on(z,x) \\ C & = & strings\_of(w,x) \end{array} \right]$$

The variables  $w$ ,  $x$ ,  $y$ , and  $z$  refer to the different entities involved in events typically associated with a violin. The violin itself is assigned the variable  $x$  and is given a basic type in  $F$ ; the agent building the violin is  $y$  (' $y$  builds  $x$ '), as expressed in  $A$ ; the person using the violin in  $T$  to produce the musical sound on the violin is  $z$  (' $z$  produces sound on  $x$ '); and in  $C$ , the strings are identified as  $w$  (' $w$  of  $x$ ').

If we compare these parameters to the other semantic features we have seen so far (quantification, reference, animacy, agency, etc.), they may come across as extremely specific and closely associated to non-linguistic attributes of events and objects denoted by words, rather than the linguistic features of words themselves. However, they have been shown to affect both the syntactic behavior and contextual interpretation of lexical items, suggesting their linguistic appropriateness.

One way to test whether the meaning components of the qualia are part of the lexical semantics of a word is to look at whether they surface in the interpretation of linguistic expressions using this word, or when the meaning of the word as a whole is reduced to one of these components. We illustrate this in (36), with each sentence taking the noun *violin* as a direct object, where specific qualia are referenced by type ( $A$ ,  $T$ ,  $F$ , and  $C$ ).

- (36) a. Antonio Stradivari **finished** the violin.  
       ('finished building the violin',  $A$ )  
       b. They **enjoyed** the violin.  
       ('enjoyed listening to the violin',  $T$ )  
       c. John **bought** a violin.  
       ('bought the physical object violin',  $F$ )  
       d. The boy **plucked** the violin.  
       ('plucked the strings of the violin',  $C$ )

Sentence (36a) contains the aspectual verb *finish*, which takes as its complement an event-denoting argument: that is, when we 'finish something', we actually 'finish doing something'. The eventive nature of the argument may not be expressed overtly but it is always present in the interpretation: *finish a beer* typically means 'finish drinking a beer', *finish the book* can mean 'finish reading or writing the book', and *finish the violin* would presumably mean 'finish building the violin'. There are two qualia roles that encode events, Agentive and Telic, and in this case the information encoded in the Agentive is exploited. The Telic event PRODUCING MUSICAL SOUND is accessed in (36b): *enjoyed the violin* means 'enjoyed listening to the violin'.

**WARNING: It's not all about Lexical Semantics**

We don't always interpret the "hidden event" in sentences like (36a) and (36b) as the value of the Agentive or Telic role associated with the direct object. It is often possible to interpret such sentences with a contextually salient or pragmatically relevant event. If I am an instrument repair person, (36a) might refer to "finish repairing the violin"; similarly, for (36b), someone visiting an instrument museum might "enjoy looking at a violin" rather than hearing it. While these are possible interpretations, it is important to point out that the inherent qualia role values for an object are the most frequently occurring in corpora.

The verbal predicate *buy* in (36c), on the other hand, targets the Formal dimension of *violin*: we usually buy physical objects, MUSICAL INSTRUMENTS being a subclass of them. Finally, *pluck* in (36d) refers to a specific part of the violin rather than the whole instrument, i.e., the strings, which are included in the Constitutive role as a component of the violin. This information is expressed only in the qualia structure, yet it still has a direct impact on the interpretation of sentences where *violin* is used. Chapter 7 provides further details on qualia-based semantic types and word classes.

## 6.4 Conceptual Structures

So far we have focused on the linguistic content of lexical items. It could be argued, however, that the lexical entry is merely the tip of an entire iceberg of concepts associated with the word, aspects of meaning that do not necessarily have syntactic and morphological consequences, even though they do affect interpretation. This part of lexical meaning usually has to do with a more primitive level of cognitive structure, comprising motion, vision, space, object manipulation, and other kinds of basic bodily and perceptual experiences. This conceptual content does not lend itself easily to formalization in terms of features, function-argument pairs, or propositional content. Rather, as we will see, most representations of conceptual structures are visual or analogical in nature.

### 6.4.1 Image Schemas

The first conceptual structure we consider is an **image schema**. This can be seen as “a recurring, dynamic pattern of our perceptual interactions and motor programs that gives coherence and structure to our experience” (Johnson 1987). This definition focuses on human beings and their experiences, rather than on objective properties of the physical world, and such representations are frequently adopted in cognitive linguistic frameworks. We already encountered some of them in Section 5.4, when talking about semantic construal in Langacker’s Cognitive Grammar.

Image schemas can represent many kinds of conceptual domains and configurations, from simple static elements (objects or entities) and spatial settings, to complex dynamic relations involving force, and even more abstract, non-spatial constructs (e.g., possession, information transfer, social interactions). Two of the most basic image schemas are CONTAINMENT and its inverse, UNCONTAINMENT. A container is a primitive notion: something is enclosed by something else. The latter schema, UNCONTAINMENT is illustrated below, where it has two components: a container, *y*, (represented by the square) and an entity, *x*, (represented by ●), that is not contained by the container.

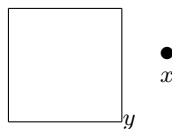


Figure 6.1 UNCONTAINMENT *image schema*

From an early age, we experience our bodies as containers into which we put things (food, water) and also as contained objects, which are constrained by the limits of our environment (the clothes, the room, the car). Hence, we know what IN and OUT mean when we move our

body from one location to another and also when we manipulate objects and place them inside other objects.

An image schema is associated with a set of well-defined *logical properties*, which crucially affect how we view a particular situation once we have applied the image schema template to it. For instance, given the CONTAINMENT schema we only have two options to define the relation between the container and the content: the latter is either inside or outside the container, there is nothing ‘in the middle’. This kind of bias has major consequences for categorization, as we saw in Section 5.5: we can decide whether or not something is a fruit, but we cannot distinguish between kinds of fruit that are ‘more inside’ this category than others. The second main property of the containment schema is *transitivity*: if X is inside Y and Y is inside Z, then X is inside Z. Applied to categories or sets of entities, it means that, if we categorize a set as a part of a larger set (an *orange* is a *citrus*), which is in turn included in an even larger set (a *citrus* is a *fruit*), then the smallest set is included into the largest set (an *orange* is a *fruit*).

As mentioned above, image schemas can structure different conceptual domains, from basic spatial configurations to highly abstract social relations. Consider the sentences in (37), which can be seen as different instantiations of the CONTAINMENT and UNCONTAINMENT image schemas.

- (37) CONTAINMENT/UNCONTAINMENT
- a. The fish is not in the fish tank. [SPATIAL UNCONTAINMENT]
  - b. The kids are at the concert. [SPATIAL+PARTICIPATION CONTAINMENT]
  - c. The concert is not on Friday. [TEMPORAL UNCONTAINMENT]
  - d. John is in denial about his son’s needs. [ABSTRACT CONTAINMENT]

(37a) is a basic spatial relation: the content *the fish* is not inside the container *the fish tank*. (37b) suggests that *concert* is reinterpreted as a location, where the kids are somehow “engaged in” the concert as an event. (37c) expresses temporal uncontainment: the container is the time period defined as *Friday* and the concert is not included within the boundaries of this container. Finally, in (37d) the containment is abstract: the state of *denial* is the container within which John is enveloped. **Metaphor** is the mechanism that maps basic spatial schemas onto abstract conceptual structures: the interpretation of (37b) is based on the metaphor EVENT AS CONTAINER, (37c) on TIME PERIOD AS CONTAINER, and (37d) on STATE AS CONTAINER.

To account for dynamic events, the CONTAINMENT schema must be combined with the PATH schema, which encodes motion and other dynamic relations, and consists of a source point, an end point and a force vector relating both points, as in figure 6.2. TR stands for *trajector*, the moving entity whose location is being determined, and LM for *landmark*, the entity with respect to which the trajector is moving. In most ‘IN and OUT’ dynamic situations, the initial position of the trajector is defined relative to the container, which is the motion landmark, and then it moves either to the inside of or outside of the container. Here we illustrate the INTO image schema.

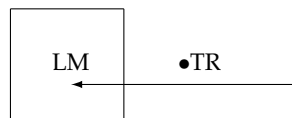


Figure 6.2 INTO image schema

The INTO image schema accounts for spatial events of entering a location (as in (38a)), while the inverse OUT.OF image schema accounts the sentence in (38b).

- (38) a. John ran into the office.



- b. The whole town population was evacuated.
- c. I really need to blow off some steam.
- d. They backed out of the deal.

These same schemas can be seen at work in the instances of metaphorical extension above, as in (38c) *–blow off some steam* is ‘expel negative energy out of the body’– and (38d) *–back out of the deal* means ‘get out of an agreement’.

### 6.4.2 Frames and Scenes

The idea of a **frame** (introduced by Charles Fillmore) is based on the observation that we understand many everyday situations by fitting them into predetermined structured representations of our past experiences and conventional social practices. For instance, we know that **THEFT** is an illegal action that involves certain participants and a particular sequence of events: a thief takes something valuable from another person (the victim), usually for the reason of profit. The term **semantic frame** is used to refer to the linguistic manifestation of this kind of representations, in particular when the meaning of specific lexical items is defined relative to a background frame or scene. The choice of background frame very often impacts on how we describe a given situation. For example, we can describe the actions of Robin Hood as *theft*, if we follow the standard interpretation of his outlaw practices, or as *expropriation*, if we believe that what he did was somehow justified. The notion of semantic frame is crucially based on the description of the involved participants in terms of **semantic roles**, which specify what part in the overall event each of them is playing and how it is affecting other participants.

#### WARNING: Semantic Roles vs. Thematic Roles

The terms **semantic role** and **thematic role** are not to be confused. The latter is mainly used in generative grammar to refer to the semantic function of typically obligatory verbal arguments, while the former can be applied to adjuncts, as well as absent participants of an event. In Frame Semantics, the semantic roles evolved from a constrained set of general situations and role specifications to a broad, more open repository of frame-specific labels.

Let us see how frames are described in FrameNet, a lexical resource inspired by Frame Semantics, by examining an abbreviated description of the frame **THEFT**. A frame description includes: a definition of the situation or event; a list of *frame elements* (i.e., semantic arguments or event participants), which can be **core** (compulsory, essential to the frame meaning) or **non-core**; the relationship between different frames – e.g., the **THEFT** frame is related to the more general frames **COMMITTING\_CRIME** and **TAKING** (inheriting their frame elements while having a more specific semantics), and it is associated to the **ROBBERY** frame, which is more specific –, and a list of lexical items (verbs, nouns and adjectives) that evoke the frame and share semantic and distributional properties (i.e., select for the same semantic arguments).

#### (39) THEFT

**Definition:** Situations in which a Perpetrator takes Goods from a Victim or a Source. The Means by which this is accomplished may also be expressed.

CORE FRAME ELEMENTS:	
<b>Goods</b>	Anything (including labor, time, or legal rights) that can be taken away. E.g.: Leslie <b>STOLE</b> <i>the watch</i> from Kim.
<b>Perpetrator</b>	The person (or other agent) that takes the goods away. E.g.: <i>Leslie</i> <b>STOLE</b> the watch from Kim.
<b>Source</b>	The initial location of the goods, before they change location. E.g.: Leslie <b>STOLE</b> the watch <i>from the table</i> .
<b>Victim</b>	The person (or other sentient being or group) that owns the goods before they are taken away by the perpetrator. E.g.: Leslie <b>STOLE</b> the watch <i>from Kim</i> .
NON-CORE FRAME ELEMENTS:	
<b>Explanation</b>	The explanation for why a theft occurs. E.g.: Leslie <b>STOLE</b> the watch from Kim <i>because she'd always wanted a Gucci</i> .
<b>Instrument</b>	An object used by the Perpetrator in taking possession of the Goods. E.g.: Chis <b>STOLE</b> it <i>with a long bamboo pole</i> through the fence.
<b>Manner</b>	The Manner in which the theft occurs. E.g.: Leslie <i>swiftly</i> <b>STOLE</b> the watch from Kim.
<b>Purpose</b>	The Purpose for which a theft occurs. E.g.: Leslie <b>STOLE</b> the watch from Kim <i>in order to sell it on Ebay</i> .

**FRAME-FRAME RELATIONS**

Inherits from: COMMITTING\_CRIME, TAKING; Is Used by: ROBBERY

**LEXICAL UNITS:** *abscond (with).v, abstract.v, abstraction.n, bag.v, cop.v, cutpurse.n, embezzle.v, embezzlement.n, embezzler.n, filch.v, flog.v, heist.n, larceny.n, lift.v, light-fingered.a*, etc.

**Table 6.2** THEFT *frame, FrameNet*

The rich conceptual knowledge encoded in frames (especially the non-core meaning components, such as **manner**, **time**, **place** or **purpose**) may seem too specific to be linguistically relevant, but we can find numerous cases where such particular knowledge not only affects interpretation but also helps account for the selectional requirements that predicates impose on their context. For example, both *lift* and *snatch* instantiate the THEFT frame, but only the latter is associated with a specific manner of stealing, i.e., sudden and fast. This is why it is incompatible with manner modifiers such as *slowly*, *gently*, *carefully*. The more general verb *lift*, on the other hand, does not show such restrictions:

- (40) a. Ed **snatched** the bag {quickly/ hastily/ \*slowly/ \*gently/ \*carefully}.  
 b. Ed **lifted** the bag {quickly/ hastily/ slowly/ gently/ carefully}.

### 6.4.3 Conventional Attributes

So far we have discussed those aspects of lexical meaning which we have assumed are essential for a linguistic theory of the lexicon, including the word's argument structure, event structure, semantic type, and qualia structure. In addition to these properties, some words evoke stable conceptual associations that may not be encoded in the lexical entry but which quite often affect the compositional interpretation of those words. We will call these characteristics **conventionalized attributes** (see Pustejovsky and Jezek 2008). For example, languages typically lexicalize the specific sounds that animals make, which we illustrate in (41) with three equivalent examples from English (41a), Spanish (41b), and Russian (41c):

- (41) a. cows **moo**/ dogs **bark**/ frogs **croak**  
 b. las vacas **mugen**/ los perros **ladran**/ las ranas **croan**  
 c. korovy **myčat**/ sobaki **gavkajut**/ ljaguški **kvakajut**

Conventional attributes are frequently rooted in how we *experience* an object through our senses, such as hearing something. Therefore it is hardly surprising that word combinations similar to the ones in (41) are among the most frequent ones in the corpora. Of course, this does not necessarily mean that these specifications belong in the lexical entries (the speakers may just happen to talk often about the events they encode), but it does speak to their cognitive prominence.

DISCUSS

Propose a set of conventional attributes for the following words: *rain, clock, rose*.

What is definitely true is that such information can be accessed and exploited when we build or interpret sentences. For example, consider the sentences in (42).

- (42) a. Mary {listened to/ heard} the violin (producing musical sounds).  
 b. Mary heard the frogs (croaking).  
 c. Mary heard the wind (whistling).

(42a) was mentioned in Section 6.3.4 in connection to the qualia structure: we saw that this sentence can refer to the event of ‘listening to the musical sounds produced by the violin’ because the specification ‘be meant to produce musical sounds’ is encoded in one of the qualia of *violin*. We cannot say the same about (42b,c): frogs and the wind are not *meant* to produce any kind of sounds, it is just one of their natural properties, which are not part of the structural or formal aspects of the meaning for *frog* and *wind*. Nevertheless, the interpretation of the latter two sequences parallels exactly the meaning of (42a): when combined with *hear*, *frog* and *wind* mean ‘the sound produced by the {frogs/ wind}’. It appears that something in the structure of a lexical entry encodes such conventionalized attributes and information, such that it allows for these interpretations to be made routinely and effortlessly in language. The nature of the compositional mechanisms enabling this interpretation will be discussed at lengths in Chapter 11.

Conventionalized beliefs associated with certain objects and living things may even become lexicalized as one of the word senses (cf. Hanks 2013). It is very common, in fact, to associate typical behavior of some animals with human characteristics: e.g., the expression ‘brave as a lion’ is based on the folk belief ‘lions are brave’. Animal names are only rarely used to refer to people: ?*That lion you work with, he is an extraordinary lawyer* is odd, while the predicative use is much more natural: *This lawyer of yours, he is a real lion!*; however, dictionaries do sometimes list human-referring meanings as separate senses. Consider the following definitions from the Oxford English Dictionary for *chicken*, *rat*, and *tiger*:

- (43) a. **chicken**: 3.a. A youthful person: one young and inexperienced.  
 3.b. Applied to one who is as timorous or defenseless as a chicken.  
 b. **rat**: 4.a. A dishonest, contemptible, or worthless person; spec. a man who is deceitful or disloyal in a romantic relationship.  
 4.e. slang. A person who gives information of an incriminating nature, on another person to the police or other authority, an informer.  
 c. **tiger**: 4.a. A person of fierce, cruel, rapacious, or blood-thirsty disposition; also: a person of very great activity, strength, or courage.

## 6.5 Properties of lexical entries

### 6.5.1 Ambiguity, polysemy, and homonymy

One of the most pervasive properties of natural languages is **ambiguity**: words and other linguistic expressions often have more than one meaning. This is a well-known fact, but it could be otherwise. Why is there so much ambiguity in language? One of the major reasons is arguably *economy* or *efficiency*: ambiguity is economical since allowing words to have more than one meaning reduces the size of the overall vocabulary that we use as speakers of a language. According to different estimates, up to a half of all the words in a natural language have two or more meanings, and the words we use most often usually have the highest number of senses: Merriam-Webster Online dictionary registers 15 senses for the intransitive use of the verb *run*, 15 senses for the adverb *well*, and 9 senses for the noun *house*. And yet, speakers have no trouble dealing with ambiguous linguistic expressions and words that have more than one meaning. Something allows us to disambiguate multiple senses of a word in context very efficiently.

Of the three basic terms dealt with in this section, **ambiguity** is the most general one. A linguistic expression is **ambiguous** when it can be understood in more than one way. Ambiguity may be generated at different linguistic levels: lexical, syntactic, semantic, and pragmatic. Although we will mainly be concerned with lexical ambiguity here, a brief comment on syntactic and semantic ambiguity seems appropriate to set the scene for further discussion. We will address some issues with pragmatic ambiguity in Chapter 11.

**Lexical ambiguity** arises at the level of word meaning: when the word has more than one possible interpretation, we need to know which one is being used in order to understand the expression containing this word. For example, the noun *seal* in (44) can refer to the marine animal or the tool used for validating documents.

(44) That *seal* is bigger than the other one.

**Syntactic ambiguity** (also called **structural ambiguity**) emerges when the same sequence of lexical items corresponds to two different syntactic structures. Recall the following examples from Section 2.1:

- (45) a. The studio recorded [DP the singer] [PP with the microphone].  
 b. The studio recorded [DP the singer [PP with the microphone] ].

In (45a), the constituents *the singer* and *with the microphone* are independent of one another, and the sentence is interpreted as ‘the studio used the microphone to record the singer’. In (45b), the constituent *with the microphone* is a part of a larger constituent headed by *the singer*, which results in the interpretation ‘the studio recorded the singer, who had the microphone’.

**Semantic ambiguity** arises when there are multiple interpretations available, regardless of the absence of structural or lexical ambiguity. It is important to point out that, while all ambiguity is *semantic* since it affects the interpretation of linguistic expressions, in this case we use this term in a more narrow sense. Consider, for example, the sentence in (46).

(46) John’s sentence was unfair.

Notice that there are two ways to interpret the role that John plays in relation to the event of sentencing denoted by the noun *sentence*. Namely, John can play the role of the *judge*, in which case it is interpreted as ‘The sentence imposed by John was unfair’, or John can play the role of the *defendant*, in which case the meaning would be ‘the sentence imposed on John was unfair’.

Another instance of semantic ambiguity arises with *quantifier scope*, illustrated in (47).

- (47) a. Every passenger watched a movie.  
       b.  $\forall x[\text{passenger}(x) \rightarrow \exists y[\text{movie}(y) \wedge \text{watch}(x, y)]]$   
       c.  $\exists y[\text{movie}(y) \wedge \forall x[\text{passenger}(x) \rightarrow \text{watch}(x, y)]]$

(47a) can mean either ‘every passenger watched one of the movies available’, or ‘every passenger watched the same movie’. In the former case (47b), the universal quantifier *every* has wide scope and the existential quantifier *a* has narrow scope, and in the latter (47c) the existential quantifier has wide scope and the universal quantifier has narrow scope.

### 6.5.1.1 Tests of sense Distinctness

Before we discuss the different kinds of lexical ambiguity, let us formulate some basic guidelines for determining when we are dealing with different senses of the same word or with different uses of the same sense. This task is not as straightforward as it might seem, as we can see from the examples in (48).

- (48) a. That seal is bigger than the others. [marine animal vs. wax blob]  
       b. This oak is really dark. [tree vs. wood]  
       c. We had a lovely breakfast. [food vs. event]  
       d. Your neighbor stopped by. [female neighbor vs. male neighbor]

For instance, we might feel strongly about (48a) being ambiguous: the noun *seal* refers to two completely different kinds of entities (an animal and an artifact). (48b) is ambiguous, too, although in this case both conflicting senses are related: *oak* as ‘a kind of tree’ is the source of the hardwood substance ‘oak’. However, in (48c-d) things are not that clear: is the ‘*breakfast* as EVENT’ meaning different from the ‘*breakfast* as FOOD’ meaning? And is the gender distinction for *cousin* in (48d) enough to declare two separate senses?

It looks like we are dealing with different degrees of meaning distinctness rather than with a categorical distinction, and in order to establish *how distinct* truly ambiguous cases need to be, we have to stipulate a set of explicit criteria. We will be using the following diagnostics for helping us determine ambiguity, or more correctly, the **sense distinctness** of a lexical item in a context: (a) common definition test; (b) identity test; and the (c) semantic relation test. What we will notice is that these tests do not always agree on whether the different uses of a word are distinct senses or not. We will discuss this apparent conflict below in Section 6.5.1.2.

#### Common Definition Test

This diagnostic determines how different two senses of a word are. We will consider two senses of a word as *distinct* if there is no definition that can cover them both (**generalize** the meanings) and at the same time differentiate them from non-synonymous words (**distinguish** the meanings). If such a definition can be formulated, it will sum up the semantic components shared by both words and ultimately show that both meanings are not distinct.

Let us demonstrate this with an example, namely the different meanings of *seal* in (48a). These cannot in fact be covered by a single definition. We can use a **generalizing** common definition (‘object, entity, thing’) for these two meanings, but it does not **distinguish** them from meanings referring to other kinds of entities or things. Therefore we conclude that these are two different senses.

Now let us turn to the senses of *oak* in (48b), where the interpretations of the noun as ‘oak

tree' and 'oak wood' are related, but if we had to come up with a common definition ('something related to oaks'), it would not be specific enough. For instance, it would not exclude the meaning of *oak* as 'the leaves of an oak used as decoration'. So, according to this test, these are two different senses.

*Breakfast* as 'event' and as 'food' do seem to be definable by the paraphrase 'the first meal of the day', which would indicate that we are dealing with the same sense.

Finally, both sex specifications of *neighbor* are subsumed in the definition 'person who lives near another person', which means that this meaning alternations correspond to the same sense.

### Identity Test

This diagnostic tests whether a word with multiple senses can refer to both senses in the same sentence. The test is based on ellipsis: when a word *x* is replaced with a placeholder, only one of the meanings of *x* can be activated in the sentence, i.e., a "crossed" reading is not allowed: that is, 'A {is/has/does} *x* and so {is/has/does} B'. For instance, in (49), both Jones and Smith may have either a device for making impressions on documents or a mammal, but it cannot be the case that Jones has a device and Smith has a mammal.

(49) Jones has a seal, and so does Smith.

When two different meanings of a word are forcibly activated at the same time, we get a pun called a **zeugma**: in (50a) the zeugma arises because *break* is interpreted as 'damage physically' and 'crush emotionally' in the same sentence, and in (50b) *jam* is 'marmalade' and also 'slow or blocked traffic':

- (50) a. This cat **broke** my window and my heart.  
 b. Big rig carrying fruit crashes on 210 Freeway, creates **jam** ["Los Angeles Times", May 20, 2013]

*Oak* and *breakfast* behave just like *seal* with respect to the identity test: only one of the senses can be activated in the sentence, but not both of them simultaneously:

- (51) a. This oak is dark, and so is the one behind my house. [=the oak tree]  
 b. Marie's breakfast was lovely, and so was mine. [either the event or the food, but not both]

Once again, *neighbor* yields different results: both 'female neighbor' and 'male neighbor' are referred to in (52):

- (52) James is my neighbor and so is Anne.

To sum up, according to this test, *seal*, *oak* and *breakfast* have different senses, while *neighbor* does not.

### Semantic Relation Test

This test is a specialization of the Common Definition test above, but is worth discussing separately. Recall our discussion of semantic relations from Section 5.2, where we briefly introduced the basic relations of synonymy, antonymy, hyponymy, and meronymy (to be presented in more detail in Section 10.5). These word-word relations can be exploited to help determine whether a word form is ambiguous. If a word has multiple senses, it can establish the same kind of semantic relation with several different words, depending on which of its senses actually establishes this relation.

For example, *seal* as ‘marine mammal’ is a **hyponym** of *mammal*, and *mammal* is a hyponym of *animal*, while *seal* as ‘wax closure’ is a hyponym of *closure*, *impression* and *device*, and a near-synonym of *stamp*. Similarly, *oak* is a hyponym of *tree* in one of its meanings, and of *substance/material* in the other one. When we wish to refer to the constituent parts of *oak* in the first sense (‘tree’), we use as **meronyms** the words *roots*, *trunk*, *bark*, *leaves*, but only one of these (*bark*) is the meronym of the second sense (‘hardwood’), as well. Finally, one sense of *breakfast* is a hyponym of the class of events, including *dinner*, *lunch*, *party*, and so on. In the ‘food’ sense, it is put in the same class as *appetizer*, *dessert* or *bagel*. Notice, however, that for the different senses for the noun *neighbor* in (48d), such a clear distinction is not possible, since both ‘female neighbor’ and ‘male neighbor’ are hyponyms of *person*.

### 6.5.1.2 Polysemy and Homonymy

Now that we have some broad notion of how to characterize word sense distinctness, we turn to the main kinds of lexical ambiguity in language, namely **homonymy** and **polysemy**. It is obvious that if a word has only one sense in a language, it is not ambiguous, and we characterize the word as **monosemous**. If a word is ambiguous, however, then it is either **homonymous** or **polysemous**. We say that a “word form” is homonymous if there are two lexemes with separate word senses, that share the same form. These two lexemes are called **homonyms**: the two senses of *seal* have the same orthographic and phonetic form; the verbal form *flew* and the noun *flu* share pronunciation but not the graphic form (i.e., are **homophones**), the noun *lead* (‘metallic element’) and the verb *lead* (‘guide, direct’) have the same orthographic form but different pronunciations (/led/ and /li:d/, respectively, these are **homographs**).

But how do we know that these words represent different lexemes? The diagnostics seen in Section 6.5.1.1 can help us decide whether two meanings represent the same sense or two different senses, but they do not address the homonymy-polysemy distinction. What is more, they are not always consistent: e.g., the two meanings of *lunch* are judged as the same sense using the common definition test, but as being two senses, according to both the identity and the semantic relation tests. A more fundamental criterion for what makes two meanings identical or different is needed, something we will refer to as **semantic relatedness**.

The semantic relatedness criterion will help us decide, among other things, if a word form is polysemous and homonymous: for an homonymous word, the senses are distinct and are not related; when the senses of a word are related, there is just one lexical entry (lexeme) with several meanings, and we say that this word is **polysemous**.

CLUE/COMMENT[magnifyng glass symbol]: Different lexemes may have the same form for a number of reasons. Sometimes different words become formally identical over time: e.g., the ‘animal’ meaning of *seal* stems from the Old English *seolh*, and the ‘wax closure’ meaning from the Old French *seel*. In other cases, the meanings of a polysemous word become so distinct that they are no longer perceived as related, e.g., *mole* as ‘burrowing animal’ and as ‘spy’. We will not rely on etymological data here since we are interested in how words are represented in our mental lexicon.

To a certain extent, judgments of semantic relatedness between word senses are subjective, but fortunately there are some systematic ways of differentiating polysemy and homonymy. For example, for the noun *seal*, there is no identifiable semantic relation connecting the two senses. For the nouns *oak* and *breakfast*, by contrast, this can be done very easily. The relationship between the ‘oak tree’ meaning and the ‘hardwood meaning’ is meronymic: the wood is a part of the tree. The same semantic relation is present in the different senses of *maple* (‘maple

tree/ maple syrup/ maple wood'), *orange* ('fruit/ fruit pulp/ fruit juice'), *lamb* ('animal/ kind of meat'), etc. For *breakfast*, the event meaning presupposes the food meaning as one of its crucial elements: *breakfast* as event consists in consuming food in the morning.

It is usually assumed that, if two formally identical words belong to different syntactic categories, then they must be treated as homonyms. For example, consider the following noun-verb pairs: *a large farm* vs. *he farms for a living*, *a blue bottle* vs. *they bottled the wine*; or these noun-adjective pairs: *her green eyes* vs. *Green is better than white*; *an orange sweater* vs. *a juicy orange*. This may be due, in part, to the conventional dictionary practice of accommodating just one syntactic category within a single lexical entry. However, we do not agree that a difference in syntactic category should be the only determining factor in this matter. If semantic relatedness is the basic criterion for telling apart polysemy and synonymy, then two semantically related words should not be declared homonyms just because they happen to belong to different syntactic categories. We will use the term **transcategorial** polysemy (or **t-polysemy**) for polysemous words that embrace two or more syntactic categories. Unlike other instances of polysemy, which occur within the same lexeme, t-polysemy relates two different lexemes.

It should be pointed out that polysemy and homonymy are often combined in the same orthographic or acoustic word. Recall from the *seal* example discussed above, that it has two non-related (i.e., homonymous) nominal senses, which correspond to two different lexemes: <sup>1</sup>*seal* ('marine mammal') and <sup>2</sup>*seal* ('wax closure/ device for stamping seals'). The second of these, <sup>2</sup>*seal* is polysemous, because its two meanings ('wax closure' and 'device for stamping seals') are clearly connected, and it is related to the verbal lexeme <sup>3</sup>*seal* ('mark with a seal') by t-polysemy.

### 6.5.1.3 Regular Polysemy

Most cases of polysemy we have examined so far are examples of productive semantic relationships that are present in a significant number of related senses. For example, the semantic relation 'Physical entity/ Material it is made of' connects the 'tree' and 'wood' senses of *oak*, and also the different senses of *orange*, *maple*, *lamb* and many other words. Similarly, the semantic relation 'Container/ Action of putting something inside a container' connects the noun *bottle* with the verb *to bottle*, as well as the following noun-verb pairs: *box-box*, *package-package*, and *can-can*.

When the same kind of semantic relationship is present in more than one pair of senses, we are dealing with **regular polysemy**. The pervasiveness of regular polysemy in natural language demonstrates that there are aspects of lexical meaning that are systematic and the processes involved in its construction are very productive. Given a regular polysemy pattern, we can predict what senses can be derived from any specific lexical meaning. For example, given the Container/Content alternation, we can derive the 'content' meaning from any noun that can denote some kind of container, as in the following sentences:

- (53) CONTAINER/CONTENT ALTERNATION:
- a. **Container:** This is my grandmother's china *bowl*.  
**Content:** I'd like another *bowl* (of soup).
  - b. **Container:** We bought two oak *barrels*.  
**Content:** The entire *barrel* spoiled during the trip.
  - c. **Container:** A need another paper *bag*.  
**Content:** The kids ate the whole *bag* (of grapes).

Regular patterns of polysemy may arise at the level of lexical-semantic structure of words (we will refer to this as **inherent polysemy**), due to contextual influences (giving rise to **selectional polysemy**) or the combination of both. One of the best studied instances of inherent



polysemy are the **dot objects**. Dot objects are special because their meaning combines two or more different semantic types, which are equally important in the word's definition. Because we discuss these cases in more detail in Section 7.3, we cover them here only briefly.

Dot objects express a logical relation between senses of a word that have distinct semantic types. For example, nouns such as *lamb* and *oak* are polysemous (with two related senses), because they are typed as both PHYSICAL\_ENTITY and SUBSTANCE (in formal notation, PHYSICAL OBJECT • SUBSTANCE). The • is the “dot operator”, which relates the two semantic types in a specific way: i.e., the PHYSICAL OBJECT is made of SUBSTANCE. The Container/Content alternation shown in (53) corresponds to another dot type, CONTAINER • CONTENT, with examples such as *bottle*, *bag*, *box*, *barrel*, etc. Other commonly occurring dot types are: PHYSICAL\_OBJECT • INFORMATION (e.g., *book*, *DVD*, *letter*), PRODUCER • PRODUCT (*Toyota*, *Armani*, *Picasso*), EVENT • INFORMATION (*lecture*, *seminar*, *quiz*), and LOCATION • HUMAN GROUP • ORGANIZATION (*university*, *city*, *New York*), among others.

Because of the simultaneous presence of both semantic types, dot objects are inherently lexically ambiguous, as illustrated in the sentences below.

- (54) *book*: PHYSICAL OBJECT • INFORMATION
- a. John bought a book online. / This is a good book.  
PHYSICAL OBJECT and INFORMATION
  - b. This is a heavy book. / Close your book right now!  
PHYSICAL OBJECT
  - c. This is a boring book. / Mary disagrees with your book.  
INFORMATION

Notice, however, that this intrinsic ambiguity can often be resolved in context, as in (54b,c), or not, as in (54a). In (54a), for example, the verb *buy* does not disambiguate the sense of *book*, because both PHYSICAL OBJECT and INFORMATION are involved in the act of purchase. By contrast, the adjective *heavy* and the verb *close* in (54b) target the PHYSICAL\_OBJECT semantic type (unlike INFORMATION, a physical object can be heavy and it can be closed), and *boring* and *to illustrate* in (54c) target the INFORMATION semantic type.

Notice in (55), however, that matters of disambiguation can get a bit more complicated, where different semantic types are simultaneously activated in context by different predicates within the same sentence, a phenomenon known as *copredication*. In the examples below, the type selected by the predicate is subscripted in brackets.

- (55) a. This book is boring<sub>[Information]</sub> and heavy<sub>[Physical.object]</sub>.  
 b. I missed<sub>[Event]</sub> the lecture, but fortunately it was transcribed<sub>[Information]</sub>.  
 c. This city is beautiful<sub>[Location]</sub> but it charges<sub>[Organization]</sub> insane property taxes.

As we will see in Chapter 7, dot object polysemy is actually a very widespread phenomenon in language. One must be careful, however, when classifying the behavior of lexical items as polysemous or not. There are many linguistic contexts where it appears that a word is behaving polysemously in a manner similar to that discussed above. For example, consider the meanings of the nouns *coffee* and *cake* in the sentences below.

- (56) a. Mary poured the **coffee** into her cup.  
 b. John enjoyed his **coffee**.

- (57) a. The kids devoured the **cake**.  
 b. John finished the **cake** just in time for the party.

While nouns such as *book* and *bottle* demonstrate what we called inherent polysemy above, where multiple senses of the same lexeme are conceptually and logically tied together, notice that the nouns *coffee* and *cake* in (56) and (57) illustrate a somewhat different kind of ambiguity, which is called **selectional polysemy**. This emerges when the word itself is not polysemous, but in context its basic meaning is further specified or modified due to contextual influences, most frequently exerted by the selecting predicate. For example, in (56a) and (57a), the core sense of *coffee* and *cake* is being denoted as something that is poured or eaten, respectively. However, in both (56b) and (57b), the original meaning of the nouns *coffee* and *cake* is altered under the influence of the syntactic head, i.e., the verbs *enjoy* and *finish*. Both verbs require the direct object to be of type EVENT. However, since neither *his coffee* nor *the cake* denote events, they need to undergo **coercion** in order to yield an acceptable predicate: that is, they are reinterpreted as an EVENT (event of ‘drinking coffee’ and of ‘making the cake’). Note that the new meanings of both nouns emerge as a result of the meaning adjustment mechanisms triggered in order to make the selectional requirements of the syntactic predicate compatible and the inherent semantic type of its argument. These adjustment mechanisms do not just override the original meaning of the affected arguments and assign them a new one. Rather, they exploit it, i.e., they retrieve the needed meaning components from the arguments’ lexical entries: the event of ‘drinking’ is a part of the meaning of *coffee* (it is encoded in the TELIC quale of *coffee*), and the event of ‘making/baking’ is a part of the meaning of *cake* (encoded in its AGENTIVE quale).

### 6.5.2 Vagueness and Underspecification

**Vagueness or underspecification** (we will be using both terms as near-synonyms here) is used to characterize an indeterminacy of words and other linguistic expressions with respect to certain features: semantic, syntactic, phonological, and otherwise. We encountered one case of vagueness above in Section 6.5.1.1: the English word *neighbor* is indeterminate with respect to gender and can be used to refer to either males, females, or both. Underspecification and vagueness should not be confounded with ambiguity, because an expression can be vague or underspecified with respect to a certain feature without being ambiguous, i.e., without having several different senses. Therefore, we will say that *neighbor* is **underspecified** with respect to gender rather than having two different senses (‘male neighbor’ and ‘female neighbor’).

Underspecification underlies much of lexical creativity and the flexibility in how words denote: if words had very specific pre-determined meaning, they would be very difficult to use in context because they would clash with the selectional requirements of other words. Underspecification enables lexical items to participate in different syntactic structures and in different kinds of semantic composition.

The role of underspecification is crucial in selectional polysemy. On the one hand, it allows for the derivation of contextual meaning variations from a unique sense without positing different senses for each context. Thus, the number of word senses remains constant and the size of the lexicon is more manageable for storing and processing. For instance, since the adjective *long* is underspecified with respect to what scale it can be applied to, it is compatible with a *spatial* scale (as in *long stick*), a *temporal* scale (*long wait*), or *numerical* scale (*long list*). The meaning of *long* is also indeterminate with respect to the exact degree that counts as long for any given entity, which allows establishing this degree in a dynamic fashion, depending on the modified

noun and other elements provided by the linguistic expression and the extralinguistic context: a long stick is probably longer than a long staple, and in a context where there is a 1 meter long stick and a 3 meter long stick, the latter would be ‘*the* long stick’.

On the other hand, underspecification imposes very clear-cut boundaries on contextual variation because it presupposes that lexical meaning does have minimal specifications that cannot be easily overridden in context: e.g., *long* cannot be combined with scalar attributes that cannot be measured as unidimensional, which is why *long redness* or *long pride* are unacceptable.

Lexical underspecification is a powerful theoretical tool. In lexicography, it allows us to represent the same lexical entry with varying degrees of granularity or specificity without modifying its general architecture: semantic information relevant for domain-specific vocabulary can be represented in greater detail while other semantic relations may be simplified by omitting or collapsing unnecessarily specific features.

## 6.6 Summary

In this chapter, we introduced the semantic component of the lexical entry.

- We first presented motivations for separating *linguistic* and *extralinguistic knowledge*, but suggested that both belong as part of the knowledge associated with a lexical entry.
- We also offered a brief description of dictionary definitions and their typology.
- Then, the major components of linguistic structure for a lexical entry were presented: *argument structure*, *event structure*, *qualia structure*, as well as the method of typed feature structures used to represent them. Some of the more representative conceptual structure proposals were reviewed, including *image schemas*, *frames*, and *conventional attributes*.

The remainder of the chapter dealt with semantic properties of lexical entries: ambiguity, polysemy, homonymy, and underspecification.

- The notion of *ambiguity* and its types was presented first: it was shown that ambiguity can emerge at different linguistic levels (syntax, semantics, pragmatics, and lexicon). We then focused our attention on *lexical ambiguity*: on how sense distinctness can be diagnosed and measured, and how it is related to the notions of *polysemy* and *homonymy*.
- Special attention was given to *regular polysemy* and the productive processes involved in its construction.
- Finally, *vagueness* and *underspecification* were introduced: we stressed that ambiguity and vagueness are different semantic properties and showed how underspecification contributes to lexical creativity and contextual flexibility of word meaning.

## 6.7 Further readings

The content of Section 6.3 (“Linguistic structures”) will be further developed in the following chapters, which also include additional references: qualia structure (Chapter 7), argument structure (Chapter 8), aspect and event structure (Chapter 9).

Topic	Primary references
Distinction between linguistic and non-linguistic knowledge	Jackendoff (2002) (sec. 9.7), Escandell-Vidal <i>et al.</i> (2011)
Relationship between the structure of the mental lexicon and the design of lexical databases	Calzolari (1995)
Image schemas	Johnson (1987), Brugman (1988)
Classical work on frames	Minsky (1975), Schank and Abelson (1977), Fillmore (1982)
Different aspects of ambiguity, polysemy, homonymy and vagueness	Quine (1960a), Cruse (1986) (ch. 3), Cruse (2000) (ch. 6)
Polysemy	Apresjan (1974), Pustejovsky (1995), Pustejovsky (2008), Ravin and Leacock (2000)
Vagueness and underspecification	Pinkal (1996)
Topic	Secondary references
Distinction between linguistic and non-linguistic knowledge	Hobbs (2011)
Theoretical and practical aspects of sense definition	Atkins and Rundell (2008), Jackson (2002), van Sterkenburg (2003)
Relationship between the structure of the mental lexicon and the design of lexical databases	Atkins and Rundell (2008) (ch.5), Batiukova (2009b)
Image schemas	Oakley (2007)
Introductory chapters on frames	Fillmore and Baker (2010), Cienki (2007)
Different aspects of ambiguity, polysemy, homonymy and vagueness	Murphy (2010) (ch. 5)
Vagueness and underspecification	Kennedy (2011)

## 6.8 Exercises

- Classify the following definitions following the typology presented in Section 6.2.1 and give similarly structured definitions for the other lexical items included in each case. Is there a reason to use a different type of definition for any of these terms?
  - annoy**: to disturb in a way that slightly irritates. Also define using the same format: *excite*, *disappoint*, *frighten*.
  - often**: many times, frequently. Also define using the same format: *now*, *before*, *always*.
  - rude**: not polite. Also define using the same format: *dispensable*, *adulterous*, *wild*.
  - skin** *noun*: your skin is the natural covering of your body. Also define using the same format: *smoke* (noun), *lousy* (adjective), *fail* (verb).
- Identify the source of ambiguity (syntactic, semantic, or lexical) in the following sentences. Bear in mind that a sentence can have more than one kind of ambiguity.
  - The dog is ready to walk.

- b. We fed her dog food.
  - c. Milk drinkers are turning to powder.
  - d. Anna's picture is very nice.
  - e. I told him to pick me up at 5:00 pm.
  - f. The bus passenger was belted.
3. For each of the following word meanings, determine if they represent the same sense or different senses (use the diagnostics in Section 6.5.1.1). If the senses are different, establish if the word is homonymous or polysemous.
- a. *run*: 'go faster than a walk' / 'compete for elected public office'
  - b. *match*: 'piece of wood tipped with a combustible' / 'game, competition'
  - c. *mad*: 'angry, enraged' / 'mentally disturbed'
  - d. *address*: 'something that identifies a location' / 'deal with, give attention to'
  - e. *case*: 'situation requiring discussion or investigation' / 'container for holding something'
4. Which of the following meaning alternations represent regular polysemy and which irregular polysemy? Do they correspond to inherent polysemy or selectional polysemy? For inherent polysemy, define the semantic relation between both senses.
- a. *guard*:  
There were two soldiers *guarding* us. ['the condition or fact of guarding']  
We were escorted by the presidential *guard* ['people that guard']
  - b. *coffee*:  
Do you have a *cigarette*? ['cylinder of finely cut tobacco']  
I might have time for a quick *cigarette*. ['the event of smoking a cigarette']
  - c. *buy*:  
John *bought* some kale. ['obtain in exchange for money']  
That's a good explanation but I'm not *buying* it. ['accept or believe']
  - d. *fracture*:  
We do not know how these *fractures* occurred. ['the act of fracturing']  
Some bone *fractures* do not heal well ['the result of fracturing']
  - e. *dog*:  
John saw a *dog*. ['domestic canid']  
John heard a *dog*. ['the sound produced by the dog (i.e., barking)']

# 7 Semantic Typing and Decomposition

---

## 7.1 Overview

In Chapter 6, we introduced four main linguistic structures that allow us to configure the meaning of a word: argument structure, event structure, and semantic typing as encoded in qualia structure. This chapter examines the role of semantic types in lexical meaning more generally, and we explore how lexical meaning can be analyzed in terms of semantic components that are smaller than the word meaning itself (i.e., how it can be *decomposed*). We will see that, just as sentences can be analyzed as complex objects with a rich array of structured subcomponents (phrases, semantic roles, morphosyntactic features), word meaning can be viewed as consisting of smaller, *sublexical* components. We will see that these components ultimately determine what kind of entity a word denotes, i.e., the word's *semantic class*.

## 7.2 Strategies for Lexical Decomposition

In the previous chapters, we encountered a number of linguistic frameworks making crucial use of sublexical semantic components, in order to account for how word meaning impacts the other components of grammar. For example, European Structuralists used semantic features to account for the properties of lexical fields, as discussed in Section 3.2. Generative Grammar includes syntactically relevant lexical-semantic features (e.g., [ $\pm$ Count], [ $\pm$ Human], etc.) in the definition of selectional constraints and syntactic models of lexical meaning (as in Distributed Morphology and Nanosyntax, cf. Section 3.2). In Conceptual Semantics (Section 5.3), linguistic expressions are decomposed into function-argument pairings, while Generative Lexicon theory (Section 3.7) uses qualia structure to identify four orthogonal meaning dimensions. Finally, Natural Semantic Metalanguage (Section 5.6) puts forward a list of semantic primitives that can purportedly express the meaning of any natural language word.

As we have seen, componential or compositional analysis can be applied to different word types. For instance, the meaning of the noun *bachelor* can be represented as a conjunction of the semantic features (or predicates) *human*, *male*, *adult*, and *unmarried*, as in (1a). Similarly, the meaning of the verb *kill* in (1b) has been analyzed by embedding simple predicates such as *alive*, within primitive relations and operators, such as *cause*, *become*, and *not*: (1b) can be paraphrased as 'cause someone to become not alive'.

- (1) a. **bachelor**:  $\text{HUMAN}(x) \wedge \text{MALE}(x) \wedge \text{ADULT}(x) \wedge \neg\text{MARRIED}(x)$   
b. **kill**:  $\text{CAUSE}(x, (\text{BECOME}(\neg\text{ALIVE}(y)))$

Notice that the decomposition of *kill* in (1b) is actually built up recursively from a subexpression which denotes the meaning of *die*, namely,  $\text{BECOME}(\neg\text{ALIVE}(y))$ . This expression is, itself,

defined in terms of the subexpression denoting the adjective *dead*, namely,  $\neg\text{ALIVE}(y)$ . Hence, we could gloss *kill* as ‘cause to die’, but the sublexical structure has a lot more going on inside.

The representations in (1) are fairly theory-neutral, but we have seen that different frameworks differ greatly with respect to the nature of the proposed primitive elements, their number, the ultimate level of decomposition and, most importantly, their status as a convenient theoretical abstraction or as linguistically and psychologically real entities. In this chapter we will demonstrate that, regardless of how we address the latter issue, decomposition can be a powerful and useful theoretical modeling tool, and we will put forward a strategy of decomposition that will allow us to represent the meaning of different word types in a unified and systematic fashion. But before we do so, let us step back and reflect on what lexical decomposition is and what can be accomplished by decomposing word meaning.

Lexical meaning is complex and there are different ways of accounting for this complexity. Classical dictionary definitions, for example, exploit the relationships that different words establish among themselves and use words to define other words. The definition of *chalet* in (2), for example, ascribes this word to a larger class (*house*) and points out the properties that differentiate it from the other members of the same class (other kinds of housing): **size** (*small*), **constituency** (i.e., it is usually a part of ‘a larger complex’), and **function** (unlike other types of dwelling, it is meant to be used during a vacation or skiing).

(2) **chalet**: a [small] [house] often [within a larger complex] [where people go for vacations].

By relating the defined lexical item with other words, the dictionary definition reveals important aspects of their respective meanings and of the overall organization of the lexicon, but this is not tantamount to decomposing word meaning. Decomposition implies that the defined word is more complex than the elements used in its definition, and that the number of these basic elements is smaller than the number of words. None of this applies to dictionary definitions.

However, the same information can be expressed with a metalanguage that represents meaning components rather than natural language words. This can be encoded through a typed feature structure (as in (3)) or as a meaning postulate based on a bidirectional entailment (as in (4), see Section 5.2). In (3), the core definitional features of *chalet* are encoded as values of the different qualia structure roles (see Section 6.3.4).

$$(3) \left[ \begin{array}{c} \text{chalet}(x) \\ \text{QS} \end{array} \right] = \left[ \begin{array}{lcl} \text{F} & = & \text{house}(x) \wedge \text{small}(x) \\ \text{A} & = & \text{be\_built}(x) \\ \text{T} & = & \text{used\_for\_vacation}(x) \\ \text{C} & = & \text{part\_of\_complex}(x) \end{array} \right]$$

The meaning postulate in (4) says that, if something is a chalet, it must be a small house, used during vacation and belongs to a larger complex. Note that these two notations do not preserve the distinction between genus proximum and differentia specifica: both are formalized as features or as semantic predicates.

$$(4) \forall x [\text{chalet}(x) \leftrightarrow [\text{small\_house}(x) \wedge \text{part\_of\_complex}(x) \wedge \text{used\_for\_vacation}(x)]]$$

These and other meaning dimensions form a grid of relations whereby every word meaning is analyzed in terms of more basic semantic components and is connected to the meaning of other words in a systematic fashion. By singling out and analyzing these different semantic dimensions (i.e., by **decomposing** word meaning), we address some of the major issues confronting lexical semantics, given below.

- (5) a. By representing the internal semantic structure of words, we provide a structural explanation for semantic relations between words, such as inference, synonymy, antonymy, hyponymy, meronymy, and so forth. For example, because CHALET is a hyponym of BUILDING, it inherits all the semantic information relating to this type. Similarly, BUILDING is a kind of CONSTRUCTION, which is a kind of ARTIFACT, which is a THING.
- b. We reduce lexical variability to a list of basic meaning components and dimensions, giving us a computationally tractable account of lexical acquisition: i.e., how are we able to incorporate over 400,000 lexical entries and their relations in our mental lexicon?
- c. We can help account for the combinatorial properties of words by encoding the way lexical features affect the properties of syntactic constructions. For example, we know that the noun *girl* can occupy the subject slot of the verb *hate* (as in *The girl hates spinach*) because this verb selects for [+animate] subjects and one of the features of *girl* is precisely [+animate].

Although lexical decomposition has been routinely used to analyze the meaning of words and larger linguistic expressions for almost a century now, there are still many aspects of decomposition that are left unanswered. While it is generally accepted that a word meaning is not merely the sum of the lexical features into which it is decomposed, it is not clear what else is needed to complete the meaning of a word. Just like a mixture of flour, sugar, eggs and butter cannot be called *cake* until these ingredients are properly blended, molded, and baked following a very precise procedure, word meaning is also more than just a set of features. Similarly, the component parts [plant], [small], and [grown for its blossom] might be seen as tantamount to the lexical concept *flower*, but only if they are meaningfully configured or structured relative to each other within an interpreted system or syntax.

Another open question in the field concerns the identification of the lexical-semantic features that go into defining word meaning. Because this is not a straightforward task, there is little agreement so far on what features must be considered as primitive, what procedure or criteria must be followed in order to discover them, and how far below word level the decomposition process may proceed. The existing componential approaches to word meaning ground their proposed sets of primitives differently: Conceptual Semantics places them in Conceptual Structure; Distributed Morphology in syntax; and Natural Semantic Metalanguage in an uninterpreted semantics (cf. Chapters 3.3 and 5).

While it seems to be obvious that the set of primitive lexical-semantic features must be smaller in size than the lexicon, the only full set of primitives (within linguistics) put forward so far is Wierzbicka's and none of the existing proposals has been unanimously accepted in the linguistic community. The ultimate demonstration that a set of features or primitives is psychologically real and not just convenient as a representational device has to come from psycholinguistic research, which is still in its infancy in this respect. Showing that a given lexical feature is crucially involved in different modules of grammar (e.g., when it can be related to explicit syntactic and morphological clues) would suggest that it is linguistically real. Finally, additional support for a particular set of primitives can also come from computational linguistics and the utility and expressiveness that such features play in natural language processing algorithms.

As for the number of primitives and the depth of decomposition are concerned, we don't really know how far lexical decomposition can take us, but this is not necessarily a bad thing. As long as the proposed features can help account for linguistic data by making relevant generalizations, they will, at the very least, be a valuable theoretical tool.

The fact that we need sublexical components in order to analyze word meaning is not sur-



prising if we look at other areas of linguistics and the natural sciences. For example, phonological distinctive features make up the sounds of a language but are not sounds themselves; substances, such as water molecules, are composed of atoms that are themselves not water, and so forth. If we assume that the components of word meaning do not need to behave as words, we can easily understand why the natural language formulas or paraphrases containing these components do not sound quite natural or do not express the defined meaning accurately. Consider an example illustrating this point in (6), with the English transitive verb *open*.

(6) *open*(x,y): CAUSE(x, (BECOME(OPEN(y))))

One can argue that this formula represents the meaning of the word *open* by using several, more basic components (CAUSE and BECOME), but we cannot say that the meaning of *open* is, literally, ‘cause something to become open’. For example, if John burnt the meal that he was cooking and somebody else opened the window to air the room, we could possibly say *John caused the window to become open* but definitely not *John opened the window*. Both sentences do not mean the same thing, because the natural language verb *cause* and the semantic primitive CAUSE are not semantically equivalent. This will prove to be a constant headache for lexical semanticist, as we see below.

Different strategies of decomposition have been proposed over the years, and we have indirectly alluded to some of them in this and other sections. Now let us present them in a more systematic fashion and assess how efficient each of them is in accounting for the meaning of a word and its compatibility with other words in context. There are essentially four distinct strategies for lexical decomposition that have been proposed, each of which we will review below.

- (7) a. Relational lexical meaning
- b. Simple predicate-based decomposition
- c. Parametric decomposition
- d. Structured predicate-based decomposition

First, within a **relational approach** to word meaning, a word is defined in terms of its explicitly specified links to other words. On this view, there is no need for decomposition since relationships between different words in the language play the role of connecting word meanings, while also allowing inferences over the meanings of complex expressions made up by words. Using this approach with the definition of *chalet* discussed above, for example, would involve a hyponymy link between *chalet* and *house* (a chalet is a kind of house), a meronymy link between *chalet* and *complex* (a chalet is a part of a larger complex), and a kind of functional link between *chalet* and *vacation*. Although this approach bypasses the problematic issues inherent in the decompositional method, it presents a number of other drawbacks which we have already mentioned and which stem from the use of natural language words as the metalanguage: if we view this technique as creating word meanings, then it can lead to circular definitions, as it fails to define basic meaning words; furthermore, it makes it very difficult to establish cross-linguistic generalizations, at least regarding word meaning.

In the second approach, **simple predicate-based decomposition**, lexicalized concepts are seen as combinations (typically conjunctions) of more basic or primitive features, as in (1) above repeated below in (8):

- (8) a. **bachelor**: HUMAN(*x*) ∧ MALE(*x*) ∧ ADULT(*x*) ∧ ¬MARRIED(*x*)
- b. **kill**: CAUSE(*x*, (BECOME(¬ALIVE(*y*))))

Simple decomposition allows a detailed description of the inherent meaning of the lexical item but it fails to relate it to the semantic properties that its syntactic context must exhibit, in order to yield acceptable word combinations. This is particularly important in the case of verbs and other functional and relational words. For example, while predicates such as HUMAN or ANIMATE can be used to help define a lexeme directly, as in (8a), this strategy typically doesn't use such predication with the arguments to verbs. Hence, (8b) does not specify that the subject and the direct object of *kill* must be [+Animate] (or EVENT for the subject, as in *The storm killed the sailor*, but we will disregard this here for the sake of simplicity).

A **parametric decomposition** strategy adds additional arguments to a predicative expression as are warranted by the inferences one wishes to perform. Consider, for example, event-denoting predicates, such as *eat* and *give*. These are traditionally analyzed as two-place and three-place predicates respectively, i.e.,  $eat(x, y)$  and  $give(x, y, z)$ . Since most events happen in space and at specific times, we can imagine using this strategy to "enrich" the meaning of these verbs by making reference to additional parameters that refer to these concepts. In this case, we add parameters for the time of the event,  $t$ , and the location of the event,  $l$ , as shown in (9).

- (9) a.  $eat(x, y, t, l)$ : 'x eats y at time t in location l.'  
 b.  $give(x, y, z, t, l)$ : 'x gives y to z at time t at location l.'

Finally, the **structured predicate-based decomposition** strategy overcomes the shortcomings of simple predicate-based decomposition, while also allowing reference to new parameters, as in the previous approach. Hence, in addition to decomposing the predicate, the strategy allows for specification of selected semantic features associated with the verb's arguments, such as animacy (ANIMATE), as shown in *kill*:

- (10)  $kill(x, y)$ :  $[ANIMATE(x) \wedge ANIMATE(y) \wedge CAUSE(x, (BECOME(\neg ALIVE(y))))]$

Most lexicalist frameworks assume this approach: e.g., Levin and Rappaport's Lexical Conceptual Structures; Jackendoff's Conceptual Structure representations, and Van Valin's Role and Reference Grammar. Despite notational variations and differences in accounting for how lexical information is projected to syntax, their semantic content is very similar as far as the treatment of lexical meaning is concerned. For example, the Conceptual Structure representation of (10) is given in (11) (recall that the INCH function denotes the initiation of states and is thus equivalent to BECOME in (10)). For the first and second argument of the verb (denoted in (10) as  $x$  and  $y$ , respectively), it specifies that they must have the conceptual category 'Object' and subcategory 'ANIMATE'.

- (11)  $[_{Event} CAUSE ([_{Object} ANIMATE], [_{Object} ANIMATE], [_{Event} INCH ([_{State} BE ([_{Object} ANIMATE] [_{Place} AT ([_{Property} not alive)])])])]$

Note that the representations in (10) and (11) define the argument type in terms of a specific *semantic parameter*, i.e., its general semantic class: the subject and the direct object of *kill* must belong to the group of animate entities, a feature of *parametric decomposition*.

It should be noted that, in Generative Lexicon theory, these parameters also include the Qualia Structure roles. They allow for the definition of the semantic type of a word not only with respect to its general class (i.e., the FORMAL quale), but also in relation to its origin and function (the AGENTIVE and TELIC qualia), which results in enriched semantic typing: a *tree* is a PHYSICAL OBJECT, but a *pen* is a PHYSICAL OBJECT and a TOOL at the same time, and a *violinist* is a HUMAN and a MUSICIAN at the same time. Enriched typing allows for classifying both predicates and their arguments more precisely while also avoiding additional stipulations

(pragmatically or otherwise motivated). For example, if we assume that the semantic type of the verb *fix* requires its direct object to be of type PHYSICAL OBJECT and ARTIFACT, we can predict that it will be compatible with names of artifacts, such as *chalet*, but not with nouns denoting naturally occurring entities, such as *apple* (in (12)). A semantic type hierarchy insures that *building* is interpreted as a subtype of *artifact*, an issue we will deal with in the next section.

- (12) a. **fix**:  $[\text{fix}(x, y) \wedge \text{animate}(x) \wedge \text{physical\_object}(y) \wedge \text{artifact}(y)]$   
 b. **chalet**:  $[\text{physical\_object}(x) \wedge \text{building}(x) \wedge \text{used\_for\_vacation}(x)]$   
 c. **apple**:  $\text{physical\_object}(x)$

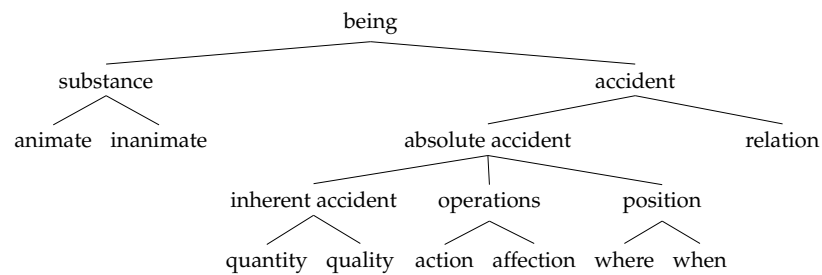
Enriched parametric decomposition reduces the need for identifying primitive meaning components inasmuch as it contributes to establishing compositional aspects of lexical semantics, i.e., how word meanings are combined in context.

## 7.3 Semantic Types

Words can be classified according to a number of different criteria: *phonological* (monosyllabic vs. polysyllabic, stressed vs. unstressed), *morphosyntactic* (simple vs. derived, inflected vs. uninflected), and also *semantic*. When we talk about **semantic types**, we refer to the kind of entity denoted by the lexical item, such as PHYS-OBJECT, EVENT, or ANIMATE (Section 2.3.2). Of course, it can be argued that ‘kind of entity’ can be almost anything, depending on the classification criteria that we choose to apply. For example, within the class TABLE there are meaningful subclasses, e.g., KITCHEN TABLE, WORK TABLE, DINNER TABLE, COFFEE TABLE, etc., that can be identified. This kind of classification (or *ontology*) makes sense in the context of our knowledge of furniture and home furnishings, but it is not particularly helpful for studying word meaning more generally. However, it seems obvious that both ways of categorizing are related. Let us try to follow the lead from a general classification of real world entities to linguistically relevant semantic types to see what aspects they share and where they diverge.

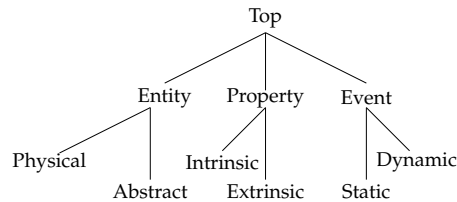
What kinds of things there are in the world and how they are related to one another is traditionally considered a *metaphysical* question; that is, an issue concerning the nature and structure of reality. One of the most influential and enduring ontologies was put forward by Aristotle, who introduced a basic distinction between the *essential* characteristics of a thing and what he called the *accidental* properties of that object. Those aspects of an entity that are essential are called the object’s *substance*, its true nature or character, as it were. Everything else about that object is merely accidental and not part of an object’s essential being.

In figure 7.1, which follows Aristotle as interpreted in Brentano (1975), a *being* (anything that exists) may be a *substance* (a thing, something with an independent being) or an *accident* (a property or attribute, something that does not have an independent being and only exists by virtue of being associated with a substance). The accidents are in turn subdivided into *relations* (between substances) and *absolute accidents* (properties of a single substance). The latter can be *inherent* (intrinsic properties of a substance: what is it, what shape does it have), related to *operations* (what the substance does, what happens to the substance), and related to *position* (spatial and temporal location: where it is and when it happens).



**Figure 7.1** *Aristotelian ontology*

In current ontologies, the focus is taken away from “substances” and their properties, and distributed amongst three separate but related types: entity, property, and event. The latter two types are what Aristotle classified as various accidents of the substances. The tree structure in figure 7.1 can be mapped to more modern interpretations of similar categories. Notice that in figure 7.2 below, SUBSTANCE is mapped to ENTITY, ABSOLUTE ACCIDENT is generally mapped to PROPERTY, and RELATION is mapped to EVENT.



**Figure 7.2** *Classic Upper Ontology*

While these taxonomies are useful for organizing information associated with objects and processes in the world, it is not clear what these categories have to do with the semantic types associated with linguistic expressions, from words all the way up to phrases and sentences. As we established in Section 6.2, a piece of conceptual information can be considered “linguistic” if it can be shown to significantly affect other modules of grammar, most importantly syntax and morphology. For example, when we first introduced semantic types (in Section 2.3.2), we used them to account for the semantic selectional requirements imposed by the verbs on their arguments. Indeed, by looking at what semantic properties are systematically shared by the arguments of different verbs we can identify syntactically relevant semantic types. For example, in (13)-(17), the verbal arguments marked in *italics* all belong to specific semantic types: ANIMATE, EVENT, LOCATION, TIME, and PROPERTY, respectively.

(13) ANIMATE

- a. The *kitten* was purring.
- b. The *boy* cares deeply for his mother.
- c. The *policemen* cooperated on the case.

(14) EVENT

- a. John witnessed {the *robbery*/ the bank being robbed}.
- b. Please stop {the *fight*/ fighting}.
- c. They correctly predicted {the financial *collapse*/ that the economy would collapse}.

(15) LOCATION

- a. The tourists reached *the city*.
- b. James summers at the *seaside*.
- c. The tribe inhabited this *valley* for many centuries.

## (16) TIME

- a. The meeting started at *noon*.
- b. A *decade* has passed since Mary visited Madrid.
- c. John spent the *afternoon* reading.

## (17) PROPERTY

- a. He seemed *friendly*.
- b. Consider yourself *lucky*!

Furthermore, selectional requirements can help us determine how semantic types are ordered hierarchically: for example, which semantic types are subtypes of a more general type. In the sentences in (18), the verbs *seem* and *consider* are combined with different adjectives of semantic type PROPERTY, but *consider* rejects some of the adjectives that are compatible with *seem*: *tired*, *hungry*, and *depressed*.

## (18) PROPERTY

- a. He seemed {*friendly*/ *intelligent*/ *respectful*}.
- b. He seemed {*tired*/ *hungry*/ *depressed*}.
- c. I consider him {*friendly*/ *intelligent*/ *respectful*}.
- d. \*I consider him {*tired*/ *hungry*/ *depressed*}.

These adjectives encode a specific kind of attribute, usually called **stage-level properties**. Stage-level properties change in time. By contrast, **individual-level properties** (such as *friendly*, *intelligent*, and *respectful*) persist in time and they usually define an entity during all or most of its existence. By looking at this data, we can conclude that *seem* is compatible with the semantic type PROPERTY, *consider* is compatible with the semantic type INDIVIDUAL-LEVEL PROPERTY, and that the latter type is a subtype of PROPERTY.

The individual vs. stage-level distinction is not the only possible way of classifying property-denoting adjectives and the semantic types they encode. Adjectives can be divided into different classes, depending on what dimensions of analysis are being used. Classic semantic field analysis (cf. Dixon 1991, Lyons 1977, Raskin and Nirenburg 1995) categorizes the attributes denoted by adjectives according to a thematic organization, centered around a human frame-of-reference, as lexically encoded in the language, such the following classes: DIMENSION, PHYSICAL PROPERTY, COLOR, EMOTIONS, TEMPORAL SPATIAL VALUE, MANNER.

As intuitive as these classes might be for organizing aspects of the lexis of a language, they fail to provide a coherent guide to the inferential patterns associated with adjectival modification. An alternative approach is to adopt a conceptually conservative but more formally descriptive and operational distinction, one which groups adjectives into inferential classes. Amoia and Gardent (2006), following Kamp (1975) and Kamp and Partee (1995), make just such a move, adopting a three class distinction based on inferential properties of the adjective, as seen below:

(19) a. INTERSECTIVE: adjectives such as *carnivorous* have the following behavior:

$$\|AN\| = \|A\| \cap \|N\|$$

a *carnivorous tiger* is both a carnivore and a tiger;

- b. SUBJECTIVE: adjectives such as *big*, can be modeled as follows:  
 $\|AN\| \subseteq \|N\|$   
 a *big mouse* is big relative to the set of mice, but not absolutely so;
- c. INTENSIONAL: these adjectives include privatives, such as *fake*, *pretend*, and non-subjectives, such as *alleged*, and can be analyzed as follows:  
 $\|AN\| \cap \|N\| = \emptyset$   
 a *fake gun* is not a real gun;  
 an *alleged* thief is not necessarily a thief, but only suspected as one.

Now that we have established how ontological categories may be related to semantic types, we should ask ourselves how semantic types correspond to other linguistic categories, e.g., to syntactic categories. Although there are clear correlations between semantic types and syntactic word categories (EVENTS are mostly encoded by verbs, THINGS by nouns, and PROPERTIES by adjectives), their nature is different: the former are units of semantic analysis and the latter belong in morphosyntax. As discussed in Section 2.3.1, these correlations are not absolute and, for many words, they cannot even be established: functional categories (prepositions, conjunctions, determiners, etc.) cannot be associated with any semantic types the way we defined them.

Let us consider very broadly how we name what we see, in order to figure out why there are very robust but not absolute correlations between the intrinsic nature of the named entities and the syntactic category of the words used to refer to them (see Miller and Johnson-Laird 1976).

First, we **perceive** something: an object and its specific qualities or attributes (shape, size, position, etc.), a situation and the change associated with it, etc. Then we **conceptualize** it in a certain way: we *construe* a concept or a mental representation of what we perceived. The semantic type is probably a part of the conceptualization that overlaps with the linguistic meaning. Finally, we **match** this concept against the *lexical concepts* that we have stored in our memory, which link particular concepts with linguistic (phonetic, syntactic and other) features: if there is a label (i.e., a word) for the concept based on what we perceived, we can use it and refer to the perceived entity with that word.

As we can see, there are a number of steps mediating between what the “perceived something” is in the real world and how we name it. And, for the same perceived reality, things may work differently at every step of this complex process, which means that the same object or phenomenon can be perceived, conceptualized, and named differently. To begin with, the same thing may be perceived differently (by different people and even by the same person): for example, the same surface can be perceived as grayish or as white depending on how intense the lighting is, and the same sound can be perceived as either loud or low depending on the level of environmental noise and the auditory acuity of the listener. Furthermore, the same perceived reality can be conceptualized differently. For example, the same situation can be described as *Peter’s arrival* or *Peter arrived* depending on how we construe it: in the first case, we conceptualize it as if it were a concrete object, which is more or less stable in time and can be apprehended as a whole instantaneously; in the second case, we conceptualize the situation as a reality that involves change in time and in space. Finally, the same concept may be expressed by more than one word, as with synonyms.

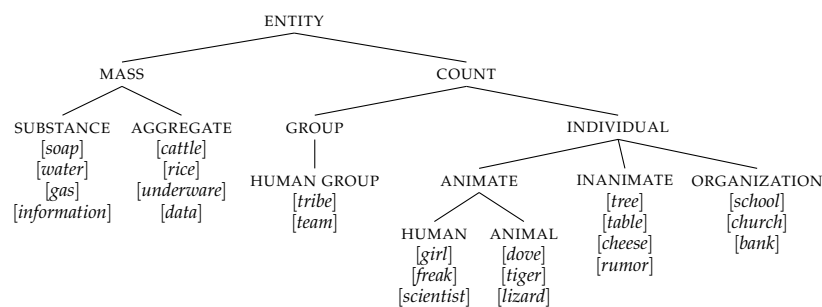
With this in mind, we can say that, by default, physical entities are perceived and conceptualized as objects and are associated with nominal lexical concepts, and changes are perceived and conceptualized as events and are associated to verbal lexical concepts (this is especially patent in the speech of children, where concrete nouns and verbs of animated motion are predominant). However, this does not need to be the case as shown above.

The following list includes most semantic types that are used in this book. We discuss how semantic types are organized to satisfy the selectional requirements in chapter 10.

Semantic type	Example
ENTITY	thing
–MASS	soap, luggage, cattle
–COUNT	cow, table, tribe, bank
EVENT	happening, situation
–STATE	happiness, depression, love, be sick, be German
–DYNAMIC EVENT	demonstration, arrival, learn, build, jump
PROPERTY	
–INDIVIDUAL-LEVEL	tall, intelligent, respectful
–STAGE-LEVEL	hungry, tired, bored
PROPOSITION	(He told me) that you left
–INFORMATION	data/datum, commentary, rumor, message, summary, handout
TIME	tonight, soon, after dark, the day we met
LOCATION	upstairs, world-wide, here, downtown, in the yard
DIRECTION	towards, via, down
QUANTITY	seven, (a) few, (a) little, numerous, great deal, severely
MANNER	fast, happily, cruelly, with joy

**Table 7.1** *Semantic types*

Although this list only contains first-order subtypes for some of the top types (ENTITY, EVENT, and PROPERTY), even more specific subcategories can be identified. Figure 7.3 represents a more complete (although not exhaustive) hierarchy of subtypes for the top type ENTITY:



**Figure 7.3** *ENTITY subtypes*

The count-mass distinction (also referred to as *continuous-discontinuous* and *unindividuated-individuated* in the literature) was first introduced in Section 2.3.3, where we dealt with the concept of countability and the impact of the lexical features underlying this notion on the syntactic behavior of nouns and verbs. The traditional concrete-abstract dichotomy is rarely used in current theoretical research, because the distinction between what can be perceived by the senses and what can only be apprehended by the intellect is not at all a clear one (e.g., it can be argued

that a *pain* is felt objectively, and yet somehow it is perceived as much more abstract than a *tree*, a *table* or even the *wind*), and because both concrete and abstract entities can be mass or count: e.g., *information* is abstract and mass, *rumor* is abstract and count, *tree* is concrete and count, and *wood* is concrete and mass.

The hierarchy in figure 7.3 only allows simple inheritance (recall Section 3.4), which means that each subtype only inherits information from one supertype: *girl* is HUMAN and, by inheritance, ANIMATE, INDIVIDUAL, COUNT, and ENTITY. But what about words with a more complex meaning, for instance those referring to functional entities? *Table* is an INANIMATE COUNT ENTITY (a physical object), but it is also a TOOL or an ARTIFACT. Similarly, *scientist* is a HUMAN but also a PROFESSIONAL. In the next section we will show how qualia structure can be used to configure a more complex and flexible internal structure of the semantic types. Chapter 10 will focus on how the semantic types are related to one another.

## 7.4 Qualia Structure as Semantic Types

Semantic types are not just convenient atomic labels that help us group words based on their meaning and their syntactic behavior. They can also be complex rather than atomic, as we will see in this section: that is, their properties ultimately depend on the sublexical features that make up the meaning of the word, where many words include more than one semantic type in their meaning. First we show why not all semantic types can be atomic, and why we need a richer typology of semantic types. For that, we will take up the distinction between words denoting naturally occurring entities and words denoting artifacts introduced in Sections 3.7 and 6.3.4.

### Natural Types and Artifactual Types

If we assume that all nominals typed as INANIMATE INDIVIDUAL are the same, we can't explain, based on their meaning, why nouns associated with a function or purpose behave differently from those nouns that have no explicit function, in the same context. Recall, for example, that functional nominals (*umbrella*, *computer*, *bicycle*) can be freely combined with evaluative adjectives (*faulty*, *good*, and *efficient* in (20a)) and phasal verbs (*start* and *begin* in (21a,b)). This is in marked contrast to their behavior when modifying natural kinds.

- (20) a. {faulty/good/efficient} {umbrella/computer/bicycle}  
       b. ??{faulty/good/efficient} {pigeon/tree/oxygen}

- (21) a. John started a {cake/journal/garden}.  
       b. John began the {cake/book/trail}.  
       c. ??John {started/began} {a pigeon/a tree/the oxygen}.

With these nouns, the adjectives make reference to the typical function that the respective objects fulfill (e.g., a good/efficient umbrella protects one from the rain), *start* refers to how these artifacts are created (*start a cake* = 'start cooking/baking the cake'), and *begin* may refer to both their origin and function (*begin the cake* = 'start baking/eating the cake'). With natural nominals ((20b) and (21c)), however, the same sentences sound odd and are only acceptable if we assume that these natural nominals represent artifactual or functional entities (*good pigeon* = 'well-behaved homing pigeon', *start a tree* = 'start painting a tree').



Let us now see how can this difference may be expressed in terms of qualia structure. As shown in (22), all entity-denoting nouns have a specific formal quale value: the functional nominal *cake* and the natural nominal *tree* are both typed as PHYSICAL OBJECT (we assume, for discussion, that *cake* is used as a count noun, and that PHYSICAL OBJECT is a shortcut for the semantic type INANIMATE COUNT INDIVIDUAL). The formal role is the *head type* because it is always present: anything can be defined through its basic category and the features that distinguish it from other members of the same category or domain. This is what makes the FORMAL quale different from all the others: it cannot be empty or *underspecified* (cf. Section 3.7 and 6.5.2). Both natural and functional nominals will also have CONSTITUTIVE features: a cake has ingredients (flour, sugar, eggs) and parts (frosting, filling, etc.), and a tree has parts (trunk, leaves, etc.).

In addition to FORMAL and CONSTITUTIVE roles, functional words have specific information referring to their origin and intended function, which is encoded in the AGENTIVE role and the TELIC role, respectively. We will refer to these as **artifactual types**. Both function and origin usually refer to the type EVENT: a cake, for example, is created through the event of baking, and its purpose is to be eaten (cf. (22a)). **Natural types**, on the other hand, are underspecified with respect to both origin and function, as indicated in (22b).

- (22) a. 
$$\left[ \begin{array}{l} \text{cake} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{phys.obj}(x) \\ \text{CONSTITUTIVE} = \text{ingredient.of}(v,x), \text{part.of}(w,x), \\ \text{TELIC} = \text{eat}(y,x) \\ \text{AGENTIVE} = \text{bake}(z,x) \end{array} \right] \end{array} \right]$$
- b. 
$$\left[ \begin{array}{l} \text{tree} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{phys.obj}(x) \\ \text{CONSTITUTIVE} = \text{trunk.of}(y,x), \text{foliage.of}(z,x) \\ \text{TELIC} = \text{unspecified} \\ \text{AGENTIVE} = \text{unspecified} \end{array} \right] \end{array} \right]$$

**WARNING: Commonsense Knowledge vs. Lexical Information**

Of course, we may know how trees and dogs come into being, but this information is not prominent enough in the mind of the speakers to be a differentiating feature of the lexical concepts *tree* and *dog*, beyond what is inherited from their supertypes. Also, natural types can, in certain concepts, be reconceptualized as artifacts. The mechanisms underlying this kind of type shifting are examined in Chapter 11.

From this perspective, the natural type (defined by the FORMAL and the CONSTITUTIVE roles) forms the ground for the functional type: an entity can have a function or not but, if it exists, it must ‘be something’ (a physical object, a substance, etc.). When the property encoded in the FORMAL role persists, other properties may not persist, but if it does not persist no other property persists because the entity no longer exists. Thus, a *broken camera* may not fulfill its intended function any longer, but if it exists it keeps being a PHYSICAL OBJECT, and a *former boss* might no longer have the functional role of controlling and supervising, but she continues being a HUMAN INDIVIDUAL.

In Generative Lexicon, the feature structure notation used above for word meaning can also be expressed as a composite type focusing on the relations between the qualia, and how richer types are built up out of simpler type structures. For example, assuming the FORMAL role to be the basic type from which all other types are constructed, we can introduce types containing other qualia with a type constructor, **tensor**, symbolized as  $\otimes$ . This constructor makes explicit the relation between the FORMAL role, on the one hand, and the CONSTITUTIVE, AGENTIVE, and

TELIC, on the other hand. The tensor adds CONSTITUTIVE ( $\otimes_C$ ), AGENTIVE ( $\otimes_A$ ) and TELIC ( $\otimes_T$ ) relations to the head FORMAL type. To illustrate this, consider the representations in (23), which are alternative representations for the qualia structure of the nouns *cake* and *tree*, shown in (22) above, as well as a tensor representation for the noun *beer*.

- (23) a. *cake*: phys\_obj  $\otimes_C$  {*flour, sugar*}  $\otimes_A$  bake  $\otimes_T$  eat  
 b. *tree*: phys\_obj  $\otimes_C$  trunk  $\otimes_C$  foliage  
 c. *beer*: liquid  $\otimes_C$  {*water, yeast*}  $\otimes_A$  brew  $\otimes_T$  drink

It should be noted that the natural-artifactual distinction illustrated in (23) is not restricted to nouns denoting inanimate physical entities, but also applies to nouns encoding social roles and professions, which are inherently functional. For example, a *student* is a person who is attending a school or studying a specific topic or discipline; and a *pianist* is person who plays piano professionally or is at least able to play piano. These are expressed as types in (24).

- (24) a. *student*: human  $\otimes_T$  study  
 b. *pianist*: human  $\otimes_T$  play\_piano

Furthermore, adjectives and verbs can also be distinguished as belonging to natural or artifactual types. The adjectives *red*, *heavy* and *flat*, for example, encode **natural qualities** that a physical object can have. *Broken*, *faulty*, *efficient*, *useful*, and *good* are only compatible with artifacts and modify the value in the TELIC role, as seen above in (20): the last three adjectives are used to indicate that the intended function is properly fulfilled and the rest that the artifact is not functioning properly. *Easy*, on the other hand, seems to be able to modify both TELIC and AGENTIVE roles: an *easy interface* is an interface that can be used easily (TELIC role modified), while an *easy meal* is a meal that is easy to prepare (AGENTIVE role modified).

It should not be surprising that this distinction between natural and artifactual typing applies to the verbal domain as well. Verbs selecting for natural types as their arguments can be classified as **natural predicates**. For example, the only argument of *fall* (in (25a)) must be typed as PHYSICAL ENTITY. Of course, artifacts may fall, too (e.g., {*The laptop/the scientist*} *fell*), but the verb does not require its subject to denote a functional entity. Similarly, the syntactic subject of *die* and *give* must denote an ANIMATE ENTITY.

- (25) a. The rock fell.  
       *fall*(arg<sub>1</sub>[PHYS\_ENTITY])  
 b. The dog died.  
       *die*(arg<sub>1</sub>[ANIMATE])  
 c. The man gave water to the boy.  
       *give*(arg<sub>1</sub>[ANIMATE], arg<sub>2</sub>[PHYS\_ENTITY], arg<sub>3</sub>[ANIMATE])

Verbs such as *spoil* and *fix*, by contrast, require the argument undergoing change to be an artifactual type, for example the subject of *spoil* and the direct object of *fix*:

- (26) a. The beer spoiled.  
       *spoil*(arg<sub>1</sub>[PHYS\_ENTITY $\otimes_T$ EVENT])  
 b. The girl fixed the clock.  
       *fix*(arg<sub>1</sub>[HUMAN], arg<sub>2</sub>[PHYS\_ENTITY $\otimes_T$ EVENT])

This conception of semantic types allows for a multidimensional rather than flat meaning representation. It allows us to define word meaning relative to different parameters and to explain how multiple inheritance works in a semantic type hierarchy. For example, figure 7.4

shows how the functional nominals *soap*, *boss*, *scientist*, *cake*, and *laptop* inherit their natural attributes from the natural type structure ENTITY, and their functional attributes from the FUNCTION type structure: *soap* is typed as SUBSTANCE and as FUNCTIONAL MATERIAL, *boss* as HUMAN and SOCIAL ROLE, *scientist* as HUMAN and OCCUPATION, *cake* as INANIMATE and FOOD, and *laptop* as INANIMATE and TOOL.

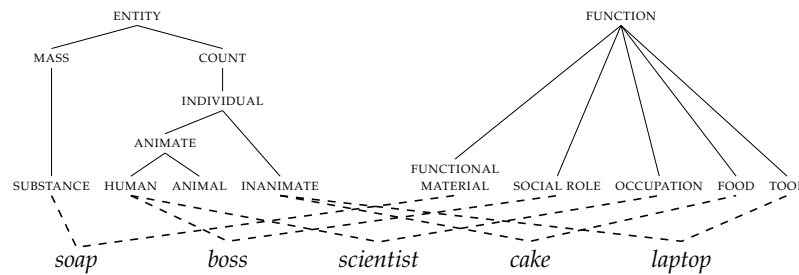


Figure 7.4 Multiple inheritance in artifactual types

Some natural entities keep their original head type, irrespective of the function that they are assigned: the type of *boss* and *scientist* is HUMAN INDIVIDUAL ENTITY (the same as for the natural nouns *person*, *woman*, and others) regardless of their function (occupation, social role, etc.). Note, however, that other natural entities (most notoriously the ones that can be reconceptualized as **food**) undergo a head type adjustment: for example, *lamb* as natural type is ANIMAL INDIVIDUAL ENTITY, while as FOOD it is SUBSTANCE.

### Complex Types

The lexical items we have been dealing with so far are defined through a unique and atomic semantic type in their formal quale. However, many words are more complex in this respect: they encode an inherent relation between two or more types or *aspects*. Such words are called **complex types** in Generative Lexicon Theory. They are also referred to as **dot objects**, since **dot** (•) is the type constructor that creates a complex type  $a \bullet b$  from any two types  $a$  and  $b$ . Some of the commonly occurring dot types were mentioned in Section 6.5.1.3.

The simple types within a dot object have their own qualia structure specifications. As shown in (27), the PHYSICAL OBJECT *novel* has pages and a cover as its constituent parts, and is created through the process of printing (whether physical or digital), for the express purpose of containing information. *Novel* as INFORMATION, on the other hand, is made up of pieces of narrative, and is created through the process of writing with the purpose of entertaining or informing the reader.

(27) a. *novel*: PHYSICAL\_OBJECT • INFORMATION

$$\left[ \begin{array}{l} \text{novel} \\ \text{QS} = \left[ \begin{array}{l} \text{F} = \text{phys.obj} \\ \text{C} = \text{page, cover...} \\ \text{T} = \text{containing information} \\ \text{A} = \text{printing, binding...} \end{array} \right] \end{array} \right] \bullet \left[ \begin{array}{l} \text{novel} \\ \text{QS} = \left[ \begin{array}{l} \text{F} = \text{information} \\ \text{C} = \text{narrative} \\ \text{T} = \text{entertain} \\ \text{A} = \text{writing} \end{array} \right] \end{array} \right]$$

Both aspects of a dot can even give rise to different interpretations as far as individuation and counting are concerned. Let's say you have on your desk one copy of *War and Peace*, two of *One Hundred Years of Solitude*, and three of *Ulysses*. How many novels do you have? The answer depends on whether we are interested in 'novels as PHYSICAL OBJECTS' or 'novels as INFORMATION': in the former case there would be six, and in the latter three.

Although the simple types within the dot may seem orthogonal or even conflicting, it can be shown that there is a deep connection between them as well as between the qualia values

associated with each simple type. Furthermore, in order for a dot object to be well-formed, there must exist such a relation. For instance, for *novel* or *book*, this relation would be ‘containment’: the PHYSICAL OBJECT (i.e., the medium) *contains* INFORMATION. In an exhaustive QS representation, this relation must be encoded in the formal role, as in (28a) below. Similarly, the relation ‘produce’ is involved in the dots denoting a producer and its product, such as *Toyota* in (28b) and the relation ‘used as’ is involved in the dot object, ANIMAL•FOOD, such as *chicken* in (28c). In dot objects having an EVENT as one of the aspects, the other type typically refers to a specific participant in the event. For example, *exam* refers to the event and to the questions themselves (EVENT•QUESTION), as represented in (28d).

- (28) a. *book*: [F = contain(PHYS\_OBJ, INFORMATION)]  
 b. *Toyota*: [F = produce(PRODUCER, PRODUCT)]  
 c. *chicken*: [F = used\_as(ANIMAL, FOOD)]  
 d. *exam*: [F = ask(EVENT, HUMAN, QUESTION)]

How can the dot objects be distinguished from other meaning extension and alteration phenomena apparently involving multiple semantic types? For example, we know that the noun BEER (usually typed as FOOD) can in certain contexts be interpreted as an EVENT, as in *I have a little time for a quick beer*. Does it mean that *beer* is a dot object (FOOD•EVENT)? Recall from Section 6.5.1.3 that dots can trigger *copredication*: both types can usually be simultaneously activated by different predicates in the same sentence. If we compare *lunch* with *beer* in (29), we can see that the former definitely supports copredication while the acceptability of the latter is much lower. Although both may refer to FOOD and EVENT, their interpretation in this context is different: *lunch* is FOOD and EVENT at the same time (therefore it can be both delicious and quick), while *beer* is FOOD that can participate in certain typical events (of drinking it, brewing it, etc.), therefore it can be delicious but not quick unless we interpret it relative to one of these events.

- (29) a. The lunch was delicious<sub>[Food]</sub> and very quick<sub>[Event]</sub>.  
 b. ??The beer was delicious<sub>[Food]</sub> and very quick<sub>[Event]</sub>.

We thus conclude that only in the case of *lunch* the EVENT type is a part of the basic word typing. The compositional mechanisms giving rise to the EVENT interpretation of *beer* (selectional polysemy) will be introduced in Section 11.4.

The copredication test yields the same results with lexically ambiguous words. For example, the noun *bat* in (30) can denote a flying mammal or a stick, but it clearly rejects copredication. Therefore we must conclude that it is not a dotted noun but rather two homonymous nouns with unrelated meanings: <sup>1</sup>*bat* typed as ANIMAL and <sup>2</sup>*bat* typed as PHYSICAL OBJECT.

- (30) ??Bats mostly [eat fruit]<sub>[Event]</sub> and [are made from ash]<sub>[Event]</sub>.

It is interesting to note that other categories appear to denote complex types. Verbs can also refer to a complex type if one of their arguments is itself a dot object (this is the functional typing of verbs, that we will encounter in Chapter 11). *Read*, *write*, *peruse*, and *scan*, for example select direct objects typed as PHYSICAL OBJECT•INFORMATION:

- (31) a. read a {book/ article/ report/ chapter}  
 b. write a {letter/ essay/ paper/ novel}  
 c. peruse the {menu/ catalog/ cookbook/ diary}  
 d. scan the {file/ resume/ tag/ photograph}

Further evidence that these verbs are actual dots is that, when they combine with nouns that are not of the required type, these nouns may be reinterpreted as a dot object. For example, the PHYSICAL OBJECT, *wall*, in (32b) and the INFORMATION, *rumor*, in (32c) are reinterpreted as PHYS.OBJ•INFO in order to satisfy the selectional requirements of *read*: we assume that the wall had some text written on it and, similarly, that the rumor was seen on some kind of physical medium (a screen, a page, etc.). The details on how these coercion mechanisms work will be discussed in Chapter 11.

- (32) a. John quickly read the wall.  
c. John quickly read the rumor.

One of the fundamental questions concerning the status of complex types is whether any two types can form a dot object, or are there logical or conventional constraints on their formation and distribution. Although this issue is far from well understood, it appears that dot objects can be treated as complex lexicalized relational states between two or more participants. From this perspective, complex objects are not unlike events, which represent a dynamic relationship between participants with specific roles (e.g., some Agent did something to some Patient). Dots may be built upon all kinds of relations between types or aspects, but only conventionalized and productive relations are prominent enough to yield a word with a typical dot behavior. As the examples in (29) show, the types FOOD and EVENT form a dot in the case of *lunch* but not in the case of *beer*. The EVENT meaning is certainly encoded as one of the sublexical features of *beer* (e.g., the drinking event), but it is not a part of its semantic typing and hence can only be accessed through coercion (cf. Section 11.4).

## 7.5 Summary

In this chapter, we examined the internal makeup of lexical meaning, namely, the semantic components out of which words are built (or *composed*). In particular, we reviewed:

- Different *strategies of lexical decomposition*: the relational approach; simple predicate-based decomposition; parametric decomposition; and structured predicate-based decomposition. We showed that *structured predicate-based decomposition* reduces the need for identifying primitive meaning components because it is compositionally oriented: both the predicate and its arguments are decomposed and their sublexical features determine how they interact in context.
- The notion of *semantic type*. We established that semantic types are not just convenient labels that help us group words based on their meaning and their syntactic behavior. They are complex constructions, whose properties ultimately depend on the sublexical features that make up the meaning of the word. We argued that the dimensions encoded in qualia structure are crucially involved in the interpretation and syntactic behavior of different semantic groups of words.
- How words can be organized in linguistic hierarchies or *ontologies* based on their semantic type. Many words can be ascribed to different semantic types depending on the particular meaning dimension that is being considered (inherent properties, function, internal constitution, etc.), which gives rise to *multiple inheritance*. Sometimes (in *complex types*) even the most basic, inherent properties can stem from two different or even (apparently) incompatible semantic types. We further explore this issue in Chapter 10.

## 7.6 Further Readings

Add these to a line mentioning semantic types: Katz 1972, Pustejovsky 1995, Pustejovsky *et al.* 2006, Havasi *et al.* 2007, Lenci *et al.* 2000b, Murphy 2010).

Topic	Primary references
Discussion of several problematic issues related to lexical decomposition	Jackendoff (2002) (sec. 11.2.)
Detailed presentation of the view on decomposition adopted in this book	Pustejovsky (2013)
Tripartite semantic type system natural/artifactual/complex	Pustejovsky (1995), Pustejovsky (2001)
Dotted types	Pustejovsky (1995) (sec. 6.2., 8.3.), Asher and Pustejovsky (2013), Babonnaud <i>et al.</i> (2016), A. Rumshisky (2007), Cooper (2007)
An alternative interpretation of qualia and dot objects	Jackendoff (2002) (sec. 11.9.-11.10.)
Topic	Secondary references
Comprehensive primers on decomposition	Engelberg (2011b), Engelberg (2011a)
Introduction into ontological categories and semantic types	Murphy (2010)
Qualia, natural/artifactual types, complex types	Ježek (2016) (sec. 3.2., 3.5., 4.4.2.)

## 7.7 Exercises

- What semantic types can appear as the compulsory arguments (subject, direct object, PP-complement) of the following verbs? For example, for *barbecue* we would have: [HUMAN] barbecues [FOOD]. Provide examples to illustrate the proposed semantic templates.
  - accuse
  - amend
  - accomplish
  - apologize
  - park
  - patrol
- Analyze the meaning of the following pairs/triples of lexical items following the simple decompositional approach. Which semantic components differentiate their meanings in each case?
  - fall-drop
  - give-take
  - walk-stroll-race
  - liquid-tea-digestif
  - student-apprentice
- Provide qualia structure representations for the following nouns. Which of them correspond to natural types and which ones to artifactuals?

- 
- a. car  
b. squirrel  
c. beer
- d. lamp  
e. president
4. Which role of the qualia structure of the head noun is selected by the modifier in these expressions?
- a. mountainous region  
b. synthetic fabric  
c. sour fruit  
d. natural light  
e. skilled instructor  
f. big house
- g. sugar cane  
h. fishing rod  
i. brick house  
j. sunburn  
k. shopping bag  
l. work stress
5. The following expressions are ambiguous. How can this ambiguity be accounted for in terms of semantic types and qualia structure?
- a. old friend  
b. criminal lawyer  
c. lavender cupcake  
d. new book
- e. long quiz  
f. finish the book  
g. welcome the appointment
6. The following words represent dot objects. Based on the provided definitions, identify the different aspects (i.e., simple types) of each dot and the inherent relation holding between them.
- a. *bottle* 'container with a narrow neck and no handle / content of such a container'  
b. *letter* 'written message / piece of paper with a message'  
c. *window* 'an opening in a wall to let in light and air / the glass and frame that cover such an opening'  
d. *orange* 'large juicy citrus fruit / evergreen citrus tree with fruits that are oranges'  
e. *dinner* 'food eaten in the afternoon or in the evening / the event at which this food is served'  
f. *concert* 'piece of music performed by several voices or instruments / public performance of music'  
g. *date* 'meeting of two persons that often has a romantic character / a person whom one meets as part of a romantic date'

## 8 Argument Structure

---

### 8.1 Overview

In this chapter, we focus on the role that **argument structure** plays in encoding the predicative force associated with lexical items in a language. Argument structure is the specification of both the number and type of logical arguments to a predicate. Although the notion of argument structure is typically defined for verbs, we will see that all major lexical categories have the capacity of encoding predications of an individual or relations between individuals. Hence, argument structure can be seen as a property of all the major categories.

### 8.2 The Basics of Function-Argument Behavior

#### 8.2.1 Motivating Argument Structure

The notion of argument structure is actually one that we are familiar with from algebra in the concepts of mathematical relation and function. Here's the connection. Both mathematical relations and natural language sentences can be seen as **saturated** expressions having two parts: a relational component and the list of arguments. 'Saturated' refers to the fact that there are no argument values missing. Together, they make up a proposition that is either true or false. For example, consider the relations 'less than' ( $<$ ) and 'equal to' ( $=$ ) in (1).

- (1) a.  $5 < 7$   
b.  $\frac{1}{2} = .5$

In (1a), the relation is ' $<$ ' and its arguments are '5' and '7', and it is a true statement. Similarly, in (1b), the relation is ' $=$ ' and its arguments are  $\frac{1}{2}$  and .5, and it is also a true statement. This is similar to how sentences have a relational part and an argument list, as demonstrated in (2b).

- (2) a. Karen likes chocolate.  
    **like**(Karen, chocolate)  
b. Peter attended MIT.  
    **attend**(Peter, MIT)

Namely, the relation **like** takes the arguments *Karen* and *chocolate*, while the relation **attend** takes *Peter* and *MIT*. Both sentences are said to be saturated, because all of their arguments have specified values.

By analogy, we say that a mathematical or natural language expression is **unsaturated** if one of the arguments is missing its value. For example, the mathematical function in (3a), which returns the square of the value of the variable  $x$ , is unsaturated when the value of  $x$  is not specified. Similarly, a natural language predicate, such as *smile* in (3b), is unsaturated until a subject is associated with it.



- (3) a.  $y = x^2$   
 b.  $\text{smile}(z)$

By specifying values to the argument in each of these expressions (e.g.,  $x = 3$ ,  $z = \text{Sophie}$ ), they go from being unsaturated to saturated, as in the examples above, and now can be evaluated as propositions, having a truth value.

One of the striking features of natural language is that most lexical categories and phrases can act as though they are unsaturated and looking for a value to fill a variable in an argument list. For example, we can think of adjectives as predicates that are lexically unsaturated, but which become saturated when they combine with the appropriate context to fill their argument slot. Consider the adjectives *large* and *proud* in (4) below, which are shown as unsaturated expressions followed by examples of their being saturated.

- (4) a.  $\text{large}(x)$   
       Boston is *large*.  
       My office has a *large* desk.  
       b.  $\text{proud}(x, y)$   
       Mary is *proud* of her daughter.

Notice how the adjective *large* in (4a) is unsaturated until it finds a value to fill the argument slot. In the first example, the subject of the sentence, *Boston*, fills the argument slot, while in the second example, the argument is filled by the NP head, *desk*. In (4b), the adjective *proud* has two arguments, and these are filled by *Mary* and *her daughter*, respectively.

In this chapter, we provide a framework to formally express how lexical items and linguistic expressions encode their arguments, while in Chapter 11 we provide the compositional mechanisms for putting these structures together to make larger phrases and sentences that have meaning. We will first examine the different strategies that allow us to identify the arguments to a predicate, i.e., how many there are and what types are associated with them. This information will be encoded through the use of typed feature structure representations. As an example, consider the intransitive verb *smile* from (3) above. Here's what we know about this verb: it has one argument (a subject); we know its syntactic category (DP); and we know its semantic category (ANIMATE). These features make up the argument structure (or **subcategorization frame**) of the verb, shown in (5) below.

$$(5) \left[ \begin{array}{l} \text{smile} \\ \text{AS} = \left[ \text{ARG}_1 = \left[ x = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{animate} \end{array} \right] \right] \right] \end{array} \right]$$

This feature structure can also be written as an unsaturated expression similar to those we encountered in (3) and (4) above, as illustrated in (6).

- (6)  $\text{smile}(x:\{\text{DP}, \text{animate}\})$

We will also refer to such representations as *functional expressions*, for reasons we explain in Section 11.2, where we introduce the  $\lambda$ -calculus. The features in the argument structure for the verb *smile* “license” (or allow) the DPs *the boy*, *the stranger*, *the dolphin*, and so forth, while rejecting other phrases, such as *the box* and *the car*. This is because the former nouns are all semantically typed as ANIMATE, while the latter are not.

In the remainder of this chapter, we explore the properties associated with a predicate's argument structure, while enriching the typed feature structure representations that account for these behaviors.

### 8.2.2 Argument Structure and Lexical Meaning in the Predicate

It should be obvious at this point that a word's tendency to select certain kinds of arguments is closely connected to the word's meaning. Many different frameworks acknowledge this fact: for example, the *Projection Principle* in generative grammar stipulates that syntactic structures are projected from the lexicon and that lexical features must be preserved at every syntactic level (Section 3.3). Indeed, it has long been noted that semantically related verbs are often close in their syntactic behavior. Let us take a brief look at two such groups of verbs in English to demonstrate this: VERBS OF DIRECTED MOTION and VERBS OF TRANSFER OF POSSESSION. Verbs of directed motion always encode a specification of the direction of motion (through its GOAL, SOURCE, or PATH) in their meaning, even if it is not expressed overtly. For instance, the meaning of *come* and *arrive* includes the GOAL of motion, which is expressed in (7a) via a prepositional phrase (*to Boston/in Madrid*) and which is interpreted as the location of the speaker or location known by the speaker (for *come* and *arrive*, respectively, in (7b) and (7c)) when there is no explicit GOAL argument.

- (7) a. John {came **to Boston** / arrived **in Madrid**}.
- b. John came late for dinner. [**to the location of the speaker**]
- c. John arrived yesterday. [**to some location known by the speaker**]

Directed motion verbs encoding the SOURCE of motion show an interesting *argument alternation*: their SOURCE argument can be expressed as a prepositional complement or as a direct object, as with *depart*, *flee*, and *leave*, shown in (8).

- (8) a. Your group just departed (from) JFK airport.
- b. John fled (from) the police station.
- c. The train left (from) Atocha Station at noon.

This alternation, however, does not work for SOURCE arguments of other groups of verbs generally, as (9) illustrates.

- (9) a. John borrowed a car from his roommate.
- b. \*John borrowed a car his roommate.

To a more limited extent, this alternation is also seen with directed motion verbs encoding the GOAL argument, such as *enter*, *infiltrate*, and *arrive*, as used in (10). Notice that *arrive home* in (10c) seems almost idiomatic, since one cannot use this alternation with other nominals: e.g., “\*Mary arrived work”.

- (10) a. The train just entered (into) Spain.
- b. The runoff will infiltrate (into) shallow groundwater.
- c. Mary arrived (at) home.

The alternation in (10) allowing the preposition to drop does not apply to simply any verb with a GOAL argument. MANNER OF MOTION verbs (*run*, *walk*, *swim*, and so forth) reject it, as illustrated below.

- (11) a. John {ran / drove} to the river.
- b. \*John {ran / drove} the river.

What the sentences in (8) and (10) show is an interesting correlation between a verb's argument structure and specific patterns of its syntactic behavior (in this case, argument alternations). How general this correlation is, however, can only be determined by studying more verb classes.

Verbs of TRANSFER-OF-POSSESSION (*give, lend, pay, feed*, etc.) constitute, a priori, a semantically homogeneous class: they denote events involving the transfer of something from one person or place to another. They also show an argument alternation known as the *dative alternation* or *dative shift*: the GOAL argument can be expressed as a *to*-PP (in (12a)) or as a direct object (in (12b)):

- (12) a. John {lent/ gave} the money *to* Mike.  
b. John {lent/ gave} Mike the money.

Finally, there is another verb class, MATERIAL-PRODUCT verbs, which illustrates an interesting alternation that is peculiar to the verb's argument structure. This class includes verbs such as: *carve, knit, fold, forge*, and so forth. Consider the alternations in (13)-(14) below.

- (13) a. Mary carved a boat out of the wood.  
b. Mary carved the wood into a boat.

- (14) a. Bill forged a blade out of the metal.  
b. Mary forged the metal into a blade.

An important consequence of this relation between word meaning and argument structure is that argument structure is defined relative to specific *word senses* rather than the word itself, i.e., a polysemous word can have different argument structures assigned to its different senses. For instance, when *come* means 'be available or produced in a certain way or format', it no longer has a GOAL argument (as in (15a)); similarly when *depart* means 'be different, deviate', the SOURCE argument is obligatorily introduced by the preposition *from* (as in (15b)).

- (15) a. These shoes come in five colors.  
b. His story departs \*(from) the official narrative.

From these few examples, it is not clear how much of a verb's argument structure is determined by its semantics; conversely, it is not obvious how much a verb's semantics is reflected in its argument structure. It would, of course, be very convenient for language learners if a word's meaning was directly and transparently reflected in its syntactic behavior in the language. As it happens, however, things are more complicated than that. First of all, if we want to base our theory of argument selection on lexical meaning, we need to isolate the exact meaning components that determine the argument structure properties. Our first attempt at defining semantic verb classes consisted in using very general labels: verbs of DIRECTED MOTION and TRANSFER-OF-POSSESSION. These labels may be intuitive but they have no theoretical basis and they have been shown to insufficiently account for argument structure realization.

To illustrate this, let us reconsider at the dative shift argument alternation we examined above in (12). Recall that this allows a GOAL argument to "shift" from a *to*-PP object into a direct object position to the verb, and this seems to occur with the TRANSFER-OF-POSSESSION verbs. As it happens, however, certain verbs in this class (e.g., *contribute, transfer, and donate* in (16)) only allow the *to* variant (in (16a)) and reject the "shifted" double object construction (in (16b)). This is also the case with *supply, present, and provide* (in (17)), which, in addition, can introduce the transferred object through a *with*-PP (see Levin 1993):

- (16) a. He {contributed/ donated/ transferred} his painting to our charity.  
 b. \*He {contributed/ donated/ transferred} our charity his painting.
- (17) a. He {supplied/ presented/ provided} new equipment to our hospital.  
 b. He {supplied/ presented/ provided} our hospital with new equipment.  
 c. \*He {supplied/ presented/ provided} our hospital new equipment.

Hence, not all members of the TRANSFER-OF-POSSESSION class participate in this argument alternation. To make matters more complicated, there are other semantically unrelated classes of verbs that do display the dative shift alternation, such as some verbs of carrying and throwing, as demonstrated in (18) with the verbs *drag*, *push*, *kick*, and *toss*.

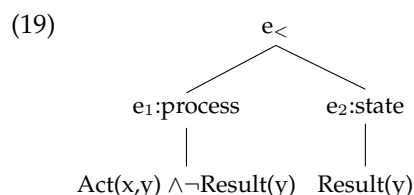
- (18) a. Mary {dragged/ kicked/ tossed} the box to John.  
 b. Mary {dragged/ kicked/ tossed} John the box.

The bottom line in all this is that there seems to be no one-to-one correspondence between a semantic class as we have defined it and a particular argument realization: that is, not all the members of the same class have the same argument structure (AS) properties; conversely, the same AS configuration can be detected in a number of semantic classes.

Although the debate over which aspects of verb meaning are mirrored in the argument structure of the predicate is far from settled (cf. Levin and Hovav 2005), most researchers seem to agree that semantic aspects of argument realization are largely determined by properties of the *events* described by verbs: the arguments refer to event participants, and the nature of the event determines how these participants interact among themselves and which roles they take on.

As we have already seen (Section 6.3.3), many of the linguistically important properties of a predicate are encoded in the lexical-semantic representation known as the *event structure*. We have seen several event structure formalizations in the preceding chapters: as a feature structure in Section 3.7 and 6.3.3, and as function-argument pairings integrated within the Conceptual Structure in Section 5.3. What these and other representations share is that they describe events as complex and structured entities, made up of different phases or subevents ordered with respect to each other, while also encoding the relations holding between different event participants in each of these phases.

To illustrate the role that events play in determining argument structure, let's consider a prototypical transitive predicate that encodes *causation*, where one participant (the AGENT) acts on another participant (usually, the THEME or PATIENT) and brings about a change in the latter. These events are complex and are typically viewed as consisting of (at least) two subevents: the *causing subevent* and the *resulting state*. As shown in the GL-like tree diagram in (19), the causing subevent  $e_1$  precedes the resulting subevent  $e_2$ .  $e_1$  is related to the semantic predicate **Act**, which takes as its arguments both the AGENT and the THEME/PATIENT, and  $e_2$  is the resulting state, **Result**, brought about by  $e_1$ , which takes the THEME/PATIENT as its only argument. The AGENT participates in the causing subevent but not in the resultant state since, unlike the THEME/PATIENT, it does not bear the consequences of the event. The semantics of **Become** is captured by the transition from the non-resulting state of the THEME/PATIENT,  $\neg\text{Result}(y)$ , to  $\text{Result}(y)$  in  $e_2$ .



The event structure notation in (19) is equivalent to both expressions in (20).

- (20) a. **Cause**([Act(x,y) ∧ ¬Result(y)], Result(y))  
 b. **Cause**(Act(x,y), **Become**(Result(y)))

This approach allows one to account for verbal meaning alternations when changes in the event structure act as a trigger to argument structure alternations. As an example of this dependency, consider the *causative-inchoative alternation*, shown by many change-of-state verbs in English, including the verb *break*. The causative variant of the verb in (21) is transitive, while the inchoative (in (22)) is intransitive. Both forms denote a change of state in the THEME/PATIENT, but only the causative form refers to the AGENT.

- (21) a. Mary broke the glass.  
 b. **Cause**([break\_act(mary,the-glass)] ∧ ¬broken(the-glass)], broken(the-glass))  
 c. **Cause**(break\_act(mary,the-glass), **Become**(broken(the-glass)))
- (22) a. The glass broke.  
 b. **Become**(broken(the-glass))

Rather than stipulating that these two uses correspond to different meanings of *break*, it is generally agreed that this is a case of regular polysemy, where similar or even identical events can be conceptualized and linguistically expressed in different ways. Both constructions are obviously related although their event structure (ES) properties are different: the inchoative variant **profiles** (as in Cognitive Linguistics) or **foregrounds** (as in Generative Lexicon) the second subevent, leaving the causing subevent in the background.

This ES alternation has a direct impact on the AS: the causative variant has two subevents and two syntactic arguments, while the inchoative variant has two subevents but just one argument. The correlation between the number of expressed subevents and arguments associated with them has been identified as an ES-governed licensing constraint on AS realization, according to which the different subevents must be *properly identified* by arguments referring to specific event participants. A simple binary event structure associated with change must have at least one argument, as in (22), where the syntactic subject encodes the only participant of the event, the THEME that undergoes a change of state. More complex subevents, in turn, must have at least two arguments, as in (21), where the syntactic subject encodes the AGENT involved in the causing subevent and the direct object encodes the THEME/PATIENT involved in both the causing and the resulting subevent.

The different approaches to AS and ES vary as to what linguistic component accommodates the primitive predicates corresponding to the subevents and their related participants. Lexicalist frameworks (e.g., Generative Lexicon and Conceptual Semantics) claim that the ES is a part of the verbal lexical entry (although it may be further augmented by the contribution of other phrasal components, as we will see shortly). Some Minimalist models (such as *neoconstructionists*), in turn, encode the event structure of the the lexical verb and verbal predicate directly in

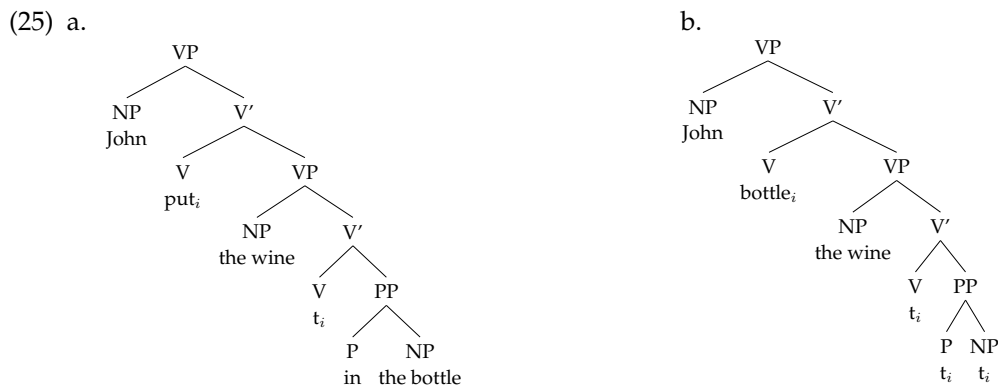
the syntactic phrase structure, where different functional projections and features represent different parts of the event and the associated participants. The latter approach goes back to the decompositional approach to verbal semantics first developed by the proponents of Generative Semantics in the 1970s, and which was integrated within the minimalist framework in Larson (1988) and Hale and Keyser (1993). Let us see how this is done in the latter study, by comparing the meaning of the two sentences in (23).

- (23) a. John **put** the wine **in the bottle**.  
 b. John **bottled** the wine.

For Generative Semantics, what is important is that these sentences share a common semantic representation, informally glossed in (24).

- (24) 'John causes the wine to be in the bottle.'

For Hale and Keyser's analysis, what is important is that, if they do mean the same thing, then they should also share syntactic representations, as illustrated in (25).



The VP in both sentences has two layers or *VP shells*. The outer VP (usually called *vP*, with a 'little *v*') is usually assumed to encode the causing subevent of a complex ES, and it has the AGENT subject in its specifier. The inner VP, in turn, encodes the resultant subevent subordinated to the "external" causing subevent, so that both sentences could be paraphrased as 'John caused the wine to be in the bottle'. The specifier of the internal VP accommodates the THEME or PATIENT undergoing change of state and its complement refers to the resultant state itself ('in the bottle'). The structure proposed for *John bottled the wine*, with the denominal verb *bottle*, is interesting because this verb's meaning is derived in the syntax (what Hale and Keyser call *lexical syntax* or *l-syntax*) and all the components of its event structure and argument structure are explicitly represented as a part of the syntactic tree.

Another way in which a verb's event structure appears to affect argument structure can be seen in the distinction between *manner* and *result* information in verbs. Manner verbs specify a particular way an action is performed: for example, manner-of-motion verbs specify how the motion is achieved (*walk*, *jog*); manner-of-clean verbs specify how a cleaning or removing is achieved (*scrub*, *wipe*), and so on. Result verbs, on the other hand, lexicalize (i.e., encode in the word) that a resultant state has been reached: for example, the change-of-state and change-of-location verbs (*quit*, *explode*, *burn*, *clean*, *arrive*, etc.). It has been argued that verbs lexicalize one of these meaning components but not both. To illustrate this distinction, let's compare the behavior of the manner-of-clean verb *scrub* with the result verb *clean*, as in (26).

- (26) a. Pete scrubbed the bathtub (clean).  
 b. Pete cleaned the bathtub (by scrubbing it/ \*clean).

In (26a), the verb *scrub* conveys the manner and the adjective *clean* expresses the result ('Pete acted on the bathtub in a scrubbing manner and as a result it became clean'). In (26b), on the other hand, the verb *clean* already encodes the result and hence it sounds odd or redundant to specify the resulting state as "clean".

It seems that the only group of verbs that can be properly defined as result verbs are those that explicitly encode an end point along a scale of change, such as height, width, weight, or even more abstract notions such as cleanliness and happiness. These are sometimes called *scalar change verbs* in the literature: they establish a correlation between the temporal progression of the event and its impact on the properties of entities denoted by the verbal arguments. For example, the *deadjectival* verb *widen* (as in *John widened the sidewalk*) expresses a gradual change along the width dimension that its direct object undergoes: as the event of widening unfolds, the sidewalk gradually gains in width. Similarly, verbs of *vertical motion* (e.g., *The balloon rose*) encode a scalar change along the dimension of height: the vertical position of the rising object changes as the rising event proceeds. Notions of scalarity and scalar change will be examined in Chapter 9. On the other hand, some manner verbs encode change without making reference to a specific scale. For example, *walk*, *jog* and *waltz* involve a particular (and quite complex) pattern of leg movements but none of the changes within this pattern makes any explicit reference to a progression along a scalar dimension, although this is often the resulting interpretation when combined with directional PPs: e.g., *John walked towards the park*.

Now that the semantic distinction between manner and result verbs has been identified, it is interesting to note that their corresponding argument realization patterns are also distinguished, as we now demonstrate. Consider again the verb pair we encountered above, *scrub* and *clean*, and their respective behavior in two different syntactic patterns, the *resultative* construction (27) and the *conative* construction (28).

- (27) a. Cinderella scrubbed her knuckles raw (on a wash board).  
       'Cinderella scrubbed something and as a result her knuckles became raw'  
 b. \*Cinderella cleaned her knuckles raw.  
       'Cinderella cleaned something and as a result her knuckles became raw'

- (28) a. John scrubbed (at) the door.  
 b. John cleaned (\*at) the door.

Overall, the argument structure of result verbs seems to be much more constrained. Manner verbs can be found with nonsubcategorized (i.e., not selected by the verb) objects (as in (27a), where the scrubbed object could be a piece of cloth and 'her knuckles raw' is the result of the scrubbing process), or with THEME arguments introduced by prepositions (in the *oblique case*, as in (28a)). As shown in (27b) and (28b), neither possibility is available with result verbs: they reject nonsubcategorized complements and can only be combined with direct object THEMES. Furthermore, most manner verbs can be used with an unspecified direct object, as in (29a), while result verbs usually require an overt direct object (as with *clear* in (29a)).

- (29) a. What is John doing? - He's scrubbing (the table).  
 b. What is John doing? - He's clearing \*(the table).

When talking about the ES properties of the verbs and their relation to the AS, it must be

taken into account that the same event can be conceptualized and linguistically expressed in different ways, and that different components of a complex event can be expressed through different components of the predicate because the event construction is compositional. Recall, for instance, how in (26a) and (26b) the same scalar change-of-state event was encoded in two very different ways: in (26a) the verb *scrub* lexicalizes the manner and the result complement referring to a scalar attribute (the ‘cleanness’) is introduced by an adjective; in (26b), by contrast, the main verb *clean* expresses scalar change and the *by*-phrase with a manner participle encodes how the change was brought about.

Another manifestation of the compositional predicate construction is that, although the verbs seems to determine (to a large extent) what kind of arguments they are compatible with, the properties of the arguments that fill in certain argument positions can affect the morphosyntactic realization of the predicate. Let us look at the following sentences in Spanish: although the verb *ver* ‘to see’ is compatible with both animate and inanimate direct objects, if the object is animate it must be introduced by the preposition *a*.

(30) a. Vi la mesa.  
‘I saw the table.’

b. Vi *a* Pablo.  
‘I saw Pablo.’

An obvious conclusion from all the facts we have reviewed so far seems to be that AS realization is predictable from verbal meaning to a large extent but not entirely. Moreover, not all factors that govern argument realization are semantic in nature (or syntactic, for that matter). For instance, heavier (i.e., longer) complements are known to appear preferably at the end of the sentence, as illustrated by the contrast between (31a) and (31b), and the contrast between (31b) and (31c).

- (31) a. John gave [Pete] [a bookshelf that he had worked on for several years in his shop].  
b. ?John gave [a bookshelf that he had worked on for several years in his shop] [to Pete].  
c. John gave [a bookshelf that he had worked on for several years in his shop] [to the one person who is most likely to not want it].

Another source of argument structure alternations is the *information structure* of the sentence: which information is presented as new or previously known, what the topic of conversation is, etc. For instance, it is generally the case that known information is presented earlier in the sentence than new information. It has been argued that the double object construction is more frequent than the *to* construction because the recipient of a transfer-of-possession event is usually human (compare *John gave his student a lot of time* with *?John gave his garden a lot of time*) and is therefore more likely to be the topic of conversation. The double object construction is more frequent precisely because the recipient appears before the theme and is more likely to be interpreted as the topic.

### 8.2.3 Arguments and Adjuncts

In the previous section, we explored how a verb’s argument structure is a reflection of its meaning, as well as how a verb’s meaning is partly determined by its arguments. In this section, we take this methodology one step further to see which “sentence participants” count as arguments to a verb in the first place. This leads us to a distinction between verbal **arguments** and what are called **adjuncts**. To illustrate this distinction, consider the sentences in (32) below.



- (32) a. Mary ate her lunch.  
       b. Mary ate her lunch **at noon**.  
       c. Mary ate her lunch **in the cafeteria**.  
       d. Mary ate her lunch **with chopsticks**.

The sentence in (32a) consists of the verb *eat* along with its two arguments (*Mary* and *her lunch*); each subsequent sentence modifies this core event description with additional information. The phrases in bold are called *adjuncts*, since they are not obligatory. In fact, one characteristic property of adjuncts is their ability to co-occur with one another, as shown in (33).

- (33) Mary ate her lunch [**at noon**] [**in the cafeteria**] [**with chopsticks**].

**WARNING: Broad and Narrow Sense of Argument**

The term **argument** can be used in a broad sense, to refer to all the components of a predicate (both arguments and adjuncts) minus the head, or in a narrow sense, to refer to the required components only (to the exclusion of adjuncts).

There is much more to the distinction between arguments and adjuncts, but for now, this will help guide us through the behavior of phrasal selection across categories. As it happens, every major lexical category can be accompanied by both arguments and adjuncts in context, as the following examples show, where Verb, Noun, and Adjective all display a kind of argument/adjunct distinction. For example, the head of each phrase in (34) is marked in bold, its argument appears in italics and the adjunct in regular characters.

- (34) a. They [<sub>VP</sub> [<sub>V</sub> **built** [<sub>NP</sub> *houses*]] [<sub>PP</sub> *for ten years*]]  
       b. They are [<sub>NP</sub> [<sub>AP</sub> *unconditional*] [<sub>N</sub> **supporters** [<sub>PP</sub> *of the referendum*]]]  
       c. Such people are [<sub>AP</sub> [<sub>A</sub> **prone** [<sub>PP</sub> *to depression*]] [<sub>PP</sub> *from an early age*]]

In (34a) the head of the VP *built houses for ten years* is the verb *built*, the direct object ‘houses’ is a required argument, and the PP ‘for ten years’ is an adjunct referring to the place of the event encoded by the predicate. The head of the NP *unconditional supporters of the referendum* in (34b) is *supporters*, which is preceded by an optional modifier ‘unconditional’ and followed by a required PP complement ‘of the referendum’. Finally, the head of the AP *prone to depression from an early age* in (34c) is *prone*, whose complement is the PP ‘to depression’ and whose modifier is the PP ‘from an early age’.

While not reliable for all cases, there are four basic properties that seem to differentiate arguments from adjuncts.

- (35) DIFFERENCES BETWEEN ARGUMENTS AND ADJUNCTS:  
       a. Adjuncts can be easily omitted or added while the arguments cannot.  
       b. The categorial realization of arguments is usually very limited, while the adjuncts display more flexibility in this respect.  
       c. Arguments usually appear closer to the selecting head than the adjuncts.  
       d. Arguments and adjuncts cannot be coordinated.

For example, the sentences below illustrate the first characteristic in (35a) concerning deletion.

- (36) a. John built \*(houses) (for ten years).  
       b. John stacked \*(the blocks) (carelessly).

In both (36a) and (36b), the time adjunct ‘for ten years’ and the manner adjunct ‘carelessly’ can be omitted without causing significant changes in the meaning of the predicate. By contrast, the

direct objects *houses* in (36a) and *the blocks* in (36b) cannot be left out, as the resulting sentences are unacceptable.

The same applies to introducing additional arguments or adjuncts: the intransitive verb *work*, for example, does not accept the complement ‘the laptop’ as a direct object in (37a), but it does allow us to introduce it as an adjunct, in the form of a PP (‘on the laptop’ in (37b)). Note that, in the latter case, we also have a time adjunct (‘everyday’), a place adjunct (‘at the university’) and a co-agent adjunct (‘with his friend Mike’).

- (37) a. John works (\*the laptop).  
 b. John works [on the laptop] [everyday] [at the university] [with his friend Mike].

Now consider the behavior of property (35b), namely, the ways in which an argument or adjunct can be realized syntactically. Consider the adjective *prone* as used in (38) below.

- (38) a. John is prone (to/ \*for/ \*towards) {depression/ getting depressed}.  
 b. John is prone to getting depressed (after a breakup/ at the beginning of every school year/ in the winter).

Notice that the PP complement of *prone* can only be introduced by the preposition *to* followed by a noun (*depression*) or a participle (*getting depressed*). By contrast, the categorial realization of its time adjunct is only limited by the kind of meaning we want to express, as shown in (38b).

Property (35c) is due to the fact that arguments are usually the first expressions to be combined with the head when a phrase is built. The contrast in (39) shows this effect.

- (39) a. John builds houses in Texas.  
 b. \*John in Texas builds houses.

In (39a) the direct object *houses* immediately follows the selecting verb, and in (39b) the verb and the direct object are separated by the adjunct *in Texas*, which results in an ungrammatical sentence.

The relative order of arguments is also more constrained than the order of adjuncts. For example, as the oddness of (40a) shows, the direct object *houses* can only be preposed to *build* in very specific contexts (e.g., in emphatic readings). The place, time, and beneficiary adjuncts, on the other hand, can be moved around almost freely, as in (40a) and (40b).

- (40) a. ?Houses built John.  
 b. John built houses [in Texas] [for underprivileged families] [for many years].  
 c. John built houses [for underprivileged families] [in Texas] [for many years].

Next, consider property (35d) concerning the constraints on coordination between arguments and adjuncts. In (41a), the direct object *cold steel* and the PP adjunct *on the laptop* are coordinated, yielding an unacceptable sentence. By contrast, (41b) and (41c) are fine because in the former case two direct objects are coordinated, and in the latter two PP adjuncts of the same kind (both *laptop* and *tablet* refer to the tools involved in John’s work).

- (41) a. \*John worked cold steel and on the laptop.  
 b. John worked cold steel and hardwood.  
 c. John worked on the laptop and the tablet.

The same constraint seems to hold when we coordinate different kinds of adjuncts, as in (42).

- (42) \*Mary ate dinner with Kate and with chopsticks.

Here, the phrase ‘with Kate’ is a co-agent adjunct and ‘with chopsticks’ is an instrument adjunct. Although both are introduced by the preposition *with*, they cannot be coordinated because they are semantically distinct.

Finally, there are some more distinctions between arguments and adjuncts that should be mentioned. Adjuncts encoding the circumstances of an event are potentially always present, because any event takes place in time, at a certain location, and is brought about in a certain manner. Adjuncts can also encode degree or measure (43a), instrument (43b), cause (43c), purpose (43d), medium (43e), etc.

- (43) a. I like cats *a lot*.  
       b. He opened the door *with a keycard*.  
       c. I helped you *out of pity*.  
       d. I helped you *to teach you a lesson*.  
       e. The came *by ship*.

**WARNING Compulsory Arguments Encoding Event Circumstances**

Predicate members expressing the circumstances of an event should not be automatically classified as adjuncts, because the same meanings can be expressed by required arguments. The verb *behave*, for example, must be combined with a manner complement (*The kid behaved \*(terribly)*), *last* and *cost* require a measure argument (*The meeting lasted \*(for two hours)*, *This suit costs \*(a fortune)*), and *reside* needs a place argument (*The Smith family resides \*(in Manchester)*).

Even though adjuncts are not required by the selecting predicate, they must be compatible with it and cannot be added freely. For example, manner adverbs such as *fast* and *slowly* can only appear in predicates headed by dynamic verbs (activities, achievements, and accomplishments, recall Section 6.3.3):

- (44) a. John {drove/ came/ baked the cake} *fast*.  
       b. \*John slept *fast*.

Time adjuncts with *for*, on the other hand, can only appear in durative predicates, i.e., activities, states, and accomplishments, as in (45a). With verbs denoting instantaneous events, the only acceptable interpretation is the iterative one: (45b) with the achievement *come* denotes the same kind of event repeated over the period of ten years (see also Sections 9.3.2, 9.3.3, and 11.3).

- (45) a. John {drove/ slept/ baked the cake} *for three hours*.  
       b. John came to visit his aunt *for ten years every summer*.

## 8.2.4 Unexpressed Arguments

This section delves further into the relation between the meaning of a predicate and its arguments. We will see several instances of how the meaning of an argument can be incorporated into the predicate’s semantics, allowing that argument to be unexpressed in the syntax. We will also see that, in addition to being *compatible* with the predicate, its arguments and adjuncts must be *informative*, i.e., must convey new information not presupposed in the meaning of the predicate. Here we examine two types of unexpressed arguments that have very different semantic and syntactic properties: implicit arguments and default arguments.

It is well known that languages allow typically “compulsory” arguments to be omitted. For example, in Russian, a direct object can be omitted in certain contexts, as illustrated in (46a). Similarly, in Spanish, a subject argument pronoun (‘she/he’) can be omitted, as in (46b).

- (46) a. Kro stroit etot dom? - Ja stroju.  
           *Who builds this house? - I build.*  
           ‘Who is building this house? - I am.’  
       b. No lo quiere.  
           *Not it wants.*  
           ‘He/she does not want it.’

Both the object in (46a) and the subject in (46b) are called *implicit arguments*. Although in both cases the omitted arguments are phonologically invisible, they are still syntactically and semantically real. Their syntactic features are visible on the verb when the subject and the verb have to agree: *quiere* is third person singular, like the pronouns *he* and *she*. In syntactic notation, these arguments are represented by the empty element *pro* (*pro* stands for ‘pronoun’). Semantically, these invisible arguments refer to specific entities in the context: we know what house is being talked about in (46a) and what person does not want something in (46b). Both Russian and Spanish are *pro-drop languages*: they allow their arguments to be left unexpressed in certain contexts. This can be done because they have rich verbal inflection and the grammatical information encoded by the implicit arguments can be recovered from the verbal predicate. English, on the other hand, has a very poor verbal morphology and is non-*pro-drop*. The literal translation of the Russian and Spanish examples is ungrammatical in English precisely because the required arguments are omitted.

In other cases, the content of the missing arguments cannot be deduced from context and it is debatable whether they are present in the syntax. For example, (47) conveys that Mary has had a meal or, more in general, ingested something edible (rather than a piece of paper of a pair of scissors).

- (47) Mary ate hastily.

This meaning seems to be contributed by the verb but it cannot be traced back to a specific element in the context. Following the Generative Lexicon tradition, we will be referring to arguments that are semantically incorporated into the lexical items as *default arguments*.

One specific group of verbs that encode their arguments directly in their root are the **cognate object verbs**. The direct object nouns in (48) are derived from the verbs and have the same form. Some of these verbs are intransitive (48a,b), others are transitive (48c).

- (48) a. They lived a \*(happy) life.  
       b. The couple danced a \*(beautiful) dance.  
       c. She buttered her toast with \*(organic) butter.

Precisely because the default arguments are semantically encoded by their predicate, they are uninformative (i.e., they just duplicate the meaning of the predicate). Therefore, they are usually *shadowed* by the predicate: if the adjectival modifiers in (48) are missing, the sentences are ungrammatical. The presence of the modifiers is compulsory here because they make the sentences informative by further specifying them: a happy life is a particular kind of life, a beautiful dance is a kind of dance and organic butter is subtype of butter. Another way of making a default argument informative consists in attaching a contrastive interpretation to it: *I eat FOOD*, with emphatic accent on ‘food’, can mean ‘I eat good/healthy food rather than junk food’.

The same constraint seems to apply to predicate members traditionally classified as adjuncts, as the examples in (49) illustrate. The information that a building event involves some kind of building material is encoded in the lexical entry of the verb *build*. This is why (49a) is uninformative and therefore unacceptable. (49b), on the other hand, is informative because it refers to a specific kind of building material (i.e., bricks).

- (49) a. \*John built the house out of building materials.  
 b. John built the house out of bricks.

It is important to note that the conditions under which an argument can be expressed or omitted are not entirely predictable from the lexical semantics of the predicate, but are also dependent on other factors in the syntax as well as the pragmatics of the discourse.

## 8.3 Argument Structure in Verbs

As mentioned in Section 8.2.2, verbs describe events and the nature of the event determines which participants are encoded as verbal arguments, how they interact with one another, and what roles they play in the event. As we know (Section 2.2), these roles are usually termed as **thematic** or **semantic** roles in grammatical studies. The number and semantic type of arguments linked to a verb are often referred to by the term **verb valency**. In this section, we take a closer look at the notion of semantic roles (in Section 8.3.1) and then show how verbs can be classified in terms of valency (in Section 8.3.2).

### 8.3.1 Semantic Roles and Related Notions

Notions related to the semantic definition of the roles taken on by different event participants go back as far as Paṇini's Sanskrit grammar written over twenty centuries ago. In generative grammar, semantic roles were first introduced by Gruber (1965) and Fillmore (1968) under the terms of *semantic relations* and *case roles*, because they were believed to be directly related to the nominal case systems in languages with rich morphology. This conception of semantic relations as associated with case roles was later inherited by Frame Semantics (see Section 3.6) and implemented in the lexical database FrameNet, introduced in Section 6.4.2. As mentioned there, in Frame Semantics, semantic roles represent an open repository of frame-specific labels assigned to every member of the predicate regardless of its status (argument/adjunct) and syntactic realization.

Later, Jackendoff (1972) enriched Gruber's notion of semantic relations into *thematic roles*, which were then adopted by the Government and Binding model in a much more limited fashion, as *theta*-roles, where they become a purely syntactic notion. In this capacity, they could only be assigned to the arguments selected by the predicate, never to the optional complements (i.e., adjuncts). Two principles were introduced in order to guarantee the correct association of the arguments listed in the lexical entry of the predicate with specific syntactic positions: the ***θ*-criterion** (Chomsky 1981) and the **Uniformity of Theta Assignment Hypothesis (UTAH)** (Baker 1988, modified in subsequent work):

- The ***θ*-CRITERION**: Each argument bears one and only one *θ*-role, and each *θ*-role is assigned to one and only one argument.
- The **UNIFORMITY OF THETA ASSIGNMENT HYPOTHESIS (UTAH)**: Identical thematic relationships between items are represented by identical underlying structural relationships between those items.

To first illustrate how the *θ*-criterion helps to filter out ungrammatical constructions, consider the following sentences.

- Now, assume that the verb *break* has the following argument structures:

- The examples in (b) and (d), by contrast, are filtered out by the  $\theta$ -criterion: in (b) the Theme  $\theta$ -role is not assigned to any argument, and in (c) there is one argument with no  $\theta$ -role (*Barbie*).

$\theta$ -ROLES	<u>AGENT</u>	THEME		
a.		broke	the watch	
b.	The boy	broke		
c.	The boy	broke	the watch	
d.	The boy	broke	the watch	Barbie

Table 8.1 Illustration of the  $\theta$ -criterion

(52) a. Mary melted the ice cream.  
b. The ice cream melted.

(53) a. Alexander Fleming discovered penicillin.  
b. The discovery of penicillin by Alexander Fleming.

Notions equivalent or similar to the semantic/thematic roles have been a matter of much controversy even with the most fundamental issues, despite their extended use in different frameworks and their potential to account for a wide range of semantic, syntactic, and even pragmatic phenomena. Some of these issues are the following:

- (54) a. Are all the components of the predicate, including adjuncts, assigned these labels, or just selected arguments?
- b. Are the semantic roles linguistic (semantic or syntactic) labels or real-world relationships, are they primitive or derived notions, natural language universals or language-specific features?
- c. What is the list of thematic roles? The existing repertoires go from two (Van Valin and LaPolla, 1997) to almost a thousand (in FrameNet).
- d. How are roles assigned to the appropriate arguments in specific grammatical relations?

In addition to these issues, both the  $\theta$ -criterion and UTAH have always been controversial. In the absence of independent proof, UTAH is purely stipulative, while the  $\theta$ -criterion has been shown to fail on a number of verb groups. For example, if we look at verbs of change of possession and communication in (55) (both usually classified within the 'transfer' group), the syntactic subject *Jane* seems to be assigned two thematic roles, Agent (it refers to the doer of the action) and Source (it is where the Theme is located before the action):

- (55) a. Jane {gave/ sold/ lend} the book to Martha.
- b. Jane {told/ revealed/ announced} Martha that she was going back to school.

Over the years, several attempts have been made to render the semantic roles system more flexible and general (i.e., applicable to larger groups of predicates and situation types). Dowty (1991) proposes to replace the traditional system of discrete roles with two cluster-concepts: PROTO-AGENT and PROTO-PATIENT. Rather than being atomic and undefinable, the proto-roles are generalizations based on a set of lexical features (which Dowty calls *entailments*) associated with the arguments of a specific verbal predicate or group of predicates. The features that are typically associated with the Proto-Agent are volitional involvement in the event, sentience or perception, causing an event or change of state in another participant, and movement relative to the position of another participant. The Proto-Patient, on the other hand, undergoes change of state, is the incremental theme, is causally affected by another participant, and is stationary relative to the movement of another participant.

A verbal argument may bear either of the proto-roles (or both) in varying degrees, depending on the number of entailments given by the verb. The arguments of the prototypical causative transitive verbs (*build*, *murder*, *eat*) usually have all (or most of) the Proto-Agent entailments associated with their subject and all the Proto-Agent entailments associated with their direct object. However, this need not be the case. The subject in (56a) only has one Proto-Agent feature (volition), and the direct object in (56b) only has one Proto-Patient feature (change of state).

- (56) a. *John* is being polite to Bill.
- b. John erased *the error*.

The number of proto-entailments that each verbal argument presents impacts the grammatical function it is assigned in the sentence: namely, the argument with the greatest number of Proto-Agent properties will be the subject, and the argument with the greatest number of Proto-Patient properties the direct object. If two arguments have similar number of entailments, then either subject can be the agent or the object. This is what happens in pairs of psychological verbs

such as *like-please* or *fear-frighten*. The Experiencer subject of the first verb in each pair has the sentence property (the Experiencer feels or perceives the Stimulus), and the Stimulus subject of the second verb has the property of causing an emotional change of state in the Experiencer. This yields a tie situation, resolved through the existence of two verbs with very similar meanings but different argument structure properties.

A similar approach is taken in Role and Reference Grammar. Van Valin and LaPolla (1997) propose two universal semantic relations (the *marco-roles* ACTOR and UNDERGOER), but their proposal is different from Dowty's in that the semantic roles are associated with primitive semantic predicates into which the verb meaning is decomposed. The macro-roles are not broken down into basic semantic features, and the algorithm for assigning the macro-roles is more sophisticated and it goes beyond the subject and direct object.

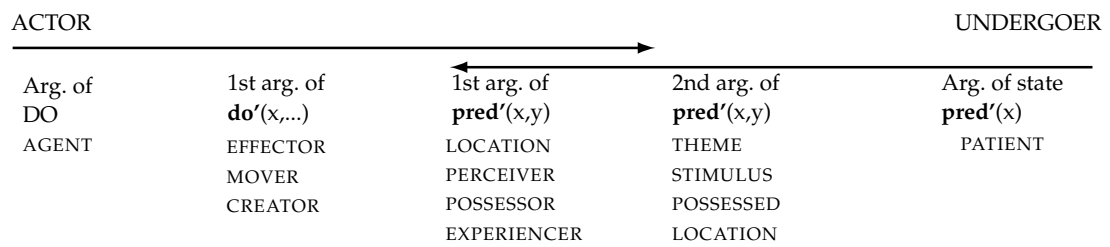
The prototypical Actor is the first argument of a verb that can only have an agentive interpretation (such as *murder* in (57a), with the semantic predicate DO). It can also be the *Effector* (a kind of agent that is not necessarily volitional) of verbs like *kill* (57b), *present* (57d) or *put* (57e), where it is the first argument of the semantic predicate **do**. In more marked cases, it can even be the Experiencer (as with *see* in (57c)). The prototypical Undergoer is the only argument of a stative semantic predicate (e.g., **dead** in (57a) and (57b)). Whenever the relevant conditions are met (which we refer to below), the Undergoer can also be the second argument of a stative semantic predicate, for example *see* in (57c), the possessive **have'** (in (57d)) or the locative **be-LOC'** (in (57e)).

- (57) a. *murder*: DO(x, [do'(x, ∅)]) CAUSE [BECOME **dead'**(y)]  
       b. *kill*: [do'(x, ∅)] CAUSE [BECOME **dead'**(y)]  
       c. *see*: **see'**(x, y)  
       d. *present*: [do'(x, ∅)] CAUSE [BECOME **have'**(y, z)]  
       e. *put*: [do'(x, ∅)] CAUSE [BECOME **be-LOC'**(y, z)]

(Van Valin and LaPolla, 1997)

There is an explicit hierarchy that establishes which predicate member can be the Actor (and be realized as the subject in active sentences) and which can be the Undergoer (and be realized as the direct object). As shown in figure 8.1, the highest ranked argument that can be the Actor is the argument of DO. The rightward arrow signals the increasing markedness of realization of an argument as the Actor: the further to the right, the less likely the argument is to be the Actor (e.g., the subject of *murder*, which is the Agent, is higher ranked than the Effector subject of *kill*, which in turn outranks the Perceiver subject of *see*). The leftward arrow signals the increasing markedness of realization of an argument as the Undergoer: a marked choice is possible if the sentence has no Patient. *Murder* and *kill* both have a Patient, which is the highest ranked Undergoer. *See* has a Stimulus argument, which is automatically treated as the Undergoer because it is the only non-Actor argument. *Present* and *put* do not have a Patient argument, and there are two non-Actor arguments that compete for undergoerhood: Theme and Recipient with *present*, and Theme and Location with *put*. When this happens, the entity that is most affected by the action is the Undergoer: the Recipient in the former case and the Theme in the latter.





**Figure 8.1** *The Actor-Undergoer Hierarchy.* Adapted from Van Valin and LaPolla (1997)

Semantic roles do not currently play a prominent role in generative linguistic theory and are considered to be a derived rather than a basic notion. The semantic properties of the arguments that they encode, on this view, can be largely derived from the properties of the events which verbs describe, as we saw in Section 8.2.2. Hence, most researchers interested in this topic focus their attention on event structure conceptualization and related issues. On the other hand, they do play an increasingly important role in computational linguistic approaches to lexical semantics and resource construction, such as VerbNet, FrameNet, PropBank, and others.

### 8.3.2 Verbal Valency

In the previous section, we discussed the manner in which semantic roles can be associated with a verb's arguments, and their subsequent role in how an argument maps to syntax. In this section, we introduce the notion of a verb's **valency**: that is, the number of arguments licensed by a verb in the syntax. This is also referred to as the verb's *arity* or *adicity* in the literature. It is generally assumed that most verbs in natural language can be grouped into one of four valency classes: **avalent**, **monovalent**, **bivalent**, and **trivalent**. We discuss each class in turn below.

On the surface, some verbs appear to require no arguments at all, as in the following example with *weather*-verbs in Italian:

- (58) Nevica/ piove/ grandina.  
lit.: 'It {snows/ rains/ hails}.'

These verbs are called **impersonal** or **avalent**. Note that in the English translation, there is a subject, called the *expletive* or *pleonastic* 'it'. It has no semantic content but it does fill the role of syntactic subject. Another example of an expletive word is *there*, as in *There was chocolate*.

Verbs selecting for one argument are called **intransitive** or **monovalent**. Their only argument in English and many other languages is the subject. Examples of monovalent verbs are shown in (59).

- (59) a. [Mike] {ran/ worked/ danced}.  
b. [Mike] {left/ fell/ died}.  
c. [The window] {broke/ opened/ shattered}.

If we pay closer attention to the examples in (59a) and (59b-c), we see that the verbs included in both groups denote very different kinds of events. The predicates in (59a) denote activities (dynamic, durative and atelic events, recall Section 6.3.3), while the predicates in (59b-c) denote achievements (dynamic, instantaneous and telic events). In addition, the semantic roles assigned to the subject in these sentences are different: in (59a), *Mike* is the Agent carrying out an activity,

while in (59b-c) the subject is more like a Theme or Patient, undergoing a change of state which it did not necessarily cause.

These and other differences led the researchers to split the group of intransitive verbs or predicates into two subgroups: **unergative** (59a) and **unaccusative** (59b). The subjects of unergative verbs display the properties of prototypical subjects of transitive verbs, which are usually agentive. The subjects of unaccusative verbs, by contrast, have the properties of direct objects of transitive verbs, beginning with the fact that their semantic role is Theme or Patient. We will see below that the unaccusatives in (59c) are distinguished from those in (59b) in having a transitive form as well.

As far as syntactic differences between unergatives and unaccusatives are concerned, there does not seem to be a unique or universal pattern. Rather, the identified diagnostics are language-specific. In Italian, for example, unaccusative predicates seem to choose the auxiliary verb *essere* in the past tense (*passato prossimo*) and the unergatives are combined with *avere*, as in (60a) and (60b), respectively. *Essere* is also used to build the passive constructions (as in (60c)), where the syntactic subject corresponds to the direct object of the active construction, which would suggest that unaccusative subjects and transitive objects are indeed related.

- |  |   |
|--|---|
| (60) a. [Marco] è uscito.<br>'Marco has left.' | c. [Marco] è stato licenziato.<br>'Marco has been fired.' |
| b. [Marco] ha lavorato.<br>'Marco has worked.' |   |

In Spanish, unaccusative verbs can appear in *participial absolute constructions* (61a) and as *adjectival perfect participles* (61c), both of which unergative verbs do not permit (in (61b) and (61d)).

- (61) a. Caído el dictador, se celebraron las elecciones.  
      lit.: 'Fallen the dictator, elections were held.' (= 'After the dictator fell, elections were held')
- b. \*Bailado Juan, todos empezaron a aplaudir.  
      lit.: 'Danced Juan, everyone started applauding.' (= 'After Juan danced, everyone started applauding')
- c. el dictador caído 'the fallen dictator'
- d. \*el niño bailado 'the danced boy'

As we can see from the translations, a similar contrast can be found in English: *fallen dictator*, with unaccusative *fall*, is acceptable, while *danced boy*, with unergative *dance*, is ungrammatical. As with the auxiliary selection, the behavior of unaccusative and transitive constructions is similar: compare *fallen dictator* with *painted wall*.

For English, the *resultative construction* (mentioned in Section 3.6) seems to be acceptable with both transitive and unaccusative verbs, as illustrated in (62) below.

- (62) a. [She] wiped [the table] *clean*.  
      b. [The bottle] broke *open*.  
      c. [Dora] shouted \*([herself]) *hoarse*. (Levin and Hovav, 1995)

In (62a), the table was wiped until it became clean, while in (62b), the result of the breaking event is that the bottle became open. Notice that this is not available as a construction for unergatives, however: if we wish to convey that the result of Dora's shouting was that she became hoarse (in (62c)), we need to insert the reflexive *herself*.

Notice that the verb, *wipe*, in (62a) is transitive, i.e., it has two arguments. In terms of valency, these are called **bivalent** verbs. This syntactic characterization covers many different semantic classes, from verbs of change of state (63a,b) to stative verbs (63c,d), as seen in (63).

- (63) a. [John] broke [the glass].  
       b. [John] baked [the cake].  
       c. [John] knew [the answer].  
       d. [John] hated [kale].

CLUE/COMMENT[magnifying glass icon]: Bivalent verbs are far more frequent in most languages than any other valency class. Roland *et al.* (2007) reports that bivalent verbs are twice as frequent as monovalent verbs in English.

The final valency class, **trivalent** verbs, characterizes the **ditransitives**, which are verbs taking three arguments. The transfer-of-possession verbs examined in Section 8.2.2 belong to this group (64a), as do the verbs of carrying and throwing (64b), some performative verbs (64c), the verbs of command (64d), and the verbs of putting (64e), among other groups.

- (64) a. [John] {handed/ gave} [Mary] [his car keys].  
       b. [John] {dragged/ kicked/ tossed} [the box] [to Mary].  
       c. [John] promised [Mary] [a cash bonus].  
       d. [John] ordered [Mary] [to leave].  
       e. [John] hung [the picture] [on the wall].

There are few verbs that allow more than three arguments, but they do exist, and include *bet* and *trade*, as shown in (65).

- (65) a. [I] bet [you] [five dollars] [that he'll leave before the end of the year].  
       b. [I] traded [her] [a purse] [for a pair of designer shoes].

As mentioned in the previous sections, verbal valency can be altered, i.e., reduced or extended. In passive constructions the subject is demoted and the verb has one less argument, and with some transitive verbs the direct object can be left unexpressed, as shown in Section 8.2.4. An additional argument may be introduced through resultative constructions, as in (62).

## 8.4 Argument Structure in Nouns

While it is natural to think of verbs as having arguments, the fact is that, from both a semantic and syntactic perspective, arguments play a role in most of major categories, i.e., verbs, nouns, adjectives, and prepositions. In this section we focus on noun argument behavior.

Recall that in Section 6.3.2 we defined *predication* as the semantic act of applying a property to an individual or establishing a relation between individuals. Although most common nouns, unlike verbs, do not establish relations between individuals, they do apply a property to an individual, and therefore they appear to function as semantic predicates with an argument. For common nouns, this predication refers to *sortal classes*, i.e., properties identifying objects as a “sort” of some larger class, and the argument can be called a *referential* argument,  $\text{arg}_{ref}$ . The lexical structure common to such nouns is shown below in (66), with examples in (67).

- (66) SORTAL\_NOUN( $\text{arg}_{ref}$ )

- (67) a. Jaco is a *dog*.  
           DOG(*Jaco*)  
       b. Mike is a *professor*.  
           PROFESSOR(*Mike*)  
       c. Some professor is American.  
            $\exists x[\text{PROFESSOR}(x) \wedge \text{AMERICAN}(x)]$

When we utter (67a), we ascribe the property of being a dog to the individual Jaco: that is, we include the individual Jaco in the class of dogs. In (67b), the property ‘professor’ is predicated of the individual Mike. As represented in (67a,b), *Jaco* and *Mike* are the semantic arguments of the predicates DOG and PROFESSOR, respectively. Of course, the referred to individual does not need to be mentioned by name. Whenever a common noun is integrated into a referring expression (see Section 4.3.3), the individual with a relevant property is identified directly through this property. For example, in (67c), an unnamed individual is ascribed the properties of being a PROFESSOR and an AMERICAN.

**WARNING: Referring expressions are not Semantic Predicates**

From what has been discussed so far (also Section 4.3), it follows that proper names (*Jaco*, *Mike*, *Subaru*, etc.) and other referring expressions (*the dog*, *my professor*, etc.) are not semantic predicates: they denote individuals rather than properties or sets of individuals, and they do not have any open argument slots. In formal semantics, they are represented by constant symbols (see §5.2).

In the remainder of this section we will focus on nouns that establish some kind of relation between individuals. This class comprises three groups:

1. INHERENTLY RELATIONAL NOUNS, which establish an association between two or more arguments by virtue of their inherent lexical meaning.
2. QUALIA-BASED RELATIONAL NOUNS, which establish an association between two or more arguments by virtue of aspects of their qualia structure.
3. NOUNS DERIVED FROM VERBS AND ADJECTIVES, which inherit their arguments from their bases.

The first group includes several subgroups, including: *kinship* and *social* relations; *inalienable possession* nouns; *inherent attribute* nouns; *artifactual* nouns; and *representational* artifacts. These will all have the general lexical structure template shown in (68), where  $\text{arg}_{ref}$  is the *referential* argument, mentioned above, and  $\text{arg}_{rel}$  is the argument introduced by the inherent relation.

- (68) RELATIONAL\_NOUN( $\text{arg}_{ref}, \text{arg}_{rel}$ )

We review each class below, and illustrate how they instantiate the general template in (68).

**Kinship terms**, such as *father* and *sister*, as well as **social relations**, such as *student* and *friend*, take as their argument an animate individual related to another individual by this relation. In English, this argument can be introduced by a genitive phrase or a PP with the preposition *of*.

- (69) a. John is Mary’s father / John is the father of Mary  
           FATHER(*John*, *Mary*)  
       b. John is Mary’s friend / John is a friend of Mary’s  
           FRIEND(*John*, *Mary*)  
       c. John is Mary’s student / John is a student of Mary’s  
           STUDENT(*John*, *Mary*)

Note that some relations are functions, because they just have one value for any given argument (recall Section 6.3.2). Hence, the noun *father* in (69) can also be interpreted as the function, *FATHER\_OF*(Mary), because it refers to a unique person (e.g., John), since humans have only one father (in the biological sense). *Cousin* and *student* are relational rather than functional nouns: a person can have more than one cousin or student. *Cousin* encodes a symmetric relation: if John is Mary's cousin, then Mary is a cousin of John. The *student* relation, on the other hand, is not symmetric: if John is Mary's student, then Mary is John's teacher and not his student.

**Nouns of inalienable possession** are also inherently relational: they establish a part-whole relation between two entities wherein the name of the part takes as its argument the name of the whole. The resulting lexical structure in (70) is a specialization of the general relational structure given in (68), and examples of such nouns include *hair*, *bank*, and *roof*, shown in (71).

(70) *PART\_OF*( $\text{arg}_{ref}, \text{arg}_{rel}$ )

- |   |  |
|---|--|
| <p>(71) a. John's hair<br/>             <i>HAIR</i>(<math>\text{arg}_{ref}, \text{John}</math>)<br/>             b. the bank of the Charles River<br/>                 <i>BANK</i>(<math>\text{arg}_{ref}, \text{Charles}</math>)</p> | <p>c. the roof of the hotel<br/>             <i>ROOF</i>(<math>\text{arg}_{ref}, \text{the\_hotel}</math>)</p> |
|---|--|

In these examples, the noun *hair* takes as its argument the animate entity that has it, *bank* presupposes as a part of its meaning that it is a part of a river or a lake, and *roof* that it is part of a building of some sort. Hence, these nouns encode both the referential argument (entity referred to as the *PART*) and the relational argument (the *WHOLE*).

However, it is important to bear in mind that not *all* possession is inalienable. For example, the sentence *Jaco is James' dog* establishes a possession relation between *James* and *Jaco*, but this does not mean that *Jaco* is a part of *James*. The noun *dog* can be used without presupposing that it must have an argument referring to its owner or anything that it might be part of.

**Nouns encoding inherent attributes** of people and things yield a specific value of these attributes for their argument. Hence, while the attributive adjective *green* predicates directly over a referential argument, *GREEN*( $\text{arg}_{ref}$ ), the noun *color* has two arguments: the value argument of the attribute ( $\text{arg}_{val}$ ), in addition to the referential argument.

(72) *ATTRIBUTE\_OF*( $\text{arg}_{ref}$ ) =  $\text{arg}_{val}$

That is, they are also acting as functional nouns. Such nouns include: *color*, *price*, and *shape*, among many others. Consider the NPs shown in (73) below.

- |   |  |
|---|--|
| <p>(73) a. the color of the car<br/>             <i>COLOR</i>(<math>\text{arg}_{val}, \text{the\_car}</math>)</p> | <p>b. the shape of the table<br/>             <i>SHAPE</i>(<math>\text{arg}_{val}, \text{the\_table}</math>)</p> |
|---|--|

In the examples above, the nominal attribute *color* refers to a specific value for the car, e.g., *COLOR\_OF*(*the\_car*) = green; and the attribute *shape* is uniquely defined for a particular table, e.g., *SHAPE\_OF*(*the\_table*) = square.

As we have already seen, **artifacts** (*sandwich*, *table*, *umbrella*) are lexically (and conceptually) identified by specific information concerning their function and origin (Section 3.7, 6.3.4, 7.4). Interestingly, there is a subclass of artifacts, whose members behave in many ways like relational nouns: namely those artifactual nouns referring to products of artistic or intellectual creation. Consider the NPs in (74) below, where the possessive argument in each example refers to the agent who brought about the entity referred to by the head noun, as its creation.

- (74) a. Pythagoras' theorem  
           THEOREM( $\text{arg}_{ref}$ , Pythagoras)  
       b. Gaudí's house  
           HOUSE( $\text{arg}_{ref}$ , Gaudí)  
       c. Mary's report  
           REPORT( $\text{arg}_{ref}$ , Mary)

However, unlike inherently relational nouns (such as those in (69), (71), and (73) above), these exhibit a relation that is associated with the AGENTIVE qualia role, rather than the FORMAL role. That is, in (74a), *Pythagoras* is an argument in the AGENTIVE role of “proving” for the noun *theorem*, *Gaudí* is an argument in the AGENTIVE role of “designing” for the noun *house*, and so on. Hence, this class specializes the relational noun template, RELATIONAL\_NOUN( $\text{arg}_{ref}$ ,  $\text{arg}_{rel}$ ), as that in (75), where  $\text{arg}_Q$  refers to an argument of a specific qualia role:

- (75) QUALIA\_RELATIONAL( $\text{arg}_{ref}$ ,  $\text{arg}_Q$ )

Another type of created artifact that also behaves relationally is the class known as **representational artifacts**. This includes nouns such as *portrait*, *painting*, *statue*, *drawing*, and *book*, and they also allow the qualia-based agentive argument to be expressed, as illustrated in (76b).

- (76) a. Da Vinci's painting  
           PAINTING( $\text{arg}_{ref}$ , Da Vinci)  
       b. Rodin's statue  
           STATUE( $\text{arg}_{ref}$ , Rodin)

Unlike artifactual nouns such as *house*, however, representational artifacts are actually inherently relational, having an underlying semantics shown below:

- (77) REPRESENTATION\_OF( $\text{arg}_{ref}$ ,  $\text{arg}_{rel}$ )

Hence, for the NPs shown in (78b), the relational argument is actually that object (or scene) being represented by the physical depiction encoded by the referential argument,  $\text{arg}_{ref}$ .

- (78) a. painting of la joconde  
           PAINTING( $\text{arg}_{ref}$ , la-joconde)  
       b. statue of David  
           STATUE( $\text{arg}_{ref}$ , David)

That is,  $\text{arg}_{ref}$  is the depiction of the relational argument in both examples: the painting is a two-dimensional image of la joconde, while the statue is a three-dimensional model of David.

It has been argued (following Vikner and Jensen 2002) that, in large part, the range of relations possible in possessive constructions with relational nouns is determined by the lexical semantics of the head N, in particular by its Qualia Structure. For example, recall that nouns of inalienable possession have as their CONSTITUTIVE value the object they are a part of, while a created artifact includes in its AGENTIVE role the information about the agent who brought it about. Hence, the lexical structure template QUALIA\_RELATIONAL, in (75), is actually invoked for both kinds of relational nouns, as indicated below.

- (79) a. John's hair  
       b. Gaudí's house
- $$\left[ \begin{array}{l} \text{hair}(x) \\ \text{QS} = \left[ \begin{array}{ll} \text{F} & = \text{phys.object}(x) \\ \text{C} & = \text{part.of}(x,y) \end{array} \right] \end{array} \right]$$
- $$\left[ \begin{array}{l} \text{house}(x) \\ \text{QS} = \left[ \begin{array}{ll} \text{F} & = \text{phys.object}(x) \\ \text{A} & = \text{build}(y,x) \end{array} \right] \end{array} \right]$$

The final class of relational nouns we review, *nominalizations*, is perhaps the most common, since they are derived from other categories and new ones are constantly being generated by morphological rules in the language. Nominalizations can be generated from either verbs or adjectives, where they inherit their arguments from their corresponding morphological base.

**Deverbal nouns** can refer to the event or state encoded by the base verb, or to one of its participants. The nominal *translation* (derived from *translate*), for example, can have two different meanings. In (80a), it means ‘event of translating’, and as for all events its duration can be measured. In (80b), *translation* is the object created as the result of the event of translating (i.e. the translated text). Since this resulting object is typed as INFORMATION (or as INFORMATION•PHYS\_OBJ), it can be read. In both cases the Theme argument of the base verb ([‘translate] the ancient manuscript’) is encoded as a part of the PP complement of *translation*.

- (80) a. The *translation* of the ancient manuscript took two years.  
 b. I read the impeccable *translation* of the ancient manuscript.

Nominalizations can also be made from states. For example, *love*, *knowledge*, *fear*, *hatred*, and *desire*, among others, are all nouns derived from stative verbs. They are often modified by possessive phrases referring to the Experiencer (EXP) of the emotional state, and sometimes also by PPs containing the Cause (CAUSE) argument of the base verb:

- (81) a. John<sub>EXP</sub> loves Mary<sub>CAUSE</sub> / John’s<sub>EXP</sub> love for Mary<sub>CAUSE</sub>.  
 b. John<sub>EXP</sub> fears the dentist<sub>CAUSE</sub> / John’s<sub>EXP</sub> fear of the dentist<sub>CAUSE</sub>.

Nominalizations referring to event participants very frequently saturate the Agent argument (as in (82b)), and also sometimes the Instrument argument, as in (82d). Both semantic roles are very similar in meaning and are usually realized as syntactic subjects of the verb.

- |   |  |
|---|--|
| (82) a. John manages the Department.<br>MANAGE(Agent,Theme) | c. The machine calculates taxes.<br>CALCULATE(Agent,Theme) |
| b. manager of the Department<br>MANAGER_OF(Theme)           | d. tax calculator<br>CALCULATOR_OF(Theme)                  |

In addition to nominalizations encoding the *resulting object* or *effected Theme* (e.g., *translation*, *building*, *proposal*, etc.), we also find nominals saturating the *affected Theme* (cf. Section 2.2 on the ‘affected/effected’ distinction):

- |   |  |
|---|--|
| (83) a. Trump appointed him as CIA Director.<br>APPOINT(Agent,Theme,Goal) | e. John hung his jacket on the coat stand.<br>HANG(Agent,Theme,Goal)     |
| b. Trump’s appointee for CIA Director<br>APPOINTEE_OF/TO(Agent,Goal)      | f. (coat) hanger<br>HANGER_OF(Theme)                                     |
| c. John attached the file to the email.<br>ATTACH(Agent,Theme,Goal)       | g. John addressed the letter to his lawyer.<br>ADDRESS(Agent,Theme,Goal) |
| d. John’s attachment to the email<br>ATTACHMENT_OF/TO(Agent,Goal)         | h. addressee of the letter<br>ADDRESSEE_OF(Theme)                        |

Notice that *appointee* in (83b) refers to the Theme of *appoint*, while *attachment* in (83d) encodes the Theme of *attach*. The other required arguments (*hanger* in (83f) and *addressee* in (83h) refer to the Goal arguments of *hang* and *address*, respectively.

A noteworthy property of nominalizations is that their arguments are usually optional, even when they are compulsory with the base verb. As shown in (84), the noun *assassination* can be used with both Agent and Theme arguments (84a), just the Theme argument (84b), or without either (84d). Notice that Agent argument cannot appear alone, however as (84c) demonstrates. For the verb *assassinate*, the presence of both arguments is required (85).

- (84) a. Chapman's<sub>Agent</sub> assassination of John Lennon<sub>Theme</sub> was tragic.  
 b. John Lennon's<sub>Theme</sub> assassination was tragic.  
 c. \*Chapman's<sub>Agent</sub> assassination was tragic.  
 d. The assassination was tragic.

- (85) a. Chapman<sub>Agent</sub> assassinated \*(John Lennon<sub>Theme</sub>).  
 b. \*(Chapman<sub>Agent</sub>) assassinated John Lennon<sub>Theme</sub>.

Let us now focus on **deadjectival nominals**. Adjectives, like common nouns, take as their semantic argument an individual to whom they apply an attribute, as in (86a-d). Deadjectival nouns (86e-h) inherit this argument and add another,  $arg_{val}$ , the actual value of the predication to the  $arg_{ref}$ .

- |                           |   |
|---------------------------|---|
| (86) a. The boy is sad.   | e. the sadness of the boy                   |
| SAD( <i>boy</i> )         | SADNESS( $arg_{val}$ , <i>boy</i> )         |
| b. The building is high.  | f. the height of the building               |
| HIGH( <i>building</i> )   | HEIGHT( $arg_{val}$ , <i>building</i> )     |
| c. The monk is wise.      | g. the wisdom of the monk                   |
| WISE( <i>monk</i> )       | WISDOM( $arg_{val}$ , <i>monk</i> )         |
| d. Mike is unfaithful.    | h. Mike's unfaithfulness                    |
| UNFAITHFUL( <i>Mike</i> ) | UNFAITHFULNESS( $arg_{val}$ , <i>Mike</i> ) |

If we take a closer look at these examples, we realize that the interpretation is slightly different in each case, depending on the properties of the base adjective. *Sadness*, for example, is a **state nominalization** derived from the stage-level adjective *sad* (see Section 7.3 on the stage-level vs. individual-level distinction). Like all states, *sadness* can be modified by certain aspectual adjectives: {*sudden/constant*} sadness of the boy.

The adjective *high* encodes an individual-level property or quality: a 'high building' is a building of a more than average height. Note, however, that the **quality nominal** *height* is ambiguous. Imagine you are watching a new apartment block being built: 'the height of the building' can refer to the height attribute generally (i.e., the distance from the bottom to the top, as in *The height of this building is rising*) or to a specific value of this attribute (as in *The height of this building is 150 meters*). We will refer to the former reading as the **attribute interpretation** and to the latter as the **value interpretation** of a quality nominalization.

Although the individual-level adjective *wise* and the nominalization *wisdom* are also related to a measurable attribute (the level of knowledgeability, so to say), we can only get the value interpretation for 'the wisdom of the monk' (=the high level of knowledge and good sense). This is because *wise* and *wisdom* lexicalize the upper end of the knowledgeability attribute.

The adjective *unfaithful* cannot be properly classified as either individual or stage level predicate, because it can denote an inherent property of a person, independent of time and circumstances, or a transient condition that might have occurred just once. When *unfaithfulness* is related to the former interpretation, it has a quality reading (i.e., Mike is an unfaithful person).



When *unfaithful* is a transient condition, we can get an **event nominalization**. Such nominalizations describe events which, independently of their specific nature and content, can be qualified through the base adjective: e.g., Mike did something that can be considered as unfaithful. Unlike other deadjectival nominalizations, *unfaithfulness*, *imprudence*, *cruelty*, and *injustice*, among others, pass the tests generally applicable to dynamic events: e.g., they are compatible as direct objects of the verbs *experience* and *witness* (87a), and as subjects of the predicates *take place* and *occur* (87b):

- (87) a. They {experienced/ witnessed} his {**cruelty/ injustice/ unfaithfulness**}.  
 b. His {**injustice/ unfaithfulness**} towards her {took place/ occurred} over years.

## 8.5 Argument Structure in Adjectives

As mentioned in 4.3 and in 8.4, adjectives are predicates ascribing a property to an individual. The main difference between the verbal predicates on the one hand, and nominal and adjectival predicates on the other hand, is that in English and many other (although not all) languages, the latter cannot syntactically form a predicate without the presence of a semantically ‘light’ verb (the copula *be* or similar), which provides tense, aspect and other features encoded by the verbal inflection. Thus, in (88b-c), the present singular form of *to be* is required to license the predication of *a runner* and *fast*, respectively.

- (88) a. John *runs*.  
 b. John **is** *a runner*.  
 c. John **is** *fast*.

Unlike nouns, however, adjectives cannot directly predicate of (or identify) a referent, but rather are said to indirectly predicate as a *secondary quality* of a referent. Nouns combine with identifying terms known as quantifiers: *a*, *every*, *the*, *most*, and so on, to build a referential expression, while adjectives must combine with nouns in order to convey their meaning. For example, in a sentence such as *The boy played with a red ball*, the meaning or denotation of the modifying adjective *red* is combined with the meaning of the noun *ball*, and it is the NP ‘a red ball’ which establishes the identity of its referent based on this combined meaning. In predicative constructions as well (e.g., *The ball is red*), the adjective does not establish a referent, but rather functions like a verb (e.g., *The ball fell*): that is, it acts to further characterize a previously identified referent (‘the ball’) as having some property, e.g., being red or having fallen.

CLUE/COMMENT[magnifying glass icon]: The copula can be dropped, usually in non-past tenses, in a number of languages: Russian, Turkish, Japanese, Arabic, etc. In these languages, constructions such as *John swimmer* and *John fast* are grammatical. English allows this only exceptionally, in idiomatic constructions: *The more the merrier*, *Enough already!*, etc.

Some adjectives, just like nouns, are relational in that they establish a link between two or more individuals. For example, adjectives such as *proud* (89a), *eager* (89b), and *sure* (89c) take two arguments: namely, the referential argument as well as the relational argument.

- (89) a. John is proud of Mary.  
           PROUD(John, Mary)  
       b. John is always eager to learn.  
           EAGER(John, learn)  
       c. John is sure that Mary left.  
           SURE(John, Mary\_left)  
       d. John is angry at Mary.  
           ANGRY(John, Mary)

More exceptionally, some adjectives can take three arguments, such as *superior* and *next* (90).

- (90) a. BMW is superior in quality to Ford.  
           SUPERIOR(BMW, Ford, quality)  
       b. John is next to Mary in line.  
           NEXT(John, Mary, line)

Adjectival complements, in English and other languages, are usually introduced by prepositions. They can contain a nominal (as in (89a,d) and (90)), an infinitive (as in (89b)) or even a clause (as in (89c)).

Deverbal adjectives often inherit the arguments of their base verb. Note that the preposition heading the complement can be also inherited from the base verb (as in the case of ‘{*worry/ worried*} *about*’ and ‘{*divide/ divisible*} *by*’ in (91a,b)) or it can be introduced by the derived adjective, as in (91c,d): ‘*tired of*’, ‘*disappointed in*’, etc.

- (91) a. John worries about Mary/ John is worried about Mary.  
       b. Divide 8 by 4/ 8 is divisible by 4  
       c. The noise tires Mary/ Mary is tired of the noise.  
       d. Mary disappointed John/ John is disappointed in Mary.

The fact that some adjectives select for their complements seems fairly uncontroversial. As we just saw, these adjectives impose categorial constraints on their complement. They can also be shown to require their complements to be of a specific semantic type: for example, *eager*, *sure*, and *tired* are compatible with EVENTS, but the same semantic type is rejected by *superior* (compare \**BMW is superior in running to Ford* and *BMW is superior in speed to Ford*).

Whether or not the modifying adjective selects for the head noun is a more tricky issue. Empirical data from numerous languages suggest that, syntactically, the N is the head of Adj-N construction. In the following Russian examples from Chapter 2, the adjective must agree with the N in case, gender and number, which indicates that the N is the syntactic head of the phrase:

- (92) a. Ona umnaja studentka [NOM.FEM.SG.] - Ja znaju umnuju studentku [ACC.FEM.SG.]  
           ‘She is a smart female student - I know a smart female student’  
       b. On umnyj student [NOM.MASC.SG.] - Ja znaju umnogo studenta [ACC.MASC.SG.]  
           ‘He is a smart male student - I know a smart male student’

On the other hand, the adjective clearly determines the semantic typing of the modified noun. For example, *generous* is mostly predicated of HUMANS and acts performed by humans (*generous* {*person/ friend/ gift/ donation*}); *true* and *false* select for complements typed as PROPOSITION or INFORMATION (*false* {*rumors/ allegations/ beliefs*}); while *fast*, *dangerous* and *surprising* are compatible with EVENTS ({*dangerous/ surprising*} {*journey/ behavior/ consequence*}). When the noun does not have the required semantic type, it can even be *coerced* to be compatible with the adjective: hence, the noun *car* in {*fast/ dangerous*} *car* is not an EVENT, but the eventive reading can be retrieved from the lexical entry of the noun (its TELIC quale), as in ‘a car that is fast/dangerous when someone drives it’. When no such information is readily available, it must be provided

As with nominalizations, adjectival arguments can often be omitted. When this is possible, two situations may arise: (1) the content of the omitted arguments can be recovered from context, or (2) the adjectives acquires a different interpretation. The sentences in (93), for example, illustrate the first situation: a *preferable alternative* is 'an alternative preferable to something else', and when someone is worried, she is 'worried about something'.

In sentence (94a), *proud* is a state-level predicate meaning ‘feeling pride’ or ‘pleased because of something’, while in (94b), without the determiner, it is an individual-level predicate meaning ‘having or showing too much pride’. Notice that, in the Spanish for (94a), one uses the copula *estar*, typically compatible with stage-level predicates. In (94b), *ser* would be used, as with all individual-level predicates. The contrast between the two uses of *fit* is much more marked: in (94c) *fit* means ‘suitable for something’ and in (94d) ‘physically strong’.

Many of these spatial prepositions can also appear as arguments to verbs, where they introduce participants in the event denoted by the matrix predicate. For example, CAUSED\_MOTION verbs make reference to a LOCATION introduced by a preposition, such as those encountered in (96).

- (97) a. Mary put the ball **in** the box.                      c. They mounted the clock **on** the wall.  
       b. John placed his bike **behind** the shed.            d. We parked the car **near** the station.

These prepositions retain their relational meaning in the sentences above, while also being selected by a verbal predicate: hence, in (97a), as a result of Mary's action,  $IN(ball, box)$  is true. How can spatial prepositions retain their relational meaning when they are themselves selected by a verb? We will discuss briefly how this works. Assume that the verb *put* has a lexical structure corresponding to that in (98).

- (98)  $PUT(AGENT, THEME, SPATIAL\_FUNCTION)$

This lexical expression states that *put* is a function which takes another function as one of its arguments, namely the semantic role called  $SPATIAL\_FUNCTION$  (or  $PATH$ ). This role can be seen as a "functional" form of the spatial relation template exploited in (95) above.

- (99) Mary put the ball **in** the box.  
 $PUT([Agent\ Mary], [Theme\ the\ ball], [Spatial\_Function\ in\ ([Location\ the\ box])])$

Hence, while the preposition *in* denotes a spatial relation when predicating by itself (as in (96a)), it is interpreted as a function when composed with the verb *put*, which selects it:

- (100) a. Relation:  $SPATIAL\_RELATION(arg_1, arg_2) \Rightarrow$   
       b. Function:  $SPATIAL\_FUNCTION(arg_1, LOCATION)$

It is important to note that there are many prepositions that have no spatial meaning at all, but which still carry relational interpretations regardless of the category that is selecting them: verb (101a), noun (101b), or adjective (101c).

- (101) a. John  $[wrote]_V$  **about** \*(the war).  
       b. a  $[dinner]_N$  **on** \*(Sunday)  
       c.  $[dead]_A$  **from** \*(cancer)

In these examples, the preposition establishes a link between its complement and the phrase that the PP modifies. In (101b), for example, the preposition *on* selects for the time-denoting NP 'Sunday', and establishes a temporal inclusion relation between this NP and the event-denoting head of the DP 'a dinner':  $TEMPORAL\_RELATION(arg_1, arg_2)$ . But, just as with the prepositions in (97), *on* is treated as a temporal function in the context of modifying the noun 'dinner'. Hence, the DP in (101b) denotes an event modified by a temporal interval, as shown below.

- (102)  $\exists e \exists t [dinner(e) \wedge Sunday(t) \wedge on(e, t)]$

While all prepositions can formally be considered relational, there are observable differences in how much lexical or conceptual content they carry. For example, a preposition such as *over* conveys the meaning of a spatial configuration (as in *over the table*), but the preposition *of* lacks any specific semantic features (as in *of a car*), indicating what is being referred to: is it a picture, engine, price, color, or what?

For this reason, prepositions (and postpositions) are usually classified into two groups, reflecting this "semantic transparency".

1. **GRAMMATICAL PREPOSITIONS:** Prepositions that act as syntactic markers to assign case and are generally devoid of conceptual content.

2. LEXICAL PREPOSITIONS: Prepositions that have a definite semantic content and impose selectional requirements on their arguments.

The first group, *grammatical prepositions*, convey no clear conceptual meaning and merely serve as syntactic markers that link words within complex expressions. This group includes prepositions (such as *of*) that introduce the compulsory arguments of some verbal predicates as well as some arguments of derived nominals. In both these cases, the preposition contributes nothing to the logical form of the sentence, as it has no conceptual meaning.

One of the consequences of the fact that these uses of the prepositions are not semantically motivated is that there is significant cross-linguistic variation. As shown in (103), the complement of *fall in love* is introduced by *with* in English, *de* ('of') in Spanish, and *v* ('in') in Russian.

- (103) a. Anna fell in love *with* Mark.  
 b. Anna se enamoró *de* (= 'of') Mark.  
 c. Anna vljubilas' *v* (= 'in') Marka.

The preposition *of* is grammatical in (104a) and (104b) because it only serves the purpose of adding the arguments after *manuscript* and *room*, respectively, after the deverbal nominal *translation* and the deadjectival nominal *cleanness*.

- (104) a. John translated the manuscript. / John's translation *of* the manuscript.  
 b. clean room / cleanness *of* the room.

Now consider the second class of prepositions in (102), the *lexical prepositions*. This class includes the prepositions in (96) and (101), in that they have definite semantic content, although the meanings they express are very general and often give rise to polysemy. This set of meanings includes location in **time** and **space** (*in, at, on*), **direction** and its components (*to, down, from, for, along*), **orientation** (*before, after, under, above, on*), and **causality** (*by, under, from*).

Lexical prepositions impose semantic typing constraints on their complements, as shown in (105). *In* in its spatial use selects for complements that can be typed as a CONTAINER, whether it is a 1-dimensional, 2-dimensional, or 3-dimensional bounded space. The temporal preposition *during* is compatible with temporal expressions denoting time intervals and events. *Between*, in both the spatial and the temporal use, selects for plural entities.

- (105) a. *in* + CONTAINER  
       in the {line (1D) / square (2D) / bottle (3D)}  
 b. *during* + TIME PERIOD / EVENT  
       during {summer / the week / the war}  
 c. *between* + PLURALITY  
       between {the hotel and the airport / the trees / jobs / now and Monday}

The selectional constraints imposed by the preposition can be clearly appreciated when different facets of the meaning of the complement are targeted, depending on the preposition, and when the meaning of the complement is coerced into the semantic type required by the preposition. The former case is illustrated in (106).

- (106) a. The police broke down the door **with** a bulldozer<sub>TOOL</sub>.  
 b. The mouse ran away **from** the bulldozer<sub>LOCATION</sub>.

As a complement of the preposition *with* in (106a), *bulldozer* is interpreted as a TOOL: the door is

broken down by using a bulldozer. As a complement of the preposition *from* in (106b), *bulldozer* is merely a point-like LOCATION, treated as the beginning or SOURCE of the motion event.

The application of such strong semantic typing constraints on an argument (in (106b)) is actually a kind of type coercion (as seen in Section 6.5.1.3 and 7.4). Another example of coercion is seen in (107).

(107) Society has evolved greatly since the Internet.

*Since* selects for a time point as its argument (as in *I haven't seen him since Monday*), but *the Internet* is an abstract entity (a kind of concept) which is reinterpreted as a temporal expression, i.e., 'time point corresponding to the advent of the use of the Internet'.

Another very frequent kind of type coercion involves the preposition *at* (see Pustejovsky 2012b). Loosely speaking, *at* selects for complements typed as LOCATION and it encodes a relation of spatial coincidence between the Figure and the Ground. The predication in (108) establishes spatial coincidence of the Figure *Mary* and the Ground *lake*.

(108) Mary is at a lake.

$$\exists x[\text{LAKE}(x) \wedge \text{AT}(m, x)]$$

When combined with an EVENT, *at* coerces it into being reinterpreted as the LOCATION where the event takes place. For example, in (109) the event noun *party* is reinterpreted as 'location of the party', and the meaning of the sentence can be paraphrased as 'Mary (*m*) is involved in some event of partying (*e*) that takes place at a location *l*':

(109) Mary is at a party.

$$\exists e \exists l[\text{PARTY}(e, m) \wedge \text{AT}(e, l)]$$

With names of functional spaces, the EVENT interpretation is made available by the telic role (through the mechanism of *qualia exploitation*, to be dealt with in Section 11.4), which encodes the intended activity to which the artifact is destined. For the noun *blackboard* in (110a), the intended function is 'to write on', as shown in the simplified Qualia Structure representation in (110b). This yields the following interpretation of (110a): 'Mary (*m*) is involved in the activity (*e*) of writing on the blackboard (*x*), which takes place at the location *l*'. Notice that Mary's participation in the writing event imposes additional constraints on the generic relation of spatial coincidence between herself and the Ground *blackboard*: she must be facing the blackboard and must be able to reach it with her hand. These constraints do not apply with other prepositions denoting contiguity but not necessarily participation in an event, e.g., *Mary is {near/by} the blackboard*.

(110) a. Mary is at a blackboard.

$$\begin{array}{l} \text{b. } \left[ \begin{array}{c} \text{blackboard}(x) \\ \text{QS} \end{array} \right] = \left[ \begin{array}{cc} \text{F} & = & \text{phys\_object}(x) \\ \text{T} & = & \text{write\_on}(y, x) \end{array} \right] \\ \text{c. } \exists e \exists l \exists x[\text{BLACKBOARD}(x) \wedge \text{AT}(e, l) \wedge \text{WRITE}(e, m, x)] \end{array}$$

## 8.7 Summary

In this chapter, we examined the behavior of argument structure (AS) in the major categories in natural language, starting with verbs and then moving onto the other major lexical categories

(nouns, adjectives, and prepositions). We saw that all of these categories have the capacity of encoding either a predication of an individual or a relation between individuals. We stressed the following points:

- Certain aspects of a word's meaning are connected to its capacity to select specific kinds of arguments, but this connection is not straightforward. The most prominent meaning components that seem to determine the AS properties of verbs are related to the properties of the events that they describe: the arguments refer to event participants, and the nature of the event determines how these participants interact among themselves. In more technical terms, different verbal arguments are associated with different phases or subevents of the event denoted by the predicate.
- Different sentence participants can be differentiated by virtue of their obligatoriness and their overall contribution to the meaning of the predicate. *Arguments* (in the narrow sense of the term) represent the core event participants, they cannot be easily omitted or introduced, and their order is constrained. *Adjuncts* modify the core event description, they can be omitted or added, and their order is virtually free.
- Whether or not an argument can be expressed or omitted is governed by the requirements of *compatibility* and *informativeness*. It can be predicted in part from the lexical semantics of the predicate, but other factors must also be taken into account. An argument can be left unexpressed in the syntax when it is incorporated into the predicate's semantics or when it can be recovered from context. *Default arguments* (semantically encoded by their predicate) can only be expressed if additionally specified. Otherwise, they are *shadowed* by the predicate.
- *Semantic roles* are used to define the involvement of each argument in the event denoted by the predicate. Although they have been widely used in different frameworks to account for a wide range of linguistic phenomena, their theoretical status is far from clear (their connection to grammatical relations, their repertoire, etc.) and they are usually regarded as derived (but useful) labels, which can ultimately be accounted for by the properties of the events encoded by the predicates.
- All common nouns select for a referential argument, and relational nouns, in addition, establish a relation between individuals. The nature of this relation can be encoded in the lexical entry of morphologically simple nouns (in particular, in their qualia structure) or be inherited from other lexical items in the case of derived (deverbal and deadjectival) nominals.
- Adjectives cannot directly identify real world referents, but they can impose semantic constraints on the phrase that they modify, and categorial and semantic constraints on their complements.
- Prepositions are inherently relational lexical items. When they have conceptual content, they can impose semantic typing constraints on their complement. When they function as grammatical glue in the syntax, however, they impose no semantic constraints.

## 8.8 Further Readings

Topic	Primary references
Comprehensive overview and assessment of current theoretical approaches to AS	Levin and Hovav (2005)
Classic monographs dealing with the relationship between ES and AS	Grimshaw (1990), Tenny (1994)
Collected volumes on argument structure projection and linking	Butt and Geuder (1998), Bornkessel <i>et al.</i> (2006)
Complementarity of manner-result encoding	Rappaport Hovav and Levin (2010)
Argument typology and informativeness	Pustejovsky (1995), Batiukova and Pustejovsky (2013)
Unaccusativity	Levin and Hovav (1995)
Nominalizations	Chomsky (1970), Grimshaw (1990), Alexiadou (2001), Fábregas (2016), Paul (2014), Badia and Saurí (1998)
Adjectives as category and their AS	Bhat (1994), Baker (2003) (ch. 4), Dixon (2004)
Eventive deadjectival nominalizations	Beauseroy (2009), Arche and Marín (2015)
Theoretic and computational approaches to the syntax and semantics of prepositions	Saint-Dizier (2006)
Semantics of prepositions	Jackendoff (1983) (ch.9), Zwarts (2010)
Semantics of Argument Structure	Jezek and Pustejovsky (2017)
Topic	Secondary references
Introduction to argument structure	Harley (2006) (sec.7.5.-7.8.), Löbner (2013) (ch. 6)
Primers on thematic/semantic roles	Davis (2011), Carnie (2002) (ch.7)
Computationally-oriented introduction to semantic roles and AS	Jurafsky and Martin (2009) (sec. 19.4, 20.9)
Primer on unaccusativity and the unaccusativity diagnostics	Zaenen (2006)
Semantics of relational nouns	Barker (2011), Jacobson (2014) (sec.8.5.)
Deverbal nominals	Grimshaw (2011)
Overview of the core issues in the study of adjectives	Cabredo Hofherr (2010)
AS and aspect of adjectives and participles	Arche <i>et al.</i> (2014)

## 8.9 Exercises

1. Propose full subcategorization frames for the verbs from exercise 1, Chapter 7, which we list again below. Recall that, in addition to the semantic type of the argument, the subcategorization frame must specify its syntactic category. Follow the model in (5), sec. 8.2.1.



- 
- a. accuse  
b. amend  
c. accomplish
- d. apologize  
e. park  
f. patrol
2. Is the fragment in *italics* an argument or an adjunct? Use the tests presented in Section 8.2.3 to motivate your answer. Are the prepositions in these fragments lexical or grammatical, and how does this affect the semantic role assigned to the PPs?
- a1. We keep the fruit *in the fridge*.  
a2. I defrosted the poultry *in the fridge*.  
a3. I defrosted the poultry *in the microwave*.  
b1. They invested a lot *in this company*.  
b2. They promote females *in this company*.  
b3. The investors believe *in this company*.
- c1. She knitted a sweater *for her son*.  
c2. She is looking *for her son*.  
c3. She can't sign *for her son*.
3. What relations encode the following constructions and what kind of arguments do they take? Specify the source of these relations: the qualia structure of the head N, the AS of its morphological base, and so on. Keep in mind that some of these expressions are ambiguous.
- a. Mike's picture  
b. the translation of Nabokov  
c. Mary's supper  
d. Rome's destruction (of Carthage/ by the Gauls)  
e. the river's edge  
f. Mike's team  
g. The Ferrari's speed  
h. Mary's concern
4. Give the interpretation of the deadjectival nominals in these sentences. Recall that they may encode either a state, a quality (attribute or value), or an event. Be sure to motivate your answer.
- a. Learning depends on the *strength* of neural connections.  
b. We need to identify our areas of *strength* and areas for improvement.  
c. Muscle *weakness* can be a symptom of hormonal disorders.  
d. Asking for help is not a sign of *weakness*.  
e. Your *happiness* depends only on you.  
f. She looked at him with a smile of *happiness*.  
g. I love the *emptiness* of the beach at night.  
h. This is another *sloppiness* like they usually do not happen to the team.  
i. This intern's *sloppiness* is exasperating.

## 9 Lexical Aspect, Tense, and Modality

---

### 9.1 Overview

In this chapter, we focus on the grammatical categories that determine the temporal makeup of events and event-encoding predicates, with a special focus on how they are encoded in the lexicon and how they interact in a clause. This includes the three categories of *aspect*, *tense*, and *modality*. We encountered the notion of event in Section 6.3.3, where we also differentiated between tense (which locates events in time relative to other events and time points) and aspect (which encodes the internal temporal structure of events). We also distinguished grammatical from lexical aspect, introduced the major aspectual features (durativity, boundedness, telicity, iteration, and intensity), and looked at how these features contribute to distinguishing the basic event types (states, activities, accomplishments, and achievements). Here we delve deeper into the theoretical status and grammatical representation of linguistically encoded events and their internal structure, the diagnostics used to identify the main event types, and the sentential components affecting the aspectual, temporal, and modal properties of predicates. In particular, we show how argument structure and event structure interact at the phrasal and sentential level, mediated by the basic semantic typing information introduced by the qualia structure. We will also look into the cross-categorical features that make it possible to relate the notions of countability, scalarity, and aspectuality.

### 9.2 Events as Arguments of Natural Language Predicates

Earlier we defined an **event** as any kind of situation or happening denoted by the predicate in a sentence (Section 6.3.3). Until relatively recently, however, events have not been explicitly represented in the logical and syntactic form of predicates. The philosophers Hans Reichenbach (Reichenbach, 1947) and Donald Davidson (Davidson, 1967) were the first ones to claim, over half a century ago, that events should be included into the ontology of semantic entities and the semantic representation of natural language predicates. Reichenbach also introduced the notion of *reference time*, which we will discuss later.

Davidson argued that events are concrete entities, which can be perceived, located in space and time and, moreover, that they are linguistically real. In (1b), for example, both instances of the pronoun *it* refer to the event ‘Brutus stabbed Caesar’, while the verb *witness* selects this event as one of its complements. In (1a), the PPs ‘in the back’, ‘in the Forum’ and ‘with a knife’ can be seen as modifying this event.

- (1) a. **He stabbed Caesar** *in the back, in the Forum, with a knife*.
- b. Brutus did **it** and everyone witnessed **it**.

Davidson proposed that events should be included in the logical description of certain predicates (action verbs) as an additional argument, one which is hidden rather than explicitly realized in the syntax. Hence, the sentence in (2a) is paraphrased in (2b), and has the logical form of (2c).

- (2) a. Brutus stabbed Caesar.  
 b. 'There was a stabbing event between Brutus and Caesar.'  
 c.  $\exists e[\text{stabbed}(\text{Brutus}, \text{Caesar}, e)]$

Note that the event variable must be quantified, either explicitly (as in *Every stabbing is harmful*, with a universal quantifier) or implicitly, as in (2) (with an implicit existential quantifier). Without quantification, the verbal predicate denotes a *property of events* or a *kind of event*, just as common nouns and NPs denote properties of individuals rather than individuals themselves. From this perspective, (2b) asserts that there was an event of the kind 'Brutus stabbed Caesar'.

Notice that adverbial and prepositional modifiers add complementary information to this core event.

- (3) a. Brutus stabbed Caesar in the Forum with a knife.  
 b.  $\exists e \exists x[\text{stab}(\text{Brutus}, \text{Caesar}, e) \wedge \text{in}(e, \text{Forum}) \wedge \text{knife}(x) \wedge \text{with}(e, x)]$

Including the event variable in the logical representation of sentences became standard in modern semantic theory, although not always as a part of the argument structure projected by the head of the predicate. In some neo-Davidsonian accounts, the event argument does not augment the valency of the verb: rather, it is taken to be the only argument of the verb, which, in turn, is linked to the event participants through semantic roles, such as AGENT (AG), PATIENT (PAT), LOCATION (LOC), and INSTRUMENT (INST), as in (4):

- (4)  $\exists e \exists x[\text{stab}(e) \wedge \text{AG}(e, \text{Brutus}) \wedge \text{PAT}(e, \text{Caesar}) \wedge \text{LOC}(e, \text{Forum}) \wedge \text{knife}(x) \wedge \text{INST}(e, x)]$

In fact, Parsons (1990) develops an interpretation of events that introduces a distinction between an event *culminating* (*Cul*) versus an event *holding* (*Hold*). This makes it possible to distinguish the telicity associated with a sentence. Hence, for an event,  $e$ , and a temporal interval,  $t$ , the following relations hold:

- (5) a. TELIC EVENTS (achievements, accomplishments):  $\text{Cul}(e, t)$   
 b. ATOMIC EVENTS (processes, states):  $\text{Hold}(e, t)$

Returning to the sentence in (3a), we now modify the logical form in (4) to that below in (6).

- (6)  $\exists e \exists t \exists x[\text{stab}(e) \wedge \text{AG}(e, \text{Brutus}) \wedge \text{PAT}(e, \text{Caesar}) \wedge \text{LOC}(e, \text{Forum}) \wedge \text{knife}(x) \wedge \text{INST}(e, x) \wedge \text{Cul}(e, t)]$

### 9.3 Internal Temporal Makeup of Events: Event Structure

Now that we have shown *how* events can be integrated into the semantic representation of predicates, we ask whether events are atomic individuals (i.e., undecomposable) or if they have internal structure having an impact on the grammatical properties of the predicates. One way of representing the aspectual properties of events was offered in Section 6.3.3, where we used binary-valued features, i.e., *durativity*, *dynamicity* and *telicity*, to define the main event types:

**states** are [+durative, -dynamic, -telic], **activities** are [+durative, +dynamic, -telic], **accomplishments** are [+durative, +dynamic, +telic], **achievements** are [-durative, +dynamic, +telic], and **semelfactives** are [-durative, +dynamic, -telic]. These features are useful for defining the properties of an event as a whole and how they affect its grammatical realization and syntactic context. For example, only telic events (e.g., *read a book*) are compatible with frame adverbials: compare ‘John *read* the book in a week’ and \*‘John *worked* in a week’.

Feature-based classifications, however, have some limitations, one of the most significant being that it can be difficult to relate the aspectual features of a predicate to its selectional properties (i.e., what arguments it requires). This is one of the reasons why, in subsequent research, feature-based approaches have been superseded by theories that decompose events into parts (subevents or phases) that can be focused in context and associated with specific event participants. Many of these approaches use the term **event structure** to refer to the definition of the event type of lexical items and predicates in terms of ordered subevents or phases.

In previous chapters (Section 3.7), we already encountered syntactic evidence suggesting that some events are complex, meaning that they are made of identifiable subparts. We illustrate this again by looking at the behavior of adverbial modification in the sentences in (7).

- (7) a. John almost ran.  
       b. John almost quit his singing career.  
       c. John almost recorded an album.

Each of the verbs above (*run*, *quit*, *record*) can be combined with *almost*, giving an interpretation of ‘John almost started running’ in (7a), ‘John almost started being a non-singer’ in (7b), and ‘John almost started recording an album’ in (7c). But recall that this last sentence has the additional interpretation of ‘John did do some recording, but it never became a full album’. Where does this additional interpretation come from? According to theories of event structure, this is an indication that the event described in (7c) has two components (subevents) that can be modified by *almost*: the subevent of ‘recording on an album’ and the subevent of ‘there existing a recorded album’. The events in (7a) and (7b), by contrast, just have one: ‘the process of running’ and the instantaneous change of state from ‘being a singer’ to ‘not being a singer’, respectively.

There have been several proposals made as to how exactly the structure of complex events can be represented, all of which address in different ways the following main issues: (1) is there a specific level of representation that describes event structure or is it integrated into the general conceptual-semantic or syntactic representation of the sentence? and (2) what basic components make up the structure of complex events?

In Section 8.2.2 we saw how an event structure can be integrated into the syntactic tree, with the *vP* projection encoding the causing subevent of complex causative events and the *VP* encoding the resultant subevent. In the next section, we will review lexical and conceptual approaches to event structure.

### 9.3.1 Perspectives on Event Decomposition and Event Structure

This section presents three different lexical-conceptual perspectives on ES representation, which can be briefly summed up as follows:

1. Events introduced as part of the general lexical-conceptual structure.
2. An independent level of Event Structure with subevents associated with predicate decompositions of the verb.

## 3. The integration of strategy (2) with a dimension of scalar change.

The first approach is inspired by the predicate decomposition theories from the generative semantics tradition (as interpreted by Dowty (1979)), as well as the representations developed in Jackendoff (1983), and adopted by Rappaport Hovav and Levin (1998), among others. This view makes crucial use of a limited set of primitive predicates, which are meant to refer to the meaning components shared by predicates with the same syntactic and aspectual behavior and by alternating forms of the same predicate. These include:

- BE: introduces stative predicates, taking an Agent (AG) or Theme (TH) as one of its arguments.
- ACT/DO: introduces activity predicates or agentive predicates in general. Takes an Agent argument and, sometimes, a Theme argument.
- CAUSE: introduces causative predicates (typically accomplishments and achievements), which take as its arguments two event arguments, or an Agent argument and an event argument.
- BECOME: introduces change-of-state predicates (achievements and accomplishments).

Of all these predicates, BECOME is the only one that is inherently aspectual. The agentive ACT/DO is often used to represent activities, but there are activities that are not agentive (e.g., *It is raining*, *The ball is rolling*), and non-activities that are agentive (*He swam (from France to England)*), which lead many researchers to conclude that agentivity and aspectuality are largely orthogonal. The causative predicate CAUSE seems appropriate to represent the meaning of many accomplishments (*John built the house*) and also achievements (*John broke the glass*), but causality is neither a necessary nor sufficient condition for an event to belong to either group: causative predicates can denote activities (*John walked his dog for an hour*), and there are non-causative accomplishments (*The ice melted in ten minutes*) and achievements (*A brilliant idea emerged in her mind*).

The following sentences illustrate how primitive predicates can be used to represent the meaning of different event types. For uniformity's sake, we label the overall event type of all the sentences as EVENT (EV), although this might not be applicable to all of them: for example, it can be argued that individual-level predicates (as in (8a)) are not eventive. We ignore the details of tense for simplicity.

## (8) STATES

a. John is tall.

[<sub>EV</sub> BE ([<sub>TH</sub> John], [<sub>PROP</sub> tall])] 

b. The glass is broken.

[<sub>EV</sub> BE ([<sub>TH</sub> the glass], [<sub>PROP</sub> broken])] 

## (9) ACTIVITIES

a. John is walking.

[<sub>EV</sub> ACT ([<sub>AG</sub> John], [<sub>EV</sub> walk])] 

c. John is pushing the cart.

[<sub>EV</sub> ACT ([<sub>AG</sub> John], [<sub>EV</sub> push [<sub>TH</sub> the cart]])] 

b. John is walking his dog.

[<sub>EV</sub> CAUSE([<sub>AG</sub> John], ACT([<sub>AG</sub> his dog], [<sub>EV</sub> walk]))] 

## (10) ACCOMPLISHMENTS

a. The ice melted.

[<sub>EV</sub> BECOME ([<sub>TH</sub> the ice], [<sub>PROP</sub> melted])] 

c. John built the house.

[<sub>EV</sub> CAUSE([<sub>AG</sub> John], BECOME([<sub>TH</sub> the house], [<sub>PROP</sub> built]))] 

b. John melted the ice.

[<sub>EV</sub> CAUSE([<sub>AG</sub> John], BECOME([<sub>TH</sub> the ice], [<sub>PROP</sub> melted]))] 

## (11) ACHIEVEMENTS

a. The glass broke.

[<sub>EV</sub> BECOME([<sub>TH</sub> the glass], [<sub>PROP</sub> broken])] 

b. John broke the glass.

[<sub>EV</sub> CAUSE([<sub>AG</sub> John], BECOME([<sub>TH</sub> the glass], [<sub>PROP</sub> broken]))]

As we can see, the same meaning components recur within the same event type as well as in alternating forms of the same predicate. For example, the stative component is present in the meaning of *broken*, and also in the intransitive and transitive forms of *break*, where it is embedded under BECOME, and CAUSE and BECOME, respectively. The change-of-state meaning of the intransitive and transitive forms of *break* is associated with the predicate BECOME. In this way, the meanings of the three forms of *break* can be shown to be related, and their syntactic behavior can be given a principled account. Also, we can see that transitivity usually correlates with a complex event structure: causative predicates (in (10b,c) and (11b)) typically take an Agent and a Theme argument.

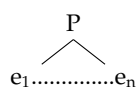
The second perspective on event decomposition we will review here was originally put forward in Pustejovsky (1988, 1991, 1995), and Grimshaw (1990), and then further adopted, developed and modified in a number of other studies. It is based on the notion of **event structure** (ES), which is a lexical semantic structure that defines the event type of verbs and predicates in terms of temporally and hierarchically ordered subevents. ES is a level of representation of lexical information that is fundamentally distinct from the representation of other lexical properties, although it is related to some of them (e.g., the argument structure properties) in systematic and predictable ways.

Different event types can be represented as typed feature structures (as seen in Section 3.7) or in the form of tree structures, as below: states (12a), processes or activities (12b), and transitions, which subsume accomplishments and achievements (12c). As we can see, the basic event types are the states and processes, which can represent independent events or be combined to derive complex events (transitions).

- (12) a. STATE: a simple event, evaluated without referring to other events: *be sick, love, know*



- b. PROCESS: a sequence of events identifying the same semantic expression: *run, push, drag*



- c. TRANSITION: an event identifying a semantic expression evaluated with respect to its opposition: *give, open; build, destroy*

Two-state transition (achievement): where  $\neg\phi \in S_1$ , and  $\phi \in S_2$



Extended transition (accomplishment): where  $\neg\phi \in P$ , and  $\phi \in S$



Subevents within an event are ordered by **temporal relations**, and **relative prominence** or **headedness**. Regarding temporal relations, two subevent orderings seem to occur for lexicalized events. One subevent may precede the other in a strictly sequential relation, with the first subevent leading to the second, as with causatives (e.g., *build*), inchoatives (e.g., *arrive*), and

ditransitive transfer verbs (e.g., *give*). This is the *meet* relation in temporal logic, and we will notate it as  $<_m$ . In transaction events such as *sell*, *buy*, and *marry* ('get married to'), both subevents overlap in time ( $\circ$ ).

An additional feature called *headedness* allows us to specify what part of a complex event is the focus of interpretation and is the 'syntactically highlighted' part in each case. Hence, given a complex structure, such as  $[\dots E_i^* \dots]_E$ , we call  $E_i^*$  the head of the event structure. Consider as an example, the accomplishment verb *build*, which has a process phase ('the process of something being built') and a resultant state phase ('the state of there existing something that was built'). Both the forms in the progressive (13a) and when modified by a durative adverbial (13b) focus on the process phase. The past tense, by default, focuses on the event as a whole in accomplishments and achievements, especially when combined with time-frame adverbials, as in (13c). Finally, the participial construction in (13d) focuses on the resultant state. The headed event in each sentence is marked with an asterisk.

- (13) a. John is building the house. [ $P^* <_m S$ ]  
 b. John built the house for two years. [ $P^* <_m S$ ]  
 c. John built the house (in two years). [ $P <_m S$ ]\*  
 d. The house is built. [ $P <_m S^*$ ]

Event headedness allows us to treat as a single lexical item, those verbs that can be used as both causative and inchoative, such as *break*, *open*, *sink*, etc. We need to assume that both forms are transition events underlyingly, with the causative variant corresponding to contexts where the first (causing) subevent or the whole event is headed (as in (14a) and (14b)), and the inchoative variant emerging when the second subevent is made prominent (as in (14c)):

- (14) a. The destroyer is sinking the boat. [ $P^* <_m S$ ]  
 b. The destroyer sank the boat. [ $P <_m S$ ]\*  
 c. The boat sank. [ $P <_m S^*$ ]

As shown in (15), each subevent is linked to a specific set of arguments in the Qualia Structure based on the following principle: "each subevent must be associated with at least one argument position at lexical structure" (Pustejovsky 1991, see also Section 8.2.2).

$$(15) \left[ \begin{array}{l} \text{sink} \\ \text{AS} = \left[ \text{ARG}_1 = x \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \begin{array}{l} \text{human} \\ \text{phys.obj} \\ \text{event} \end{array} \end{array} \right] \right] \left[ \text{ARG}_2 = y \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{phys.obj} \end{array} \right] \right] \\ \text{ES} = \left[ \begin{array}{l} E_1 = \text{process} \\ E_2 = \text{state} \\ e_1 <_m e_2 \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \text{sink.act}(e_1, x, y) \\ \text{FORMAL} = \text{sink.result}(e_2, y) \end{array} \right] \end{array} \right]$$

Notice that, unlike primitive predicates, subevents can be quantified in the logical form of the sentence, in the same way that arguments can be.

- (16) a. The destroyer is sinking the boat.  
 $\exists e_1 \exists x \exists y [\text{sink.act}(e_1, x, y) \wedge \text{destroyer}(x) \wedge \text{boat}(y)]$

- b. The destroyer sank the boat.

$$\exists e_1 \exists e_2 \exists x \exists y [\text{sink\_act}(e_1, x, y) \wedge \text{destroyer}(x) \wedge \text{boat}(y) \wedge \text{sink\_result}(e_2, y) \wedge e_1 <_m e_2]$$

- c. The boat sank.

$$\exists e_2 \exists e_1 \exists y \exists x [\text{sink\_result}(e_2, y) \wedge \text{boat}(y) \wedge \text{sink\_act}(e_1, x, y) \wedge e_1 <_m e_2]$$

- d. The boat is sunk.

$$\exists e_2 \exists y [\text{sink\_result}(e_2, y) \wedge \text{boat}(y)]$$

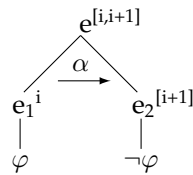
The logical form of the causative (16b) differs from the inchoative (16c) only in the explicit identification of a specific causer. Also, notice that the participial adjectival form in (16d) makes reference to only the resultant state (although the semantic representation invites the presupposition that some event sank the boat).

In subsequent work within GL (Pustejovsky and Moszkowicz 2011), ES has been enriched to dynamically track those object attributes modified in the course of the event (the location of the moving entity, the extent of a created or destroyed entity, etc.), as a sequence of states (containing formulas) related by functions which go from state to state (i.e., programs). The resulting event structure representation is called a **Dynamic Event Structure** (DES). In this model, there are only two primitive event types: *states*, which are simply propositions describing a snapshot in time; and *transitions*, which are pairs of states connected by a function that moves from the first state to the second state. These two event types are illustrated below in (17).

- (17) a. State



- b. Simple Transition



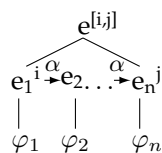
The structure in (17a) represents a **state** as a snapshot of the world in time,  $e^i$ , with the propositional content,  $\varphi$ . The event structure in (17b) illustrates how the program  $\alpha$  takes the world from the state in  $e^i$  with content  $\varphi$ , to the adjacent state,  $e_2^{i+1}$ , where the propositional content has been negated,  $\neg\varphi$ . This structure corresponds directly to **achievements**. From these two types, the other two Vendlerian classes can be generated, as we now demonstrate. **Processes** can be modeled as an iteration of simple transitions, where two conditions hold: the transition is a change in the value of an identifiable attribute of the object; every iterated transition shares the same attribute being changed. This is illustrated in (18b) below.

Finally, **accomplishments** are built up by taking an underlying process event,  $e:P$ , denoting some change in an object's attribute, and synchronizing it with an achievement (simple transition): that is,  $e:P$  is unfolding while  $\psi$  is true, until one last step of the program  $\alpha$  makes it the case that  $\neg\psi$  is now true. This can be seen in the event structure in (18c) below.

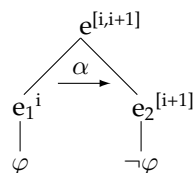
- (18) a. State



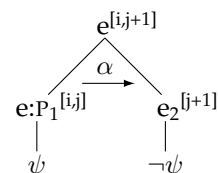
- b. Process



- c. Achievement



- d. Accomplishment





The two-dimensional geometric analysis of event types put forward in Croft (2012) is similar to Dynamic Event Structure in that it accounts, on the one hand, for the different qualitative phases or states that make up the event and, on the other hand, it represents how these phases unfold in time. The former dimension is represented on the  $q$  axis and the latter on the  $t$  axis. This approach differentiates the different event types depending on the following criteria: (1) Does the event/subevent span a point or an interval on either dimension? (2) Which phases of the event are *profiled* (explicitly asserted to hold at a particular point in time) and which ones are presupposed or entailed by the profiled phase(s)? One of the advantages of this approach is that it allows one to identify a wide variety of event types and construals, well beyond the four Vendlerian classes discussed above. Here we will limit ourselves to reviewing just a few of them for illustration purposes. Consider the diagrams in figure 9.1 below.

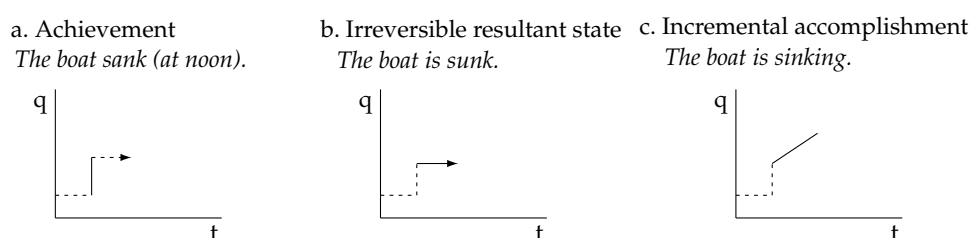


Figure 9.1 Geometric analysis of event types

These 2D diagrams represent the geometric analyses for the sentences *The boat sank (at noon)*, *The boat is sunk*, and *The boat is sinking*, respectively. Diagram (a) is composed of one profiled phase, marked with a solid line, which symbolizes an instantaneous transition from one state ('not be sunk') to another ('be sunk'), and two phases that are presupposed or entailed (a 'rest phase' before the transition and a resultant state phase). In (b), the profiled phase is the resultant state, and the rest phase and the transition state are presupposed/entailed. In (c) the event is construed differently (i.e., has a different *semantic frame*). The transition phase is not instantaneous anymore, rather, it is transformed into an incremental durative subevent, wherein consecutive points in time are related to a gradual change of state and the resultant state is not entailed (the boat might not have sunk after all).

Another relatively recent and very productive line of aspectual research delves precisely into how the temporal progression of events impacts the properties of the verbal arguments. It focuses on the fact that, very often, the event denoted by the verb does not affect the entity denoted by its argument as a whole but rather one of its specific properties, which is being progressively altered as the event unfolds (a property also modeled by Dynamic Event Structure above). This kind of incremental relation is associated to different **scalar** properties, which can be lexicalized by the verb and/or one of its arguments. A **scale** is a set of ordered degrees representing a specific attribute (size, position, price, etc.). Adjectives (and their morphological derivatives) can lexically encode a maximal degree on a scale (e.g., *clean*) or a minimal degree (e.g., *dirty*). Consider the sentences in (19), followed by the properties that distinguish them.

- (19) a. John ate a sandwich.  
       b. John wrote a book.  
       c. John approached Mary.  
       d. The balloon rose five meters.  
       e. The gap widened six inches.

1. PHYSICAL EXTENSION: this characterizes the *incremental theme predicates*, which establish a mapping between the physical extension of the affected object and the temporal progression of the event. This group includes consumption (19a) and creation (19b) predicates. In (19a), the physical extension of the sandwich decreases as the eating event unfolds. In (19b), the extension of the book increases as the writing event progresses.
2. SPATIAL LOCATION (PATH): this characterizes directed motion predicates. The verb *approach* in (19c) encodes a spatial path that begins at the initial location of the moving entity (John) and ends at the location of the goal (Mary). Vertical motion verbs (e.g., *rose* in (19d)) encode a vertical path oriented with respect to the source of gravity (e.g., the earth).
3. SECONDARY ATTRIBUTES: these characterize adjectival properties encoded by *gradual achievement predicates*. *Widen* in (19e), encodes a property (*wide*) whose degree increases as a consequence of the event: at the end of the event the gap is six inches wider than at the beginning.

The properties of the specific scale lexicalized by the predicate have been argued to determine its aspect (Hay *et al.* 1999, Kennedy and Levin 2008). To see how, let us examine one verb class in a bit more detail, namely the deadjectival gradual achievement verbs.

The underlying adjectives forming the base for this verbal class differ as to whether the property they denote has a minimal degree, a maximal degree, or both. For example, degree modifiers such as *totally*, *perfectly* and *completely*, are compatible with adjectives that have a maximal degree, while the modifiers *somewhat*, *slightly*, and *partially* are compatible with minimal degree adjectives (Kennedy 2007). The adjectives *wide*, *long*, and *deep* lexicalize OPEN SCALES that have neither minimal nor maximal degree: there is neither minimal nor maximal degree of width, length or depth that is required for an object to be called *wide*, *long*, and *deep*. *Empty*, *open*, and *visible* are TOTALLY CLOSED SCALE adjectives, because they can be interpreted relative to either the maximal or the minimal degree of a specific property: e.g., a door can be *open* somewhat (it's not closed), or it can be completely *open* (so you can walk through it). *Wet*, *dirty*, and *sick* are LOWER CLOSED SCALE adjectives, since they only have a lower bound: as soon as something has a little water, dirt or sickness in it, we can call it *wet*, *dirty*, and *sick*, and there is no upper limit to the degree of these properties. Finally, *straight*, *clean*, and *flat* are UPPER CLOSED SCALE adjectives, since they can only be predicated of an entity when it has the maximal degree of straightness, cleanness, or flatness. These classes are summarized below in (20).

- (20) a. OPEN SCALES  
       \*totally/\*somewhat {wide/ long/ deep}  
       b. TOTALLY CLOSED SCALES  
           totally/somewhat {empty/ open/ visible}  
       c. LOWER CLOSED SCALES  
           ?totally/somewhat {wet/ dirty/ sick}  
       d. UPPER CLOSED SCALES  
           totally/\*somewhat {straight/ clean/ flat}

All scales that have more than two degrees (all of those in (20)) can yield durative atelic (or *weakly telic*) predicates when they are interpreted with respect to a non-maximal degree of change: through the use of the progressive, the sentences in (21) entail that *some* change has taken place, although its maximal degree has not been achieved.

- (21) a. The workers are widening the gap. ⇒ The workers have widened the gap somewhat.  
       b. John is emptying the tank. ⇒ John has emptied the tank somewhat.

- c. Jaco is dirtying the floor.  $\Rightarrow$  Jaco has dirtied the floor somewhat.
- d. John is flattening the wire.  $\Rightarrow$  John has flattened the wire somewhat.

In addition, predicates based on a partially or totally closed scale can have a telic (i.e., *strongly telic*) interpretation conveying that one of its bounds has been reached. The upper degree is involved in the telic reading of totally closed (22b) and upper closed scales (22d), and the lower degree in the telic reading of lower-closed scales (22c). As shown in (22a), this kind of interpretation is only acceptable with open-scale predicates if we assume that there is a contextually relevant measure that determines when the event reaches its culmination.

- (22) a. #The workers widened the gap completely and now the gap is wide.  
           [with respect to a previously planned width]  
       b. John emptied the tank completely and now the tank is empty.  
       c. Jaco dirtied the floor (\*completely) and now the floor is dirty.  
       d. John flattened the wire completely and now the wire is flat.

The same rationale can be applied to other kinds of scales. Two-valued scales (which have only minimal and maximal degrees, with no intermediate degrees) usually yield non-durative telic interpretation, because they are associated with an instantaneous change of state. This would be the case of achievements including some directed motion verbs (*arrive, leave, enter*, etc.).

### 9.3.2 Event Type as a Property of Phrases and Sentences

While the task of assigning a particular event type to a verb or other event-denoting lexical items might appear straightforward (e.g., *walk* is a PROCESS and *arrive* is an ACHIEVEMENT), the task of determining the event type of a phrase or an entire sentence can be complicated by many factors contributing to the interpretation of aspect in semantic composition. While the inner workings of these processes will be presented in more detail in Chapter 11, here we list some of the factors that affect the aspectual properties of complex expressions.

- 1 **Lexical aspect of the verb:** The primary contribution to sentence aspect is the type assigned to the matrix verb of the sentence. For example, in (23a), the activity verb *roll* yields an atelic predicate, and the accomplishment verb *make* in (23b) yields a telic predicate.

- (23) a. John rolled the dough {for an hour/ \*in an hour}.  
       b. John made the dough {\*for an hour/ in an hour}.

In (23) above, we can determine the aspectual properties of the predicate by testing which verbs allow modification by the durative adverbial ("*for* TIME\_PERIOD") and the time frame adverbial ("*in* TIME\_PERIOD"). The presence of these adverbials can be used as the indicator for identifying atelic and telic predicates, respectively.

- 2 **Grammatical aspect of the verb:** The past tense in English is usually associated with the perfective aspect, which is used to mark completed events. This is why the past tense form is freely compatible with accomplishment verbs and predicates, as in (24a). By contrast, progressive forms are always imperfective. They denote processes and they reject any form of delimitation, including those introduced by *for*- and *in*-adverbials (24b).

- (24) a. John made the dough {\*for an hour/ in an hour}.  
       b. John was making the dough {\*for an hour/ \*in an hour}.

- 3 **Grammatical number (singular vs. plural) of the subject and verbal complements:** Plural subjects and complements usually turn the predicate into durative, and sometimes even unbounded, if the plural subject or object does not have a determiner. Observe how the achievement verb *arrive* can be construed as a process when the subject is plural.

- (25) a. John arrived at the refugee camp {\*for two weeks/ in two weeks}.  
 b. The evacuees arrived at the refugee camp {for two weeks/ in two weeks}.

Sentence (25a) is not compatible with the *for* adverbial, while (25b), when the subject is plural, is acceptable with the same adverbial, with the interpretation 'the process of the evacuees arriving one after another at the camp lasted for two weeks'. Curiously, both predicates are compatible with the *in* adverbial. In both cases the *preparatory phase* of the event can be focused ('it took John two weeks to get to the refugee camp', 'it took the group of refugees two weeks to arrive'). In addition (25b) can have an accomplishment interpretation: 'there were multiple arriving events, which were completed as a whole within two weeks'.

We see a similar event shift below in (26), with the accomplishment verb *build*. Namely, it is compatible with *for*-adverbials with both singular and plural complement (*house/houses*), but with distinct interpretations: in (26a), 'for six months' measures the duration of the building process without there being a culmination of this process presupposed ('John built the house for six months and then stopped'), and in (26b) the adverbial measures the overall duration of different house building processes ('John build houses, one after another, for six months'). The *in* adverbial is compatible with the singular complement ('it took John six months to build the house'), and with the plural complement it can be acceptable with a habitual interpretation ('It used to take six month for John to build a house').

- (26) a. John built a house {for six months/ in six months}.  
 b. John built houses {for six months/ ?in six months}.

- 4 **Presence of a determiner with the subject and the verbal complements:** *Bare NPs* (NPs without a determiner) usually denote unbounded sets of entities, which are related to unbounded events. Nominal groups with a determiner, by contrast, denote single entities or bounded groups of entities, which can make the predicate bounded or telic. For example, the DPs *some evacuees* and *three apples* in (27a) and (28a) delimit the events encoded by their respective predicates to bounded groups of entities affected by the actions of 'arriving' and 'eating' denoted by the verbs. Therefore, as expected, they yield telic predicates compatible with durative adverbials and incompatible with time frame adverbials. By contrast, the bare plural NPs *evacuees* and *apples* in (27b) and (28b) cannot provide a boundary for the events described by the predicate, thus resulting in atelic readings.

- (27) a. Some evacuees arrived at the refugee camp {?for two weeks/ in two weeks}.  
 b. Evacuees arrived at the refugee camp {for two weeks/ \*in two weeks}.  
 (28) a. John ate two apples {?for ten minutes/ in ten minutes}.  
 b. John ate apples {for ten minutes/ \*in ten minutes}.

- 5 **Choice of preposition introducing the verbal arguments:** In the spatial domain, prepositions introducing the Goal argument (e.g., *into* in (29a)) are associated with telic motion predicates, while directional spatial prepositions (e.g., the direction preposition *toward* and the source preposition *from* in (29b)) appear in atelic predicates.

- (29) a. John walked into the train station {\*for ten minutes/ in ten minutes}.  
 b. John walked {toward/ from} the train station {for ten minutes/ \*in ten minutes}.

As these examples show, the choice of verb is just one of the many factors that determine the aspectual makeup of the predicate when building an entire sentence.

### 9.3.3 Event Type Diagnostics

In the previous sections we discussed how event types can be differentiated based on the analysis of the predicate meaning, by making reference to their aspectual features, event structures, and what temporal adverbials they co-occur with. These meaning differences have a direct impact on the compositional or syntactic properties of the predicates, as we saw in Section 9.3.2, so that the presence of certain sentential components is often indicative of the overall event type of the predicate and the aspectual class of its head (the verb or other event-denoting word). However, these event type indicators must be used carefully, as we shall now show.

Generally, the notion of a *diagnostic* or *test* presupposes that there are properties inherent in a certain class of phenomena or entities that can therefore be used to identify their nature: for example, the ability to encode tense and aspect is used to identify verbs as a word class, and the presence of a Theme/Agent subject is used to distinguish between unaccusative and unergative verbs. If, as we have been assuming, the verbal predicate imposes specific compatibility constraints on its arguments and adjuncts (see Section 8.2), we would expect the latter to be either accepted or rejected depending on the event type of the verb. If this were the case, the nature of the different predicate components would help us identify the event type encoded by the predicate head. However, we saw in the previous section that this is often not the case, and the verb can often change its original event type to yield an acceptable sentence, as shown in (30) below.

- (30) a. John came to visit the refugee camp in two weeks.  
b. John came to visit his grandfather for twenty years.

When the achievement verb *come* is combined with either *in* or *for* time adverbials, which encode durations, it shifts to a durative interpretation as well, referring to the time period prior to the event culmination ('two weeks passed before John came to the camp'), as in (30a), or to iterative events taking place over an extended time period, as in (30b).

CLUE/COMMENT[magnifying glass icon]: What these examples show is that, **rather than being mere event modifiers, certain predicate components** (e.g., time adverbials) **function as event predicates** that take the verb as its argument and impose their aspectual requirements on the verb. As a consequence, the aspectual properties of the verb undergo modification or coercion known as **event-type shift**. As will be shown in this section, some event type shifts are interpreted more easily than others, depending on the sentential context and the degree of compatibility of the verb's lexical aspect and the aspectual properties of other predicate components.

It is important to bear in mind that the event type tests applicable to a specific verbal predicate are determined by several factors: the nature of the denoted event; the way that it is conceptually packaged by a specific lexical item; and the language-specific syntactic behavior of different event types. Here we will focus on four groups of aspectual diagnostics typically used for English:

1. TEMPORAL MODIFIERS: time adverbials and the adverbial *almost*;
2. ASPECTUAL VERBS: *begin*, *finish*, *stop*, and others;
3. TENSE INTERPRETATION: present and progressive forms;
4. IMPERFECTIVE PARADOX: interpreting predicates in the imperfect form.

**Group 1** typically includes the time adverbials *in* and *for*. Their selectional requirements can be stated as follows:

- (31) a. *in* TIME\_PERIOD + VP<sub>[+durative,+telic]</sub>  
 b. *for* TIME\_PERIOD + VP<sub>[+durative,-telic]</sub>

This means that '*in* TIME\_PERIOD' typically selects for accomplishments, and '*for* TIME\_PERIOD' for activities, which seems consistent with the data, as illustrated below.

- (32) a. John built the house in two years. ACCOMPLISHMENT  
 b. John ran for half an hour. ACTIVITY

States are [+durative,-telic], like activities, but in order to be compatible with *for* they must be potentially finite. Recall the distinction from Section 7.3 between stage-level (SL) predicates, such as *sick* and *tired*, and individual-level (IL) predicates, such as *tall* and *intelligent*. The former are acceptable with *for* adverbials while the latter are not.

- (33) a. John was sick for two days. SL                      c. My legs were tired for several hours. SL  
 b. \*John was tall for two years. IL                      d. \*John was intelligent for several hours. IL

Since achievements and semelfactives are [-durative], only coerced interpretations are available with both adverbials. *For* typically yields the iterative or habitual interpretation, as in (34a) and (35a), and sometimes focuses on the duration of the state following the event culmination (i.e., the resultant state), if this resultant state is reversible, as in (34b) ('John left and stayed outside for half an hour'). With non-durative events, *in* usually results in a preparatory phase reading ('TIME\_PERIOD x passed until the onset of the event'), as in (34c) and (35b).

- (34) ACHIEVEMENTS with *for* and *in* adverbials  
 a. John came to visit his grandfather for twenty years. ITERATIVE/HABITUAL  
 b. John left for half an hour. RESULTANT STATE DURATION  
 c. John {left/ came} in twenty minutes. PREPARATORY PHASE
- (35) SEMELFACTIVES with *for* and *in* adverbials  
 a. John blinked for two minutes. ITERATIVE  
 b. John blinked in two minutes. PREPARATORY PHASE

When the underlying telicity of the event and that associated with the temporal adverbial do not agree, an event type shift typically occurs: e.g., when a *for* adverbial is combined with accomplishments (which are [+telic]), or when an *in* adverbial is combined with activities (which are [-telic]). This can be seen below in (36a) and (36b), respectively.

- (36) a. John built the house for six months.  
 b. The computer worked in half an hour.

In (36a), as shown in Section 9.3.3, the adverbial seems to focus on the duration of the process preceding the culmination: 'John was engaged in the building process for six months and then stopped'. In (36b), on the other hand, we get a preparatory phase interpretation ('it took the computer half an hour to start working').

Group 1 also includes the adverbial *almost*, which as we already learned in Section 9.3, is sensitive to the internal structure of the event it modifies. As shown in (37), it can modify an event, *e*, of any event type, yielding an interpretation of: '*e* did not take place, but it could have.'

- (37) a. John almost *believed* what Mary had said. STATE

- It has long been noticed that stative predicates differ from the other event types when used in present simple. They are the only event class that has an *ongoing interpretation* in this tense: e.g., (40a) means that John knows the answer at the time of the utterance. Activities (40b) and achievements (40c), on the other hand, have an *ability* interpretation in the present tense: 'John can swim/ practices swimming' and 'John is able to notice lack of order'. The accomplishment in (40d) can have one of the special readings associated to present simple, depending on the

(41) a. John is swimming. ACTIVITY  
d. John is building a barn. ACCOMPLISHMENT

(42) a. \*John is knowing the answer.  
b. Mary lives in Waltham.

c. Mary is living in Waltham.  
d. John is {waiting for a friend/ sleeping}.

(43) a. \*John is {noticing lack of order/ losing his wallet/ realizing his mistake}.  
b. John is {dying/ reaching the summit/ coming}.

(44) a. Der Professor spricht schon. (G)  
           'The professor is speaking already.'  
           'The professor can speak already.'  
       b. El profesor ya está hablando. (S)  
           'The professor is speaking already.'

c. El profesor ya habla. (S)  
       'The professor is already able to speak.'  
       d. Profesor uže govorit. (R)  
           'The professor is speaking already.'  
           'The professor is able to speak already.'

(45) a. John was building a house  $\not\models$  John built a house  
 b. John was reaching the summit  $\not\models$  John reached the summit  
 c. John was living in Boston  $\models$  John lived in Boston  
 d. John was swimming  $\models$  John swam



This diagnostic, therefore, allows us to differentiate between achievements and accomplishments, on the one hand, and states and activities, on the other hand, because the latter do not give rise to the imperfective paradox, as can be seen in (45c,d).

#### 9.3.4 Eventive Readings of Nouns and Adjectives

As we have already seen, verbal predicates are not the only event-denoting expressions in language. In Section 8.4, for example, we encountered both nominalizations and nominals that directly refer to events, such as *destruction* and *movie*. Most nouns and adjectives denote properties or attributes of individuals rather than events; e.g., the nouns *dog* and *girl* and the adjectives *blue* and *tall* act more like statives than other event types, when it comes to their aspectual type, since they are typically not dynamic, nor do they usually involve a change of state. This is not always true, however, as we shall now see.

We can think of properties as being either *temporally* or *atemporally* associated with an individual object: that is, a property can be associated with a specific time interval (temporal) or can be predicated of an object independent of any temporal interpretation (atemporal). This approach has been couched in terms of the **stage-level** vs. **individual-level** opposition in numerous analyses of the adjectival semantics (cf. Section 7.3). The distinction was initially stated in semantic terms over half a century ago (in Milsark 1974 and Carlson 1977), and it was shown to affect the syntactic behavior of different groups of predicates. Although there is still much controversy involved in its definition, most researchers agree that individual-level (IL) predicates encode the inherent properties of an individual, which usually persist in time and are associated with it during all or most of its existence. Stage-level (SL) predicates, by contrast, describe specific states of an individual, linked to external circumstances or to specific temporal and spatial coordinates. SL properties change in and over time and are usually transient in nature.

There are specific diagnostic tests, presented in (46)-(49) below, that can be used to distinguish SL and IL properties. One of the basic diagnostics used in English is the use of *presentational 'there'*, as in the sentence 'there are *x* entities that have the property *P*'. This construction can be used with SL adjectives as the property *P*, as in (46a), but not with IL adjectives (46b).

- (46) a. There are too many people {hungry/ tired/ alert}.  
 b. \*There are too many people {boring/ intelligent/ respectful}.

A second diagnostic involves complementation with specific predicates, in particular the verbs *consider* and *see*. For example, the sentences in (47) illustrate that *consider* selects for IL complements, while *see* selects for SL complements.

- (47) a. I consider him {boring/ intelligent/ respectful/ \*hungry/ \*tired/ \*alert}.  
 b. I saw John {\*boring/ \*intelligent/ \*respectful/ hungry/ tired/ alert}.

More broadly, as shown in (48), only SL adjectives can be subject predicative complements ('*x* did something, and *x* had property *P* when *x* did it').

- (48) John came home {\*boring/ \*intelligent/ \*respectful/ hungry/ tired/ alert}.

Finally, SL predicates are freely compatible with temporal and spatial modifiers, which IL predicates typically reject, as shown in (49).

- (49) a. \*John is {boring/ intelligent/ respectful} {in London/ this year}. (IL+temporal/spatial)  
 b. John is {hungry at his office/ tired at home/ alert in the classroom}. (SL+spatial)  
 c. John is {hungry in the evening/ tired after work/ alert after the accident} SL+temporal)

One way to account for this distinction in aspectual terms is to claim that IL properties have no temporal boundaries while SL properties are somehow bounded in time, either at the left boundary (i.e., the beginning) or the right boundary (the end). Thus, the IL properties denoted by *friendly*, *boring*, *intelligent*, and *respectful* would be coextensive with the whole existence of a certain individual, and would have no temporal boundaries to this effect. In the group of SL properties, at least one of the boundaries must be present: *dead* would only have the left boundary (someone dies and is dead forever after), and *sick*, *hungry*, *tired* and *alert* would have a compulsory left boundary and an optional right boundary (it is conceivable that someone becomes sick, hungry, or alert, and stays that way or loses this property).

There are some data suggesting that the SL/IL distinction is not always a clear-cut one. For example, as seen in (50), the adjectives *happy*, *fat*, *pretty*, and *anxious* are compatible with both IL and SL contexts:

- (50) a. There are many people {happy/ pretty/ fat/ anxious}. SL  
 b. I consider him {happy/ pretty/ fat/ anxious}. IL  
 c. I saw Mary {happy/ pretty/ fat/ anxious}. SL  
 d. Mary came back home {happy/ pretty/ fat/ anxious}. SL

Property-denoting words from other languages with similar meanings show a very similar ambiguity. The sentences in (51) contain the Spanish adjectives *feliz* ('happy'), *gordo* ('fat'), *guapo* ('pretty/handsome'), and *ansioso* ('anxious'), which are compatible with both the IL copula *ser* and the SL copula *estar*:

- (51) Juan {es/ está} {feliz/ guapo/ gordo/ ansioso}. IL/SL  
 Juan is {happy/ handsome/ fat/ anxious}.

Complicating matters even further, adjectives denoting specific human behavior (*unfaithful*, *polite*, *brave*, *careful*, etc.), in addition to being ambiguous between IL and SL (in (52a) and (52b)), can show an eventive, dynamic behavior: the predicates in (52c) denote events because only events can 'happen', and the predicates in (52d) are dynamic, as seen by the use of progressive. In these contexts, the adjectives describe a property of the event rather than individual: 'John did something, and whatever he did can be described as unfaithful, polite, brave or careful', 'John is acting in a certain manner, which can be described as unfaithful, polite, brave or careful'.

- (52) a. There are too many people {unfaithful/ polite/ brave/ careful}. SL  
 b. I consider him {unfaithful/ polite/ brave/ careful}. IL  
 c. What happened is that John was {unfaithful/ polite/ brave/ careful}.  
 d. John is being {unfaithful/ polite/ brave/ careful}.

The second line of research mentioned at the beginning of this section focuses on deverbal nominals, which can refer to the event or state encoded by the base verb, and also to one of its participants. Underived nouns can denote events (*war*, *riot*, *party*, *game*) and event participants (*surgeon*, *fan*, *knife*, *furnace*), too, but we will not be dealing with this specific group here. Deverbal nouns have a hybrid nature: on the one hand, they have all or most of the grammatical features associated with nouns, and on the other hand they display some of the typically verbal properties, in particular those related to aspect and, as seen in Section 8.4, argument structure.

Deverbal nominals exhibit a wide variety of meanings, which can be situated along a continuum with two extremes: forms having mostly verbal properties and forms with mainly nominal properties. The former denote events and can be argued to have AS and ES, and the latter have individual reference and have little or no verbal structure. Between those two ends, there are

nominalizations that exhibit both verbal and nominal characteristics in a variable proportion. Let us take a closer look at event-denoting nominals first and then at individual-denoting nominals. We will be mainly following the approach to deverbal nominals put forward in Grimshaw (1990) and subsequent work.

**Event-denoting nominals** can be derived from verbs belonging to all aspectual classes: activities (53a), accomplishments (53b), achievements (53c), and states (53d):

- (53) a. The *rehearsal* of the play for many weeks paid off at the premiere. ACTIVITY
- b. The *preparation* of the banquet in just two hours amazed the guests. ACCOMPLISHMENT
- c. The frequent *assassination* of politicians by guerrillas was shocking. ACHIEVEMENT
- d. John's *admiration* for his new colleague's discretion did not last long. STATE

The nominals in (53) show many of the aspectual properties that are typically displayed by verbs: in addition to denoting events (and inheriting the base verb's arguments), they are compatible with temporal adverbials ('for many weeks' in (53a) and 'in two hours' in (53b)) and aspectual adverbials (*frequent* in (53c)). Moreover, they seem to preserve the specific aspectual properties of their base verbs. *Rehearsal* is compatible with durative *for* time adverbials, like all activities, but with *in* adverbials it is interpreted as an accomplishment (*The rehearsal of the play in two weeks*). *Preparation* is compatible with both *in* and *for*, but with the latter it is interpreted as a non-culminating event, as all accomplishments. *Assassination* behaves as an achievement in that it acquires an iterative interpretation with *for* adverbials (*The assassination of politicians for decades*) and a preparatory phase interpretation with *in* adverbials (*The assassination of the President in two weeks*). Finally, *admiration* is only compatible with *for* adverbials (*The admiration of his father's wisdom for decades*) and it rejects the iterative aspectual adverb *frequent* (*\*frequent admiration*), which is typical for states.

Some event nominals (termed *simple* or *fact nominals*) appear to have impoverished event and argument structures and are closer to normal nouns than the event nominals we just described. When combined with aspectual adverbs *frequent*, *constant* and similar, they only appear in plural: compare the event nominal *examination* in (54a) with the fact nominal *exam* in (54b).

- (54) a. The frequent examination of students led to numerous complaints.
- b. The frequent {*\*exam* / exams} led to numerous complaints.

**Individual-denoting** deverbal nominals can refer to the event participants or to the event result. The result nominals often refer to the object created as a result of the event, which is usually encoded as the direct object of the base verb: we build something and the result is the existence of an object called a *building*; we invent something and the result is the existence of an *invention*; we stain something and the result is the existence of a *stain*. Other result nominals have a less straightforward relation with the base verb. For example, *agreement*, *referral* and *mixture* can certainly be defined as the result of agreeing, referring, and mixing, but they are not related to the direct object of the base verb and they may or may not denote created objects: *agreement* is the fact of agreeing or an actual contract; *referral* is an instance of referring or a legal document; and *mixture* is a product of mixing but what is mixed are the ingredients combined and not the 'mixing' itself.

As discussed in Section 8.4, deverbal nouns can also encode different event participants: Agent (*translator*, *smoker*), Theme (*appointee*, *attachment*), Instrument (*opener*, *washer*), Place (*hanger*), etc. What concerns us here are the aspectual properties of these nouns. Being nouns that can refer to individuals, they can be pluralized (compare the event-denoting *\*preparations of manuscripts*

with individual-denoting *mixtures*, *agreements*, *translators* or *appointees*), and they reject modification by aspectual and temporal adverbials: the examples with result nominals in (55a,b) are only good with an event interpretation, and those with participant nominals, in (55c), are not acceptable at all.

- (55) a. #{{frequent/ constant} {agreement/ referral/ mixture}  
 b. #parties' agreement {in/ for} two months, {doctor's referral/ chef's mixture} in five minutes  
 c. \*{{frequent/ constant} {translator/ opener/ hanger}

However, some participant nominals do have interpretations involving the underlying event. In (56a), what is frequent or occasional is the event of flying or smoking, not the person involved in this event. In (56b), what is counted may be the number of flying customers or flying events (so that each person may have been counted more than once, every time he happened to be a customer). Some of these nominals are also compatible with PPs encoding the circumstances of the event that define them: someone is a flyer just while flying, but not at home or on a sidewalk.

- (56) a. {{frequent/ occasional} {flyer/ smoker}  
 b. Over two million flyers chose our company this year.  
 c. the flyer in the first row of the aircraft/ \*the flyer {on the sidewalk/ at home}

As shown in Busa (1996), the difference between *translator* and *opener*, on the one hand, and *smoker* and *flyer* on the other hand is that the events defining the latter two nominals must actually have happened if we want to apply them to a person: a flyer is someone who is actually flying and a smoker is someone who has actually smoked and has the habit of smoking. By contrast, the events defining *translator* and *opener* might never happen: in order to be called a translator, a person must have the ability to translate and/or a college degree certifying this ability, but she/he is not required to have produced a single translation; and an opener is a tool meant to open things, and we call it this way whether or not it has been actually used. In other terms, *translator* and *opener* are **modal**, and *smoker* and *flyer* are **extensional**.

## 9.4 Tense-Aspect Details

As discussed in Section 6.3.3, tense and aspect represent two different conceptions of time: **tense** tells us *when an event happens* and **aspect** *what the internal temporal structure of this event is*. Temporal information is essential for determining whether a proposition is true or false: the same tenseless predicate (e.g., 'John *be* my boss') might be true when combined with a past tense marker ('John *was* my boss'), if the denoted event took place before we utter this sentence, but possibly false if we are referring to the present or future ('John {*is/ will be*} my boss').

The term **tense** is used to refer specifically to a *functional category* (cf. Section 1.3), encoded in syntax as a Tense Phrase (TP) or Inflectional Phrase (IP). Indeed, in many languages tense is encoded in the verbal inflection. Take a look at the simple present, past and future forms of 1<sup>st</sup> person singular of the Spanish verb *trabajar* 'to work': different inflectional morphemes are used in each case, and very often tense and grammatical aspect are merged in the same morpheme, as in *trabaj-é* 'I worked' (perfective past) and *trabaj-a-ba* 'I was working' (imperfective past) in (57b). English verbal morphology, on the other hand, is not this rich. The only available tense endings are *-s*, as in *works*, and *-ed*, as in *worked*, and auxiliary verbs are often used instead, as in 'I *am* working' or 'I *will* work' in (57a,c).

- (57) a. *trabaj-o* 'I work/ I am working' PRESENT  
 b. *trabaj-é* 'I worked' [PERF]/ *trabaj-a-ba* 'I was working' [IMPERF] PAST  
 c. *trabaj-a-ré* 'I will work' FUTURE

Despite the fact that tense is a functional category, the study of verbal endings and auxiliary verbs as a part of the lexicon is amply justified since both kinds of markers must be encoded in the lexicon (as morphemes in the former case and as lexical items in the latter). Of course, temporal distinctions other than tense can also be encoded by *lexical categories*, which is particularly relevant in languages that lack compulsory grammatical markers of tense: e.g., think of the time adverbs *now*, *then*, *today*, *yesterday*, etc.

Tense is a *referential* and *deictic category*: that is, it allows us to identify a specific event among others of the same kind, and it 'anchors' it in time with respect to some temporal location (time point or time interval). This is similar to the way the deictic adverbs *here/there* and demonstratives *this/that* anchor utterance relevant spatial locations to the location of the speaker: *here/this* are used to describe whatever is near the speaker, and *there/that* for everything else.

One helpful way to broadly characterize the semantics of tense is in terms of the possible temporal orderings of three distinct time points (*S*, *E*, and *R*), defined below (Reichenbach, 1947).

- SPEECH TIME (*S*): time when the sentence is uttered, the 'now' of the speaker;
- EVENT TIME (*E*): time when the event takes place;
- REFERENCE TIME (*R*): time with respect to which the event is located in time.

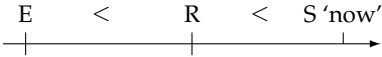
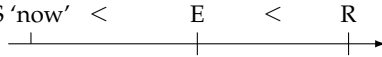
Let's see how tenses can be analyzed in terms of different combinations of these three times. Consider first the **absolute tenses**, which include the simple past and simple future in English. These locate the event (*E*) relative to the speech time (*S*). As schematically represented in (58a), a declarative sentence in simple past asserts that the denoted event occurred before the speech time, and a sentence in simple future asserts that the event will happen after the speech time, as in (58b). We use the symbols '<' and '=' to represent temporal precedence and simultaneity on the timeline, respectively.

**WARNING: Ongoing Present Interpretation in English**

Recall from Section 9.3.3 that the English simple present cannot be used to refer to an event that is happening at the moment of speaking, with the only exception being stative verbs. To talk about most ongoing events, we have to use the present continuous instead, as in (58c).

- (58) a. Kim sang.                      b. Kim will sing.                      c. Kim is singing.
- 

**Relative tenses** (e.g., past perfect and future perfect in English) have a flexible orientation point: they locate the described event relative to a reference time *R*, which does not need to coincide with the speech time. Two examples are illustrated with timelines in (59) below: a proposition expressed by a sentence in past perfect is true if the event *E* happens before a reference time *R*, which precedes the speech time (as in (59a)); similarly, a proposition expressed by a sentence in future perfect is true if the event *E* happens before a reference time *R*, which is posterior with respect to the speech time (as in (59b)). The reference time can be expressed by a time adverbial, as in (59), or by referring to another event, as in 'Kim {had/ will have} sung the aria by the time *we* {arrived/ arrive} at the opera house'.

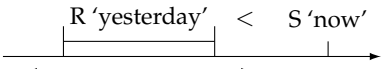
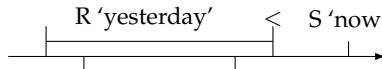
- (59) a. Kim had sung the aria by 10 p.m.  
  
 Kim sings the aria 10 p.m.
- b. Kim will have sung the aria by 10 p.m.  
  
 Kim sings the aria 10 p.m.

It should be mentioned that the semantic status of future is much more complex than that of present and past. Future is different because it is *inherently modal*: we can be sure of what happened in the past or what is happening now, but there cannot be such certainty in the case of future because what it expresses is our belief, expectation, or prediction. Declarative sentences in past and present tense entail that what is stated is true as long as the relevant truth conditions are met (among them, that the situation takes place before or during the time of the utterance), but sentences in the future merely imply it, and the implication can be canceled, as seen below.

- (60) a. I saw you yesterday. - ??No you didn't.  
 b. I am looking at you right now. - ??No you are not.  
 c. I will see you tomorrow. - No, you won't, you'll be traveling all day tomorrow.

The diagrams in (58) and (59) are simplified in that they represent the events as instantaneous and lacking internal structure. However, we know by now that, no matter when an event takes place, it has an inherent temporal structure, encoded through the lexical aspect or event type, and it can also be represented by the speaker from a particular perspective, when a choice can be made between the grammatical perfective and imperfective aspect. Tense interacts with both lexical and grammatical aspect. This is a complex topic which we will only briefly illustrate here.

Let us compare the sentences *Kim was drawing a picture yesterday* and *Kim drew a picture yesterday*. The former is marked with imperfective aspect and it represents the event of drawing as unbounded, with no beginning or end. The latter predicate is perfective: it represents the event as a whole, including the (unmentioned) initial and final endpoints. As shown in (61), this difference has an impact on how the event time and the reference time are located relative to each other: in the case of perfective, the boundaries of E are contained within the extension of R, and for the imperfective, R is included within E, which does not have boundaries. We use a double-headed arrow to represent unbounded time intervals and a line with two vertical bars for bounded time intervals.

- (61) a. Kim was drawing a picture yesterday.  
  
 Kim draws a picture
- b. Kim drew a picture yesterday.  
  
 Kim draws a picture

Another instance of how tense and grammatical aspect interact is the pervasive tendency, attested in most natural languages, of allowing the combination of both imperfective and perfective forms with past tense, but rejecting the association of perfective forms with present tense (logically, the boundaries of such a situation would go beyond the present moment). In Russian, where grammatical aspect marking is obligatory, present can only be imperfective (as in (62a)) and the combination of an imperfective stem with a perfectivizing suffix (*s-* in *sdelaju* in (62b)) yields a future interpretation.

- (62) a. Ja delaju obed.  
 I-NOM make-PRES.IMPERF lunch-ACC  
 'I am making lunch.'

- b. Ja        sdelaju        obed.  
 I-NOM make-FUT.PERF lunch-ACC  
 'I will make lunch.'

In languages where tense marking is optional or missing, the basic pattern of default temporal location associates unbounded situations with the present and bounded situations with the past, and there is usually a constraint that prevents bounded situations from being located in the present. In the Chinese examples below, taken from Smith (2011), the progressive imperfective particle *zài* in (63a) yields a present interpretation, and the resultative verb complement (RVC) *dào* in (63b), which encodes perfective, yields a past interpretation by default.

- (63) a. shìshí-shàng zhè-zhǒng móshì shì zài chāoxí zìrán kēxué  
 fact-on this kind model be ZAI copy natural science  
 'In fact, this model is already copying the natural sciences.'
- b. [...] zhè shì wǒ hé duō-wèi niànqīng xuézhě jiāo-tán hòu suǒ dé-dào de jiélùn  
 [...] this be I and many-CL young scholar exchange-talk after SUO reach-RVC DE conclusion  
 'This is the conclusion which many young scholars and I reached after exchanging views.'

As noted above, lexical aspect also applies specific constraints on the interpretation of both tense and grammatical aspect. For example, perfective aspect does not necessarily imply that the event had a specific beginning and end point if the lexical aspect of the verb is not compatible with the existence of these kind of boundaries. This is the case with stative predicates, such as *be well-behaved*, in the past tense.

- (64) a. Your son was very well-behaved yesterday (and he still is well-behaved today).  
 b. John wrote a resignation letter yesterday (\*and he is still writing the letter today).

As we can see, (64a) can be true if the boy continued to be well-behaved until the time of speech and even beyond. Compare this to the accomplishment *write a resignation letter* in (64b): the proposition is not true if John began writing the letter yesterday but did not finish it (i.e., if the end point of the event is beyond the time of utterance).

When these expected correlations do not hold in a specific predicate, the so-called *secondary uses of the tenses* may emerge in discourse. Present tense is often used to bring the described events closer to the speaker, even if they happened in the past. This is what we see in (65), where achievement verbs *catch* and *assassinate* are combined with simple present: although telic events are usually rejected by the present, especially if they are instantaneous (see Section 9.3.3), in these contexts the achievements yield acceptable sentences with a slow-motion interpretation ('At this moment, the goalkeeper is catching the ball/ Has just caught the ball' in (65a)) and a historic present interpretation ('Chapman assassinated John Lennon' in (65b)). The past tense, on the other hand, distances an ongoing situation from the here-and-now of the speaker and the listener, which may result in a more indirect and polite expression, as in (66), where both sentences have a present interpretation.

- (65) a. The goalkeeper *catches* the ball.  
 b. Chapman *assassinates* John Lennon in 1980.
- (66) a. Hi, boss. *Did you want* any help? = 'Do you want any help?'  
 b. Excuse me, I just *wanted* to say hi. = 'I want to say hi.'

So far we have been talking about tense as a verbal category. However, it has recently been argued that, at least in some languages, nominals have a tense system as well (cf. Nordlinger and Sadler 2004, Tonhauser 2007). Consider the following examples from Guaraní (taken from

Tonhauser 2007), with the past nominal marker *-kue* and the prospective marker *-rã*. In both cases, the time at which the property denoted by the N ( $t_N$ ) is true is different from the time at which the property denoted by the NP ( $t_{NP}$ ) is true, and both reference times may be different from the speech time ( $t_S$ ).

- (67) a. Juan ha'e pa'i-kue/-rã.  
           Juan 3-PRON priest-KUE/-RA  
           'Juan is a former/future priest.'  
       b. Ko'agã a-hecha che-ròga-kue.  
           Now see-1SG house-KUE  
           'I am seeing my former house'.  
           ='I see something that I own but it is not a house anymore.'  
           ='I see a house that I used to own.'

In (67a), with *-kue* ('Juan is a former priest'), the time at which the property *priest* is true precedes the time at which *former priest* is true, and the former overlaps with the speech time ( $t_N < t_{NP}$ ,  $t_{NP} = t_S$ ). In (67a) with *-rã* ('Juan is a future priest'), a reverse relationship holds:  $t_{NP} < t_N$  and  $t_{NP} = t_S$ . (67b) is ambiguous: the interpretation 'I see something that I own but it is not a house anymore' corresponds to the same temporal ordering as in (67a) with *-kue* ( $t_N < t_{NP}$  and  $t_{NP} = t_S$ ), and the interpretation 'I see a house that I used to own' has the ordering  $t_{POSS} < t_{NP}$  and  $t_N = t_{NP} = t_S$  (the possession relation between the speaker and the house no longer holds at the speech time, but the house still exists).

It should be noted that the properties of these markers are not well understood yet, and their theoretical status is far from being clear: some authors treat them as nominal tense markers, and others relate them to aspect. What is interesting for the purposes of this book is that the application of both markers is not free: *-kue*, for example, is not compatible with nouns denoting natural kinds (*person, child, hair, water*). This semantic constraint might be governed to a significant extent by the lexical features encoded in the qualia structure of the nouns: if we assume that *-kue* cancels the value in the TELIC role but not in the FORMAL (e.g., a former priest is a former religious servant, but not a former human being), then natural kinds are logically excluded because their telic value is underspecified (cf. Section 7.3). Although the semantics of *-rã* is more complex, in (67a) it also acts on the TELIC value of the noun but in the opposite direction: it introduces a TELIC value on top of the FORMAL ('someone who at the time of speech is just a human being will acquire the functional property of being a priest').

## 9.5 Modality

**Modality** is the semantic category that allows the speaker to express her/his attitude towards the content of a proposition. As we'll see, as a grammatical category it is often (although not always) conflated in verbal inflection with other categories that apply at the level of the sentence (tense and aspect), giving rise to the category cluster referred to as TAM (Tense, Aspect, Modality/Mood).

Traditionally, the two most common kinds of modality identified in the philosophical and linguistic literature are **epistemic** and **deontic**. **Epistemic modality** expresses the degree of confidence that the speaker has in the state of affairs expressed by a particular utterance. **Deontic modality**, on the other hand, expresses an attitude towards how a state of affairs should be, with



respect to social and ethical norms, and encodes various degrees of obligation, permission, and responsibility.

Both of these modal classes are scalar in nature: the values of an epistemic modal can range from the assertion of a fact to speculation of a mere possibility of something; for a deontic modal, the highest value on the scale is associated with an obligation, while the lowest corresponds to permission or allowance to perform some act. The examples in (68) contain adverbs and adjectives associated with different degrees of certainty on the part of the speaker.

- (68) a. He is *certainly* around. NECESSARILY T      e. He is *unlikely* to be around. POSSIBLY F  
       b. He is *likely* to be around. POSSIBLY T      f. It is *impossible* that he is around. NECESSARILY F  
       c. He is *probably* around. POSSIBLY T  
       d. He is *possibly* around. POSSIBLY T

Namely, regarding the truth of the proposition, the degree of certainty ranges from *certainly*, which entails that the proposition is necessarily true (at least for this speaker), to the negative *impossible*, which entails that the proposition is necessarily false. In between we have several options for what is qualified as 'possibly true' and 'possibly false'. A similar meaning gradation can be observed in (69), with auxiliary verbs expressing different degrees of deontic modality: from strict obligation with *must* to permission with *may/might*, *could*, and *can*.

- (69) a. You *must* return the car. OBLIGATION  
       b. You *should* return the car. OBLIGATION / PROPRIETY  
       c. You *need* to return the car. OBLIGATION / DESIRABILITY / NECESSITY  
       d. You *ought to* return the car. OBLIGATION / DESIRABILITY  
       e. You *may/might* return the car. PERMISSION  
       f. You *could* return the car. PERMISSION  
       g. You *can* return the car. PERMISSION

The connection between both modalities is evidenced by the fact that, in English and other languages, the same auxiliaries can be used to express both epistemic and deontic modalities.

- (70) a. He *may* join us.  
       DEONTIC - 'It is socially acceptable for him to join us.'  
       EPISTEMIC - 'It is epistemically possible that he joins us.'  
       b. He *must* be at school.  
       DEONTIC - 'It is socially necessary for him to be at school.'  
       EPISTEMIC - 'It is epistemically necessary that he is at school.'

Notice that, when used with epistemic meaning, different English auxiliaries are associated with different sources of evidence that the speaker relies on in order to assess the truthfulness of the utterance. Compare the sentences in (71), for example.

- (71) a. John *may* be around.  
       b. John *must* be around.  
       c. John *will* be around.

By using *may* in (71a), the speaker is conveying mere speculation and the utterance denotes uncertainty; sentence (71b) with *must*, on the other hand, denotes the only possible conclusion and a firm judgment based on direct evidence (e.g., the speaker sees John's coat on his chair); finally, sentence (71c), with the use of the future auxiliary *will*, denotes a reasonable conclusion based

on the logical inference from what the speaker knows about John (his schedule, his punctuality, etc.). Reference to the source of information which we base our judgment on is associated with *evidentiality*, a category closely linked to epistemic modality, which we discuss below.

Modality can also be encoded directly in the meaning of a predicate. For example, VERBS OF PROPOSITIONAL ATTITUDE (*know, think, consider, believe, suspect, guess, doubt*) denote mental states, acts, or attitudes held by the speaker toward the proposition encoded in their complement clause. Again, they can encode different degrees of commitment to the truthfulness of the expressed content, as seen in the examples in (72).

- (72) a. I *know* that he is around. NECESSARILY T      d. I *guess* that he is around. POSSIBLY T  
       b. I *believe* that he is around. POSSIBLY T      e. I *doubt* that he is around. POSSIBLY F  
       c. I *suspect* that he is around. POSSIBLY T      f. I *deny* that he is around. NECESSARILY F

Many of these verbs (*think, consider, believe, suspect, guess*), along with other verbs expressing intentions or desires (*seek, want, try*, etc.) are called **non-factive** because they do not *presuppose* that their complement clauses express true propositions. They introduce the so-called *opaque environments*, ‘belief worlds’ which may be different from the real world. The contexts they create are called opaque precisely because they make it impossible to assess the truth value of the embedded clause, and the meaning of the whole sentence does not depend on the truth of the proposition expressed by the embedded clause, as in (73a): it can be true that John believes that Mary won, regardless of whether she won or not. **Factive** verbs, on the other hand, *trigger a presupposition* that the embedded proposition is true (see Section 4.2.2). These include the verbs *find out* and *know*, as used in (73b).

- (73) a. John {*suspected / thought*} that Mary  $\nVdash$  Mary won  
       b. John {*found out / knew*} that Mary won  $\models$  Mary won

Notice that certain complementizers can sometimes introduce different epistemic interpretations, as seen in (74). The English *that* is associated with a neutral or positive degree of certainty, and *if* and *whether* are markers of uncertainty.

- (74) a. He will confirm *that* she is there. [The speaker is more or less sure that she is there]  
       b. He will confirm {*whether / if*} she is there. [The speaker is unsure about her being there]

CLUE/COMMENT[magnifying glass icon]: **The Behavior of Implicatives**

There are many verbs in English and other languages that create very specific patterns of entailments and presuppositions. The factive verbs above are related to a class of predicates known as *implicatives* (Karttunen, 1971). For example, in both English (E) and Spanish (S), sentences with the **factive** constructions *forget that/ olvidar que* have different inferences than those with *forget to/ olvidar*. Sentence (a) presupposes that I paid you, while (b) entails that I didn't pay you, but presupposes that I intended to. The sentences in (b) are called **implicative** constructions.

- a. I forgot that I paid you. (E)  
*Olvidé que (yo) te {pagué/ había pagado}*. (S)
- b. I forgot to pay you. (E)  
*Olvidé pagarte*. (S)

Implicatives can be grouped into two semantically distinct classes. *Two-way implicatives* (such as *forget to* above) yield an entailment in both positive and negative contexts. That is, when (b) is negated, there is (the opposite) entailment that I paid you. Notice that negating the factive in (a), on the other hand, does not change the presupposition that I paid you. Other two-way implicative verbs include: *manage to*, *fail to*, *neglect to*, and *remember to*.

*One-way implicatives* yield an entailment only under one context (or polarity). This class includes the constructions: *refuse to*, *prevent NP from*, and *force NP to*. For example, while (c) entails that Mary did not leave, (d) could be true with Mary leaving or not.

- c. Kim prevented Mary from leaving.
- d. Kim did not prevent Mary from leaving.

It should be noted that most implicatives have two aspects of meaning, both an entailment and a presupposition. For example, in the question,

- e. Did John fail to show up for work?

there is a presupposition that that John tried or was expected to show up for work; but there is also an implicative, where it is asking whether he showed up or not. The behavior of both classes of implicatives is, in fact, much more complicated, and shows how lexically specific semantic information interacts with negation and other linguistic expressions affecting modality (Karttunen, 2012).

The notion of modality, as described so far, is a *semantic* category that affects the epistemic or deontic attitude of a speaker towards a proposition. The notion of **mood**, on the other hand, refers to a *grammatical* category encoded by the verbal inflection in a language. The universal inventory of mood types is extensive and includes notions frequently associated with *utterance types* (declarative, interrogative, imperative, optative, etc.). Here we will focus mainly on the opposition between **indicative** and **subjunctive** moods, found in the verbal system of many European languages.

There are many syntactic, semantic, and pragmatic factors involved in the choice of indicative vs. subjunctive in different languages: in some cases the syntactic context is only compatible with one mood and in others there is flexibility for the speakers to choose between either, based on how they want to portray the situation. If they choose to describe it as a certain fact of reality, indicative is used. If, by contrast, they portray it as potential or possible, preference is given to subjunctive.

The contrast between indicative and subjunctive has often been defined in terms of ‘assertion’ vs. ‘non-assertion’: assertive predicates state facts and beliefs and non-assertive predicates do not contribute new propositional content, but rather comment on it or evaluate it. In Spanish, assertive predicates are introduced by verbs of perception (*ver* ‘see’, *oír* ‘hear’, *percibir* ‘perceive’), knowledge (*saber* ‘know’, *conocer* ‘know’, *entender* ‘understand’, *enterarse* ‘learn, find out’), and communication (*decir* ‘say’, *afirmar* ‘state’, *explicar* ‘explain’, etc.), among others. The subordinate clause always appears in indicative mood after these verbs, as in (75).

- (75) Ana {*dijo* / *recordó* / *vio*} que Luis se había ido.  
 ‘Ana {said / remembered / saw} that Luis had left-IND.’

Non-assertive predicates, on the other hand, are introduced by verbs of emotional valuation (*lamentar* ‘regret’, *alegrarse* ‘be happy / pleased’, etc.), verbs of volition and influence (*desear* ‘want / wish’, *prohibir* ‘forbid’), performative and causative verbs (*hacer* ‘make’, *conseguir* ‘achieve, manage’, etc.), and numerous verbs of necessity, mandate, etc. Their subordinate clause may be factual (76a) or non-factual (76b), but in any case it must be assigned subjunctive.

- (76) a. Ana {*lamentó que* / *se alegró de que*} Luis se fuera.  
 ‘Ana {regreted / was glad} that Luis had left-SUBJ.’  
 b. Ana {*dijo* / *deseaba* / *prohibió*} que Luis se fuera.  
 lit.: ‘Ana {said / wanted / forbade} that Luis left-SUBJ.’

Note how the verb *decir* ‘say’ is compatible with both indicative and subjunctive, depending on whether it expresses assertive meaning (as in (75), where it denotes communication) or not (as in (76b), where it conveys order).

In other cases, the factuality of the proposition does determine the choice of mood: after *cuando* ‘when’, indicative is used if the clause refers to past or present events (which yield factual propositions), as in (77a), and subjunctive if the clause refers to future events (which, by definition, yield non-factual propositions), as in (77b).

- (77) a. Cuando vino empezamos a cenar.  
 ‘When he came-IND we started eating dinner.’  
 b. Cuando venga empezaremos a cenar.  
 ‘When he comes-SUBJ we will start eating dinner.’

Finally, as mentioned above, in some cases speakers can choose either mood depending on their level of certainty and other semantic factors:

- (78) Posiblemente {*tiene* / *tenga*} hijos.  
 ‘It is possible that he has-IND / SUBJ children.’

Mood has been shown to have manifold connections with tense and aspect. As mentioned in Section 9.4, future tense is inherently modal: it is non-factual because what has not happened cannot be described as a fact but rather as a possibility. From this perspective, future is inherently epistemic. In a number of languages, the same marker is used for the future tense and for the epistemic present, as in the Spanish example in (79):

- (79) *Estará* en clase. ‘He will be in class (in the future) / He is probably in class (right now).’

Modal meanings are often expressed through past tense forms, as well. It can be argued that the semantic relationship between past tense and modal non-factuality may be defined as ‘in-actuality’ or ‘distance’ (in time and with respect to the reality). The English modal auxiliaries

*could*, *would*, and *might*, which are past forms of *can*, *will*, and *may*, are predominantly used as a *conditional*. Past tense forms are used in ‘unreal’ conditionals, which refer to the future, while in ‘real’ conditionals present is used, as observed below.

- (80) a. If Kim joins us, the party will be more fun. [‘Kim is not with us right now and the party is not fun’]  
 b. If Kim joined us, the party would be more fun. [Speculation about a potential relation between Kim being here and the party being fun]

In Russian, on the other hand, the subjunctive is built by attaching the particle, *by*, onto the subordinate complementizer, *čto*, while the embedded sentence carries a past tense form of its verb (*prišel* in (81)).

- (81) Ja {xoču/ trebuju}, čto-*by* ty *prišel*.  
 I-NOM {want/ demand}-1.SG.PRES that-BY you-NOM come-1.SG.PAST.PERF  
 ‘I {want/ demand} that you come.’

**Evidentiality** is a strategy closely related to modals, which indicates the various sources of epistemic judgments about a proposition. While an epistemic modal allows the speaker to make judgments about the degree of factuality of a proposition (i.e., to what degree it applies in the real world), an evidential indicates the source of information that the proposition is based on and its degree of reliability. The reliability of information coming from first-hand experience (visual and auditory perception) is usually considered higher than that acquired from other sources (hearsay, logical inference, or information based on external sources). To illustrate this phenomenon, consider the propositions in (82), which are ordered according to the degree or reliability of the source of obtained information, from the highest in (82a), which is based on direct perception, to the lowest in (82d), which is based on hearsay.

- (82) a. I saw it raining last night.  
 DIRECT PERCEPTION  
 b. Apparently it rained last night, the ground is still wet.  
 INFERENCE BASED ON EXTERNAL EVIDENCE  
 c. It is possible that it rained last night: it rains a lot here in October.  
 INFERENCE BASED ON COMMON KNOWLEDGE  
 d. I hear it rained all night yesterday.  
 HEARSAY

Lexical items encoding evidentiality are present in all languages, and some languages even have grammatical markers distinguishing between different sources of reported information. In the Arawakan language Tariana, spoken in northwest Amazonia, sentences are obligatorily marked with morphemes that encode tense and evidentiality (cf. Aikhenvald 2004). The morphemes marked in bold in (83) all encode recent past and, in addition, they mark evidentiality: *-ka* marks visual evidentiality, *-mahka* non-visual evidentiality, *-nihka* evidentiality inferred from external evidence, *-sika* evidentiality inferred from general knowledge, and *-pidaka* reported evidentiality.

- (83) a. Juse irida di-manika-**ka**.  
 José football 3SG-play-VIS  
 ‘José has played football (we saw it).’

- b. Juse irida    di-manika-**mahka**.  
 José football 3SG-play-NONVIS  
 ‘José has played football (we heard it).’
- c. Juse irida    di-manika-**nihka**.  
 José football 3SG-play-INFR  
 ‘José has played football (we infer it from visual evidence: José and his boots are missing).’
- d. Juse irida    di-manika-**sika**.  
 José football 3SG-play-ASSUM  
 ‘José has played football (we infer this based on what we know about José’s habits).’
- e. Juse irida    di-manika-**pidaka**.  
 José football 3SG-play-REP  
 ‘José has played football (so we were told).’  
 (Aikhenvald, 2004)

Before we close this section, a brief comment is in order on how certain sublexical features encode the modal dimension. Recall that the value encoded in the TELIC role of artifactual nouns is, more often than not, modal in the epistemic sense: this applies to all the names of tools and many other inanimate artifacts (*opener, pen, table*), and also to nouns denoting occupations (*translator, lawyer, teacher*). All these nouns can be applied to an object or a person just because they have the *potential* of being used for a specific activity, but not because they have actually been involved in this activity.

## 9.6 Summary

In this chapter, we examined the linguistic categories that encode the temporal properties of events in natural language: *aspect*, *tense*, and *modality*. We first defined the notion of *event* from a linguistic perspective, as a situation or happening denoted by a predicate, and then explained the advantages of its integration into the logical description of predicates and sentences, including explicit association with specific arguments involved in the event description and with quantification. We then focused on different properties related to the *internal temporal makeup* of events, and elaborated on the following points:

- A theory of event decomposition is necessary if we wish to account for how the internal structure of events both impacts the grammatical behavior and characterizes the semantic properties of verbal predicates. This can be accomplished by either introducing primitive predicates that encode telicity, agentivity, and causality, or by postulating the existence of a level of representation called *event structure* (ES), which allows us to define the event type of words and predicates in terms of ordered subevents or phases. The description of ES can be further refined by associating discrete subevents with the temporal scale, to track how the temporal progression of events impacts the properties of the verbal arguments.
- The definition of *event type* is determined by multiple factors, contributed by both the head of the predicate as well as other morphosyntactic factors (lexical and grammatical aspect of the verb, grammatical number of the verbal arguments, the determiners used with the subject and the complements, etc.), and hence it should be defined at the phrasal and sentential level. This is why *event type diagnostics* need to be used cautiously: rather than signaling the overall

event type of the head verb, many of the sentential components impose their own aspectual requirements on the verb, triggering *event type-shifting operations*.

- Verbal predicates are not the only event-denoting expressions in language: many nouns can refer to events (as well as their participants), and many adjectives can be viewed as either temporally or atemporally associated with individual objects, giving rise to the distinction between *stage-level* and *individual-level* properties, which affect the syntactic behavior of different groups of predicates. Deverbal nouns often inherit the aspectual properties of their base verb and, depending on the proportion of verbal and nominal features that they display in each case, they can be classified as *event-denoting* or *individual-denoting*. Even individual-denoting nominals can have interpretations involving the underlying event.
- *Tense* is a functional category that encodes when an event happens. It is a referential and deictic category: it allows us to identify a specific event among others of the same kind, while also anchoring it in time with respect to some temporal location. The *event time* can be defined relative to the *speech time* in absolute tenses or the *reference time* in relative tenses. Tense interacts with lexical and grammatical aspect: e.g., present tense is usually associated with imperfective grammatical aspect and unbounded event types, whereas there are no such constraints for past tense. Nominal expressions can also be marked to indicate how the properties they denoted should be interpreted in time (e.g., *future senator*, *former residence*, etc.).
- *Modality* is the semantic category that allows the speaker to express an attitude towards the content of a proposition. Modal meanings can be encoded either lexically (e.g., through *verbs of propositional attitude* and other *non-factive verbs*), or grammatically (through the functional category of *mood*, associated with verbal inflection). *Epistemic modality* allows us to express how certain we are that the proposition we are uttering is true, while *deontic modality* has to do with the degree of moral acceptability of the state of affairs expressed by the utterance, with respect to social or ethical norms. Mood also interacts with tense in many ways: future tense is inherently non-factual, while past tense is often used to evoke modal uncertainty, due to lack of direct connection with the present or reality. *Evidentiality* is related to epistemic modality, in that it indicates the source of information that the proposition is based on and its degree of reliability. In some languages, sentences are obligatorily marked with morphemes that encode evidentiality.

## 9.7 Further Readings

Topic	Primary references
Event types and aspect	Vendler (1967), Bertinetto (1986), Smith (1991), Comrie (1976)
Aspectual diagnostics	Dowty (1979)
Aspectual and argumental properties of nominals	Bloch-Trojnar and Malicka-Kleparska (2017)
Individual-level/ stage-level distinction	Milsark (1974), Carlson (1977), Arche (2006), Husband (2010), Marín (2010), Pérez-Jiménez <i>et al.</i> (2015)
Aspect of deverbal nominals	Grimshaw (1990), Borer (2013) (Part I), Alexiadou and Grimshaw (2008), Busa (1996), Pustejovsky (2000)
Tense	Comrie (1985), Dahl and Velupillai (2005)
Nominal tense	Nordlinger and Sadler (2004), Tonhauser (2007)
Mood, modality, evidentiality	Palmer (2001), Aikhenvald (2004), Boye (2012), Frawley <i>et al.</i> (2006)
Implicatives	Karttunen (1971), Kiparsky and Kiparsky (1970)
Topic	Secondary references
Event types	Filip (2011), Smith (2011)
Aspectual diagnostics	De Miguel (1999), Kearns (2000)
Individual-level/ stage-level distinction	Fábregas (2012), Leonetti <i>et al.</i> (2015)
Aspect of deverbal nominals	Grimshaw (2011)
Tense	Cann (2003) (ch.8), Kearns (2000) (ch.7), Riemer (2010) (sec. 9.2.), Chierchia and McConnell-Ginet (2000) (ch.5), Bosque and Gutiérrez-Rexach (2009) (sec. 10.4.)
Mood, modality, evidentiality	Nuyts and van der Auwera (2016), Cann (2003) (ch.9,10)
Implicatives	Karttunen (2012), Nairn <i>et al.</i> (2006), Karttunen (2016)

## 9.8 Exercises

- Identify the event type encoded by each of the following sentences. Use the diagnostics introduced in Section 9.3.3 to motivate your answer.
  - The pirates were looking for a treasure.
  - The pirates found the treasure.
  - The scientists discovered a new pathogen.
  - The scientists discovered new pathogens.
  - We recently painted the house.
  - Mike went to the store.
  - That door goes to the cellar.
  - The boy yawned.
- What event phase is focused on in the following predicates? Remember that it can be the preparatory phase, the onset, the course of the event, the final phase (result, culmination), and the resultant state (the phase beginning from the culmination).



- 
- a. The writer died in 1975.  
 b. My laptop died for two hours.  
 c. I knew it right then.  
 d. I have been working here since 2005.
- e. John is sleeping.  
 f. He read the paper in two hours.  
 h. He read the paper for two hours.  
 g. The wall is built now.
3. Each of the following sentences is acceptable, each sentence also contains some kind of violation of the canonical compatibility constraints that different event types impose on the predicate and its arguments (e.g., *in* time adverbials are only compatible with durative and telic events). Identify these violations and explain what event type shift is triggered in each sentence.
- a. The train is coming!  
 b. We'll pick you up in two hours.  
 c. I am loving my vacation in Paris!  
 d. Our baby swims already.
- e. The convict escaped for just two days.  
 f. Convicts escaped from this prison for many years.
4. What is the interpretation of the deverbal nominals in these sentences? Recall that they may encode events and individual objects. Motivate your answer.
- a. They brought us two *drinks*.  
 b. We went home after a few *drinks*.  
 c. The *baker* burnt the loaf.
- d. You were talking in your *sleep*.  
 e. *Writing* is my only hobby.  
 f. His *writings* are stored at a museum.
5. Represent the temporal configuration encoded by the following sentences on a timeline following the Reichenbachian approach. Use the diagrams in Section 9.4 as a reference.
- a. The goalkeeper is catching the ball.  
 b. We will have finished this chapter by 10.  
 c. We are going to Rome tomorrow.  
 d. She promised that she would call.
- e. After that encounter, we met every day.  
 f. You'll go to bed when you are done playing.
6. What modal meanings are expressed in the following sentences?
- a. Your phone is ringing. - That *will be* John.  
 b. Mary *could do* that.  
 c. It's *threatening to rain*.
- d. They *should be* here by noon.  
 e. If you *had done* it you'd have regretted it.  
 f. I suggest that he *see* a doctor.

## **Part III**

---

# **Lexicon as a System**

# 10 General Architecture of the Lexicon

---

## 10.1 Overview

In Part III, we discuss the lexicon as an independent but inter-connected system within the language faculty. The present chapter addresses the question of how the lexicon is structured globally, while Chapter 11 investigates how lexical information is accessed by other parts of the grammar when creating linguistic expressions as used for communication. Here we define the different components of a *lexical architecture*, which provides us with the **content**, **functionality**, and **organization** of lexical information. The first component we examine is the syntactic type hierarchy, as differentiated by syntactic category and syntactic valence. Then, we look at the semantic type hierarchy, which provides sortal typing and subtyping information for basic semantic classes in the language. We then study the lexical semantic relations that are not directly encoded in the semantic type hierarchy, such as meronymy, antonymy, and synonymy.

## 10.2 Lexical Architecture

It is currently estimated that any typical speaker of a natural language knows over 40,000 words. This refers to a speaker's *active vocabulary*, which contains all those words the speaker can produce or generate on command, in a communicative context. In fact, though, we can identify or recognize many more words than this estimate suggests, perhaps up to 350,000 different lexical entries, from what is called a *passive vocabulary*. How can there even be so many words, you might ask? This estimate includes all the names of people, products, places, cars, countries, cities, files, banks, web addresses, and so forth, that we encounter every day. And for all of these words, we need to be able to store, access, and process them.

When we think about the overall organization of our lexicon, it seems clear that one thing it is **not** is a listing of words as in a dictionary. The way we organize words in our everyday life suggests that the lexicon is a highly structured system. For example, consider the phenomenon known as *folk etymology*, which refers to a speaker's tendency of reanalyzing the form and meaning of unfamiliar words by (incorrectly) associating them with familiar words (especially with high frequency familiar words). Folk etymology explains, for instance, how the word *femelle*, borrowed from Old French, became *female* in Middle English: the similarity in form led speakers to believe that it was related to the English word *male*, which resulted in the modified spelling *fe-male*. Folk etymology illustrates that speakers look for relations between lexical items no matter what, even if the hypothesis or judgment of similarity they come up with is wrong and the form and meaning of the analyzed lexical item is affected by it. We subconsciously look for patterns and regularities, and are even willing to impose them when they are not readily available.

As we have seen from discussions in the preceding chapters, determining the architecture

of the lexicon involves understanding the relationships between several distinct components making up the structure of lexical items themselves. These are listed below in (1).

- (1) a. SYNTACTIC TYPE: this identifies the structural mode of presentation of a word in the syntax, e.g., as a Noun, Verb, Adjective, as so on, as well as the word's valence or argument structure.
- b. SEMANTIC TYPE: this identifies the conceptual type for a lexical item, while positioning it within a type hierarchy. This typing includes basic ontological type distinctions as well as those associated with individuation classes and qualia specifications.
- c. LEXICAL SEMANTIC RELATIONS: this includes relations such as hyperonymy, meronymy, antonymy, and synonymy.
- d. WORD SYNTAX: this includes the structure of a lexical item as a word or morpheme (morphology), or as a *multiword expression* or *phrasal construction*.

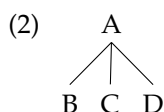
As we will see, many of the lexical structures and relations that will be reviewed here are not language-specific and have been used in other disciplines to represent many kinds of knowledge (e.g., taxonomies, inheritance hierarchies, etc.).

Before examining each of these components in more detail, let us consider more precisely what we mean by an architecture for the lexicon. As mentioned above, a lexical architecture specifies the content, functionality, and organization of our knowledge of words. More specifically, different aspects of the *content* of a lexical item (e.g., its syntactic or semantic type) will *function* in distinct ways (e.g., build a VP or require an animate subject) in order to facilitate communication and representation through language. The global *organization* behind both the content and the function of our words is what we refer to as a *lexical architecture*.

One of the major organizing principles in the lexicon is the notion of a *type hierarchy*, a concept we have already encountered in our discussion of HPSG from Section 3.4. The members of a domain of study can be organized into different classes, based on properties that those elements share. When these classes are themselves then subdivided into classes, we end up with a class or type hierarchy, where the top node in the hierarchy can be thought of as including all the elements in the entire domain. The properties that are associated with any particular class will include the properties of the class that it is a part of, and so on, up the hierarchy. This is why such structures are called *inheritance hierarchies*, because these properties are inherited from above. To be a bit more precise, let's say that the types (classes) in our domain are ordered by a subtyping relation,  $\sqsubseteq$ , defined as a partial order on the set of types,  $\mathcal{T}$ .

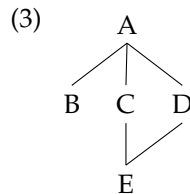
CLUE/COMMENT[magnifying glass icon]: A partial order,  $\sqsubseteq$ , over a set of elements,  $A$ , is a binary relation that is: *reflexive*, where each element is comparable to itself; *antisymmetric*, where no two distinct elements precede each other; and *transitive*, where if an element  $a$  is related to an element  $b$ , and  $b$  is related to an element  $c$ , then  $a$  is also related to  $c$ . A partially ordered set is called a *poset*.

For example,  $B \sqsubseteq A$  means that  $B$  is a kind of  $A$  in our domain. Hence, for a type  $A$  that has several subtypes ( $B$ ,  $C$ , and  $D$ ), the subtyping relation holds between each subtype and its parent:  $B \sqsubseteq A$ ,  $C \sqsubseteq A$ , and  $D \sqsubseteq A$ .



In addition, the type  $A$  can be defined configurationally by its relations to its daughters: that

is, it is the *least upper bound* for  $B$ ,  $C$ , and  $D$ . Using the operation,  $\sqcup$ , called *join*, we see that  $A = B \sqcup C \sqcup D$ . If we can intersect the properties of different types, then we have an operation called *meet*,  $\sqcap$ , which is formally the greatest lower bound of two types. In the tree below,  $E$  is the meet of  $C$  and  $D$ .



That is, the category  $E$  inherits all the properties from both  $C$  and  $D$  above it. Such *multiple inheritance* structures, where a type is defined by referring to two parent types, will be needed for several type hierarchies in the lexicon, as we will see in the following sections.

### 10.3 Syntactic Type Hierarchy

As seen in Chapter 6, much of the information encoded in the linguistic structure that make up a lexical entry has some bearing on the syntax and morphology of that entry. Within the notion of **syntactic type** we reify those lexical features that are directly involved in the specification of the compatibility constraints of words in context, including their syntactic category and syntactic valence. Certain semantic features and types (animacy, countability, EVENT, PHYSICAL OBJECT, etc.) also affect syntactic composition and are traditionally encoded as a part of the semantic selectional requirements (see Section 2.3.2), but they will formally be treated as part of the semantic hierarchy, and we will review them in the next section.

As we know (cf. Section 3.4), lexical items can be classified both in terms of their syntactic category and their syntactic valence, where the latter dimension is *transcategorical* (applies to multiple category values): words belonging to all major lexical categories can be distinguished depending on their valence (i.e., how many syntactic arguments they take) and the syntactic category of the selected arguments. This means that, in a syntactic type hierarchy, each lexical type will have multiple *supertypes*. As we saw above, this kind of structure is called a **meet semilattice**, resulting in a **multiple inheritance hierarchy** (see Sections 3.4 and 10.2). Figure 10.1 illustrates how the overall syntactic hierarchy is structured.

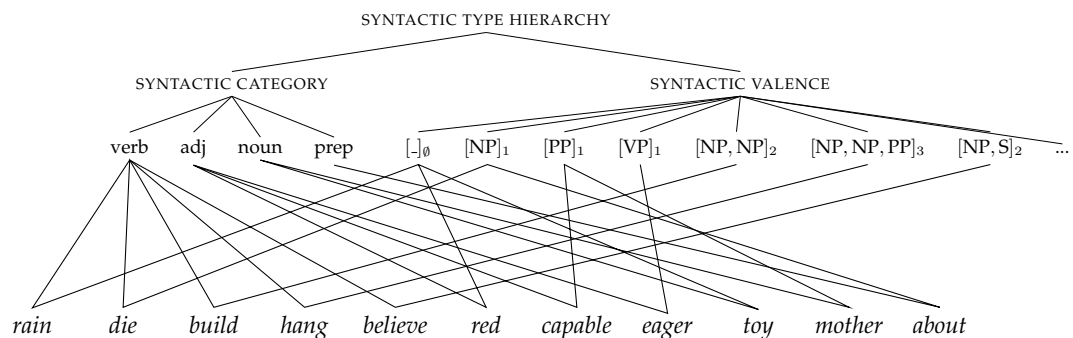


Figure 10.1 Syntactic type hierarchy

All of the example words in this figure inherit their syntactic type from two parent nodes or supertypes: syntactic category (Verb, Adjective, Noun, and Preposition) and syntactic valence ( $[-]_{\emptyset}$ ,  $[NP]_1$ ,  $[PP]_1$ ,  $[VP]_1$ ,  $[NP, NP]_2$ ,  $[NP, NP, PP]_3$ ,  $[NP, S]_2$ ; the subscript outside the square brackets indicates the number of required arguments). Note that the latter includes avalent lexical items (with valence  $[-]_{\emptyset}$ ), which can only have null or pleonastic arguments, e.g., the verb *rain*, the adjective *red*, and the noun *toy*. As was explained in Sections 8.4 and 8.5, all nouns and adjectives take a referential argument (i.e., the object that we identify as belonging to the classes ‘toy’ and ‘red’), but this argument is semantic rather than syntactic and we therefore do not include it in the syntactic valence. The noun *mother*, and the adjectives *capable* and *eager*, on the other hand, do take relational arguments: *mother*+PP (*mother of Mary*), *capable*+PP (*capable of dealing with stress*), *eager*+VP (*eager to learn*).

As this hierarchy shows, different syntactic categories can share the same syntactic valence: for example, the verbs *die* and *arrive* and the prepositions *about* and *into* must be combined with one NP argument (as subject and prepositional object, respectively), while the nouns *mother* and *edge* and the adjectives *capable* and *skilled* take a PP argument.

(4) a. **[The plane] arrived**:  $[NP]_1$

b. **into [the house]**:  $[NP]_1$

(5) a. **edge [of the table]**:  $[PP]_1$

b. **skilled [at chess]**:  $[PP]_1$

While the syntactic typing information in Figure 10.1 is certainly necessary for specifying the grammatical behavior of words in composition, it is by no means sufficient (see Section 2.3). For example, notice that while the expressions in (6) have the categorial and valence features required by *build* ( $[NP, NP]_2$ ) and *mother* ( $[PP]_1$ ), they are unacceptable because the nominal arguments have the wrong semantic features.

(6) a. \*[An idea]<sub>NP</sub> builds [the sand]<sub>NP</sub>.

b. \*mother [of the knife]<sub>PP</sub>

In (6a), the first argument of *build* must be of type ANIMATE, which the noun *idea* does not satisfy (Section 7.4); further, its second argument must be typed as ARTIFACT (as in *build a house*), which *sand*, denoting a naturally occurring entity, also doesn’t satisfy (there is another sense of *build* as in *to build confidence*, that we are ignoring for now). A similar mismatch in typing is seen in (6b), where the argument of *mother* is an ARTIFACT, when it should be ANIMATE (*mother of the duckling*).

A full argument structure description for the verb *build* and the noun *mother* will need to reference both the syntactic type specification presented in Figure 10.1, along with the semantic constraints just discussed. As we know, these are referred to as *syntactic and semantic selectional requirements* or *constraints* in the literature. Such an enriched structure is shown for the verb *build* in (7), where both syntactic type and selectional semantic features are encoded as features of the arguments in the argument structure.

$$(7) \left[ \begin{array}{l} \text{build} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \left[ x = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{animate} \end{array} \right] \right] \\ \text{ARG}_2 = \left[ y = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{artifact} \end{array} \right] \right] \end{array} \right] \end{array} \right]$$

As we saw already from Section 8.2, this is roughly equivalent to the more compact relational form shown in (8).

$$(8) \text{ build}(x:\{\text{DP}, \text{animate}\}, y:\{\text{DP}, \text{artifact}\})$$

In fact, it is generally the case that the category values that constitute a verb's syntactic valence will map systematically to equivalent relational forms with the same arity, as shown in (9).

- (9) a.  $[\text{NP}]_1 \Rightarrow \text{verb}(x:\text{NP})$   
 b.  $[\text{NP}, \text{NP}]_2 \Rightarrow \text{verb}(x:\text{NP}, y:\text{NP})$   
 c.  $[\text{NP}, \text{NP}, \text{PP}]_3 \Rightarrow \text{verb}(x:\text{NP}, y:\text{NP}, z:\text{PP})$   
 d. ...

For relational nouns, such as *mother*, and for nouns generally, syntactic valence and selectional restrictions are also encoded in the lexical representation in the argument structure, as illustrated in (10).

$$(10) \left[ \begin{array}{l} \textbf{mother} \\ \text{CAT} = \textbf{count-N} \\ \text{SEM} = \left[ \text{ARG}_{ref} = \left[ \text{SEM TYPE} = \textbf{animate} \right] \right] \\ \text{AS} = \left[ \text{ARG}_1 = \left[ y = \left[ \begin{array}{l} \text{CAT} = \textbf{PP(of+NP/DP)} \\ \text{SEM TYPE} = \textbf{animate} \end{array} \right] \right] \right] \end{array} \right]$$

Recall that sortal nouns, such as *boy*, as well as relational nouns, such as *mother*, carry a *referential argument*, which identifies an individual as having the property characterized by the noun.

- (11) a.  $\text{SORTAL\_NOUN}(\text{arg}_{ref})$   
 b.  $\text{RELATIONAL\_NOUN}(\text{arg}_{ref}, \text{arg}_{rel})$

This argument structure representation accounts for both the categorial and semantic selectional requirements of *build* and *mother*, but we may have difficulty applying it when the lexical entries of the potential arguments are matched against the argument structure of the head word. For example, consider the combination of *mother* with a PP containing the noun *boy* ('of the boy'). The lexical entry of *boy* is shown below in (12), with its categorial feature (count-N) and semantic type (HUMAN).

$$(12) \left[ \begin{array}{l} \textbf{boy} \\ \text{CAT} = \textbf{count-N} \\ \text{SEM} = \left[ \text{ARG}_{ref} = \left[ \text{SEM TYPE} = \textbf{human} \right] \right] \end{array} \right]$$

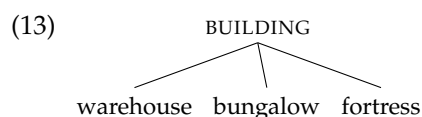
The argument structure of *mother* in (10) specifies that its relational argument must be typed as NP and ANIMATE. Of course, we know that all humans are animates, which is why *mother of the boy* is an acceptable expression. As will be shown in the next section, semantic types and features are also organized as inheritance hierarchies in the lexicon, allowing us to establish meaningful relations between different types (such as ANIMATE and HUMAN) and perform inferences when words are used in composition.

## 10.4 Semantic Type Hierarchy

The term **semantic type** refers to the kind of entity denoted by the lexical item, in particular to linguistically relevant semantic distinctions which may affect other components of grammar

(syntax, morphology, etc., see Section 7.3). As shown in the previous section, semantic types are an essential part of determining the argument structure of a word, because of their impact on syntactic selection. They are also directly involved in different compositional operations and mechanisms when we exploit lexical items to build sentences, as we will see in Chapter 11.

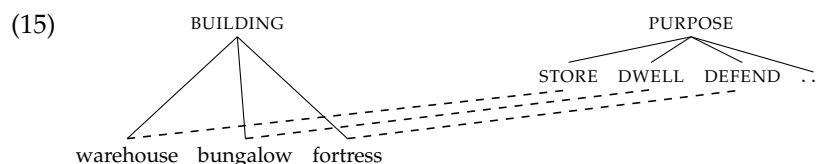
As we saw with syntactic typing, a major organizing principle for semantic information is the type hierarchy, which explicitly represents all supertype-subtype relations as a lattice structure (Section 10.2). The tradition of **taxonomic categorization** within linguistics can be seen as a special case of an inheritance hierarchy. A taxonomy relates different semantic types in terms of class membership, often referred to as the IS-A relation or **hypernymic relation**. That is, “B IS-A A” is equivalent to  $B \sqsubseteq A$ , from Section 10.2. In a **simple taxonomic hierarchy**, each subtype inherits information from one supertype, as in Figure 7.3 (Chapter 7), in (2) (Section 10.2), or in (13) below. *Building* is the **hypernym** of *warehouse*, *bungalow*, and *fortress*, which are the **hyponyms** of *building* and **co-hyponyms** with respect to each other. A *warehouse*, a *bungalow* or a *fortress* is-a kind of *building*.



Formally, this is expressed as:

- (14) a. WAREHOUSE  $\sqsubseteq$  BUILDING  
 b. BUNGALOW  $\sqsubseteq$  BUILDING  
 c. FORTRESS  $\sqsubseteq$  BUILDING

As a result, each of these co-hyponyms inherits all the semantic features of BUILDING: i.e., they denote physical constructions, which are INANIMATE, COUNT, and ARTIFACTUAL entities. However, as we know, lexical-semantic relations are more complex than this, because a lexical item can inherit its semantic features from more than one supertype (Section 7.4), resulting in a *multiple inheritance* hierarchy, such as the one shown in (15) below.



Here we have introduced a new type, PURPOSE, with its own subtypes, STORE, DWELL, and DEFEND, along with many other types not listed. The subtype associated with the word *warehouse* is then formed by inheriting information from both BUILDING and the purpose type STORE, as are the other subtypes with their respective purpose types:

- (16) a. *warehouse* = BUILDING  $\sqcap$  STORE  
 b. *bungalow* = BUILDING  $\sqcap$  DWELL  
 c. *fortress* = BUILDING  $\sqcap$  DEFEND

Other lexical types similar to *warehouse* include *barn* and *storeroom*; those similar to *bungalow* include *chalet*, *townhouse*, and *villa*; and for *fortress*, they include *bunker* and *castle*.

With this in mind, and taking into account the relevant lexical-semantic distinctions we have dealt with so far, let us now try to come up with a general architecture for the semantic type



system. As discussed in Section 7.3, most current ontologies establish a tripartite distinction between ENTITIES, PROPERTIES, and EVENTS (see Figure 7.2). Since this distinction has been shown to be linguistically supported, we adopt it here, and refer to these as ONTOLOGICAL types. We also identify a node encoding a *transcategorical lexical-semantic feature* called INDIVIDUATION, with values BOUNDED vs. UNBOUNDED (Section 2.3.3). This distinguishes the constitution of a type and differentiates between discrete (i.e., *bounded*) entities, properties, and events, which have some kind of spatial or temporal limit; and continuous (i.e., *unbounded*) entities, properties, and events, which do not. Within this feature, we also introduce a binary distinction [ $\pm$ internal structure]: this has a positive value when an entity, a property, or an event, is composed of separate, distinguishable individuals (for entities) or phases (for properties or events); and a negative value when it is not composed of discernible individuals or phases. Here we will refer to BOUNDED or UNBOUNDED combined with [+internal structure] as SET; to [−internal structure] when combined with BOUNDED as ATOMIC; and to [−internal structure] combined with UNBOUNDED as HOMOGENEOUS. Figure 10.2 summarizes these distinctions as a tree structure.

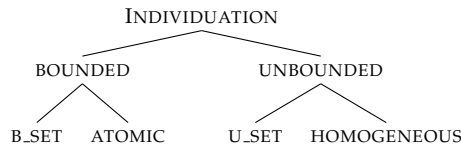


Figure 10.2 *Individuation tree*

The way this feature is used to differentiate the semantic types within the ONTOLOGICAL hierarchy is illustrated in Figure 10.3 below. Note that *lexical types* (the words at the bottom of the structure) are identified as the meet ( $\sqcap$ ) of both ONTOLOGICAL types and the INDIVIDUATION feature values: e.g., *table* = INANIMATE  $\sqcap$  ATOMIC.

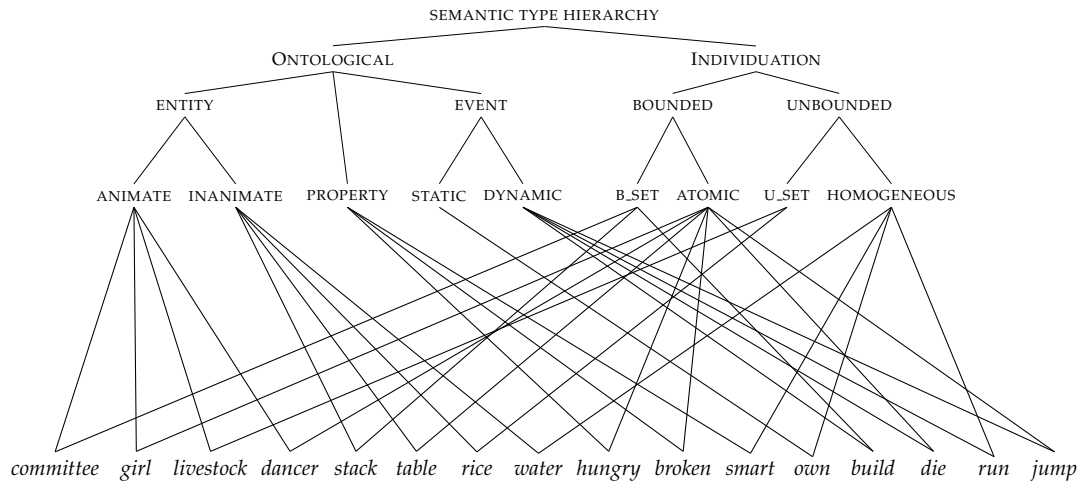


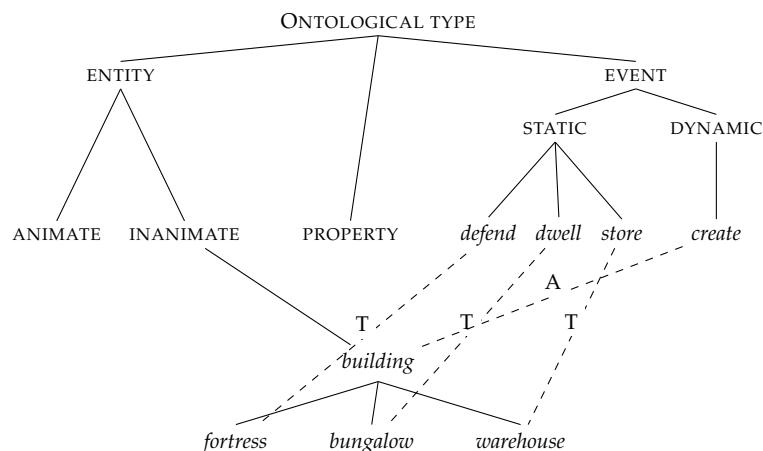
Figure 10.3 *Ontological types with individuation hierarchy*

It is worth pointing out that the ONTOLOGICAL types and the transcategorical feature INDIVIDUATION correspond roughly to the types encoded in the FORMAL and CONSTITUTIVE roles in Generative Lexicon, although the mapping is not exact.

Given the type hierarchy in Figure 10.3, let us return to the issue of PURPOSE types, discussed above in (13)–(16), and how they can be formalized in the type system. While the hierarchy in

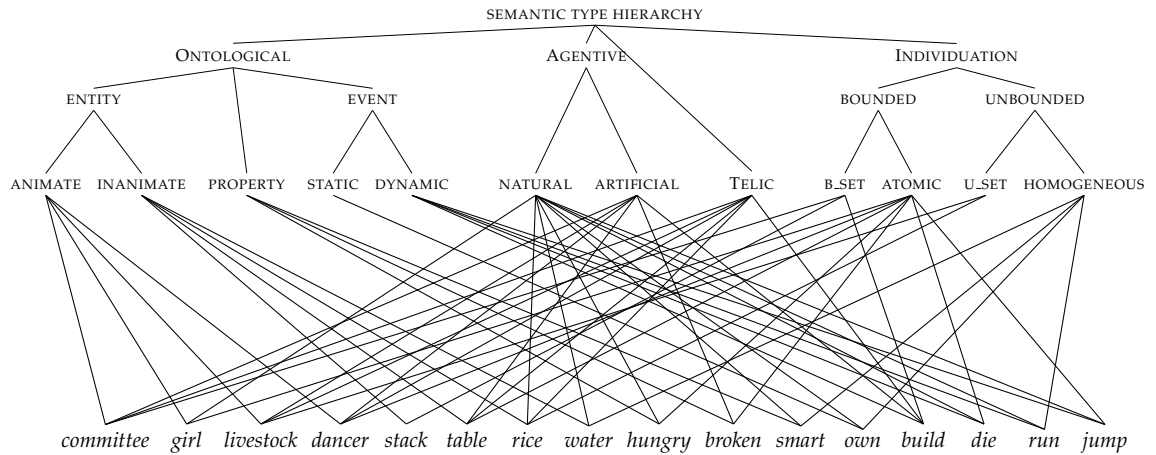
(15) is **illustrative** of how the lexical semantics of *warehouse*, *bungalow*, and *fortress* is based on the meet of two features, as in (16), it is not formally correct to think of PURPOSE as a type, but rather as a *relation* between types that identify the use or function of something, i.e., the TELIC role from Generative Lexicon. One of the problems with (15) is that any verb identified as a PURPOSE must already be positioned within the EVENT sub-hierarchy of ONTOLOGICAL types. In fact, the PURPOSE node has no identifiable internal structure, but is simply a listing of verbs. For this reason, we will represent the TELIC as a label between types in the hierarchy, reflecting its functional interpretation. This allows us to distinguish FUNCTIONAL from NON-FUNCTIONAL types, encoding whether a concept carries a *purpose*, *function*, or *use*. Similarly, we can identify NATURAL from ARTIFICIAL types with the introduction of an AGENTIVE value, distinguishing naturally-occurring from human-created phenomena. (Note that the terms ARTIFICIAL and ARTIFACTUAL are not to be confused: ARTIFACTUAL types are defined relative to both origin and function, and ARTIFICIAL types only with respect to origin. In this type system, the type ARTIFACTUAL is defined as the meet of FUNCTIONAL and ARTIFICIAL:  $\text{ARTIFACTUAL} = \text{FUNCTIONAL} \sqcap \text{ARTIFICIAL}$ .)

In Figure 10.4, the lexical type *warehouse* inherits a TELIC value from the event *store*, while *building* inherits its AGENTIVE role from the event *create*.



**Figure 10.4** Semantic type hierarchy (fragment)

For the purpose of visualization, however, we can interpret both the AGENTIVE and TELIC roles as transcategorical features, similar to INDIVIDUATION, allowing us to examine the global structure of the type system. The following semantic type hierarchy sums up these distinctions and provides illustrative examples. Although it is reasonably complete for the purposes of this presentation, it is not claimed to be exhaustive: e.g., it contains no abstract semantic types (but see Fig. 10.6 below).



**Figure 10.5** Ontological types with qualia specification and individuation

Let us take a closer look at the examples from this hierarchy. The semantic type **ENTITY** has two subtypes, **ANIMATE** and **INANIMATE**:  $\text{ANIMATE} \sqsubseteq \text{ENTITY}$ , and  $\text{INANIMATE} \sqsubseteq \text{ENTITY}$ . Notice that *committee*, *girl*, and *livestock* are lexically typed as **ANIMATE**, while *stack*, *table*, *rice*, and *water* are each lexically typed as **INANIMATE**:  $\text{committee} \sqsubseteq \text{ANIMATE}$ ,  $\text{table} \sqsubseteq \text{INANIMATE}$ , and so on. Because if a subtype  $B$  inherits every property from its parent  $A$ , then any subtype  $C$  of type  $B$  will also inherit the properties from  $A$ . This is the property of transitivity of *subtyping*, as defined in Section 10.2), and is stated in (17) below.

(17) If  $C \sqsubseteq B$  and  $B \sqsubseteq A$ , then  $C \sqsubseteq A$ .

This allows us to effectively “traverse” the type structure, to see what other types are consistent with an expression or type. For example, since  $\text{committee} \sqsubseteq \text{ANIMATE}$ , and  $\text{ANIMATE} \sqsubseteq \text{ENTITY}$ , we know that  $\text{committee} \sqsubseteq \text{ENTITY}$ . Similarly, the verbs *own* and *build* are typed as **STATIC** and **DYNAMIC**, respectively, but since these are both subtypes of the semantic type **EVENT**, we can climb the hierarchy to see that they are both events: that is,  $\text{own} \sqsubseteq \text{EVENT}$ ,  $\text{build} \sqsubseteq \text{EVENT}$ .

Now consider the role of the lexical semantic features **TELIC** and **AGENTIVE** in the hierarchy. Recall that **TELIC** is formally a relation specifying the function or purpose of a concept, but here we are treating it as a binary feature indicating whether a concept has a **TELIC** value or not. Similarly, **AGENTIVE** is viewed as a feature as well, having two values, **NATURAL** and **ARTIFICIAL**. For example, the lexical types *girl*, *dancer*, *water*, and *rice*, are all **NATURAL** types, while *table* and *committee* are **ARTIFICIAL** types, i.e., a physical artificial entity and social artificial entity, respectively. Because *dancer* is an agentive nominal, however, it is a **TELIC** type, while *girl* is not. Similarly, *table*, *committee*, and *livestock* are also all **TELIC** types, because they encode a purpose or function for the concept. Each of these lexical items inherits from an **ONTOLOGICAL** type as well: e.g.,  $\text{girl} = \text{ANIMATE} \sqcap \text{NATURAL}$ ;  $\text{water} = \text{INANIMATE} \sqcap \text{NATURAL}$ ;  $\text{committee} = \text{ANIMATE} \sqcap \text{TELIC} \sqcap \text{ARTIFICIAL}$ ; and  $\text{table} = \text{INANIMATE} \sqcap \text{TELIC} \sqcap \text{ARTIFICIAL}$ .

Note that the lexical type *stack* is left underspecified with respect to the **NATURAL** / **ARTIFICIAL** distinction, because it may refer to spatial configurations of objects which arise naturally (e.g., *stack of fallen rocks*) or intentionally, as a consequence of a goal-oriented activity (e.g., *stack of blocks* or *stack of newspapers*).

The semantic feature **INDIVIDUATION** in Figure 10.5 provides information regarding the con-

stitution of a type. For example, both *committee* and *stack* are BOUNDED and represent SETS of objects (e.g., *committee* = ANIMATE  $\sqcap$  B.SET). *Girl* and *table* are also BOUNDED, but they are ATOMIC (i.e., not composed of independent individuals): e.g., *table* = INANIMATE  $\sqcap$  ATOMIC. Likewise, *livestock* and *rice* are UNBOUNDED SETS (U.SET), while *water* is a substance, therefore it is UNBOUNDED and HOMOGENEOUS: e.g., *rice* = INANIMATE  $\sqcap$  U.SET; and *water* = INANIMATE  $\sqcap$  HOMOGENEOUS. Because INDIVIDUATION is a transcategorial semantic feature, it also contributes to distinguishing the semantic types for properties, such as *hungry*, *broken*, and *smart*. *Hungry* and *smart* are NATURAL typed properties, while *broken* is a FUNCTIONAL type: that is, it predicates of an individual that itself has a purpose or function (e.g., a *broken watch*).

- (18) a. **Natural properties:** *hungry, smart* = PROPERTY  $\sqcap$  NATURAL;  
 b. **Functional properties:** *broken* = PROPERTY  $\sqcap$  FUNCTIONAL.

Recall that we distinguished between inherent properties of an individual, which usually persist over time (*individual-level* properties), and temporal or transient properties (*stage-level* properties). The latter class includes *hungry* and *broken*, which can be classified as BOUNDED, while the former, including *smart*, are classified as UNBOUNDED, because they are coextensive with the whole existence of an individual, but in either case they have no internal parts or phases, which makes them ATOMIC (*hungry* and *broken*) or HOMOGENEOUS (*smart*).

- (19) a. **Stage-level properties:** *hungry, broken* = PROPERTY  $\sqcap$  ATOMIC;  
 b. **Individual-level properties:** *smart* = PROPERTY  $\sqcap$  HOMOGENEOUS.

As far as EVENTS are concerned, the hierarchy in Figure 10.5 reflects two of the aspectual features mentioned in Section 6.3.3: STATIC/DYNAMIC and BOUNDED/UNBOUNDED. The former distinguishes between states and the other three Aktionsarten (processes, accomplishments, and achievements), while the latter is meant to represent telicity in the verbal domain. For example, the verb *own* represents a STATIC EVENT, and *build*, *die*, *run*, and *jump* are DYNAMIC EVENTS. *Own*, *die*, *run*, and *jump* select for arguments typed as NATURAL and can therefore be classified as NATURAL predicates. *Build*, by contrast, is FUNCTIONAL as well as ARTIFICIAL, because its complement is an ARTIFACT.

- (20) a. **Natural events:** *own, die, run, jump* = EVENT  $\sqcap$  NATURAL;  
 b. **Functional events:** *build* = EVENT  $\sqcap$  FUNCTIONAL.  
 c. **artifactual events:** *build* = EVENT  $\sqcap$  ARTIFICIAL.

As all states and activities, *own* and *run* are UNBOUNDED and HOMOGENEOUS. The accomplishment *build* and the achievement *die* are both BOUNDED, but the former is defined as SET because it has discernible phases (the process of building and the resultant state of there existing something built) and the latter as ATOMIC because it has no phases. The semelfactive *jump* is BOUNDED because it refers to an instantaneous event, and hence is ATOMIC. Semelfactives, however, can routinely be coerced into processes by iterating an atomic event into a sequence (a series of jumps or blinks). This occurs often with verbs such as *blink*, *cough*, *knock*, and *clap*. In such cases, the verb is retyped as SET and is interpreted as a process. We return to the topic of coercion in Chapter 11.

Note that the ENTITY subtree of the type hierarchy in Figure 10.5 makes no mention of abstract types, which is remedied in Figure 10.6 below. This structure is clearly not exhaustive, but is suggestive of what concepts appear in this hierarchy, and will be referenced in our discussion of argument type selection and coercion in Chapter 11.

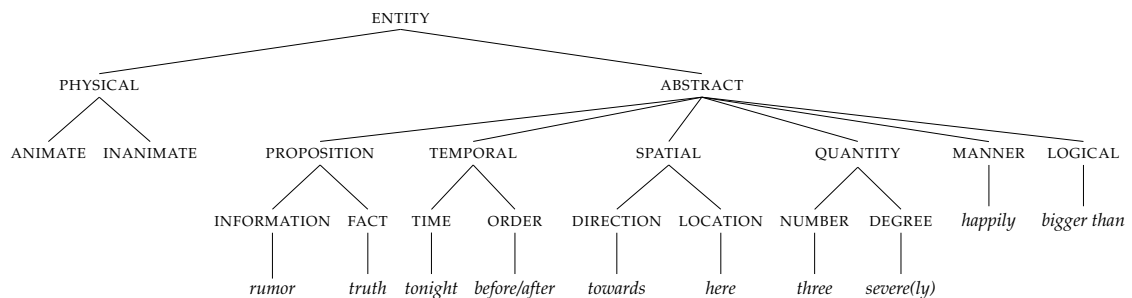


Figure 10.6 Semantic subtyping of ENTITY

One of the advantages of the hierarchy in Figure 10.5 is that it allows us to define complex semantic notions and classes in terms of more basic semantic types. For example, the different classes of entities (*dog, water, rice*, etc., cf. Section 2.3.3) can be distinguished by establishing different meet relations of ENTITY (or subtypes PHYSICAL and ABSTRACT) with different values within INDIVIDUATION (21).

(21) **Entity classes:**

- a. Individual:  $\text{ENTITY} \sqcap \text{ATOMIC}$
- b. Group:  $\text{ENTITY} \sqcap \text{B\_SET}$
- c. Aggregate:  $\text{ENTITY} \sqcap \text{U\_SET}$
- d. Substance:  $\text{ENTITY} \sqcap \text{HOMOGENEOUS}$

Similarly, Vendler's event classes (introduced in Section 6.3.3) can be defined when the subtypes of EVENT (STATIC and PROCESS) combine with different meet relations within INDIVIDUATION (22).

(22) **Event classes:**

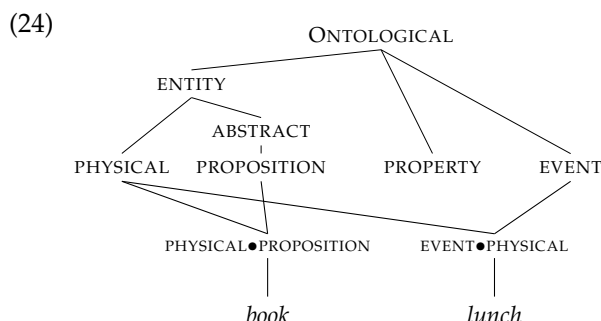
- a. State:  $\text{STATIC} \sqcap \text{HOMOGENEOUS}$
- b. Accomplishment:  $\text{DYNAMIC} \sqcap \text{B\_SET}$
- c. Achievement:  $\text{DYNAMIC} \sqcap \text{ATOMIC}$
- d. Activity:  $\text{DYNAMIC} \sqcap \text{HOMOGENEOUS}$

So far, every semantic type we have studied has been defined as a combination of a single type from each of the three major classes from Figure 10.5:  $\text{ONTOLOGICAL} \sqcap \text{AGENTIVE/TELIC} \sqcap \text{INDIVIDUATION}$ . Recall from Section 7.4, however, that there are some lexical items that seem to denote concepts requiring the unification of multiple types from the same ONTOLOGICAL class. These were called *complex types* (or dot objects), and include nouns such as *lunch* and *book*, as illustrated in (23).

- (23) a. The  $\text{lunch}_{\text{EVENT}}$  lasted two hours. But  $\text{it}_{\text{ENTITY}}$  was delicious.
- b. The  $\text{book}_{\text{ENTITY}}$  cost \$25.00. And  $\text{it}_{\text{PROPOSITION}}$  is confusing!

**Complex** types are unique in that they combine two distinct ONTOLOGICAL types. For example, the noun *lunch* inherits both the types ENTITY and EVENT, which are conjoined within its ONTOLOGICAL type. This kind of multiple inheritance cannot be defined with a meet operator,  $\sqcap$ , since elements within the ONTOLOGICAL node form a strict taxonomic hierarchy: that is, it is a tree structure, allowing no multiple parent nodes. Hence, the  $\bullet$ -operator (dot-operator) was

introduced to create a complex type  $a \bullet b$  from two types  $a$  and  $b$ . The result of this operation is shown in (24) with the nouns from (23) above.



So far we have been referring to the inheritance in type hierarchies as a completely regular and parsimonious phenomenon: the subtype inherits *all* the properties from its supertype(s). This way of organizing the types maximizes the economy of representation in that a feature or a property only needs to be stated once, as a part of the description of the supertype. We know, however, that real-life lexical taxonomies do not always work this way. Some categories allow members which do not have all the features of the supertype (Section 5.5): e.g., some members of the category BIRD do not fly (penguins, ostriches, birds with broken wings, etc.), but we still classify them as birds. In these cases, full inheritance is blocked by the specific information provided by the subtype, because some features of the supertype are *defeasible*, that is, can be negated or ignored (Copestake and Briscoe 1995). Also, it can be argued that the strength of the downward links relating a supertype with its subtypes may vary depending on the degree of prototypicality of the latter: *sparrow* would have a stronger connection with the supertype BIRD than *penguin*, and an achievement, accomplishment or an activity would have a stronger connection with the supertype EVENT than a state, which has many property-like characteristics (as is done, for example, in Construction Grammar, Goldberg 1995; Croft and Cruse 2004).

## 10.5 Lexical Semantic Relations

One of the principle goals of semantics is to account for the major relations of meaning that inhere between words from the same (or similar) class, what we called **paradigmatic relations** in Section 3.2. Recall that these are relations that hold between elements that are compatible with the same linguistic context, and which can be replaced with each other in that context. As we will see, word meaning is not just defined by the relation of the word to a concept or to real-world entities (as we saw in Chapter 4) but also by the relation of the word to other words in the lexicon.

First let us define what we mean by a *lexical relation*. As we already know, words are organized in different kinds of lexical structures: inheritance hierarchies (Section 10.4), lexical fields (Section 3.2), frames (Section 6.4.2), etc. Lexical semantic relations between words can be defined by looking at how different words are connected within these structures. The semantic type hierarchies presented in the previous section already provide us with the basic structure needed to define several of the most commonly studied lexical semantic relations. These include **hyponymy** and **hyperonymy**, **troponymy**, **co-hyponymy**, and, to a large extent, **meronymy**.

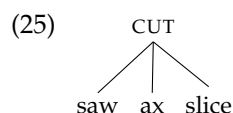
**WARNING: Lexical Relations between Word Senses**

It is important to point out that lexical relations can only be defined as *relations between word senses* rather than between words as such (because different senses of a polysemous word can establish meaning relations with other words) or between the referents that these words point to. For example, *low* meaning ‘of a limited extent upward’ is related to *short* and *small*, and the sense ‘lacking strength or vivacity’ is related to *depressed*, *discouraged*, and *blue*. Also, the fact that two or more words share the same referent means that they are *coreferential* but not necessarily that their meanings are related: as noted in Section 4.3.1, the expressions *Mary’s father*, *the high school football coach*, and *the Chair of Computer Science Department* may refer to the same real-world entity, but their meanings do not need to be related.

**Hyperonymy** and **hyponymy** are sense relations between a general term and a more specific term. This corresponds exactly to the subtyping relation,  $\sqsubseteq$ , that we introduced in Section 10.4, where a hypernym  $A$  has a more specific term (the hyponym)  $B$  as its subtype:  $B \sqsubseteq A$ . As we saw, this subtyping relation can be paraphrased as ‘ $B$  is a kind of  $A$ ’: *girl* is a kind of *human*, *rose* is a kind of *flower*, *sandwich* is a kind of *food*, etc. Further, because of the transitive nature of subtyping introduced in (17) above, if  $C$  is a hyponym of  $B$  and  $B$  is a hyponym of  $A$ , then  $C$  is a hyponym of  $A$ : e.g., if *rose* is a hyponym of *flower*, and *flower* is a hyponym of *plant*, then *rose* is a hyponym of *plant*.

CLUE/COMMENT[magnifying glass icon]: Troponymy as a lexical relation was first introduced in the WordNet project, a very influential relational model of the lexicon developed by George Miller and Christiane Fellbaum. WordNet is a relational database where word meanings are defined through *synsets*, sets of words that are, roughly, synonymous with the defined word (e.g., *sign*, in its different senses, is defined through *subscribe*, *contract*, and *bless*). Relations between different words and groups of words are determined in terms of hyperonymy, but other lexical semantic relations are also taken into account: entailment (e.g., *sign* entails *ratify*) and meronymy (*study*, *porch*, and *attic* are meronyms of *house*). The relation of troponymy (a term first coined by Fellbaum) identifies manner subtypes for verbs: e.g., *saunter* and *stagger* are troponyms of *walk*.

While hyponymy relations within the ENTITY types can be defined in terms of the subtyping relation,  $\sqsubseteq$ , the inclusion or hyponymy relation between verb types (*troponymy*) is more complicated, for two reasons: a verb’s type can be specialized by specifying a distinct *means* of performing an activity; or a verb’s type can be specialized by identifying the different *manners* in which an activity can be performed. While the latter type of inclusion will be referred to as a *manner subtyping* relation,  $\sqsubseteq_{ma}$ , we will refer to the former relation as *means subtyping*,  $\sqsubseteq_{me}$ . Let’s examine briefly how these relations differ semantically. Formally, we will say that a category  $B$  is a “means subtype” of a category  $A$ ,  $B \sqsubseteq_{me} A$ , if and only if  $B$  has a more specific subtype for the INSTRUMENT semantic role for category  $A$ . For example, consider the inclusion relations shown in the hierarchy in (25).



The verb *cut* denotes a transition event (i.e., accomplishment) that results in the separation of the entity occupying the direct object position in syntax. The lexical semantics for this verb is given in (26).

$$(26) \left[ \begin{array}{l} \text{cut} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \mathbf{x} \left[ \text{SEM TYPE} = \mathbf{human} \right] \\ \text{ARG}_2 = \mathbf{y} \left[ \text{SEM TYPE} = \mathbf{phys.obj} \right] \\ \text{D-ARG}_1 = \mathbf{z} \left[ \text{SEM TYPE} = \mathbf{instrument} \right] \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} \text{E}_1 = \mathbf{e_1:process} \\ \text{E}_2 = \mathbf{e_2:state} \\ \mathbf{e_1 < e_2} \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \mathbf{cut.act(e_1,x,y,z)} \\ \text{FORMAL} = \mathbf{separated.state(e_2,y)} \end{array} \right] \end{array} \right]$$

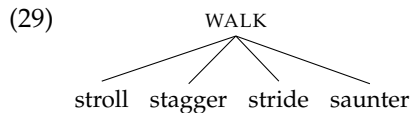
Examples with both *cut* and the three subtypes from (25) are shown in (27) below.

- (27) a. Mary **cut** the {wood/ tree/ bread}.  
 b. Mary **sawed** the wood (=‘cut with a saw’).  
 c. Mary **axed** the tree (=‘cut with an ax’).  
 d. Mary **sliced** the bread (=‘cut with a knife’).

Notice that each lexical subtype specifies the means with which the cutting is brought about. Here the means is a specialization of the INSTRUMENT default argument (D-ARG<sub>1</sub>) in (26). Hence, the lexical subtyping on the verb *cut* is actually a reflection of the subtyping on one of its arguments, i.e., the INSTRUMENT argument.

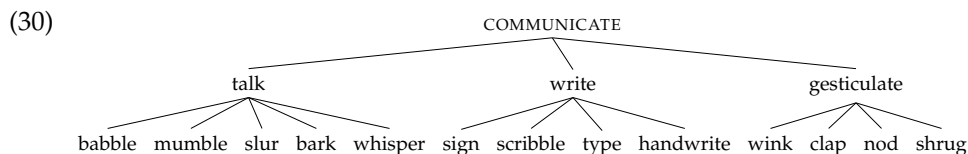
- (28) a. SAW  $\sqsubseteq$  INSTRUMENT  
 b. AX  $\sqsubseteq$  INSTRUMENT  
 c. KNIFE  $\sqsubseteq$  INSTRUMENT

Now consider the second inclusion relationship between verbs mentioned above, that of **manner subtyping**. Formally, we will say that a category *B* is a “manner subtype” of a category *A*,  $B \sqsubseteq_{ma} A$ , if and only if *B* specifies a particular manner in which to perform *A*. For example, the motion verbs *stroll*, *stagger*, *stride*, and *saunter* would be considered manner subtypes of *walk*, because they each denote a certain manner of walking.



That is, each subtype in (29) is a walking activity: *stroll* is done “in a leisurely manner”; *stagger* is done in an “unsteady manner”; *stride* is done in a “decisive manner with long steps”; and *saunter* is done in “a slow, relaxed manner”. It should be pointed out that WALK can itself be seen as a means subtype of MOVE,  $\text{WALK} \sqsubseteq_{me} \text{MOVE}$ , since the instrument or “means” of movement is specified as involving the legs of the mover.

Both means and manner subtyping can appear in the same hierarchy: in fact, some lexical type-subtype relations incorporate elements of both. Consider the verb subhierarchy in (30).



This hierarchy has a root type, COMMUNICATE, which first branches into three means subtypes:  $\text{TALK} \sqsubseteq_{me} \text{COMMUNICATE}$ ,  $\text{WRITE} \sqsubseteq_{me} \text{COMMUNICATE}$ ,  $\text{GESTICULATE} \sqsubseteq_{me} \text{COMMUNICATE}$ . These are seen as distinguished by means because each subtype involves a distinct instrument in bringing about the communication: “with speech”, “with a script”, or “with head or



arm gestures”. Each of these subtypes, in turn, branches into manner subtypes of its own: e.g., WHISPER  $\sqsubseteq_{ma}$  TALK; SCRIBBLE  $\sqsubseteq_{ma}$  WRITE; and NOD  $\sqsubseteq_{ma}$  GESTICULATE.

It should be pointed out that an inherent property of the hierarchical structures introduced in this chapter is that any two types which are subtypes of the same supertype (hypernym) are considered **incompatible** with one another. That is, they have no members in common. For example, within the ontological types (i.e., ONTOLOGICAL) in Figure 10.5, the three subtypes ENTITY, PROPERTY, and EVENT share no members. When the incompatibility is binary, then we refer to it as a **contradiction**. For example, all ENTITIES are either ANIMATE or INANIMATE, but not both; similarly, the POLARITY for all INTEGERS is either EVEN or ODD. Hence, for contradictory concepts, we can make the following sort of inferences:

- (31) a. This number is even.  $\models$  This number is not odd.  
 b. This number is not even.  $\models$  This number is odd.

Consider now the concept HEIGHT. This is a subtype of MEASUREMENT involving the vertical distance traversed by a space or object occupying that space. Such concepts (including WEIGHT, AGE, LENGTH) are usually seen as attributes predicated of another object. As such, the subtype relation is interpreted as an *attribute-value* relation (see Section 8.4). Hence, we say that *short*, *tall*, and *medium* are expressing **values** of the concept HEIGHT. When there are more than two values for any attribute (unlike the polarity values of EVEN and ODD), they are still incompatible with one another, but not contradictory. Notice that the sentences in (32) allow an incompatibility-based inference, (32a), but not a contradiction, (32b).

- (32) a. This tree is tall.  $\models$  This tree is not short.  
 b. This tree is not tall.  $\not\models$  This tree is short.

That is, while *tall*, and *short* are **incompatible**, they are not exhaustive (**contradictories**) in the values available to the concept HEIGHT, since there is (at least) a middle value, *medium*, which designates a height between the other two. Rather, we say that they are **contraries**, in that they cannot both be simultaneously true. Contrariety is a weaker relation than contradiction, since two contraries can both be false, but lexical items that are contradictories are never both true or false.

Attributes such as POLARITY and COLOR are called *nominal scales*, since they refer to “named” values of the class: odd, even, red, blue, and so on. Attributes such as HEIGHT, however, have different values that are ordered with respect to each other. For this reason they are called *ordinal scales*. In Section 9.3.1 we discussed such adjectives in the context of “open” and “closed” scalar structures. This terminology (taken from Kennedy and McNally 2005) refers to the classification of a predicate into a specific scale based on its semantic gradability. We distinguished four classes: OPEN SCALE adjectives include *short*, *tall*, *young*, and *old*; CLOSED SCALE adjectives include *empty* and *full*; LOWER-CLOSED SCALE adjectives include *wet* and *dirty*; and UPPER-CLOSED SCALE adjectives include *straight*, *clean*, and *flat*. Hence, *tall* falls on the *tallness* scale, which is typed as OPEN, while *clean* is on the *cleanness* scale, which is typed as UPPER-CLOSED. Seen from the perspective of lexical semantic relations, we can make some interesting connections between scalar classes and the semantic types representing them. However, in order to do so within the type hierarchy for properties (and attributes), this classification needs to be extended.

Recall that the dimension being measured is a specific conceptual type, e.g., HEIGHT or AGE. Let us now think of how scalar concepts fit within a semantic type hierarchy. Rather than assigning scalar classes to individual adjectives, let us categorize the *dimension* itself as being associated with a specific scalar structure. As mentioned above, an attribute refers to a *conceptual*

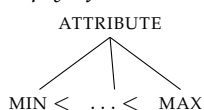
*type* in the PROPERTY subhierarchy, while the values of this attribute are *lexical types*, i.e., distinct lexemes in the language. Of course, the conceptual type for an attribute may also have a lexicalization (e.g., *height*, *cost*), and there may be lexical gaps for specific values of an attribute (as we shall see shortly). The values,  $v_i$ , for any scalar attribute,  $A$ , are structured by an ordering relation,  $<$ , indicating the position of  $v_i$  on the scale denoted by the attribute. For some scales, there is a minimum (MIN) or maximum (MAX) value, or even both. The MIN value is the lowest ordered value on the scale, while the MAX is the highest ordered value, according to that scale. For instance, *empty* is the lowest value on a scale indicating the quantity of content in a container. Furthermore, some scales have a contextualized (or relative) MIN or MAX value (such as *short/tall*), but not absolute values. We will indicate a “relative minimum” as MIN\*, and a “relative maximum” as MAX\*. For example, for the attribute HEIGHT, we can say that *short*  $<$  *medium*, and *medium*  $<$  *tall*. By a rule of **transitive ordering**, we can infer that *short*  $<$  *tall*. For either a MIN\*, such as *short*, or a MAX\*, such as *tall*, it is possible to find a value that is smaller or larger (respectively). For this reason, we can think of such open ends as “semi-closed”, i.e., partially closed by the contextualized minimum or maximum, but still open for further interpretation. In addition to the four classes mentioned above, we add two more, and we adopt the term SEMI-CLOSED to help characterize these scales. LOWER-CLOSED/UPPER-SEMI-CLOSED SCALE adjectives include *wet/dry*; and LOWER-SEMI-CLOSED/UPPER-CLOSED SCALE adjectives include *open/closed*. These six possible scalar classes can now be represented as semantic type structures as shown in (33), along with adjectives representing the appropriate scale.

On this view, we can associate **lexical antonym** pairs with specific conceptual attributes in the type hierarchy directly. For example, we have SEMI-CLOSED SCALE antonym pairs *short/long* (for the dimension LENGTH), *short/tall* (for the dimension HEIGHT), *near/far* (for the dimension DISTANCE), and *friendly/rude* (for the dimension CIVILITY). Notice that the two scale classes, LOWER-CLOSED and UPPER-CLOSED, have no natural antonym pairs.

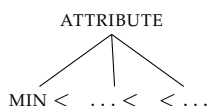
(33) a. SEMI-CLOSED SCALE: *short / tall*



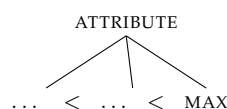
b. CLOSED SCALE:  
*empty / full*



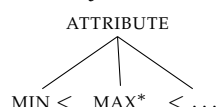
c. LOWER-CLOSED SCALE:  
*stained (MIN)*



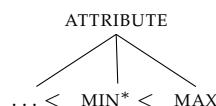
d. UPPER-CLOSED SCALE: *flat (MAX)*



e. LOWER-CLOSED/UPPER-SEMI-CLOSED:  
*wet / dry*



f. LOWER-SEMI-CLOSED/UPPER-CLOSED:  
*open / closed*



As mentioned above, this classification predicts that an adjective forms part of an antonym pair in a language only if the concepts denoted by each adjective are members denoting values on the same scale, and one containing both a MIN/MIN\* and a MAX/MAX\*, a prediction which seems

to accord with the data. Interestingly, there are some ambiguous adjectives which are members of multiple scales, and hence enter into different antonym pairs. For example, the adjective *thin* is a member of (at least) two antonym pairs: *thin/thick*, referring to the width dimension of a material (as in *thin/thick piece of metal*); and *thin/fat*, referring to an animal's shape due to having less or more body fat (as in *thin/fat house cat*). While these denote different attributes, they are both on the OPEN SCALE in (33a) above. The adjective *old* also enters into two antonym pairs, but they fall onto different scalar structures: *young/old*, referring to an animate object's age (as in *young/old cat*); and *new/old*, referring either to an artifact (as in *new/old phone*) or a relational role (as in *new/old friend*). The former pair (*young/old*) falls on the OPEN SCALE in (33a), while *new/old* is a member of the LOWER-CLOSED/UPPER-SEMI-CLOSED scale, in in (33e).

#### DISCUSS

If we assume that the words such as *dead* and *alive* are contradictories, how can we account for the following sentences, where these concepts (along with *pregnant* and *true*) seem to behave as gradable terms, allowing for intermediate options or values?

- a. I hear that your grandfather passed away. - No, he didn't, he is *very much alive*!
- b. Mary is looking *very pregnant* these days.
- c. What you're saying is *so true*.

Antonymy is a lexical relation that applies not only to adjectives, but is used to describe pairs of verbs, nouns, and prepositions, as well. In the broadest sense, antonymy refers to an **opposition structure**, where two words,  $w_1$  and  $w_2$ , denote opposites of each other relative to a scale. We already encountered such oppositions above, between ontological types such as ANIMATE and INANIMATE (within the semantic type hierarchy in Figure 10.5), and between the lexical types (words) *open* and *closed*. One type of verbal antonymy is directly related to the oppositions that are part of the scalar structures inherent in adjective antonym pairs. For example, the verb pairs *open/close*, *clean/dirty*, and *empty/fill*, are all associated with their corresponding adjectival minima and maxima. Further, they are distinguished semantically in the same way as their related adjective pairs.

There is another type of antonymy in verbs, which does not necessarily correlate with opposition structures, but rather with semantic **converses**. **Converseness** characterizes antonym pairs in all of the major categories. This is the relation holding between two relational terms that can be used to describe the same situation viewed from two different perspectives. Formally, two words,  $w_1$  and  $w_2$ , are *relational converses* of each other, if for two entities,  $x$  and  $y$ , we can express both the following:

- (34) a. " $x$  is  $w_1$  with respect to  $y$ ."
- b. " $y$  is  $w_2$  with respect to  $x$ ."

Examples of such relational pairings can be found in verbs and prepositions, with pairs such as *precede/follow*, *buy/sell*, *give/receive*, and *above/under*, as shown in (35).

- (35) a. Monday precedes Tuesday.  $\models$  Tuesday follows Monday.
- b. John bought a car from Mary.  $\models$  Mary sold a car to John.
- c. The woman gave the dog a bone.  $\models$  The dog received a bone from the woman.
- d. The lamp is above the table.  $\models$  The table is under the lamp.

Hence, for any  $x$  and  $y$ , if " $x$  precedes  $y$ ", then " $y$  follows  $x$ ". Similar converses exist within the domain of nouns, as well. For example, if  $x$  is 'Mary',  $y$  is 'John',  $w_1$  is *wife*, and  $w_2$  is *husband*, then *Mary is John's wife* entails *John is Mary's husband*. Both sentences describe the same situation.

**Reversibility** is a similar relation, involving change in two opposite directions, which leads to two opposite resultant states. It is particularly salient in motion verb antonyms (*come-go, rise-fall, enter-exit*, etc.), and directional adverbials (*up-down, into-out of, left-right*), but it can also be detected in non-spatial expressions (*do-undo, arm-disarm, tighten-loosen, bend-straighten*, etc.).

Having examined antonymy, we now define **synonymy** as a semantic identity relation between two words,  $w_1$  and  $w_2$ : i.e., the classes of entities denoted by two synonyms totally overlap (have the same members). The formal proof of equivalence is the biconditional or mutual entailment: for synonyms  $w_1$  and  $w_2$ , and an entity  $A$ , if 'A is  $w_1$ ' is true, then 'A is  $w_2$ ' is also true. For example, the nouns *childhood* and *infancy*, and the verbs *calm* and *soothe* both allow this substitution, as seen in (36) below.

- (36) a. Noa had a happy childhood.  $\models$  Noa had a happy infancy.  
 b. Noa had a happy infancy.  $\models$  Noa had a happy childhood.  
 c. Arwen calmed the beast  $\models$  Arwen soothed the beast.  
 d. Arwen soothed the beast  $\models$  Arwen calmed the beast.

It has long been argued that the existence of synonyms violates a basic principle of "linguistic economy", because it entails that the linguistic system has two or more items which fulfill the same function, i.e., denoting the same concept. Indeed, this is precisely why **true** (or **absolute**) synonymy is very rare. In theory, absolute synonyms are supposed to fulfill two main requirements: they are supposed to have the same conceptual meaning and to be freely interchangeable in all contexts. In practice, however, the first requirement is met by many word pairs, but they cannot be used in the same contexts without causing unacceptability or some significant meaning alternations. For example, if we take the pair *calm/soothe*, we can see that they share the same conceptual meaning, loosely definable as 'to cause to become quiet or peaceful'. And they both can be used in some contexts but not all (see (37a,b)).

- (37) a. The sea has {calmed/ \*soothed}.  
 b. This cream will {soothe/ \*calm} your sunburn.

Another factor that quite often has an impact on the contextual distribution of synonyms is the associative and connotative meaning: in the context of wedding vows (in (38a)), for example, *man* is appropriate where *guy* is not; in other more informal contexts, either term might be used, as in (38b).

- (38) a. Do you take this {man/\*guy} to be your wedded husband?  
 b. This {man/guy} stopped me in the street yesterday, and asked me for money.

For these reasons, most linguists now assume a less restrictive definition of synonymy, which requires that synonyms have the same *conceptual* meaning but not necessarily the same *associative* meaning or the same usage contexts.

The final lexical relation we discuss here involves the study of how an object relates to its parts, and how objects are parts of larger structures. This is an area of philosophy and ontology known as **mereology** (Greek for 'study of parts'). In linguistics, we are interested more in how such semantic concepts manifest themselves in the lexical relations between words in a language: the major relations are known as **meronymy** and **holonymy**. Let us introduce a PART-OF relation,  $\sqsubseteq_c$  (a kind of CONSTITUTIVE relation), between types  $A$  and  $B$ . A word  $w_1$  is said to be a **meronym** of a word  $w_2$ , if and only if  $w_1$ 's type,  $A$ , forms a part-of  $w_2$ 's type,  $B$ : i.e.,  $A \sqsubseteq_c B$ . Conversely, if this relation holds, we say that  $w_2$  is the **holonym** of  $w_1$ .

Since there are many ways in which something can be part of something else, the semantics

of the PART-OF relation (and the lexical relation, meronymy) is more complex than that for subtyping (and the corresponding lexical relation, hyponymy). For example, the PART-OF relation is not universally transitive as is the subtyping relation. Consider just a few examples of the kinds of PART-OF relations we speak of (adapted from Winston *et al.* 1987).

PART-WHOLE RELATION	EXAMPLE
a. COMPONENT-OBJECT	<i>handle-door, finger-hand</i>
b. MEMBER-COLLECTION	<i>tree-forest, card-deck</i>
c. MATERIAL-OBJECT	<i>gold-ring, water-lemonade</i>
d. UNIT-MASS	<i>slice-pie, grain-rice</i>
e. FEATURE-ACTIVITY	<i>pay-shop, swallow-drink</i>
f. PLACE-AREA	<i>Madrid-Spain, oasis-desert</i>

**Table 10.1** *Types of part-of Relations*

Let us see how the relations in Table 10.1 can be formally distinguished from each other, in terms of the semantic types involved in the  $\sqsubseteq_c$  relation. Consider first the notion of COMPONENT. This relation corresponds, perhaps, most closely to the notion of PART-OF denoted by  $\sqsubseteq_c$ . As indicated in Table 10.1a, ‘handles’ are a proper part of ‘doors’, and ‘fingers’ are proper parts of ‘hands’. That is, if  $\text{TYPE}(w)$  denotes the semantic type of the word  $w$ , then  $\text{TYPE}(\text{handle}) \sqsubseteq_c \text{TYPE}(\text{door})$ , and  $\text{TYPE}(\text{finger}) \sqsubseteq_c \text{TYPE}(\text{hand})$ . Notice that the COMPONENT-OBJECT relation exhibits transitivity: i.e., if  $A \sqsubseteq_c B$  and  $B \sqsubseteq_c C$ , then  $A \sqsubseteq_c C$ .

- (39) a.  $\text{TYPE}(\text{finger}) \sqsubseteq_c \text{TYPE}(\text{hand})$ : *finger* is a meronym of *hand*;  
 b.  $\text{TYPE}(\text{hand}) \sqsubseteq_c \text{TYPE}(\text{body})$ : *hand* is a meronym of *body*;  
 c.  $\text{TYPE}(\text{finger}) \sqsubseteq_c \text{TYPE}(\text{body})$ : *finger* is a meronym of *body*.

Next consider the relation of MEMBER to COLLECTION. The semantic type of a COLLECTION is SET (B\_SET or U\_SET), according to Figure 10.5: hence it will inherit the ONTOLOGICAL type from that of its members. That is, sets and collections of things inherit the type associated with the collected objects (e.g., collections of humans can be treated as human, etc.). For example, since *card* is an ATOMIC individual, lexically typed as INANIMATE  $\sqcap$  AGENTIVE, the COLLECTION term, *deck*, will be a B\_SET, also typed as INANIMATE  $\sqcap$  AGENTIVE. This is the case regardless of ONTOLOGICAL type. Hence any type, TYPE, can, in principle, be a MEMBER of a COLLECTION, since COLLECTION acts as a function to make a set of those elements: i.e., COLLECTION: TYPE  $\rightarrow$  SET. Because of this, it appears that MEMBER-COLLECTION allows for PART-OF transitivity (a type-dependent relation), and therefore also allows for meronym transitivity (a lexical relation): i.e., a *senator* is PART-OF the *Senate*; the *Senate* is PART-OF the *Government*; and a *senator* is PART-OF the *Government*. Transitivity over this relation, however, is not as consistent or robust as with COMPONENT-OBJECT.

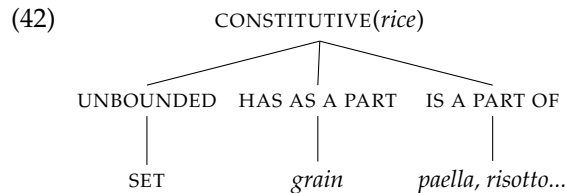
The MATERIAL-OBJECT PART-OF type corresponds to the “made-of” relation. This is effectively the material CONSTITUTIVE qualia role for an object, as is seen in the examples in Table 10.1c: the *ring* is made of *gold*, the *lemonade* is made of *water*, *lemon*, and *sugar*, and so on. The noun *ring* is lexically typed as a physical artifact, i.e., INANIMATE  $\sqcap$  ARTIFICIAL  $\sqcap$  TELIC  $\sqcap$  ATOMIC; the noun *gold* is typed as a substance, i.e., INANIMATE  $\sqcap$  NATURAL  $\sqcap$  HOMOGENEOUS. This is expressed as the following PART-OF relation:  $\text{TYPE}(\text{gold}) \sqsubseteq_c \text{TYPE}(\text{ring})$ .

The remaining PART-OF types in Table 10.1 can also be analyzed in terms of the semantic

types introduced above in Figure 10.5. For example, in the FEATURE-ACTIVITY relation, both elements are types of EVENT, while in the PLACE-AREA relation, both can be typed generally as REGION or LOCATION. As mentioned above, PART-OF does not seem to support full transitivity over all relations, unlike the subtype relation. That is, we can infer from  $\text{TYPE}(\text{cat}) \sqsubseteq \text{ANIMATE}$  and  $\text{ANIMATE} \sqsubseteq \text{PHYSICAL}$  that cats are physical ( $\text{TYPE}(\text{cat}) \sqsubseteq \text{PHYSICAL}$ ). But transitivity does not hold across the different relation types within the PART-OF family. This is illustrated in the sentences in (40) and (41).

- (40) a. This *tree* is part of the *forest*. MEMBER-COLLECTION;  
 b. This *forest* is part of the *city*. PLACE-AREA;  
 c. ! This *tree* is part of the *city*. \*MEMBER-AREA.
- (41) a. A *roof* is part of a *house*. COMPONENT-OBJECT;  
 b. A *house* is part of a *subdivision*. MEMBER-COLLECTION;  
 c. ! A *roof* is part of a *subdivision*. \*COMPONENT-COLLECTION.

The different dimensions of the PART-OF relation can be visualized for specific lexical items in the language. Since the semantic type hierarchy encodes distinctions related to the internal constitution of entities, properties, and events, it can be augmented to account for which specific parts something is made up of and what bigger entity it belongs to. For example, the constitutive typing hierarchy of *rice* in (42) states that, in addition to being typed as an UNBOUNDED ENTITY (see Figure 10.5), *rice* is the holonym of *grain* (by virtue of the relation in Table 10.1d) and the meronym of *risotto* and *paella* (by virtue of the relation in Table 10.1c).



It should be pointed out that there are many pragmatic and conventional factors that influence the interpretation of what we conceptualize as being PART-OF something else, and what lexical items in language we judge to be meronym-holonym pairs. Winston *et al.* (1987) and Cruse (2000) point out some of the factors affecting the degree of prototypicality of PART-OF and meronymic relations. 'Good' meronyms have the characteristics given in (43).

- (43) a. **Necessary** to their wholes rather than optional: a *roof* is a necessary part of a well-built house while a *porch* is optional.  
 b. **Integrated** into their wholes rather than attached: the *ears* are attached to the head while the *forehead* and the *cheeks* are integrated into the head.  
 c. **Discrete** or clearly distinguished from other parts of the whole: within a *hand*, a *finger* can be easily distinguished from the palm, while, within the *head*, the *crown* cannot be so easily demarcated from its other parts.  
 d. **Functionally motivated**: a *roof* protects the inside of the house, a *keyboard* serves to operate a computer, a *handle* is made to be grasped or held, etc.  
 e. **Compatible with a single holonym**: *roof* is the meronym of just one holonym (*house* or its synonyms) and *handle* is the meronym of many different holonyms (*door*, *drawer*, *sword*, *knife*, etc.).

- f. **Coexistent in time with their holonym:** the meronym *finger* and its holonym *hand* exist at the same time, while *clay* and *brick* do not (the former is an *ingredient* of the latter rather than its part).

## 10.6 Morphology and Word Structure

So far we have looked at how lexical structures integrated by lexical units are organized depending on what lexical properties we use as the structuring criterion. However, if we descend below the word level, we discover that words have a complex internal structure and that their form and meaning are determined by even smaller linguistic units called **morphemes**. As we saw in Section 1.6.1, the term morpheme is used to refer to the smallest linguistic unit that carries any lexical or grammatical meaning. There are two basic types of morphemes in a language: *free* morphemes are lexical items that can appear as independent words (e.g., *smell* and *get*); and *bound* morphemes are items that can appear only as part of another lexical item (e.g., the suffixes in *smell-y* and *get-s*). Characterizing all the possible combinations of these two types of morphemes is the major focus of morphology, which plays an essential role in determining the word-internal structure of the vocabulary of a language. Importantly, it allows us to establish a connection between different grammatical forms of the same word or lexeme (cf. Section 1.3), known as **inflectional** morphology. It also allows us to identify different lexemes that share common morphological units, in particular the **root**. This is known as **derivational** morphology.

The root is the morpheme carrying the most significant aspects of semantic content for a lexical item, and which cannot be reduced into smaller constituents. Morphologically simple words have only a root (as in *sun*, *get*, *black*), while in morphologically complex words, the root is combined with other morphemes (*smell-y*, *get-s*, *black-en*, etc.). For example, it is a part of our lexical and morphological knowledge that the verb *open* has the forms *opens* and *opened*, depending on what tense, person, and number features it acquires in context. In morphologically richer languages, the variety of verbal forms can be much more extensive: consider the conjugation of the German verb *öffnen* ‘open’ in present and simple past:

Person/number	Present	Past
1 sg.	öffne	öffne
2 sg.	öffnest	öffnetest
3 sg.	öffnet	öffnete
1 pl.	öffnen	öffneten
2 pl.	öffnet	öffnetet
3 pl.	öffnen	öffneten

**Table 10.2** Conjugation of the German verb *öffnen* (‘open’)

The bound morphemes marked in italics are *inflectional* suffixes, and they are used to derive different grammatical forms of the same lexeme. The set of all the inflectional forms of a given lexeme is called **inflectional paradigm**. These grammatical forms of a word are not usually included in traditional dictionaries, since the rules that derive them are productive and regular: there are very few, if any, constraints on their application, and these constraints can be easily defined by identifying the paradigm that a word belongs to. From the point of view of the mental

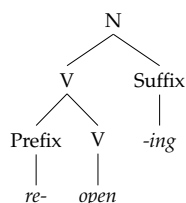
lexicon, it is likely that such regularities suggest an economy of lexical representation. That is, given a base word, we can always or almost always derive (or generate) the corresponding word form to encode the grammatical distinctions required in a given syntactic context: e.g., different tense, aspect and mood forms for the verbs; plural forms for count nouns (and adjectives in many languages), etc. We even do so with loan words that come from languages having very different morphosyntactic systems: think of the Chinese loan word *wonton*, which has as its plural *wontons*, when we use it in English. Furthermore, inflection never changes the lexical meaning or the syntactic category of the base word.

**WARNING: Irregular Inflection**

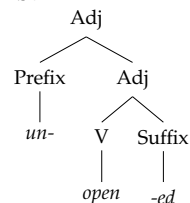
Not all inflectional forms of a root are completely regular or predictable by membership in a specific paradigm. As a result, such forms are called **irregular** inflections. For example, the past tense inflection for the English verb *drink* does not follow the inflectional paradigm that generates the grammatical forms for *open* and other regular verbs. Rather than *I dranked/ you dranked/ she dranked*, we use the form *drank*. Irregularities can themselves be irregular: the past tense for *hit* is not *hitted*, but *hit*; the past tense for *have* is not *haved*, but *had*, and so on. Such inflectional irregularities are a property of most languages. For instance, irregular past forms for the Spanish verb *poner* ‘put’: *yo puse* ‘I put’, *tú pusiste* ‘you (sg.) put’, *él/ella puso* ‘he/she put’, *nosotros pusimos* ‘we put’, *vosotros pusisteis* ‘you (pl.) put’, *ellos pusieron* ‘they put’. When regularity is absent in inflectional forms, it is necessary to learn (and represent) each grammatical form as a separate lexical item in the lexicon.

Unlike the morphological operations in Table 10.2, which result in category and meaning-preserving variations in grammatical form for the same word, **derivational** morphology refers to processes that operate over a base morpheme to derive words with possibly different syntactic categories, along with related but distinct meanings. For example, consider the English verb *open*. There are a number of words in the lexicon that are formed from this verb as their base (or **root**), together with a morpheme that changes the meaning: *opening*, *opener*, *openly*, *openness*, *reopen*, *reopening*, *unopened*, etc. These words form a **derivational paradigm** or **word family**, where all the lexemes share the same root. *Opening*, *opener*, *openly*, and *openness* are derived from *open* by the derivational process called *suffixation*: suffixes *-ing*, *-er*, *-ly*, and *-ness* were added to the base. *Reopen* is derived by *prefixation*: the prefix *-re* was added to the base. The case of *reopening* and *unopened* is more complex, because affixation has been applied recursively (see Section 2.2 on the notion of recursiveness). As shown in (44), *reopening* is formed by first deriving the verb *reopen* from prefixing the root verb *open* with *re-*, and then adding the suffix *-ing*. The adjective *unopened*, on the other hand, is formed by adding the prefix *un-* to the adjective *opened*, which was itself inflectionally formed from the verb *open* plus the passive participle suffix *-ed*.

(44) a.



b.





All the words we have mentioned so far are actually part of the English lexicon, and most of them are listed in dictionaries, but **lexical morphology**, through a process called **derivation** or **word formation**, also allows speakers to create completely new lexemes, which have never been used before, and which are not registered in conventional dictionaries: these are often called **potential words** as opposed to **actual words**. For example, we can imagine a concept of *unreopenability*, as ‘the property of something not being capable of being opened again’: *The unreopenability of this bottle means we can’t drink any water later!* Most likely, this word would be understood by most English speakers, because it follows existing derivational patterns also found in *unpredictability*, *unreliability*, or *undesirability*.

Although both derivational and inflectional morphology make use of the same mechanisms (e.g., affixation), the productivity of derivational morphology and derivational sense relations is much lower than that of inflection, and lexical gaps are quite frequent. For example, the suffix *-th*, which appears in a number of deadjectival nouns (*broad-breadth*, *deep-depth*, etc.), is no longer used to derive new English words. By contrast, the nominalizing suffix *-ness* is very productive, and we can imagine circumstances or situations allowing us to coin and understand new words, such as *apoplecticness* (from *apoplectic*), *bloggishness* (from *blog* < *bloggish*), or *undulatingness* (from *undulating*).

As explained in Section 3.4, derivational patterns are often represented in the form of rules, whose input represents the base word and the output the derived word. It is assumed that, as long as the base word has the required properties, there will always be a derived word with the properties specified in the output. Let us take another look at the rule that derives deverbal agentive nominals in *-er*, which is the revised version of the HPSG lexical rule presented in Figure 3.1:

$$\left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{V} \\ \text{SEM} = \text{EVENT} \\ \text{AS} = \langle \boxed{1} [x:\text{DP}], (y:\text{DP}) \rangle \end{array} \right] \Rightarrow \left[ \begin{array}{l} \text{PHON} = / \phi\text{-er} / \\ \text{CAT} = \mathbf{N} \\ \text{SEM} = [\text{ARG}_{ref} = \boxed{1}] \\ \text{AS} = \langle (\text{PP}[\text{of } y:\text{DP}]) \rangle \end{array} \right]$$

Figure 10.7 *-er* nominalization rule

According to this rule, an *-er* nominal (with PHON form ‘/φ-er/’) can be derived from verbs (with PHON form ‘/φ/’) that have at least one compulsory nominal argument (*x*), and that can have another, optional argument (*y*). The derived noun has a referential argument ( $\text{ARG}_{ref}$ ), which points to the same entity as *x*, and an optional relational argument (*y*), which is introduced by the preposition *of*. This pattern accounts for the meaning of most *-er* nominals, which refer to the agent of the action denoted by the base verb: e.g., *runner*, *dancer*, *driver* (*of the school bus*), *advertiser* (*of the sportswear*), etc. However, as seen in Sections 8.4 and 9.3.4, some *-er* nominals can denote instruments (*opener*, *cutter*, *washer*) as well as functional locations (*hanger*, *diner*, etc.), among other meanings. Both instruments and locations are inanimate, unlike true agentive nominals. Being inanimate, the instruments do not themselves perform the action but rather facilitate it: we say that ‘we open a bottle *with* an opener’. As far as location nominals are concerned, their meaning has no direct relationship with the agentive subject argument, but can often be considered an adjunct or modifier of the verb (e.g., a *diner* is ‘a place to dine’).

What all these words have in common is that their meaning is not fully compositional. If their semantics had been solely determined by the meanings of the base and the suffix (affixes usually have a very general and abstract meaning), we would expect anything that performs the activity of toasting to be able to be called *toaster* and anything that performs the activity of advertising to be able to be called *advertiser*, but the former only refers to an instrument (and not to an animate agent that toasts something), while the latter only applies to animate agents (and not to the advertising panels, for example). This property is known as **specialization of sense**

or **lexicalization**. The effects of lexicalization are even more visible in cases of *conversion*, where no morphological material is added to the base and where we would expect the meaning of the derived word to be only constrained by the meaning of the base: the verb *email*<sub>V</sub>, derived from the noun *email*<sub>N</sub>, would mean ‘any action related to the email’; the verb *bottle*<sub>V</sub>, derived from the noun *bottle*<sub>N</sub>, would mean ‘any action related to a bottle’, etc. However, this is not what we get: *email*<sub>V</sub> can only mean ‘send something by email’ (and not ‘compose an email’ or ‘put one’s thoughts in the form of an email’); similarly, *bottle*<sub>V</sub> can only mean ‘put something into a bottle’ (and not ‘hit someone with a bottle’ or ‘turn something into a bottle’), and so on.

In morphologically complex words where compositionality is preserved, the meaning is only partially predictable from the meaning of their parts, i.e., the lexical entry of the base word and the morphemes combined with it. For example, let us take the adjective *industrial*, which is derived from the noun *industry* by adding the suffix *-al*. *-al* is a productive adjectival suffix in English with a very general meaning: adjectives in *-al* are interpreted as meaning ‘property pertaining or relative to the entity *N*’, where *N* is the base noun (*educational* ‘pertaining to education’, *behavioral* ‘relating to behavior’, *anatomical* ‘relating to anatomy’, etc.). The following lexical rule sums up these properties of adjectives derived with *-al*:

$$\left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{N} \\ \text{SEM} = \left[ \text{ARG}_{ref} = \boxed{1} \left[ \text{SEM TYPE} = \mathbf{entity} \right] \right] \end{array} \right] \Rightarrow \left[ \begin{array}{l} \text{PHON} = / \phi - \mathbf{al} / \\ \text{CAT} = \mathbf{Adj} \\ \text{SEM} = \mathbf{property}(\boxed{1}) \end{array} \right]$$

Figure 10.8 *-al* adjectivization rule

In specific contexts, this general meaning becomes much more specific. Take a look at the following combinations of *industrial* with nouns:

- (45) a. industrial {enterprise/ sector}  
 b. industrial {waste/ pollution/ noise/ accident/ goods}  
 c. industrial {area/ zone/ park}  
 d. industrial {chemicals/ minerals/ truck}

The [industrial *N*] combinations in (45a) can be paraphrased as ‘the *N* involved with industry’: an enterprise involving industry, a sector of something consisting of industry. In (45b), the interpretation that we get is ‘*N* which is generated by an industry’: e.g., waste, pollution, and noise caused by an industry; accidents that happen in the course of the industrial process; goods manufactured by the industry. In (45c), an industrial area, zone, and park *contains* industrial facilities; and in (45d) industrial chemicals, minerals, and trucks are *used* by the industry. In all these examples the relation between the modified noun, the adjective, and the base noun is much more specific than the general ‘property’ feature included in the rule above, and we can say exactly what aspect of the semantics of the modified noun is targeted by the adjective. Using Generative Lexicon terminology, we can say that the base noun *industry* **selectively binds** (i.e., modifies) one of the qualia roles of the modified noun, as shown in the lexical entry of [industrial *N*] in (46).

- (46) a. [[[industri]<sub>N1</sub> -al]<sub>Adj</sub> N2]<sub>NP</sub>  
 b. If *N*<sub>2</sub> is ABSTRACT or ORGANIZATION, then *N*<sub>1</sub> selects for FORMAL;  
 c. If *N*<sub>2</sub> is LOCATION, then *N*<sub>1</sub> selects for CONSTITUTIVE;  
 d. If *N*<sub>2</sub> is SUBSTANCE or ARTIFACT, then *N*<sub>1</sub> selects for TELIC;  
 e. If *N*<sub>2</sub> is ARTIFACT, then *N*<sub>1</sub> selects for AGENTIVE.

What this illustrates is how the  $[[N_1\text{-al}]_{Adj} N_2]$  pair, ‘*industrial N*’, can be interpreted depending on the type of the head noun. The base noun of the adjective (*industry*) can modify any of the qualia roles of the head noun  $N_2$ . Namely, the contexts in (46) establish a specific connection between the qualia role that is ultimately modified and the semantic type of  $N_2$ : if it denotes an ABSTRACT ENTITY (e.g., *sector, property*) or ORGANIZATION (e.g., *enterprise, establishment*), then the formal role of  $N_2$  is likely to be bound; if  $N_2$  denotes a LOCATION (e.g., *area, zone, park*), then the constitutive role is bound yielding the interpretation ‘ $N_1$  is a part of  $N_2$ ’; if  $N_2$  is typed as SUBSTANCE (*chemicals, minerals*) or ARTIFICIAL/ARTIFACT (e.g., *truck*), then the telic role of  $N_2$  is likely to be bound; ARTIFICIAL/ARTIFACT  $N_2$  (*waste, pollution, noise, accident, goods*) can also yield an agentive interpretation. Of course, this correlation between the semantic type of  $N_2$  and the nature of the link between  $N_1$  and  $N_2$  can only be stated as a tendency because, as we have just seen, the same semantic type of  $N_2$  can yield different interpretations: e.g., ARTIFACTS can be the product of the industry and they can also be used for the industry.

What these examples illustrate is how the lexical information encoded in the entry of the base word and its immediate context determines the interpretation of the derived word. The compositional mechanisms that make this possible are very general and, as will be shown in the next chapter, they apply whenever two lexical items are combined in context regardless of their morphological constitution.

## 10.7 Summary

In this chapter, we defined the main principles comprising the organization of the lexicon (the *lexical architecture*), understood as the content, functionality, and organization of our knowledge of words, and examined its different components, consisting of: the syntactic type system, the semantic type system, a system of lexical semantic relations, and morphological structures. We stressed the following points:

- The major principle responsible for how lexical information is structured is called *inheritance*, which allows a particular class or type of items to include the properties of the type that it is a part of in the hierarchy. When a lexical type has two or more parent types or supertypes, we talk about *multiple inheritance*.
- The *syntactic type hierarchy* reifies those lexical features that are directly involved in the specification of the compatibility constraints of words in context, including their syntactic category and syntactic valence (i.e., how many syntactic arguments they take). These features need to be combined with semantic selectional features in a full argument structure description in order to account for the grammatical behavior of words in composition.
- The *semantic type hierarchy* identifies the conceptual type for a lexical item, while positioning it within a type hierarchy. This typing includes basic ontological class distinctions (ENTITY/PROPERTY/ EVENT and their subtypes) as well as those associated with individuation classes (BOUNDED/UNBOUNDED and SET/ ATOMIC/HOMOGENEOUS) and qualia structure relations (TELIC and AGENTIVE). These distinctions are *transcategorical* and they allow us to define complex semantic notions and classes in terms of more basic semantic types.
- Relations of meaning that inhere between words from the same (or similar) class and which can be replaced with each other in a given syntactic context are called *lexical semantic relations*. Most commonly studied lexical semantic relations (hyponymy and hyperonymy, troponymy,

co-hyponymy, and meronymy) can be defined by looking at how different words are connected within the semantic type hierarchy. *Hyperonymy* and *hyponymy* are sense relations between a general term and a more specific term, wherein the latter is a subtype of the former. Two hyponyms of the same hypernym (co-hyponyms) are always integrated into an **opposition structure**, wherein they are somehow opposed to each other. Co-hyponyms are always *incompatible* and, when a taxonomy only includes two members, they are also *contradictory*. *Contrariety* is a kind of incompatibility that arises when two terms encode extreme points of the same gradable scale, but where these terms do not exhaust the possible values on the scale. *Converseness* is the relation holding between two relational terms that can be used to describe the same situation viewed from two different perspectives. *Reversibility* involves change in two opposite directions, which leads to two opposite resultant states. *Synonymy* is the identity relation: the classes of entities denoted by two synonyms are supposed to have the same members. *Meronymy* and *holonymy* are sense relations between a term that refers to a whole and a term or terms that refer to its parts.

- Word-internal (i.e., morphological) composition plays an essential role in structuring the vocabulary of a language. It allows us to establish a connection between different grammatical forms of the same word or lexeme (called *inflectional paradigm*) and different lexemes that share some morphological segments, in particular the root (called *derivational paradigm* or *word family*). The productivity of derivational morphology and derivational sense relations is much lower than that of inflection, and the meaning of the derived lexical items is usually not fully compositional. It is affected by *lexicalization* and by the immediate syntactic context wherein the derived word appears.

## 10.8 Further Readings

Topic	Primary references
Syntactic types and hierarchies	Pollard and Sag (1994), Sag <i>et al.</i> (1999)
Lexical semantic types and hierarchies	Pustejovsky (1995), Lenci <i>et al.</i> (2000b), Fellbaum (1998), Pustejovsky <i>et al.</i> (2006), Cruse (1986) (ch.5-8), Cruse (2000) (ch.8-10), Nirenburg and Raskin (2004)
Lexical semantic relations	Lyons (1977) (ch.9), Cruse (1986) (ch.4, 9-12), Cruse (2000) (ch.8,9)
Cross-categorial lexical semantic types	Krifka (1989), Krifka (1992), Krifka (1998), Jackendoff (1991), Verkuyl (1989), Verkuyl (1996), Verkuyl (2005), Kiparsky (1998)
Lexical morphology	Lieber (2004), Levin and Rappaport Hovav (1998), Jackendoff (1975)

Topic	Secondary references
Lexical semantic types and hierarchies	Löbner (2013) (sec. 5.3), Aitchison (2012) (ch.7), Harley (2006) (sec. 7.4)
Lexical semantic relations	Löbner (2013) (ch.4-5), Aitchison (2012) (ch.7)
Lexical morphology	Aronoff and Fudeman (2011) (ch. 4, 5, 8), Adams (2014), Aronoff and Anshen (1998), Aitchison (2012) (ch.10), Cruse (2000) (sec. 8.1.3.3)

## 10.9 Exercises

- Provide lexical items satisfying the following syntactic typing:
  - Syntactic category: Adj, N; syntactic valence: [PP]<sub>1</sub>
  - Syntactic category: V; syntactic valence: [NP,Adj]<sub>2</sub>
  - Syntactic category: Adj; syntactic valence: [PP,PP]<sub>2</sub>
- The following pairs and triples of words are contrasted by one of the semantic features represented in the semantic type hierarchy (figure 10.5). Provide a full feature set for each word and identify the contrasting features.
  - fraternity/ government
  - blood/ serum
  - synthetic/ damaged
  - look for/ find
  - observe/ examine/ blink
- Organize the words in [a.] and [b.] in the form of a hypernymic hierarchy and the words in [c.] in the form of a meronymic hierarchy. Follow the simple inheritance schema illustrated in (2).
  - Book, index, introduction, table of contents, title page, chapter, paragraph, section.
  - Shape, rectangle, line, circle, square, pentagon, point, ellipse, quadrilateral, triangle, polygon.
  - Vehicle, van, SUV, passenger car, hatchback, sedan, convertible, commercial vehicle, sports car, truck.
- What lexical semantic relations hold in the following pairs of words?
  - fail - pass
  - black - red
  - kill - strangle
  - borrow from - lend to
  - easy - hard
  - hard - soft
  - hire - lay off
  - deep - shallow
- Are these expressions synonymous? Recall that, for polysemous words, synonymy must be established between specific word senses rather than between words as such. Use a dictionary to confirm your intuitions.
  - die - pass away
  - young - new
  - diligent - accurate
  - buck - dollar
  - begin - commence
  - Washington, D.C. - capital of the USA
- Determine the degree of compositionality for each of the following English compounds. For example, can the relationship between the first and the second stem be defined based on the lexical entry of both elements?

a. businessman  
b. cameraman  
c. caveman  
d. clergyman  
e. congressman  
f. craftsman

g. doorman  
h. freshman  
i. gunman  
j. mailman  
k. policeman  
l. salesman

m. seaman  
n. showman  
o. snowman  
p. sportsman  
q. yachtsman

# 11 Compositionality in the Mapping from the Lexicon to Syntax

---

## 11.1 Overview

In this chapter, we show how individual lexical items are integrated into the larger system of grammar, in order to construct both syntactic forms and semantic representations. In Chapter 8, we outlined the basic principles of *argument selection* and, in particular, the role of syntactic and semantic subcategorization constraints on how predicates map their arguments into specified syntactic positions in a phrase. In this chapter, we integrate these principles of argument selection within the system of syntactic and semantic types introduced in Chapter 10. By so doing, however, we expose some fundamental inconsistencies relating to lexical polysemy in language, motivating an apparent need for non-compositional mechanisms. Specifically, we examine the various kinds of *verbal polysemy* that occur in language, including: (a) the ways in which a verb can appear with multiple syntactic arguments or semantic types (**polymorphism**); (b) the type-shifting nature of verbs on their complements (**coercion**); (c) contexts where “bottom-up” compositionality is unable to account for the meaning of an entire phrase (**constructions**); and (d) the metaphorical sense extensions that are possible with many verbs (**metaphor**). To address these problems, we discuss three different strategies: lexical rules; constructions; and another approach taking advantage of underspecified representations in the lexicon combined with dynamic compositional processes. Finally, we examine the problem posed by multiword expressions and idioms for procedures of lexical insertion and mapping to syntax.

## 11.2 The Basics of Compositionality

Compositionality is an essential property of complex linguistic expressions. As explained in Section 4.2.2, the meaning of a complex expression is **compositional** if it is determined by the meanings of its component parts and their syntactic arrangement. Compositionality is the key for understanding how we can build and understand a potentially infinite number of word combinations (including those we have never heard or used before) based on the knowledge of the lexical meaning of a finite set of words and phrases, and the syntactic rules that are used for combining them. From this perspective, compositionality can be regarded as *the* necessary link between lexical and sentential meaning (see Chapter 4).

There are two aspects of compositionality which are intricately related: first, syntax recursively builds well-formed expressions based on the combination of smaller syntactic expressions; likewise, semantics determines the interpretation of larger expressions based on the meaning of smaller expressions (words and morphemes). Ideally (but not always, as we’ll see shortly), both processes run in tandem: each step of syntactic composition is coupled with a specific semantic effect. In this section, we illustrate how this double-faceted procedure works.

Consider the two sentences in (1a) and (2a), along with their respective syntactic structures in (1b) and (2b).

- (1) a. John feeds Fido.  
       b. [<sub>S</sub> [<sub>DP</sub> John] [<sub>VP</sub> [<sub>V</sub> feeds ] [<sub>DP</sub> Fido ] ] ]
- (2) a. A boy feeds Fido.  
       b. [<sub>S</sub> [<sub>DP</sub> A [<sub>NP</sub> [<sub>N</sub> boy]]] [<sub>VP</sub> [<sub>V</sub> feeds ] [<sub>DP</sub> Fido ] ] ]

Both sentences above are derivable using the syntactic rules in (3), which are expressed as phrase structure rules; e.g.,  $A \rightarrow BC$ ,  $A \rightarrow B$ , or  $B \rightarrow b$ .

- (3) a.  $DP \rightarrow D \quad NP$   
       b.  $NP \rightarrow N$   
       c.  $VP \rightarrow V \quad DP$   
       d.  $S \rightarrow DP \quad VP$   
       e.  $DP \rightarrow \text{John}$
- f.  $DP \rightarrow \text{Fido}$   
       g.  $D \rightarrow a$   
       h.  $N \rightarrow \text{boy}$   
       i.  $V \rightarrow \text{feed}$

With each of the syntactic rules in (3), there is an associated semantic operation. To better understand what kinds of semantics rules are associated with the syntactic structures above, let us revisit the notion of **function** in linguistics. In modern semantic theories, the basic mechanism underlying semantic compositionality is **function application**. As discussed in Chapter 5, natural language predicates can be seen as complex expressions composed of two parts: the functional expression and its argument or arguments. Only when we know the value of the argument (i.e., when the function is *saturated*) we can compute the value of the whole expression. For example, we know that the predicate *feed* requires two arguments, represented as  $\text{arg}_1$  and  $\text{arg}_2$  in (4a), and therefore two function applications are needed in order to derive the interpretation of the sentence. We first apply the function  $\text{feed}(\text{arg}_1, \text{arg}_2)$  to the argument *Fido* in order to get  $\text{feed}(\text{arg}_1, \text{Fido})$ , as in (4b). And then, for sentence (1a), we apply  $\text{feed}(\text{arg}_1, \text{Fido})$  to the argument *John*, to get the saturated predicate  $\text{feed}(\text{John}, \text{Fido})$ ; for sentence (2a), we apply this same function to *a boy* in order to get the saturated predicate  $\text{feed}(\text{a\_boy}, \text{Fido})$ .

- (4) a.  $\text{feed}(\text{arg}_1, \text{arg}_2)$   
       b. APPLY  $\text{feed}(\text{arg}_1, \text{arg}_2)$  to 'Fido'  $\Rightarrow \text{feed}(\text{arg}_1, \text{Fido})$   
       c. APPLY  $\text{feed}(\text{arg}_1, \text{Fido})$  to 'John'  $\Rightarrow \text{feed}(\text{John}, \text{Fido})$   
       c'. APPLY  $\text{feed}(\text{arg}_1, \text{Fido})$  to 'a\\_boy'  $\Rightarrow \text{feed}(\text{a\_boy}, \text{Fido})$

As we know, in order to derive well-formed predicates it is important to make sure that the arguments have the appropriate semantic type. This requirement is actually built into the rule of function application, stated below in (5).

- (5) FUNCTION APPLICATION:  
       a. INFORMAL: A predicate  $\beta$  is an unsaturated expression, which, when combined with its argument,  $\alpha$ , becomes a saturated expression,  $\beta(\alpha)$ ;  
       b. FORMAL: If the argument  $\alpha$  is of type  $a$ , and the function  $\beta$  is of type  $a \rightarrow b$  (i.e., if  $\beta$  maps expressions of type  $a$  into expressions of type  $b$ ), then  $\beta(\alpha)$  is of type  $b$ .

Notice the type  $a \rightarrow b$ : this is called a "derived type", built up from types  $a$  and  $b$  with the **type constructor**,  $\rightarrow$ . An expression of this type will combine with anything of type  $a$  and then return (turn into) an expression of type  $b$ . Hence, it is like an input-output type:  $a$  is the input, and  $b$  is the output.



As an example of function application, consider the **successor function** in mathematics, which returns, for any natural number  $n$ , the next number,  $n + 1$ :  $f(x) = x + 1$ . Every time we apply this function to a number, we perform function application as defined above. Let's see how this works. If a natural number, such as 5, has type NAT, then the function **successor** has a type that maps expressions of type NAT into another type, in this case, also of type NAT. Hence, the type for **successor** is  $\text{NAT} \rightarrow \text{NAT}$ , and the application of this function to an argument, 5, is shown below.

- (6) a. **successor** is type  $\text{NAT} \rightarrow \text{NAT}$ , 5 is type NAT;  
 b. **successor**(5) = 6, which is of type NAT.

Now let us see how this extends and applies to the semantics of natural language expressions. In the previous chapter, we presented an elaborate system of semantic types and how they relate to each other. Before we dive into the details of how those types are exploited in constructing meanings, we need to become more familiar with the basic mechanics of how function application can be implemented using the lexical items and linguistic expressions in natural language. To do this, we will simplify our type system to include just two basic types,  $e$  and  $t$ :  $e$  is the type of individual entities;  $t$  is the type of propositions; and all other types are derived from these types, using the type constructor  $\rightarrow$ , introduced above. This is the underlying type system for the semantics proposed by Montague, which we discussed in Section 5.2, and we will refer to here as the **M-type** system. Examples of individuals are 'John' (which we represent with the constant symbol  $j$ ) and 'Fido' ( $f$ ). Sentences, on the other hand, are syntactic expressions denoting propositions, typed as  $t$  (for 'truth value'). Consider the two sentences in (7) below, along with their logical forms.

- (7) a. John feeds Fido.  
        $\text{feed}(j, f)$   
 b. A boy feeds Fido.  
        $\exists x[\text{boy}(x) \wedge \text{feed}(x, f)]$

In order to show how the semantic interpretations in (7) were derived based on the meaning of smaller syntactic constituents making up the sentence, we will make use of the **lambda calculus** ( $\lambda$ -calculus), a language for expressing function application. The ' $\lambda$ ' is the name given to the operator that allows us to introduce placeholders for missing semantic components (arguments and predicates) in an expression, which are represented as variables. Every  $\lambda$ -expression is a function looking for an argument to act on. To see how this works, let's revisit the derivation in (4) to show how the verb *feed* formally acts as a function over its arguments. Expressed as a  $\lambda$ -expression, the predicate in (4a) would be represented as (8b).

- (8) a. PREDICATE-ARGUMENT NOTATION:  $\text{feed}(\text{arg}_1, \text{arg}_2)$   
 b.  $\lambda$ -NOTATION:  $\lambda y \lambda x [\text{feed}(x, y)]$

These two expressions express the same thing, namely, that the verb *feed* is a relation between two arguments: but the term in (8b) makes the computational behavior of the verb explicit in the way that it is semantically typed. Let's see how this happens. First, consider a simple intransitive verb such as *sleep*, as used in (9).

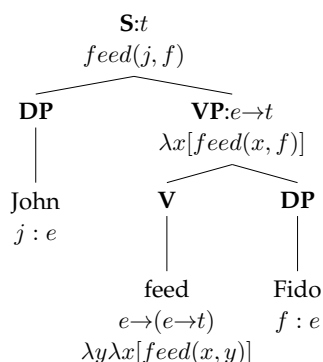
- (9) a. Mary sleeps.  
 b.  $\text{sleep}(m)$

Following the definition of function application in (5), *Mary* is an argument  $\alpha$ , of type  $e$  (she is an individual!), and *sleep* is a function  $\beta$ , of type  $e \rightarrow t$  (it is looking for an argument of type  $e$  to make a  $t$ ). When the function is applied to its argument, the two expressions are combined through a process called  $\lambda$ -conversion (or  $\beta$ -reduction). This is similar to  $\theta$ -saturation (or assignment) in various generative theories, with the difference being that, here the type of an expression tells you exactly what its behavior is going to be: if I am a functional type (e.g.,  $e \rightarrow t$ ), then I have to apply to something of type  $e$ . The resulting expression is of type  $t$ , the type of the meaning of a sentence. The derivation of sentence (9a) is illustrated below in (10).

- (10) a. **Mary**,  $m : e$   
 b. **sleep**,  $\lambda x[\text{sleep}(x)] : e \rightarrow t$   
 c. APPLY  $\lambda x[\text{sleep}(x)](m) \Rightarrow \text{sleep}(m) : t$

Now let us return to the examples in (7) and examine how function application and semantic typing work in parallel with the syntactic rules of the grammar to ensure a compositional interpretation of a sentence. To help illustrate this connection, we will employ a tree structure that encodes three facets of information on each node: (a) **syntactic category**; (b) **semantic type**; and (c) **semantic expression** (Logical Form). Consider what such a tree looks like for the sentence in (7a).

(11)



As mentioned above, both *John* and *Fido* are individuals, hence they are typed as  $e$ . The *V*, *feed*, is a two-place predicate, which applies to two individual arguments in order to yield a proposition. Hence, its semantic type is  $e \rightarrow (e \rightarrow t)$ , and its corresponding  $\lambda$ -expression is  $\lambda y \lambda x[\text{feed}(x, y)]$ , which can be paraphrased as ‘the set of all  $(x, y)$  pairs, such that  $x$  feeds  $y$ ’. In the first application, it successfully takes the DP *Fido* as its argument, as *Fido* has the required type,  $e$ : this function application results in a new expression, the VP, whose type is  $e \rightarrow t$  (the type of a basic predicate). The logical form of the VP, [*feed Fido*], is  $\lambda x[\text{feed}(x, f)]$ , where the constant  $f$  has replaced the  $\lambda$ -bound variable  $y$ . This can be paraphrased as: ‘the set of all individuals who feed Fido’. Finally, the subject *John* is combined with the VP *feed Fido*, through another function application, to make a complete sentence. The latter requires an  $e$  argument in order to yield a proposition ( $t$ ), and *John* denotes such an individual. With this function application, the last remaining  $\lambda$ -bound argument is replaced with the constant  $j$  and the resulting proposition gets the interpretation  $\text{feed}(j, f)$ , as in (7a).

Before we turn to the somewhat more complicated example in (7b), where the subject argument is not an individual proper name, *John*, but an indefinite DP (*a boy*), let us look more carefully at how semantic types are constructed in the M-type system. As we mentioned above, in this system, there are only two basic types,  $e$  and  $t$ , and every other type is built out of these using the type constructor,  $\rightarrow$ . In general, all predicates are treated as sets of individuals, which translates to the type  $e \rightarrow t$ . This has the effect, however, of translating multiple syntactic categories into the same semantic type. For example, while it seems intuitive that intransitive verbs such as *sleep* and *walk* are typed as  $e \rightarrow t$ , it turns out that common nouns (N) and adjectives (Adj) are also of type  $e \rightarrow t$ , since they are both predicates in a generic sense. Furthermore, anything that is semantically a predicate is  $e \rightarrow t$ , e.g., all VPs. For example, the noun *boy* denotes the ‘set of all boys’,  $\lambda x[\text{boy}(x)]$ ; the adjective *hungry* denotes the ‘set of all hungry things’,  $\lambda x[\text{hungry}(x)]$ ; and the VP *visits Boston* denotes the ‘set of those individuals who visit Boston’,  $\lambda x[\text{visit}(x, \text{Boston})]$ . Table 11.1 illustrates the correspondence between some of the major syntactic categories and their semantic types.

SYNTACTIC TYPE	SEMANTIC TYPE	SEMANTIC EXPRESSION
Proper Name	$e$	individuals ( <i>Mary</i> )
Sentence	$t$	propositions
Intransitive Verb	$e \rightarrow t$	$\lambda x[\text{Verb}'(x)]$
Transitive Verb	$e \rightarrow (e \rightarrow t)$	$\lambda y \lambda x[\text{Verb}'(x, y)]$
Noun	$e \rightarrow t$	$\lambda x[\text{Noun}'(x)]$
Adjective	$e \rightarrow t$	$\lambda x[\text{Adj}'(x)]$
DP (referential)	$e$	individuals ( <i>my oldest daughter</i> , <i>the sun</i> )
VP	$e \rightarrow t$	$\lambda x[\text{VP}'(x)]$

**Table 11.1** Syntactic Categories and their Semantic Types (Part A)

Missing from this table, however, is the semantic type for non-referential DPs, such as *a boy*, *every woman*, and *most dogs*, which, in turn, involves understanding the type associated with determiners, e.g., *a*, *every*, and *most*. Let us see how this works. Recall the derivation for sentence (9) above, *Mary sleeps*. If we replace the subject with a non-referential DP, such as *a woman*, somehow the grammar needs to derive the logical form shown in (12b) compositionally, through function application.

- (12) a. A woman sleeps.  
 b.  $\exists x[\text{woman}(x) \wedge \text{sleep}(x)]$

From Table 11.1, we see that the type for the Noun, *woman*, is  $e \rightarrow t$ , which is also the type for the verb, *sleep* (and its VP projection). An annotation of (12a) with these type labels is shown in (13), and it illustrates an interesting property of the DP determiner, *a*: it is a *relation* between predicates, i.e., expressions of type  $e \rightarrow t$ .

- (13)  $[[\overbrace{[\text{A woman}]_{DP}}^{e \rightarrow t} [\overbrace{[\text{sleeps}]_{VP}}^{e \rightarrow t}]_S]$

In fact, most language determiners can be analyzed as relations between two predicates,  $P$  and  $Q$ : that is, a quantifier such as the determiner *a* denotes the relation,  $\lambda P \lambda Q[R(P, Q)]$ . For the indefinite determiner, it is a relation between the predicate denoted by the NP that it combines

with  $(DP \rightarrow \text{Det } NP)$ , and the predicate denoted by the VP. The corresponding lexical semantics for *a* is shown in (14a), along with the semantics for the quantifier *every* in (14b).

- (14) a.  $\llbracket a \rrbracket = \lambda P \lambda Q \exists x [P(x) \wedge Q(x)]$   
 b.  $\llbracket \text{every} \rrbracket = \lambda P \lambda Q \forall x [P(x) \rightarrow Q(x)]$

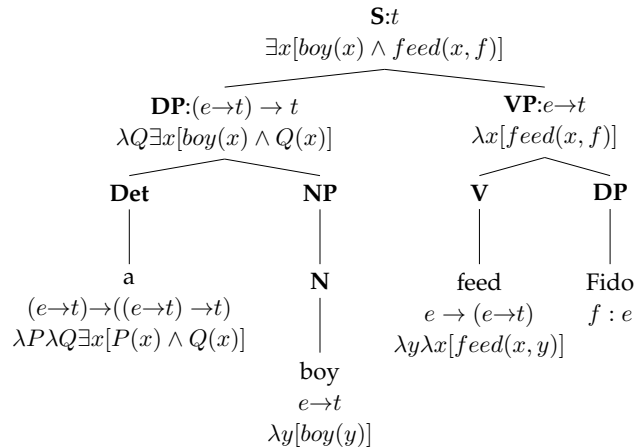
The expression in (14a) can be paraphrased as: “the relation between the properties *P* and *Q*, such that there is an individual, *x*, who has both these properties”. Similarly, the expression in (14b) is paraphrased as: “the relation between the properties *P* and *Q*, such that for every individual *x* that has *P*, it also has *Q*”. When an NP is combined with a quantifier, the resulting DP is referred to as a **generalized quantifier**. We can now extend our table of correspondences between syntactic categories and their semantic types to include: the quantifiers in general; the determiners *a* and *every*, in particular; and the behavior of DPs that are generalized quantifiers (GQs). These are shown below in Table 11.2.

SYNTACTIC TYPE	SEMANTIC TYPE	SEMANTIC EXPRESSION
Quantifier	$(e \rightarrow t) \rightarrow ((e \rightarrow t) \rightarrow t)$	$\lambda P \lambda Q [R(P, Q)]$
Det ( <i>a</i> )	$(e \rightarrow t) \rightarrow ((e \rightarrow t) \rightarrow t)$	$\lambda P \lambda Q \exists x [P(x) \wedge Q(x)]$
Det ( <i>every</i> )	$(e \rightarrow t) \rightarrow ((e \rightarrow t) \rightarrow t)$	$\lambda P \lambda Q \forall x [P(x) \rightarrow Q(x)]$
GQ DP	$(e \rightarrow t) \rightarrow t$	$\lambda P [DP'(P)]$

**Table 11.2** Syntactic Categories and their Semantic Types (Part B)

Now that we better understand the compositional behavior of determiners, let us return to the function application and type composition involved with sentence (7b), *A boy feeds Fido*. The syntactic derivation is shown in (15), along with the type structure and semantic interpretation associated with each node.

(15)



The transitive verb *feed*, applies to its direct object, *Fido*, as in the previous derivation (*John feeds Fido*), resulting in a predicate of type  $e \rightarrow t$ , with the interpretation,  $\lambda x[\text{feed}(x, f)]$  (‘the set of those individuals who feed Fido’). However, notice now what is going on inside the subject DP. As

mentioned above, since the N *boy* is a one-place predicate, its type is  $e \rightarrow t$ , a function that maps individuals into propositions, and its interpretation is  $\lambda x[\text{boy}(x)]$ . The determiner *a* combines with *boy*, and the resulting expression is a function from one-place predicates to propositions,  $(e \rightarrow t) \rightarrow t$ , which is the semantic type of the indefinite DP, *a boy*. Note that, by combining *a* with *boy*, we converted one of the  $\lambda$ -variables in  $\lambda P \lambda Q \exists x [P(x) \wedge Q(x)]$ , since now we know the specific value of the predicate *P*, i.e., *boy*. In the last step of the derivation, we take the entire VP, *feed Fido*, as the argument to the subject DP, *a boy*: the VP has the type,  $e \rightarrow t$ , which is what the DP requires of its argument, i.e.,  $\lambda Q \exists x [\text{boy}(x) \wedge Q(x)]$ . The result of this function application is a proposition of type  $t$ , the type of the sentence *S*. In the process of this  $\lambda$ -conversion, the last remaining  $\lambda$ -bound variable (*Q*) is replaced with the predicate denoted by the VP,  $\lambda x[\text{feed}(x, f)]$ , and the resulting proposition has the interpretation  $\exists x [\text{boy}(x) \wedge \text{feed}(x, f)]$ , as in (7b).

There are, of course, many phenomena we have not discussed, including the interpretation of generalized quantifiers in non-subject positions (16a), and the interpretation of *quantifier scope* with sentences containing multiple quantifier expressions (16b).

- (16) a. Mary ate *every* cookie.  
       b. *Every* passenger watched *a* movie on the plane.

Sentence (16a) is a problem because, given the type system as presented above, a transitive verb such as *eat* is a relation between two individuals,  $e \rightarrow (e \rightarrow t)$ , but the direct object DP in this case is a generalized quantifier, i.e.,  $(e \rightarrow t) \rightarrow t$ . This involves some further machinery that is beyond the scope of our discussion. Further, sentence (16b) is problematic because, as we discussed already in Section 6.5, there are two interpretations possible, one where all the passengers are watching their own movie, and the other where everyone is watching the same movie.

In this section, we have examined the basic mechanisms responsible for the compositional construction of meaning in language. What we have seen is that, perhaps surprisingly, the lexicon emerges as the principle component of grammar associated with maintaining compositionality in language. In the next section, we look at a broader set of linguistic phenomena which seem to violate the definition of compositionality as presented in this section.

## 11.3 Apparent Violations of Compositionality

In the previous section, we outlined the basic operations necessary for building sentence meanings out of lexical items. We focused on lexical semantic typing and function application in order to demonstrate the most basic model of compositionality in language. On this view, every syntactic operation has a unique semantic effect, since there is a strict mapping between the syntactic form of an expression and its semantic interpretation. In this section, however, we discuss a number of contexts in language that appear to contradict the claim that meaning can be modeled compositionally in language. These include the following linguistic phenomena:

1. SYNTACTIC POLYMORPHISM (and ARGUMENT ALTERNATIONS);
2. SEMANTIC POLYMORPHISM;
3. TYPE SHIFTING or COERCION;
4. CONSTRUCTIONAL MEANING;
5. METONYMY AND METAPHOR.

*Polymorphism* is the ability of an object to take on many forms, and is, in fact, a kind of polysemy

(17) a. Billy painted [<sub>DP</sub> a portrait of his mother].  
 b. Billy painted [<sub>DP</sub> his mother] [<sub>DP</sub> a picture].  
 c. Mary paints [<sub>PP</sub> with acrylics].  
 d. Mary painted [<sub>DP</sub> the mural] [<sub>AdjP</sub> black and white].  
 e. Mary will paint [<sub>DP</sub> her way] [<sub>PP</sub> to fame and fortune].

(18) a. [DP \_\_ DP]  
b. [DP \_\_ DP DP]  
c. [DP \_\_ PP]  
d. [DP \_\_ DP AP]  
e. [DP \_\_ DP PP]

**Semantic polymorphism** arises when a word can be interpreted in different (but related) ways, depending on the type of the argument it takes. To illustrate this phenomenon, consider again the verb *paint* when appearing in syntactic frame (18a), that is, [DP \_\_ DP]. There are actually two interpretations for this frame, only one of which has been mentioned. For every syntactic frame in (17), *paint* has a CREATION meaning, where the entity denoted by the direct object (*portrait/ picture/ mural*) comes into existence as a result of the painting event. There is another sense for *paint*, however, denoting a CHANGE-OF-STATE, where the entity denoted by the direct object (*fence, cabinet, and surface*) is covered with paint, as illustrated in (19).

(20) a. Mary baked the potato.  
b. John sewed a button.  
c. The child carved the stick.

- (21) a. Mary baked a cake.  
 b. John sewed a dress.  
 c. The child carved a boat.

Notice how a specific sense of the verb is selected, depending on the semantic type of the direct object: when the direct object is an artifactual entity, the CREATION sense is invoked; otherwise a CHANGE-OF-STATE sense is denoted. This is illustrated in (22), where the verb slot and direct object position have been annotated with semantic types.

- (22) a. CREATION: [DP \_\_\_\_ DP<sub>ARTIFACT</sub> ]  
 b. CHANGE-OF-STATE: [DP \_\_\_\_ DP<sub>PHYS.OBJ</sub> ]

The polysemy that results from semantic polymorphism is not a phenomenon restricted to verbs. In (23), for example, the adjective *easy* appears to take on a different meaning with every noun it modifies (these adjective-noun pairs were first introduced in Section 3.7): ‘cook’ for *recipe*, ‘respond’ or ‘give’ for *answer* and *question*, and ‘catch’ for *prey*.

- (23) a. *easy recipe*: ‘a recipe that is easy to follow’  
 b. *easy answer*: ‘an answer for a question that is easy to give’  
 c. *easy question*: ‘a question that is easy to answer’  
 d. *easy prey*: ‘prey that is easy to catch’

How can we account for both the verbal and adjectival polysemy cases above without giving up on compositionality? Positing a different word sense for each of the verb contexts above is possible, but this fails to capture any generalizations regarding why these senses occur with these verbs. For the polysemy resulting from adjectival modification with *easy*, such a solution is not even available, since it is a completely productive and predictable interpretation, and we would end up with as many senses as there are modified nouns for *easy*. However, what these and other word combinations definitely show is that, although word meaning as specified in the lexical entries might be an important ingredient of the compositional interpretation, it is sensitive to being further determined in context. This obviously makes the task of computing the meaning of complex constructions more complicated.

The next phenomenon that poses a challenge to conventional models of compositionality in language is something called **type shifting** or **coercion**. Coercion takes place when the combinatorial requirements imposed by the selecting predicate are not directly satisfied by its argument, and yet the whole construction turns out to be acceptable.

Two types of coercion are usually discussed in the literature: **aspectual coercion** and **complement coercion**. Aspectual coercion arises when a verb’s lexically specified event type undergoes modification under the influence of other predicate components (time adverbials, verbal complements, etc.), as was shown in Sections 9.3.2 and 9.3.3. Consider, for example, how an achievement verb, *come*, takes on an iterative/habitual interpretation, as in (24).

- (24) John came to visit his grandfather. / John came to visit his grandfather for 20 years.  
 [DYNAMIC  $\sqcap$  ATOMIC]  $\implies$  [DYNAMIC  $\sqcap$  B.SET]

In (25a), an accomplishment predicate, *build*, assumes a durative bounded atelic interpretation, while in (25b) it is interpreted as an unbounded event.

- (25) a. John built a house. / John built a house for six months.  
 [DYNAMIC  $\sqcap$  B.SET]  $\implies$  [DYNAMIC  $\sqcap$  ATOMIC]

- b. John built a house. / John was building a house.  
 $[DYNAMIC \sqcap B\_SET] \Rightarrow [DYNAMIC \sqcap HOMOGENEOUS]$

Similarly, stative unbounded predicates, such as *live* and *be obnoxious*, can become bounded (26a) or dynamic (26b), depending on the syntactic context.

- (26) a. John lived in Boston.  $\Rightarrow$  John lived in Boston for twenty years.  
 $[STATIC \sqcap HOMOGENEOUS] \Rightarrow [STATIC \sqcap ATOMIC]$   
 b. John is obnoxious. / John is being obnoxious.  
 $[STATIC \sqcap HOMOGENEOUS] \Rightarrow [DYNAMIC \sqcap HOMOGENEOUS]$

Note that each event type coercion above has been cast in terms of semantic type modifications, using the inventory of types from Section 10.4: e.g., we can see that the *for* adverbials affect the INDIVIDUATION typing of the original event and they yield BOUNDED (ATOMIC or B\_SET) predicates, and the progressive affects both the INDIVIDUATION and the ONTOLOGICAL typing and it yields  $[DYNAMIC \sqcap HOMOGENEOUS]$  predicates.

The other major form of coercion is called **complement coercion**, where the predicate imposes the required semantic type to a complement that does not comply with its semantic constraints. One of the best known cases of complement coercion involves aspectual verbs (cf. Sections 6.2, 7.4): *start/begin, finish/end*, etc. These verbs take as their complement an event-denoting argument, e.g., *finish the {job/ race/ tour/ training}*, *begin the {journey/ campaign/ construction/ discussion}*. However, we often find combinations with non-eventive nominals, which sound quite natural and which speakers have no trouble producing and interpreting: *finish the {novel/ sentence/ coffee}* and *begin the {cake/ book/ trail}* contain complements typed as different kinds of ENTITY and not EVENT. In such cases, coercion takes place and the complement nominal is interpreted as though it were part of an event: when we say that we ‘begin/finish a thing’, we actually mean ‘begin/finish doing something to or with that thing’ (reading or writing a novel, pronouncing a sentence, drinking a coffee; eating the cake, reading a book, walking a trail, etc.).

Complement coercion is not restricted to aspectual predicates, but can occur in many different contexts, as illustrated by the sentences in (27)–(29).

- (27) a. The spokesperson denied the statement. SELECTION: PROPOSITION  
 b. The spokesperson denied the attack. COERCION: EVENT  $\Rightarrow$  PROPOSITION
- (28) a. The boy heard a noise. SELECTION: SOUND  
 b. The boy heard the violin. COERCION: ARTIFACT  $\Rightarrow$  SOUND
- (29) a. Society has evolved greatly since the 1980s. SELECTION: TIME  
 b. Society has evolved greatly since the last dictator. COERCION: ANIMATE  $\Rightarrow$  TIME

In (27a), the verb *deny* is combined with an appropriately typed complement, with *statement* denoting a PROPOSITION, while in (27b) it is combined with an EVENT noun *attack*, which must be coerced into the required propositional interpretation (‘denied the information that there has been an attack’). The verb *hear* requires a SOUND complement, which we have in (28a) with *noise*, but in (28b), with an ARTIFACTUAL nominal *violin*, we get a coerced interpretation (‘heard the sound of the violin’). Further, as shown in (29), non-verbal predicates can also trigger coercion: the preposition *since*, which selects for TIME complements (recall that TIME is a subtype of ABSTRACT ENTITY, as in Figure 10.6), coerces the ANIMATE noun *dictator* into a temporal interpretation, i.e. ‘time period corresponding to the ruling of the last dictator’.



Another potential problem faced by conventional theories of compositionality is what has become known as **constructional meaning** (as discussed in Section 3.6). This is a label given to a number of diverse linguistic structures, all of which share the following properties: both the syntax and the semantics seem to depend on the linguistic construction *as a whole*, in addition to the meanings contributed by the individual components. Since compositionality presupposes that the meaning of an expression is determined by the meaning of its parts, and not by the meaning of the bigger expression to which it belongs, constructional meaning poses a serious challenge to the compositional treatment of natural language semantics. This kind of “top-down” determination of meaning can manifest itself to varying degrees: from being very schematic and general, and coexisting with the meaning contributed by the individual components (see the ditransitive construction in Figure 3.3), to being very specific, where the constructional meaning completely cancels the meanings of the individual components.

To illustrate the range attributed to constructional meaning, let us consider a number of linguistic phenomena with increasingly “construction-specific” meanings. We begin with the “causative-resultative” construction, which has a very general meaning: AGENT **causes** PATIENT **to become** RESULT-GOAL. This construction is compatible with a wide range of verbs, both transitive (30a-c) and intransitive (30d-f), as illustrated below.

- (30) a. Sue froze the lemonade solid.  
       b. Lisa licked her plate clean.  
       c. Sue rolled the ball down the hill.  
       d. Sue ran herself to exhaustion.  
       e. Sue laughed herself hoarse.  
       f. Sue danced out of the room.

Moving up the construction-specific scale, the *drive*-construction, which is an instance of the causative-resultative template, has a much more specific meaning: AGENT **causes** PATIENT **to undergo** NEGATIVE-EMOTIONAL-STATE. This is seen in the sentences in (31).

- (31) a. My job is driving me insane.  
       b. His accent drove me nuts.  
       c. That incessant noise is driving me mad!

In this construction, the verb *drive* is not interpreted as a motion verb, but rather as a psychological change-of-state verb, and the RESULT-GOAL argument is more specifically typed to a NEGATIVE-EMOTIONAL-STATE, and is lexically constrained to a limited set of adjectives and nouns synonymous with *crazy*: e.g., *mad*, *insane*, *bananas*, *nuts*, etc.

Some resultative predicates enter into construction-specific interpretations that are even more syntactically constrained and idiomatic. Consider the examples in (32).

- (32) a. We cut our vacation short.  
       b. Can I have some more cake? - Sure, knock yourself out!

‘AGENT *cuts* THEME/PATIENT *short*’ in (32a) only has two open slots which allow variation (for Agent and Theme/Patient) and its meaning has nothing to do with ‘cutting’ or ‘being short’. ‘Agent *knocks* himself/herself *out*’ in (32b) has an open slot for the Agent and another one for the reflexive, and it is not compositional either: in colloquial English it is used as a way of giving permission to do something without feeling inhibited.

The last (and perhaps most difficult) challenge to compositionality in language involves the use of **metonymy** and **metaphor**, both very productive mechanisms for driving semantic and

lexical change. They underlie the process of meaning extension, whereby words acquire new and previously unattested senses, that are related to the original sense in generally systematic or paradigmatic ways. **Metonymy** allows one to refer to an entity with the name of another entity, if both entities are closely related (physically, causally, and otherwise), in particular when one of the entities is an attribute of the other. Some of the most frequent relations are illustrated in (33). Note that in most of these cases, the meaning change involves a semantic type shift, as shown in the third line of each example:

- (33) a. PART  $\Rightarrow$  WHOLE  
 You can always hire good *brains*.  
 [INANIMATE  $\sqcap$  HOMOGENEOUS]  $\Rightarrow$  [ANIMATE  $\sqcap$  ATOMIC]  
 b. CONTAINER  $\Rightarrow$  CONTENT  
 This *bottle* is delicious.  
 [INANIMATE  $\sqcap$  ATOMIC]  $\Rightarrow$  [INANIMATE  $\sqcap$  ATOMIC]  
 c. TOOL  $\Rightarrow$  PROFESSIONAL  
 We had to fire the lead *violin*.  
 [INANIMATE  $\sqcap$  ATOMIC]  $\Rightarrow$  [ANIMATE  $\sqcap$  ATOMIC]  
 d. PRODUCER  $\Rightarrow$  PRODUCT  
 My father drives a black *Toyota*.  
 [INANIMATE  $\sqcap$  B.SET]  $\Rightarrow$  [INANIMATE  $\sqcap$  ATOMIC]  
 e. ARTIFACT  $\Rightarrow$  PRODUCTION PROCESS  
 How is *the birdhouse* coming along?  
 [INANIMATE  $\sqcap$  ATOMIC]  $\Rightarrow$  [DYNAMIC  $\sqcap$  B.SET]  
 f. ARTIFACT  $\Rightarrow$  USER  
 The *green shirt* behind you is making me nervous.  
 [INANIMATE  $\sqcap$  ARTIFICIAL  $\sqcap$  FUNCTIONAL  $\sqcap$  ATOMIC]  $\Rightarrow$  [ANIMATE  $\sqcap$  NATURAL  $\sqcap$  ATOMIC]

Recall that some of these instances of metonymy were analyzed as dot objects in Section 7.4. We return to this issue in Section 11.4, in connection with lexically driven approaches to compositionality.

**Metaphor** also allows us to use the name of one thing for that of another, but the relation between those things is usually more abstract and less obvious than in the case of metonymy. In fact, metonymy is sometimes classified as a kind of metaphor, where the relation is more concrete. Recall the following examples from Section 4.5:

- (34) a. Your words are music to my ears.  
 (= 'Your words make me happy')  
 b. He spent hours wandering through the forest of his memories.  
 (= 'He spent hours remembering things')  
 c. His first novel came out in 1978.  
 (= 'His first novel was published in 1978')

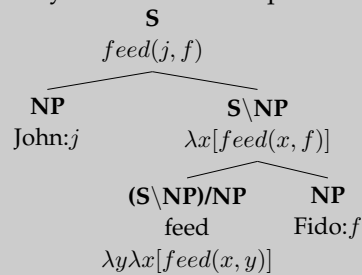
Both metonymy and metaphor complicate the conventional compositional construction of meaning, because they involve a change in lexical meaning, which is supposed to be the point of departure for the construction of phrasal and sentential meaning. In order to preserve compositionality, we must be able to derive metonymic and metaphoric word uses based on general and systematic mechanisms of meaning extension.

In view of these and other phenomena that challenge the basic tenets of the compositionality principle, we must ask whether it is worth preserving. If we decide that it is, as most linguists

do, for all the reasons provided at the beginning of this section and in Section 11.2, then we must address two main questions: (1) how can lexical meaning be modified (specialized or extended) and what are the limits of lexical-semantic flexibility; and (2) how do predetermined lexical meanings coexist or interact with different instances of phrasal and sentential meaning? The next section presents several approaches to answering these questions.

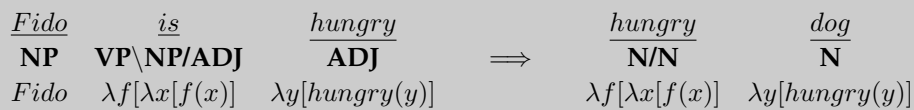
CLUE/COMMENT[magnifying glass icon]:

Combinatory Categorical Grammar (CCG) (Steedman (1996, 2000)) is a grammar formalism that combines the functional expressiveness of the  $\lambda$ -calculus with the combinatorial syntax of categorial grammar. On this view, words that take arguments, such as verbs, are not just semantically functional types ( $e \rightarrow t$ ), but are explicitly functional from a syntactic perspective as well. That is, a verb is specified as being a syntactic type that encodes what kind of argument(s) it combines with. Since this is a syntagmatic encoding (sensitive to linear ordering), it needs to specify the directionality of the syntactic combination (is my argument to the left or right?). The primitive symbols in CCG are: N, S, NP, ADJ, and PP; a syntactic combinator operator ( $\backslash, /$ ), specifies the order and direction of the arguments. For example, an intransitive verb *sleep* would be the category  $S \backslash NP$ , since it combines with an NP to its left (the subject) and forms a sentence as a result. Likewise, a transitive verb, *feed*, carries the category  $(S \backslash NP) / NP$ , which says that it needs to combine with an NP to its right (direct object), before combining with its subject (to the left). The semantic categories are basically the  $\lambda$ -calculus expressions we encountered above.



There are two ordered function application rules,  $<$ , and  $>$ . Given an argument of category  $B$  with meaning  $g$ , and a functor,  $f$  of category  $A \backslash B$ ,  $f$  can apply backward ( $<$ ) to derive  $f(g)$  of category  $A$ . This is what the VP in the example above ( $S \backslash NP$ ) is doing, when applying to the subject. If  $f$  is of category  $A/B$ , it applies forward ( $>$ ), to derive  $f(g)$  of category  $A$ , which is how the verb *feed*, of type  $S \backslash NP / NP$ , applies to its direct object, *Fido*.

Importantly, CCG categories can *type-shift* to accommodate to novel contexts that words can appear in. The type flexibility of CCG makes it a very adaptable and expressive framework for both linguistic description, as well as for computational applications to natural language parsing. For example, *hungry* as a predicative adjective has the type ADJ, as in *Fido is hungry*: in order to combine with nouns attributively inside an NP, however, we apply a type-shifting rule:  $\text{ADJ: } \lambda x.g(x) \Rightarrow \text{N/N: } \lambda f \lambda x.[f(x) \wedge g(x)]$ . This is illustrated in the two derivations below.



## 11.4 Main approaches to compositionality

In order to address the questions facing the conventional theory of compositionality that were listed in the previous section, four main approaches have been put forward:

1. SENSE-ENUMERATIVE LEXICONS;
2. ADJUSTMENT MECHANISMS: LEXICAL RULES and COERCION FUNCTIONS;
3. CONSTRUCTIONS;
4. UNDERSPECIFIED LEXICAL ENTRIES combined with DYNAMIC COMPOSITIONAL PROCESSES.

The most direct approach to solving the selectional conflicts introduced by polymorphism and coercion can be defined as **sense-enumerative lexicons**. In such a lexicon, each lexical entry registers just one syntactic and semantic type and meaning, and different meanings (either related or not) are listed as different lexical entries. For example, the verb *paint*, as used in (17) and (19) above, would have at least two meanings and two lexical entries: the CREATION meaning, ‘create something by painting’; and the CHANGE-OF-STATE meaning, ‘cover with paint’. The argument structure of the latter can include a direct object typed as PHYSICAL\_OBJECT (e.g., *fence*, *cabinet*, *surface*, as in (19)) while the argument structure of the former could include a REPRESENTATIONAL\_ARTIFACT direct object (e.g., *portrait*, *picture*, or *mural*, as in (17a-d)). However, this solution runs into problems with sentence (17e), *He painted his way to fame and fortune*. For this context, we would have to posit another (somewhat implausible) word sense, corresponding to ‘achieve a particular goal by painting’.

Similarly, for the different senses of the adjective *easy* in (23), we would need to posit distinct lexical entries, relative to the various actions that can be performed in an ‘easy’ manner on the modified noun: ‘easy to cook’ (for *easy recipe*), ‘easy to answer’ (for *easy question* and *easy answer*), ‘easy to catch’ (for *easy prey*), etc. This is less than desirable, since it requires us to compile an exhaustive list of all the possible meanings of a given lexical item, which is not feasible given the range of contexts where a lexical item can be inserted. Furthermore, we would have to assume that speakers are able to store and process such a huge lexicon. Finally, this lexicon would be extremely rigid and unable to predict the other senses that words can assume in novel contexts, something that happens constantly and is, in fact, one of the basic properties of the lexicon.

The approach based on **adjustment mechanisms** consists of introducing general tools that operate on the lexical entries to derive the meaning required by a certain predicate or a meaning compatible with a specific syntactic configuration. The use of these sort of mechanisms allows us to avoid listing each word sense (with its respective syntactic and semantic type) in a separate lexical entry. This way we can capture the relationship between the different senses and keep the size of the lexicon as small as possible. We discuss two kinds of adjustment mechanisms here: *lexical rules* and *coercion functions*.

The notion of **lexical rule**, introduced previously in Section 3.4, allows us to capture relationships between lexical entries in the format ‘ $X \Rightarrow Y$ ’: for any input lexical entry consistent with the description ‘ $X$ ’, there exists an output lexical entry with the description ‘ $Y$ ’. For example, the morphological lexical rules presented in Section 3.4 and 10.6 described the *-er* nominalization in English.

The lexical rule in Figure 11.1 accounts for the COUNT-MASS alternation involved in several types of meronymy (we referred to these as *grinder constructions* in Section 2.3.3): TREE/WOOD (e.g., *oak tree* and *oak wood*), ANIMAL/MEAT (e.g., *lamb animal* and *lamb meat*), FRUIT/JUICE (e.g., *orange fruit* and *orange juice*). It takes as its input nouns typed as ENTITY  $\sqcap$  ATOMIC and yields homophonous nouns typed as ENTITY  $\sqcap$  HOMOGENEOUS:

$$\left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{N} \\ \text{SEM} = \left[ \text{ARG}_{ref} = \left[ \text{SEM TYPE} = \mathbf{entity} \sqcap \mathbf{atomic} \right] \right] \end{array} \right] \Rightarrow \left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{N} \\ \text{SEM} = \left[ \text{ARG}_{ref} = \left[ \text{SEM TYPE} = \mathbf{entity} \sqcap \mathbf{homogeneous} \right] \right] \end{array} \right]$$

Figure 11.1 COUNT-MASS alternation rule

Next consider how lexical rules can account for the causative-inchoative alternation (cf. Section 9.3.1), displayed by verbs such as *break* and *sink*.

- (35) a. The boy broke the watch.  
b. The watch broke.
- (36) a. The destroyer sank the boat.  
b. The boat sank.

This syntactic correspondence is handled by the lexical rule in Figure 11.2. The input is a transitive verb denoting a complex event: the first subevent is a causative process that relates both verbal arguments (*'x acts on y'*); and the second subevent is the resultant state of the argument *y*. In the causative use, the first subevent is the head of the event structure. The output of this rule is an intransitive verb whose first argument *x* is not realized, i.e., the specific causer of the event is not identified and its involvement in the event is left underspecified. Its event structure differs from the causative use in that its head is the second subevent (the resultant state) and not the initial causative process.

$$\left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{V} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \mathbf{x} \\ \text{ARG}_2 = \mathbf{y} \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} \text{E}_1 = \mathbf{process} \\ \text{E}_2 = \mathbf{state} \\ \text{E}_1 < \text{E}_2 \\ \text{HEAD} = \mathbf{e1} \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \mathbf{act(e_1, x, y)} \\ \text{FORMAL} = \mathbf{result(e_2, y)} \end{array} \right] \end{array} \right] \Rightarrow \left[ \begin{array}{l} \text{PHON} = / \phi / \\ \text{CAT} = \mathbf{V} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \mathbf{x \text{ NON-REALIZED}} \\ \text{ARG}_2 = \mathbf{y} \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} \text{E}_1 = \mathbf{process} \\ \text{E}_2 = \mathbf{state} \\ \text{E}_1 < \text{E}_2 \\ \text{HEAD} = \mathbf{e2} \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \mathbf{UNDERSPECIFIED(e_1, x, y)} \\ \text{FORMAL} = \mathbf{result(e_2, y)} \end{array} \right] \end{array} \right]$$

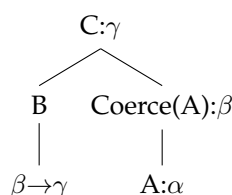
Figure 11.2 Causative-inchoative alternation rule

One of the main issues with lexical rules is that they are not fully productive and tend to overgenerate. As mentioned in Section 2.3.3, most noun types actually reject the COUNT-MASS alternation (artifacts, abstract terms, group or set terms, etc.): names of animals and edible entities are actually two of the exceptions. Further, the CAUSATIVE-INCHOATIVE alternation rule does not apply to just *any* causative verb: verbs such as *build*, *paint*, and *plant*, among many others, do not have an inchoative variant. One way of preventing lexical rules from overgenerating is to state very carefully the conditions that the input must satisfy. For example, for the COUNT-MASS alternation we can stipulate that it applies to nouns typed as  $\mathbf{ENTITY} \sqcap \mathbf{ARTIFICIAL} \sqcap \mathbf{FUNCTIONAL} \sqcap \mathbf{ATOMIC}$  (for names of animals and plants especially produced for human consumption). For the CAUSATIVE-INCHOATIVE alternation, we must state that it applies to events that can occur spontaneously or conditioned by the inherent properties of the entity undergoing the change of state (as in *sink*, *melt*, *fossilize*, *splinter*, etc.). In other words, we must specify that ARG2 is the *internal cause* of the event.

Another approach to the selectional mismatches discussed in the previous section involves a mechanism called **coercion**. This is an operation that works dynamically in the composition

of a phrase, converting an argument to the type expected by its predicate or function, where otherwise their combination would result in a type conflict. Most existing definitions of coercion rely on a *function* which serves as a buffer of sorts between the predicate demanding a specific kind of argument and the argument which does not satisfy this requirement: this intermediate function has the type required by the predicate and, in turn, it can be satisfied by the semantic type of the argument:

- (37) COERCION: In the structure  $[B A]_C$ , where  $A$  is of type  $\alpha$ , and  $B$  is a function of type  $\beta \rightarrow \gamma$ , a coercion function, *Coerce*, can apply to  $A$ , changing its type to that expected by  $B$ : i.e.,  $Coerce(A)$  is of type  $\beta$ . Now, the functional type,  $\beta \rightarrow \gamma$ , applies to  $Coerce(A)$ , to return  $\gamma$ , the type of the phrase  $C$ .

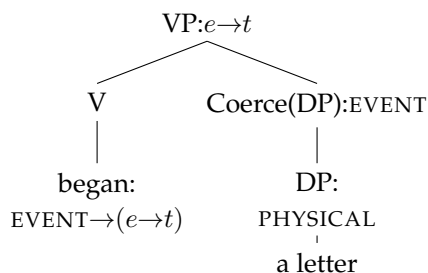


To illustrate coercion at work, recall the polymorphic behavior of verb-object selection from Section 11.3, shown in (38) and (39), with the verbs *begin* and *deny*, respectively.

- (38) a. Mary began [to write a letter to her mother]<sub>EVENT</sub>.  
 SELECTION: EVENT  
 b. Mary began [a letter to her mother]<sub>PHYSICAL</sub>.  
 COERCION: ENTITY  $\Rightarrow$  EVENT
- (39) a. The spokesperson denied [the statement]<sub>PROPOSITION</sub>.  
 SELECTION: PROPOSITION  
 b. The spokesperson denied [the attack]<sub>EVENT</sub>.  
 COERCION: EVENT  $\Rightarrow$  PROPOSITION

Notice that in both (38b) and (39b), the direct object does not denote the type expected by the verb. However, through the use of a coercion rule we can accommodate the type violation, and allow the verb's argument to satisfy the typing context. In the case of (38b), the object *a letter*, which is typed as PHYSICAL, has been coerced to the type expected by *begin*, EVENT. In (39b), on the other hand, *the attack*, an EVENT, has been coerced to a PROPOSITION, satisfying the typing requirements of *deny*. The application of coercion in sentence (38b) is illustrated below in (40).

(40)



Here we see how the verb *begin*, which is typed as a relation between events and individuals,  $\text{EVENT} \rightarrow (e \rightarrow t)$ , applies to the result of the coerced DP, which has undergone a coercion from PHYSICAL to EVENT. The result is a conventional VP type,  $e \rightarrow t$ .

There is abundant semantic evidence suggesting that the reinterpretation of the coerced argument is driven by lexically encoded information to a large extent, which means that in the coerced interpretation, we can identify bits of semantic information originally encoded in the **underspecified lexical entry** of the argument. For example, in (38b) the EVENT information associated with a *letter* comes from its AGENTIVE qualia role, i.e., *writing*. In (41), on the other hand, the most likely semantic contribution from the objects being coerced by the verbs *finish*, *enjoy*, and *begin*, comes from the TELIC value for each noun.

- (41) a. John enjoyed the movie. (TELIC = “watching”)  
 b. Mary finished the coffee before we left. (TELIC = “drinking”)  
 c. Mary began her dessert. (TELIC = “eating”)

While these coercion-based derivations help explain the interpretations of the above sentences, the use of type-changing rules during composition should be applied in a constrained fashion. Type coercion is clearly a very powerful mechanism, and if we assume that a coercion function can be freely inserted whenever the argument does not have the semantic type required by the predicate, there would be no type errors at all. However, we know that this is not the case. Consider the coercive verbs from (38) and (39) above. Not every type-violating direct object can be successfully coerced, as the sentences in (42) and (43) demonstrate.

- (42) a. Mary began [to open/ close the door]<sub>EVENT</sub>.  
 SELECTION: EVENT  
 b. \*Mary began [the door]<sub>PHYSICAL</sub>.  
 PHYSICAL  $\not\Rightarrow$  EVENT
- (43) a. The spokesperson denied [that the car was stolen]<sub>PROPOSITION</sub>.  
 SELECTION: PROPOSITION  
 b. \*The spokesperson denied [the car]<sub>PHYSICAL</sub>.  
 PHYSICAL  $\not\Rightarrow$  PROPOSITION

Neither of the coercions in (42b) nor (43b) is acceptable. Why coercion applies successfully in some cases and not in others is not always so obvious. Many coercions are systematically attributable to the lexical and compositional semantic properties of the phrases involved. Still, there are clearly pragmatic and contextual factors which can facilitate or block the acceptance of a coerced interpretation, and such constraints need to be taken into consideration when building an interpretation.

So far, we have looked at how type coercion helps explain the polymorphic behavior of verbs (with pragmatic constraints), but it also accounts for how polysemous nouns are interpreted in distinct contexts. Recall from Section 6.5.1.3 how nouns known as *complex types* (dot objects) seem to denote two or more kinds of things and can appear in distinct, and even contradictory, typing contexts. For example, a *book* can be *expensive*, *tattered*, and *small*, all properties that refer to it as a PHYSICAL OBJECT. But books can also be *boring*, *thoughtful*, or *hilarious*, properties that refer to the content or INFORMATION. Similarly, a *lecture* can be both *long* (referring to an event) and *confusing* (referring to the content). Such nouns have a complex typing structure, similar to a relation, by virtue of a type constructor, •, known as *dot*.

- (44) a. *book*: PHYSICAL • INFO  
 b. *lecture*: EVENT • INFO

For example, notice in (45b) and (46b), how the noun *book* can appear with verbs that select for very different types, PROPOSITION and PHYSICAL.

- (45) a. Mary doesn't believe [that John would write that]<sub>PROPOSITION</sub>.  
 SELECTION: PROPOSITION  
 b. Mary doesn't believe [this book]<sub>PHYSICAL•INFO</sub>.  
 COERCION: PHYSICAL•INFO  $\Rightarrow$  INFO, where INFO  $\sqsubseteq$  PROPOSITION
- (46) a. The fire burnt [the furniture]<sub>PHYSICAL</sub>.  
 SELECTION: PHYSICAL  
 b. The fire burnt [her books]<sub>PHYSICAL•INFO</sub>.  
 COERCION: PHYSICAL•INFO  $\Rightarrow$  PHYSICAL

This kind of compositional mechanism, wherein the selectional requirements are satisfied by a part of the argument's semantic typing, is called **coercion by exploitation** in the Generative Lexicon model. For a dot object nominal, such as *book* or *lecture*, for example, this allows either of the component types in a dot object,  $a \bullet b$ , (i.e.,  $a$  or  $b$ ) to satisfy a local typing environment.

The solutions to selectional mismatches we have examined thus far have been lexically-based: that is, they involve modifications to the selected types of the expressions in the composition. One approach that does not share this assumption is that based on **constructions**, discussed already in Section 3.6. On this view, *constructional meaning* emphasizes the properties associated with word combinations or constructions, as a whole, in addition to what is contributed by individual lexical items. This can be illustrated with the polymorphism associated with the verb *paint*, mentioned in (17) above. Recall that this verb can also appear with a benefactive argument, as repeated in (47) below.

- (47) Bill painted his mother a picture.

This kind of interaction in sentence (47) was discussed in Section 3.6. Here the transitive verb *paint* is integrated into a ditransitive construction (Agent CAUSES Recipient TO RECEIVE Theme) in order to yield the meaning 'Bill painted a picture with the intention of giving it to his mother'. The contribution of the construction to the interpretation of this sentence is crucial, since *paint* alone is not able to express transfer of possession. The argument structure of *paint* remains as shown schematically in (48a), but can appear with the constructional form, illustrated in (48b).

- (48) a. CREATION: [DP \_\_\_\_ DP<sub>REPRESENTATIONAL\_ARTIFACT</sub>]  
 b. CREATION-FOR: [DP \_\_\_\_ DP<sub>ANIMATE</sub> DP<sub>REPRESENTATIONAL\_ARTIFACT</sub>]

The argument structures for both *paint* and the ditransitive construction are represented in (49). As we can see, they share two arguments: the first argument of *paint*, referring to the painter, binds the agentive subject argument of the ditransitive construction, and the second argument of *paint*, referring to the painted artifact, binds the theme argument of the ditransitive construction. The third argument (the recipient, 'his mother') is not a part of the argument structure of *paint*, and it is contributed to the sentence by the ditransitive construction.



$$(49) \quad \text{a. } \left[ \begin{array}{l} \text{paint} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \boxed{1} = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{human} \end{array} \right] \\ \text{ARG}_2 = \boxed{2} = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{artifact} \end{array} \right] \end{array} \right] \end{array} \right] \quad \text{b. } \left[ \begin{array}{l} \text{ditransitive construction} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \boxed{1} = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{ROLE} = \text{Agent} \\ \text{SEM TYPE} = \text{UNDERSPEC} \end{array} \right] \\ \text{ARG}_2 = \boxed{2} = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{ROLE} = \text{Theme} \\ \text{SEM TYPE} = \text{UNDERSPEC} \end{array} \right] \\ \text{ARG}_3 = \boxed{3} = \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{ROLE} = \text{Benefactive} \\ \text{SEM TYPE} = \text{UNDERSPEC} \end{array} \right] \end{array} \right] \end{array} \right]$$

A similar analysis can be deployed to explain the sense extension available in *causative-resultative* constructions, the term given to predicative complexes consisting of an activity that results in a specific state or situation, as illustrated in (50).

- (50) a. [Lisa]<sub>Agent</sub> licked [her plate]<sub>Patient</sub> [clean]<sub>Result</sub>.  
 b. [Sue]<sub>Agent</sub> rolled [the ball]<sub>Patient</sub> [down the hill]<sub>Goal</sub>.  
 d. [Sue]<sub>Agent</sub> ran [herself]<sub>Patient</sub> to [exhaustion]<sub>Result</sub>.

This construction can be paraphrased as ‘Agent CAUSES Patient TO BECOME Result-Goal’: the Agent and Patient arguments are shared by both the argument structure of the underlying head verb as well as the construction; the Result-Goal argument, however, is contributed by the resultative construction alone. Again, it is important to emphasize that the three verbs in (50) (*lick*, *roll*, and *run*) each denotes an activity that does not entail an inherent culmination or result, therefore it can be claimed that the addition of the Result-Goal argument and of the resultant state subevent is due to the construction rather than the verb.

It should be pointed out that constructional meaning does not need to be resorted to when the meaning of a word combination can be accounted for by a lexically determined interaction of its components. Let us take another look at *paint* and other verbs (e.g., *bake*, *cook*, *sew*, etc.) that also have CREATION interpretations in addition to their CHANGE-OF-STATE meaning. Notice that the verbs in (51a-53a) each denote a CHANGE-OF-STATE, while with specific complements, a CREATION interpretation is possible, as in (51b-53b).

- (51) a. Ethan *paint*ed the {fence/ cabinet/ surface}. ‘color, cover with paint’  
 b. Ethan *paint*ed a portrait. ‘create by painting’  
 (52) a. Ethan *bake*d a potato. ‘cook in an oven’  
 b. Ethan *bake*d a cake. ‘create by baking’  
 (53) a. Ethan *sew*ed a button. ‘attach by stitches’  
 b. Ethan *sew*ed a quilt. ‘create by sewing’

These are examples of semantic polymorphism, where a predicate is assuming a related but distinct interpretation, depending on the type of its direct object. One way of dealing with this would be postulating a CREATION construction meaning: ‘Agent CAUSES Theme to EXIST by doing V’. However, this solution is problematic because, in addition to stipulating an ad hoc constructional meaning for these cases, we would have to specify which combinations of the verb with direct object are compatible with the creation construction: e.g., why *paint a portrait* can be a part of the creation construction while *paint a fence* cannot. This can be avoided if we assume that, in these cases, function application works in two directions: the function (the main predicate) applies to the argument in the usual fashion (i.e., as in any verb-direct object combination, cf. Section 11.2), and the direct object affects the meaning of the function beyond its contribution as an argument to the phrase (e.g., *portrait* turns the phrase ‘*paint* + DP’ into a creation predicate). This phenomenon is known as **co-composition** in Generative Lexicon theory,

and it can take place when one specific condition is met: within the argument's lexical entry (e.g., its qualia structure) there must be an explicit reference to the predicate or to the predicate's semantic type. To illustrate this, observe how the lexical entries of *fence* and *portrait* in (54) differ from one another (repeated from Section 3.7).

$$(54) \text{ a. } \left[ \begin{array}{l} \text{fence} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{physical}(x) \\ \text{TELIC} = \text{enclose}(x,y) \\ \text{AGENTIVE} = \text{build}(w,x) \end{array} \right] \end{array} \right] \text{ b. } \left[ \begin{array}{l} \text{portrait} \\ \text{QS} = \left[ \begin{array}{l} \text{FORMAL} = \text{physical} \bullet \text{info}(x) \\ \text{TELIC} = \text{depict}(x,y) \\ \text{AGENTIVE} = \text{paint}(w,x) \end{array} \right] \end{array} \right]$$

It now becomes clear why a CREATION meaning can emerge with *paint* from the latter noun, but not with the former: namely, *paint* is the AGENTIVE value of *portrait* but not of *fence*. According to this analysis, the CREATION sense does not exist a priori (e.g., as the meaning of a creation construction), but rather emerges 'phrasally', as a consequence of a bottom-up composition of lexical structures, as indicated in the phrasal composition in (55).

$$(55) \left[ \begin{array}{l} \text{paint a portrait} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \boxed{1} \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{human} \end{array} \right] \left[ \begin{array}{l} \text{ARG}_2 = \boxed{2} \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{physical} \bullet \text{info} \end{array} \right] \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} \text{E}_1 = \text{e}_1 : \text{process} \\ \text{E}_2 = \text{e}_2 : \text{state} \\ \text{e}_1 < \text{e}_2 \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \text{paint.act}(\text{e}_1, \boxed{1}, \boxed{2}) \\ \text{FORMAL} = \text{exist}(\text{e}_2, \boxed{2}) \end{array} \right] \end{array} \right]$$

Similar reasoning can be applied to the resultative constructions, such as those in (30) and (50). One important constraint on their acceptability that we failed to mention is that the phrase encoding the result must somehow 'cohere' with the main predicate: in *Sue froze the lemonade solid*, *solid* is compatible as a resultant state following an event of freezing; in *Lisa licked her plate clean*, *clean* is compatible as a result with the event of licking; and in *Sue rolled the ball down the hill*, *down the hill* is compatible as a locational goal argument with the event of rolling.

It can be claimed that such a co-dependence between the resultative phrase and the main predicate is at least partially encoded (or facilitated) in the lexical entry of the former. We illustrate this idea with the adjective *clean*, whose lexical semantics is shown in (56).

$$(56) \left[ \begin{array}{l} \text{clean} \\ \text{CAT} = \text{Adj} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = \boxed{1} \left[ \begin{array}{l} \text{CAT} = \text{DP} \\ \text{SEM TYPE} = \text{physical} \end{array} \right] \left[ \begin{array}{l} \text{D-ARG}_1 = \boxed{2} \left[ \text{CAT} = \text{DP} \right] \end{array} \right] \end{array} \right] \\ \text{ES} = \left[ \begin{array}{l} \text{E}_1 = \text{e}_1 : \text{state} \\ \text{D-E}_1 = \text{e}_2 : \text{process} \\ \text{e}_2 < \text{e}_1 \\ \text{Head: e}_1 \end{array} \right] \\ \text{QS} = \left[ \begin{array}{l} \text{AGENTIVE} = \text{R.act}(\text{e}_2, \boxed{2}, \boxed{1}) \\ \text{FORMAL} = \text{clean}(\text{e}_1, \boxed{1}) \end{array} \right] \end{array} \right]$$

One important property of the resultative phrases in (50), such as *clean*, *solid*, *down the hill*, is that they encode *stage-level* properties or states that emerge as a consequence of some prior action or event: this is why they were semantically typed as ARTIFICIAL in Figure 10.5. For the stage-level adjective *clean*, this event is encoded as a default subevent (D-e<sub>1</sub>) in its event structure: it is semantically incorporated but not expressed syntactically. The argument making reference to the causer of this state (D-arg<sub>1</sub>) is also default (see Section 8.2.4). The crucial piece of lexical information that makes the resultative interpretation possible is encoded in the AGENTIVE quale of the adjective: *R* is the predicate variable that subsumes any action that can yield *clean* as a resultant state. For example, *R* can also stand for *wipe*, *wash*, *scrub*, *sweep*, and so on.

Many word combinations that are usually interpreted as metaphoric extensions of more basic lexical meanings may also involve co-composition of some sort. Consider the verb-particle construction *come out* as appearing in (57), with different subject types, where each sentence is glossed with a distinct interpretation.

- (57) a. The boy *came out* of the room.  
       'The boy went from being inside the room to being outside.'  
       b. His first novel *came out* in 1978.  
       'His first novel was published in 1978.'  
       c. At last the secret *came out*.  
       'The secret became known, stopped being a secret.'  
       d. The stain *came out* in the wash.  
       'The stain was removed, stopped existing.'

What could be considered the basic spatial interpretation of *come out*, as used in (57a), takes on a more abstract meaning in (57b), with the subject *novel* ('become public'). A similar abstract sense ('become public') emerges with the subject *secret* in (57c), the difference being that a secret stops being a secret when it becomes known. Also with the subject *stain* in (57d), 'come out' means 'stop to exist', since when a stain comes out it disappears. What is somewhat surprising is that (57b) can be paraphrased with the verb *appear*, while (57d) can be paraphrased with its antonym, *disappear*, as demonstrated in (58a) and (58b), respectively.

- (58) a. His first novel *appeared* in 1978.  
       b. The stain *disappeared* in the wash.

These examples are interesting because the meaning extensions in (57) seem to exploit two aspects of the core spatial semantics of *come out*, which can be analyzed as a change-of-location event with two subevents,  $e_1$  and  $e_2$ . Both senses focus on the resulting event,  $e_2$ , but they emphasize different states, as illustrated in (59).

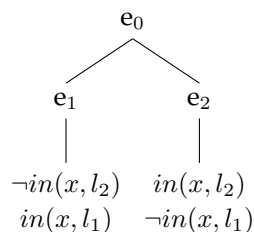
- (59) a. APPEAR: an object,  $x$ , enters a new location,  $l_2$ ;  
       b. DISAPPEAR: an object,  $x$ , leaves a previous location,  $l_1$ .

The underlying spatial semantics of *come out*, in fact, can highlight both of these senses in the same sentence, as shown in (60).

- (60) The boy came out of his room into the kitchen.

This suggests that the underlying event structure for the verbal expression, *come out*, includes the two opposition structures given in (61).

- (61)



With an understanding of the underlying spatial semantics of *come out*, let us return to the examples in (57), which can be analyzed as “subject-induced” co-compositions. Notice that the nouns that are associated with the DISAPPEAR sense are all relational nouns: something is a *stain* in something else; something is a *secret* to someone else. The lexical semantics for *stain* illustrates this dependent interpretation, as shown in (62).

$$(62) \left[ \begin{array}{l} \text{stain} \\ \text{AS} = \left[ \begin{array}{l} \text{ARG}_1 = [\boxed{1}] = [\text{SEM\_TYPE} = \text{physical}] \\ \text{D-ARG}_1 = [\boxed{2}] = [\text{SEM\_TYPE} = \text{physical}] \end{array} \right] \text{QS} = [\text{C} = \text{in}(\boxed{1}, \boxed{2})] \end{array} \right]$$

It is this relational structure, in fact, which co-composes with the verb *come out*, to highlight the DISAPPEAR sense. Other relational nouns that behave in this manner include: *wrinkle*, *dent*, *crease*. When the subject is a non-relational physical object, such as *boy*, *dog*, and so, it assumes the spatial sense in (61). When it is a non-relational artifact, such as *novel*, *movie*, *car*, and so on, it assumes the APPEAR sense.

One important property shared by all the instances of co-composition is that the basic meaning of the syntactic head (the verb in the cases examined here) is present in the meaning of the derived predicate and is, in fact, entailed by the resulting phrasal meaning: that is, the basic process meaning of *paint* is entailed in the creation meaning (‘create something by painting it’ entails ‘painting something’); and the change-of-state meaning of *come out* is present in the derived meanings ‘appearing’ and ‘disappearing’ in (57b-d).

## 11.5 Non-compositional constructions

In the previous section, we outlined several approaches to some of the challenges to maintaining compositionality in linguistic models: namely, syntactic and semantic polymorphism; coercion; constructional meaning; and metonymy and some metaphors. What we discovered is that, in many cases, a bottom-up compositional interpretation can be preserved by combining under-specified lexical entries with dynamic compositional processes. However, this approach cannot be applied in all cases of non-compositional interpretations, and in this section we briefly review two classes of word combinations that resist this kind of treatment: **metaphors** and **multiword expressions**.

Let us first consider the range of semantic creativity available to language speakers through the use of metaphor. This can be thought of as the interpretation of one concept in terms of another, with the assumption that there is some salient association between the two. A metaphor often makes use of a concept that we can easily understand (e.g., human perception or bodily experience) in order to represent a more complex or more abstract notion. In classical cognitive approaches (Lakoff and Johnson 1980), this is viewed as linking a concept from the **source domain** (physical or familiar) to a more abstract **target domain**. For example, the spatial metaphor with *over* and *under* as used in (63a) and (63b), respectively, involves the *experiential basis* ‘HAVING CONTROL IS UP, BEING DOMINATED IS DOWN’. Hence, the source domain provides experiential spatial relations, such as “an object situated over/ under another object”, and these are mapped to the target domain, which involves “social dominance and control”.

- (63) a. She has a great power over her children.  
 (= ‘She dominates her children’)  
 b. He had twenty engineers working under him.  
 (= ‘He was directing the work of twenty engineers’)

Metaphors are fairly *systematic*, in that they usually link multiple components of the source and the target domains: e.g., the ‘HAVING CONTROL IS UP, BEING DOMINATED IS DOWN’ metaphor applies to the names of social and professional roles (*somebody’s superior/subordinate*), actions related to social and professional status (*upgrade, downgrade, knock down, raise*), etc. However, metaphors are also *idiosyncratic*, since not all of the components of the source domain necessarily map to the expected target domain. Notice that, while the spatial metaphor associated with *under* applies in a “downward” direction, it fails to apply “upward”, as shown in (64).

- (64) a. \*Twenty engineers have a hard manager working over them.  
b. \*John works over twenty engineers.

Metaphors are a productive and broadly employed strategy for extending the semantics associated with lexical items (e.g., verbs) and related phrases (e.g., their arguments). For example, consider the class of metaphors known as ‘Ideas are Moving Objects’, illustrated in (65).

- (65) a. His attention drifted during the lecture.  
b. The new regulations led the economy to a full recovery.

The verb in (65a), *drift*, in its literal sense, refers to a manner of gentle motion of a physical object. When it is interpreted metaphorically, the physical is mapped into a psychological state, and the meaning of the verb is now taken as a cognitive event.

- (66) a. *drift* as MOTION: [ DP<sub>PHYSICAL</sub>\_\_\_ ] (PHYSICAL in **source** domain)  
b. *drift* as COGNITIVE: [ DP<sub>PSYCH\_STATE</sub>\_\_\_ ] (PSYCH\_STATE in **target** domain)

Similarly, in its source domain, the “caused directed motion” verb in (65b), *lead*, takes a LOCATION as its Goal argument, and a PHYSICAL as the Theme argument (*lead someone to the exit*). However, in the metaphorical reading, the physical is mapped to an abstract process, while the location is linked to a state. Even the subject in the target domain has mapped to an abstract interpretation.

- (67) a. CAUSED\_MOTION: [ DP<sub>ANIMATE</sub>\_\_\_ DP<sub>PHYSICAL</sub> PP<sub>LOCATION</sub> ]  
b. CAUSE: [ DP<sub>ABSTRACT</sub>\_\_\_ DP<sub>ABSTRACT\_PROCESS</sub> PP<sub>STATE</sub> ]

It is clear from these examples that the semantic type transformations necessary to account for metaphorical interpretations are not compositional in any conventional way. While it is possible to implicate type coercion for a single “source-target” mapping (e.g., LOCATION  $\mapsto$  STATE in (67)), it would be difficult to invoke coercion to compositionally account for the systematic shifts between all the arguments to a predicate at the same time. In such cases, it seems as though a larger conceptual unit is being exploited, such as an image schema or semantic frame. Hence, such examples continue to challenge theories of compositionality, even those with enriched semantic mechanisms.

Our second example of a construction resisting compositional analysis is a broad class of word combinations called **multiword expressions** (MWE). These include expressions that can be either syntactically and morphologically complex (i.e., can be subdivided into smaller lexical units) but whose meaning is more or less fixed and is interpreted as idiomatic rather than literal. MWE is a very broad notion, which includes a wide range of expressions that vary according to their degree of **lexical specification** and **syntactic fixedness**: phrasal verbs, light verb constructions, collocations, conversational formulae, proverbs, and even advertising slogans, as shown in Table 11.3. **Lexical specification** (which we referred to as *schematicity* in Section 3.6, following the Construction Grammar terminology) is the capability of certain word combinations to allow

variation as far as their components are concerned: e.g., *by and large* is totally fixed and *X push Y's buttons* has two open slots, for the subject *X* and the possessive *Y*. **Syntactic fixedness** has to do with whether the components of a MWE show the expected syntactic behavior given their syntactic category: *it takes one to know one*, *see you later*, and *no can do* are fixed with respect to the verbal tense (they can only appear in present simple); *have an X (bite, drink)*, by contrast, is not fixed (*have* can take on any tense, person and number, and the direct object can be quantified and modified: *have two drinks*, *have a quick drink*, etc.). Notice that, in addition to being syntactically fixed, some MWEs show a highly irregular syntactic structure, which is not found anywhere else in English: e.g., *no can do* and *by and large*.

EXAMPLE	CLASS	LEXICAL SPECIFICATION	SYNTACTIC FIXEDNESS
<i>give up</i>	phrasal verb	fixed	not fixed
<i>have an X (bite/drink)</i> <i>take an X (walk/shower)</i>	light verb construction	partially fixed	not fixed
<i>answer the X (door/phone)</i>	collocation	partially fixed	partially fixed
<i>X kick the bucket</i> <i>X push Y's buttons</i> <i>X drive Y crazy/insane/bananas</i>	idiom	partially fixed	partially fixed
<i>the X-er the Y-er</i>	schematic idiom	minimally fixed	fixed
<i>kith and kin</i>	idiom	fixed	fixed
<i>no can do, watch me!,</i> <i>see you later</i>	conversational formula	fixed	fixed
<i>it takes one to know one</i>	proverb	fixed	fixed
<i>Today Tomorrow Toyota</i>	slogan	fixed	fixed

**Table 11.3** *Types of MWEs*

When dealing with MWEs, it is important to keep things in perspective and not to forget that words are *never* combined freely and that MWEs only represent one of the extremes as far as the strength of interword connections is concerned. As we know, even in syntactically regular and fully compositional predicate-argument and head-modifier pairs, there are two kinds of selectional requirements present, categorial and semantic, which are determined by their meaning to a large extent and are usually shared by more or less numerous groups of words. If we take one step further up the scale, we will encounter word combinations that are more stable and where one of the components imposes specific *lexical* combinatorial constraints not necessarily shared by semantically similar words. Consider Table 11.4 below, to illustrate the kinds of cooccurrence relations involved in MWEs.

ENGLISH	SPANISH	RUSSIAN
<b>Enemy:</b> <i>sworn, mortal</i>	<b>Enemigo:</b> <i>acérrimo</i> ‘rough, harsh’, <i>mortal</i> ‘mortal’, <i>enemigos irreconcilables</i> ‘irreconcilable enemies’	<b>Vrag:</b> <i>zakljatyj</i> ‘sworn’, <i>smertel’nyj</i> ‘mortal’, <i>krovnnyj</i> ‘blood’, <i>ljutyj</i> ‘fierce’, <i>neprimirimye vragi</i> ‘irreconcilable enemies’
<b>Victory:</b> <i>resounding, overwhelming, sweeping</i>	<b>Victoria:</b> <i>aplastante</i> ‘crushing’, <i>contundente</i> ‘blunt, heavy’, <i>abrumadora</i> ‘overwhelming’	<b>Pobeda:</b> <i>bezogovoročnaja</i> ‘unconditional’, <i>uverennaja</i> ‘firm, positive’, <i>blestjaščaja</i> ‘brilliant’, <i>sokrušitel’naja</i> ‘crushing’, <i>slavnaja</i> ‘glorious’
<b>Rain:</b> <i>cats and dogs, heavily, hard</i>	<b>Llover:</b> <i>a cántaros</i> ‘lit.: by jugs’, <i>torrencialmente</i> ‘torrentially’	<b>liť</b> <i>kak iz vedra</i> ‘lit.: pour like from a bucket’
<b>Deaf</b> <i>as a doornail</i>	<b>Sordo</b> <i>como una tapia</i> ‘deaf as a fence’	<b>gluxoj</b> <i>kak pen’</i> ‘deaf as a stump’

Table 11.4 Collocation examples in English, Spanish, and Russian

This table contains examples of **collocations** in English, Spanish, and Russian, where the nouns *enemy* and *victory*, the verb *rain*, and the adjective *deaf* are combined with modifiers functioning as intensifying adverbials, called **maximal degree of intensity** modifiers by Mel’čuk (1996). For each language, the **base** words are in bold, i.e., for English they are: *enemy*, *victory*, *rain*, and *deaf*. These words select for very specific **collocates** as their intensity quantifiers. Note that, in these combinations, most collocates lose their original literal meaning and come to denote a much more general and abstract notion of ‘large quantity/intensity’: a *sworn enemy* is ‘the biggest enemy’, *rain cats and dogs* is ‘rain heavily/intensely’, and someone is *deaf as a doornail* when she or he is ‘completely unable to hear’. Also, as these examples show, there is a significant amount of typological variation between languages, as far as the choice of collocates is concerned: the same idea of greatness or magnitude is often expressed differently in the three languages.

The study of the MWEs has been at the heart of the research agenda of several major theoretical frameworks. As explained in Section 3.6, in Construction Grammar the MWEs are regarded as constructions, i.e., form-meaning pairings whose properties are not strictly predictable from the properties of their component parts. MWEs as we defined them above would differ from morphemes and morphologically simple words in being complex (i.e., non-atomic) and from syntactic constructions in being, as a rule, more lexically specific and more syntactically constrained.

Thus, the idiomatic *drive*-construction is an instance of the causative-resultative construction [DP Agent [VP CAUSE [DP Patient] TO BECOME [Adj/N Result-Goal]]] where the CAUSE predicate is bound by *drive*, the Result-Goal argument belongs to a small set of adjectives and nouns (*crazy, mad, insane, bonkers, bananas, nuts*), and where the interpretation (‘Agent CAUSE Patient to undergo an emotional change’) is constrained to a specific kind of change of state. In simplified terms, we can say that the *drive*-construction is encoded as a regular [DP [VP DP Adj/N]] structure in the syntax: we can derive a passive (*I was driven crazy by their way of addressing me*), the Adj/N argument can be quantified (*She drove me totally insane*), the verb can have any tense, number and person ending, etc. This syntactic structure is associated with a semantic interpretation which is partially compositional and partially idiomatic: *drive* gets the idiosyncractic meaning ‘cause to undergo an emotional change’ (rather than its usual sense ‘cause something to move’ or ‘determine the course of an event’), but the three arguments are assigned the semantic roles of Agent, Patient, and Result in the usual manner. In *kick the bucket* and other idioms, however, establishing a connection between the syntactic and semantic structure is much more difficult, because not every syntactic constituent corresponds to a distinct semantic constituent:





scratched the surface, and there are many issues which we have only dealt with in passing, that are currently at the forefront in research on lexicon and its interaction with other components of grammar. We will briefly lay out some of these questions in this section, focusing first on the continuing challenges in formalizing the relationship between the lexicon and syntax. We then briefly examine the interaction between pragmatics and the lexicon.

As far as the **syntax-lexicon interface** is concerned, the following issues are still actively being researched, with individual frameworks proposing different but not always incompatible solutions (as highlighted already in Chapters 2, 3, 6, 7, and 11).

1. *How much do lexical features drive the derivation of syntactic form?* There is currently a broad consensus between proponents of both syntactically and semantically oriented frameworks about certain lexical features driving the derivation of syntactic forms. As discussed in Chapters 2, 3, and 9, these features include the syntactic category and semantic type, animacy, and countability and related aspectual features. Ongoing and future research in syntax and lexicon will, without a doubt, contribute to completing this list and determining how fine-grained and complex lexical-semantic types must be in order to account for the syntactic behavior of words.
2. *What lexical features are relevant to syntax?* A major issue related to this question is whether such features must be considered as syntactic or constructional (as in Generative Grammar and some versions of Construction Grammar), or rather genuinely lexical and encoded as a part of lexical entries (as in the Generative Lexicon, HPSG, and Conceptual Semantics). The former approach presupposes that all the productive and regular parts of lexical meaning must be integrated into the syntax, and that the lexicon only accommodates idiosyncratic and syntactically inert features. We adopted the latter view and argued for a highly organized lexicon, made up by both specifically linguistic and general conceptual structures. Linguistic structures significantly affect other components of grammar (most importantly, syntax and morphology) while the conceptual structures may not have the same kind of impact, but they do influence the interpretation and allow us to differentiate between lexical items that show the same syntactic behavior (we return to this point below in connection to the lexicon-pragmatics interface). Psycholinguistic research has a lot to say about how lexical features are neurally and cognitively encoded and processed, as well as about the empirical grounds for separating the lexicon from syntax and other modules of grammar.
3. *How much of the meaning of a phrase is lexically determined?* From the overview offered in Chapter 11, it can be deduced that a significant part of the meaning encoded at phrasal and sentential level is lexically determined, and can therefore be built bottom-up, making use of the general compositional mechanisms and without postulating meaning components contributed by the syntactic structure as a whole rather than its components. However, we did not deny that at least in some cases resorting to constructional meaning can be unavoidable, the main issues being how the interpretation is shared between syntax and lexicon, which semantic components are contributed by each of them, and how the meaning of individual lexical items can be influenced by the meaning of the construction, of which they are a part.

The **relationship between lexicon and pragmatics** is an issue that we have not discussed at any length in this book, despite its importance in the field. Pragmatic information embraces a wide range of meanings relative to the circumstances of the speech act and its participants (speaker and hearer), as well as the world knowledge they make use of while communicating. As argued in Section 6.2, we believe lexical and real-world knowledge to be fundamentally distinct, on the grounds that the former is constrained to those aspects that affect linguistically

relevant generalizations, while the latter is open-ended and not necessarily associated with the morphosyntactic consequences of language use.

In general terms, it can be said that pragmatics and discourse knowledge are responsible for computing anything associated with the utterance that has not been computed compositionally, based on the selectional requirements and type-driven interpretation of the sentence components and their lexical content. Lexical items quite often leave meaning elements underspecified, and pragmatic knowledge acts to further specify and disambiguate these elements within the overall semantic interpretation, including (among other effects) assigning them specific rhetorical roles within the discourse structure, and presuppositional force within the assumed common knowledge. This implies that the information flow between lexicon and pragmatics is a two-way process.

On the *words-to-pragmatics* side, lexical entries determine, for instance, what kind of rhetorical relationships can hold between the parts of discourse that they represent. Consider the example narrative in (71).

- (71) a. Mark cleaned the basement.  
       b. He dusted the shelves and scrubbed the floor for hours.  
       c. It looks spotless now.

A competent English speaker understands immediately that the events described in (71b) are *elaborations* of the event description in (71a), while the event in (71c) describes a *consequence* of this same event. That is, (71b) goes into an description of the details of what was involved in the cleaning, while (71c) describes the resulting consequent state of the event in (71a).

How might both inferences be drawn? It can be argued that they are driven, in part, by lexical-semantic information associated with the verb and other components of the predicates. (71b) can be interpreted as an *elaboration* (i.e., a more detailed description) of (71a) because the direct objects *shelves* and *floor* are meronyms of *basement*, and *dust* and *scrub* are two manner verbs conventionally associated with the result ‘clean’: if ‘x {*dusts/scrubs*} y’, then, typically, ‘y BECOMES clean’. (71c) can be interpreted as a *consequence* of (71a) because the result of the *clean* event (‘x *cleans* y’) is ‘y is clean’, which is compatible with the stative description ‘y looks *spotless*’.

On the *pragmatics-to-words* side, lexical information can be further specified, disambiguated, or even altered in order to warrant discourse coherence. Let us look at several examples of how lexically encoded scalar properties can be altered in context. As discussed previously in Sections 9.3.1 and 10.5, the adjectives *flat* and *straight* encode UPPER-CLOSED SCALES: that is, we say that something is *flat* or *straight* when it is completely flat or straight. Notice, however, in (72), that this maximality requirement cannot be maintained.

- (72) a. Belarus is *flat*.  
       b. The road is *straight*.  
       c. Don’t worry, these injections *don’t hurt*.

In (72a), ‘Belarus is a flat country’ means ‘there are no mountains’ rather than ‘it is completely flat’, while in (72b), a ‘straight road’ can be ‘almost straight’ in absolute terms. Similarly, the predicate *hurt* in (72c) must be interpreted in context, as ‘hurt just a little’.

As noted in Sections 6.3.4 and 6.5.1.3, the combination of aspectual verbs with nominals denoting artifacts often gives rise to ambiguous expressions, where the event required by the aspectual verb can be linked to the AGENTIVE or the TELIC value of the artifactual nominal: in (73), *finished the cake* can mean ‘finished making the cake’ or ‘finished eating the cake’. However,

if we know from previous discourse who exactly John is, we can easily disambiguate this sentence: if he is a pastry chef, the former interpretation is more likely, and if he is a customer in a cafe, the latter will be preferred.

(73) John finished the cake.

We can say that the AGENTIVE and the TELIC interpretations for *finish the cake* are lexically predetermined and are resorted to by default. However, they are *defeasible*, and can be easily overridden if they are incompatible with larger discourse. Consider the following fragment: *finish the cake* in this context can only mean ‘finished painting the cake’.

(74) John is painting a picture of his niece in front of her birthday cake. He just *finished the cake* and now is painting the girl’s face.

Even in more stable word combinations, lexical meaning is defeasible. For example, the compound *garbage truck* is identified with the meaning ‘truck used to take away garbage’ in conventional usage, where the link between *garbage* and *truck* is of a fairly complex functional nature. However, in the context of (75), *garbage* is the material which the truck is made from, and *garbage truck* means ‘truck made from garbage’:

(75) Mary won the recycling contest with her toy made from reclaimed wood and soda cans: both children and adults loved her *garbage truck*.

What these examples show is that specific internal aspects of lexical meaning can be accessed by pragmatics and discourse. This also means, for the purposes of the lexicon-pragmatics interface, that lexical meaning is complex and decomposable, rather than merely atomic.

One remaining issue pertaining to the interaction of lexicon and pragmatics concerns their respective areas of application: where does the domain of lexical semantics end and the domain of world knowledge begin? We showed that some of the information traditionally considered as encyclopedic is linguistically relevant and must therefore be integrated into lexical entries (e.g., the *qualia*). Similar considerations apply to the compositional mechanisms in the grammar, in particular, *coercion* and *constructions*: pragmatists often claim that these processes are licensed by general pragmatic principles and that the appropriate discourse context can ‘repair’ any selectional conflict. We hope to have shown in this section that, while this is true in some contexts, contextual interpretation is also sensitive to the actual lexical items.

These and other issues are at the center of the agenda of **lexical pragmatics**, a relatively new field that explores the semantics-pragmatics interplay at the level of individual words, i.e., how lexically specified word meanings are modified in use and how they affect pragmatically encoded inferences.

## 11.7 Summary

In this chapter, we examined the basic principles and mechanisms underlying the combination of individual lexical items into larger linguistic expressions.

- We first explained how syntactic rules and the semantic mechanism of *function application* interact in order to yield compositionally derived word combinations. For that, we used a simplified Montagovian type semantics and *λ-expressions* combined with conventional syntactic tree structures.

- Next, we discussed linguistic phenomena that apparently resist a compositional treatment, including *semantic and syntactic polymorphism*, *coercion*, *constructional meaning*, and *metonymy* and *metaphor*. We made use of the syntactic and semantic type systems introduced in Chapter 10 in order to formalize these instances of compositionality violation.
- Four main approaches to non-compositional expressions were presented: *sense-enumerative lexicons*, *adjustment mechanisms* (*lexical rules* and *coercion functions*), *constructions*, and *under-specified lexical entries combined with dynamic compositional processes*. We reviewed the advantages and drawbacks of each approach, and concluded that many apparent instances of non-compositionality can be accounted for by a lexically determined interaction of the combined words, thus allowing us to preserve a bottom-up compositional interpretation.
- We also acknowledged that for some expressions –including *metaphors* and *multiword expressions*– no straightforward compositional treatment can be reasonably posited at this point. In particular, some metaphoric expressions seem to involve larger conceptual representations, possibly accountable for by image schemas, semantic frames, and other conceptual structures, which are more general cognitive representations rather than strictly linguistic. Multiword expressions, on the other hand, usually present a higher degree of lexical specification and syntactic fixedness than fully compositional word combinations. They can be analyzed as involving specific *lexical* combinatorial constraints (not necessarily shared by semantically similar words), which can be formalized through *lexical functions*, *constructions*, and other theoretical devices suited to account for non-systematic selectional constraints and idiosyncratic word cooccurrence.
- This chapter concludes with a brief overview of some of the issues pertaining to how individual lexical items are integrated into the larger system of grammar, in particular with respect to syntax and pragmatics. How most of these issues are settled ultimately hinges on how the respective domains of lexicon, syntax, and pragmatics are demarcated, and what status is attributed to the features and structures encoded by words.

## 11.8 Further readings

Topic	Primary references
Compositionality	Partee (2008), Recanati (2004), Fodor (2003)
Type coercion	Pustejovsky (1995) (ch.4,7), Pustejovsky (2011), Egg (2005), Partee (2007), Cohen (1986), Moens and Steedman (1987), De Swart (1998), Bott (2010), Pustejovsky and Jezek (2008)
Metaphor, metonymy	Lakoff and Johnson (1980), Croft and Cruse (2004) (ch. 8)
Constructional meaning and co-composition	Goldberg (1995), Goldberg (2006), Pustejovsky (1995) (ch.7,10)
Multiword expressions	Fillmore <i>et al.</i> (1988), Nunberg <i>et al.</i> (1994), Jackendoff (1997), Croft and Cruse (2004) (ch. 9), Bosque (2004), Sinclair (1991), Mel'čuk (2006), Mel'čuk (1998), Mel'čuk (1996)
Lexicon and pragmatics	Asher and Lascarides (1995), Lascarides and Copestake (1998), Asher (2011), Blutner (1998), Wilson and Carston (2007), Carston (2010)

Topic	Secondary references
Compositionality	Werning <i>et al.</i> (2012), Jacobson (2014)
Type coercion	De Swart (2011)
Constructional meaning and co-composition	Hoffmann and Trousdale (2013) (Part I-III), Pustejovsky (2012a)
Metaphor, metonymy	Cruse (2000) (ch.11), Saeed (2003) (sec. 11.2,11.3), Aitchison (2012) (ch.13)
Multiword expressions	Wulff (2013), Ježek (2016) (ch.6)
Lexicon and pragmatics	Murphy (2010) (sec. 2.2), Löbner (2013) (sec. 9.6)

## 11.9 Exercises

- The verbs in the following sentences all have a basic spatial meaning and they all display semantic polymorphism. Define the specific verb meaning for each use and determine what semantic type of arguments it is associated with. Also, indicate if there are any significant aspectual differences between these uses.
  - The girl turned to us with a smile.
  - The speaker turned to the origin of human language.
  - The cat approached the food bowl cautiously.
  - Every author approaches this subject differently.
  - The temperature is approaching 40° C today.
  - The tourists reached the river by dawn.
  - Billy is short: his head only reaches his mother's shoulder.
  - They finally reached an agreement on their divorce.
- The following sentences contain instances of *complement coercion*. Formalize the coercion oper-

ation following the representation scheme from Section 11.3: i.e., ORIGINAL SEMANTIC TYPE  $\Rightarrow$  REQUIRED SEMANTIC TYPE. Can you tell when the lexical information associated with the original semantic type of the argument determines the interpretation of the coerced semantic type?

- a. We will have to *postpone our coffee*.
  - b. The singer *arrived at the party* an hour late.
  - c. You'll end up *regretting this tattoo*.
  - d. The witnesses *heard the explosion* at noon.
  - e. I *prefer green tea* over all others.
  - f. Let's question the father *before the son*.
3. In the following sentence pairs, the combination of the verb with its direct object in the second sentence of each pair results in a new meaning for the whole predicate (we analyzed these cases as involving *constructional meaning* or *co-composition* in Section 11.4). Define the basic meaning of the verb and the meaning it acquires in combination with the relevant argument, and try to explain how the latter can be derived.
- |   |  |
|---|--|
| a1. John fried an egg.                    | c2. Mary touched the wall to check if the paint was still wet. |
| a2. John fried an omelet.                 | d1. Sam waltzed around the room.                               |
| b1. Mary killed the fish.                 | d2. Sam waltzed into the room.                                 |
| b2. Mary killed the conversation.         |  |
| c1. My bed touches two walls of the room. |  |
4. Using the **Lexical Function** notation from Meaning-Text Theory, provide collocates with the required meaning for the following base words. Compare the English expressions with equivalent collocations in other languages. *B* stands for 'base word':
- |   |   |
|---|---|
| a. 'Real, genuine, as it should be' B: <i>friend, love</i>    | c. 'Feel' B: <i>fear, hope, admiration</i>        |
| b. 'Excessively intense' B: <i>love, reaction, enthusiasm</i> | d. 'Initiate' B: <i>violence, war, discussion</i> |
|   | e. 'Terminate' B: <i>guilt, rumor, riot</i>       |
5. Provide contexts that override any lexically predetermined interpretations of the complement coercion examples in exercise 2. For example: the default interpretation of *I prefer green tea over all others* is 'I prefer to drink green tea' (the telic value of *tea* is exploited). However, in the following context the most likely interpretation is 'prefers to use green tea as an ingredient': *Sam is a pastry chef. Like many of his colleagues, he uses herbal infusions to make his pastries and cupcakes more refined. He prefers green tea over all others.*

# Appendix A Answers to Selected Exercises

---

## A.1 Chapter 1

### Exercise 2

- a. Three orthographic words: *I, won't, come*; four grammatical words, corresponding to *I, /wəʊ/ (=will), /nt/ (=not)*; two phonological words, corresponding to <*I won't*> and <*come*>.
- b. One orthographic word; two grammatical words (*unbelievable* and *friggin*); three phonological words, corresponding to *un-, -frigging-, and -believable*.
- c. Two orthographic words; one grammatical word (the compound only gets one inflection in context, on the second noun: *two washing machines*); one phonological word (there is only one main stress, on *washing*, *machine* only carries secondary stress).
- d. Two orthographic words; one phonological word (with main stress on *ex*); two grammatical words (*ex* can be used as a free morpheme meaning 'ex-wife' or 'ex-husband', as here, or as a bound morpheme, as in *ex-president*).

## A.2 Chapter 2

### Exercise 1

- a. 'a letter in ten minutes' is not a constituent (there are two separate constituents: 'a letter' and 'in ten minutes'): She wrote this (*this*='a letter', ≠'a letter in ten minutes'); What did she write? - \*A letter in ten minutes; \*A letter in ten minutes is what she wrote.
- b. 'Mary a letter' is not a constituent (there are two separate constituents: 'Mary' and 'a letter'): She promised this (*this*='a letter', ≠'Mary a letter'); What did she promise? - \*Mary a letter; \*Mary a letter is what she promised.
- c. 'a letter to Mary' is a constituent: She wrote this (*this*='a letter to Mary'); What did she write? - A letter to Mary; A letter to Mary is what she wrote.
- d. 'a book of proverbs' is a constituent: She promised this (*this*='a book of proverbs'); What did she promise? - A book of proverbs; A book of proverbs is what she promised.

### Exercise 3

- *freddled*: this is probably a past participle (*-ed* ending) preceding a noun within the vocative 'Oh freddled gruntbuggly'
- *micturations*: N: after determiner *thy* (archaic equivalent of *your*), *-tion* nominal ending, plural ending *-s*
- *lurgid*: Adj: after determiner *a*, before the noun *bee*
- *foonting*: present participle: after determiner *my*, ends in *-ing*
- *hooptiously*: deadjectival Adv: adjectival ending *-iously* and adverbial ending *-ly*
- *drangle*: V: assigns accusative case to the following pronoun (*me*)

- *blurplecruncheon*: N: after determiner *my*

**Exercise 4**

## 1. Lexical categories:

- N: morning, tears, face, thing
- Adj: early, still, primal, extraordinary
- V: looking [look], running [run], writing [write]
- Adv: outside

## 2. Functional categories:

- Prep: in, about, at
- Pron: this, something, what, I, it
- Det: the, my, this
- Conj: and, as
- Quantifiers/intensifiers: very, so, just
- Auxiliary verbs: was/were [be]
- Closed-class adverbs: there, down

**Exercise 5**

## a. We have enough {soup/ volunteers}.

The quantifier *enough* precedes singular mass Ns and plural count Ns.

## b. Get me some {soup/ chairs}.

The stressed form of the quantifier *some* is compatible with plural count Ns; the unstressed form is compatible with singular mass Ns.

## c. I did not get any {soup/ chairs}.

The stressed form of the quantifier *any* is compatible with plural count Ns; the unstressed form is compatible with singular mass Ns.

## d. A great {amount of soup/ quantity of money /number of tents} was provided.

Measure phrases *amount of* and *quantity of* precede mass Ns; *number of* precede count Ns.

**Exercise 6**

- leaves: [-b, +i]: numerous leaves, large leaves (=‘each leaf is big in size’)
- foliage: [-b, -i]: \*large foliage, \*the foliage were abundant, \*many foliages, \*a piece of foliage
- sect: [+b, +i]: many sects, large sect (=‘numerous sect’), member of the sect
- grass: [-b, +i]: \*many grasses, a little grass, \*large grass. The fact that it has a dedicated unitizer singling out an individual part (*blade of grass*) might indicate that it is [+i].
- poultry: [-b, -i]: \*many poultries, large poultry (=‘each bird is big in size’), \*a piece of poultry
- fowl: ambiguous between [+b, -i] (a few fowls) and [-b, -i] (too much fowl, fowl is good for you)
- flock: [+b, +i]: many flocks, large flock (=‘numerous flock’), the flock were feeble, member of the flock
- underwear: [-b, +i]: \*many underwears, large underwear (=‘each garment is big in size’), {a piece/ a pair} of underwear
- barley: [-b, +i]: \*many barleys, a grain of barley

**Exercise 7**

- a. leaves-foliage: *foliage* refers to a spatially contiguous mass of leaves attached to the tree; *leaves* does not have any of these specifications.



- b. dishes-crockery: *dishes* can refer to a plurality of same-kind objects (when interpreted as a strict plural of *dish*) or, as in 'to do the dishes', to "a heterogeneous collection of objects which are gathered together in one place after a meal and which have to be washed". *Crockery* refers to a taxonomically heterogeneous plurality, too (jars, pots, dishes, etc.), and emphasizes function (objects meant for cooking and eating), and the material from which the individual objects are made (typically, baked clay).
- c. letters-mail: *mail* is not limited to *letters*, it refers to all the material involved in the same event: it is sent or carried in the postal system (i.e., contiguity in time, space, and the same function).

## A.3 Chapter 3

### Exercise 1

- a. The relation between the verb and the adverbs:  
*She works {well/fast}.*: syntagmatic
- b. The relation between *a* and *the*:  
*I passed {a/the} student.*: paradigmatic
- c. The relation between the noun and the determiner:  
*I got myself a jacket.*: syntagmatic
- d. The relation between color-denoting adjectives:  
*Black, yellow, blue, red, green:* paradigmatic

### Exercise 2

- 2.1. Minimalism (neoconstructionist approach). See Borer (2005a).
- 2.2. Generative grammar (Principles and Parameters Theory, Government and Binding model).
- 2.3. Nanosyntax and Distributed Morphology. See Starke (2010), Starke (2011), Starke (2014).
- 2.4. HPSG.
- 2.5. Construction Grammar. European Structuralism makes a similar assumption regarding the nature of the linguistic sign as a form-meaning pairing, but syntactic structures are not treated as signs.
- 2.6. European Structuralism (Trier, Coseriu, Weisgerber, etc.).
- 2.7. Generative Lexicon.
- 2.8. Lexical-Functional Grammar.

## A.4 Chapter 4

### Exercise 2

- a. Referential: I know exactly what cake I am talking about.
- b. Non-referential: I am not referring to a particular object, the nominal has as its extension all the entities in the real world that we can call *chocolate cake*.
- c. Non-referential: I do not have any particular cake in mind.
- d. Referential: I am talking about a concrete object.
- e. Non-referential: I am not comparing what you made to a concrete cake but evaluate it with respect to what I believe a cake must look like.

### Exercise 3

- a. *Horse* has the smallest intension and the largest extension. *Stallion* and *foal* have as their intension all the features of *horse* plus the features 'used for breeding' and 'young', respectively. Their intension is larger than that of *horse* and their extension is smaller.
- b. *Book* has the smallest intension and the largest extension. *Novel* and *dictionary* have as their intensions all the features of *book* plus the features 'contains fictitious prose narrative' for *novel*, and 'contains a list of words of a language, usually in alphabetical order' and 'serves as a reference' for *dictionary*. Their intensions are larger than that of *book* and their extensions are smaller.
- c. *Move* has the smallest intension and the largest extension, and *saunter* has the largest intension and the smallest extension. *Walk* has as its intension all the features of *move* plus the feature 'on foot', and *saunter* has as its intension all the features of *walk* plus 'in a relaxed or leisurely manner'.

**Exercise 4**

- a. presupposition (presupposition trigger *re-*, which implies iteration)
- b. presupposition (the DP *Juan's Picasso* is the presupposition trigger, the use of a definite DP presupposes that the referred to entity actually exists)
- c. entailment (*x set y on fire*) lexically entails *y burns*
- d. presupposition (presupposition trigger *realize*)
- e. entailment (*move* is lexically entailed by *swim*)
- f. entailment (*be meant to be read* is lexically entailed by *to be a book*)
- g. presupposition (*to be surprised that* is a factive predicate, it presupposes that its complement clause is true)

**Exercise 5**

- mutt (neg.): dog (neutr.)
- cop (neg., colloquial): police officer (neutr.)
- slum (neg.): underprivileged neighborhood (neutr.)
- to pass away (formal): die (neutr.), kick the bucket (colloquial)
- to fire (someone) (neg.): lay off (neutr.), terminate (neutr.)
- lackadaisical (neg.): relaxed (neutr.), laid-back (positive)
- crippled (neg.): disabled (neutr.), (person with) special needs (neutr.)
- youthful (pos.): childlike (neutr.), young (neutr.), childish (neg.)
- vocal (neg.): outspoken (neutr.), forthright (pos.), free speaking (pos.), frank (pos.)

**A.5 Chapter 5****Exercise 1**

- a.  $\forall x \forall y [\text{nephew}(x, y) \leftrightarrow \text{uncle}(y, x)]$
- b.  $\forall x \forall y [\text{remember}(x, y) \rightarrow \text{be-true}(y)]$
- c.  $\forall x \forall y [\text{be-inside}(x, y) \leftrightarrow \neg \text{be-outside}(x, y)]$
- d.  $\forall x [\text{dead}(x) \leftrightarrow \neg \text{alive}(x)]$
- e.  $\forall x [\text{huge}(x) \leftrightarrow \text{enormous}(x)]$

**Exercise 2**

- a. John is in love.  
[State BE<sub>Ident</sub> ([Obj John], [Place AT ([Prop in love]])])]
- b. The snow covers the valley.  
[State BE<sub>Loc</sub> ([Obj snow], [Place ON ([Obj valley]])])]

- c. The hotel faces the sea.

[State ORIENT<sub>Loc</sub> ([Obj hotel], [Path TO ([Obj sea])])]

- d. The cake fell onto the floor.

[Event GO<sub>Loc</sub> ([Obj cake], [Path TO ([Place ON ([Obj floor])])])]

- e. John buttered the toast.

[Event CAUSE ([Obj John], [Event INCH ([State BE<sub>Loc</sub> ([Obj butter], [Place ON ([Obj toast])])])])]

- f. The scandal forced John into retirement. [Event CAUSE ([Obj scandal], [Event GO<sub>Ident</sub> ([Obj John], [Path TO ([Place AT ([Prop retirement])])])])]

### Exercise 3

- a1. John became a celebrity.

[Event INCH ([State BE<sub>Ident</sub> ([Obj John] [Place AT ([Prop celebrity])])])]

- a2. Mike made John a celebrity.

[Event CAUSE ([Obj Mike], [Obj John], [Event INCH ([State BE<sub>Ident</sub> ([Obj John] [Place AT ([Prop celebrity])])])])]

- a3. John remained a celebrity.

[Event STAY<sub>Ident</sub> ([Obj John], [Place AT ([Prop celebrity])])]

- b1. The flower is yellow.

[State BE<sub>Ident</sub> ([Obj flower], [Place AT ([Prop yellow])])]

- b2. The flower yellowed.

[Event INCH ([State BE<sub>Ident</sub> ([Obj flower], [Place AT ([Prop yellow])])])]

- b3. The craftsman yellowed the glass.

[Event CAUSE ([Obj craftsman], [Obj glass], [Event INCH ([State BE<sub>Ident</sub> ([Obj glass] [Place AT ([Prop yellow])])])])]

- c1. Mary has a doll.

[State BE<sub>Poss</sub> ([Obj doll], [Place AT ([Obj Mary])])]

- c2. Mary received a doll.

[Event INCH ([State BE<sub>Poss</sub> ([Obj doll], [Place AT ([Obj Mary])])])]

- c3. Mary kept the doll.

[Event CAUSE ([Obj Mary], [Obj doll], [Event STAY<sub>Poss</sub> ([Obj doll], [Place AT ([Obj Mary])])])]

### Exercise 4

- a1-a3 The same event is described in each of the three sentences, but there is a contrast in the trajector-landmark alignment: in (a1) *John* is the trajector and *Mary* the landmark; in (a2) *Mary* is the trajector and *John* the landmark; in (a3) the trajector is *Mary and John* and it is the only focal participant (i.e., there is no landmark)
- b1-b2 Contrast in the vantage point of the speaker: in (b1) his location is internal with respect to the described situation (e.g., it is drizzling where his home is located); and in (b2) it is external (the speaker can be located anywhere).
- c1-c2 Contrast in the trajector-landmark alignment: in (c1) the trajector is *the professor* and the landmark is *the students*; and in (c2) the trajector is *the students* and the landmark is *the professor*.
- d1-d2 Contrast in profiling within the same conceptual base, which includes grandparents, parents and children.

### Exercise 7

- a. *X is Y's mother.*

a. before Y was a person Y was inside X and was like a part of X

b. because of this one would think that X would think this:

'I want to do good things for Y

- I don't want bad things to happen to Y'
- b. *X is unhappy*  
 X feels something  
 sometimes a person thinks something like this:  
 something bad happened to me  
 I don't want this  
 if I could, I would want to do something because of this  
 because of this, this person feels something bad  
 X feels something like this
- c. *I order you to do this*  
 I say this now: "I want you to do this (A)"  
 I know that because I say this, after this, you can't not do it  
 you know the same

## A.6 Chapter 6

### Exercise 1

- Definition by genus proximum et differentia specifica.
- Definition by synonym.
- Definition by antonym and negation.
- Definition by context.

### Exercise 2

- 'The dog is ready to start walking' / 'The dog is ready to be walked'. Semantic ambiguity: *the dog* is the Agent in the first interpretation and the Theme in the second.
- 'We fed food to her dog' / 'We fed dog food to her'. Syntactic ambiguity: [We [fed [her dog] [food]]] ('her dog' is the indirect object of *fed* and 'food' is the direct object) / [We [fed [her] [dog food]]] ('her' is the indirect object and 'dog food' is the direct object).
- 'Milk drinkers are transforming into powder' / 'Milk drinkers are drinking more powdered milk'. Two instances of lexical ambiguity: *turn* means 'transform into' and 'change one's habit', while *powder* means 'fine dry substance' and 'powdered milk', in the first and second cases, respectively.
- 'The picture that Anna took is very nice' / 'The picture with Anna's image is very nice' / 'The picture that Anna owns is very nice'. Semantic ambiguity: Anna can be the Agent who created the picture, the figure represented in the image, or the person in possession of the picture.
- 'I told him at 5:00 pm to pick me up' / 'I told him that he had to pick me up at 5:00 pm.' Syntactic ambiguity: [I told him [to pick me up] [at 5:00 pm]] ('5:00 pm' modifies 'I told him') / [I told him [[to pick me up] [at 5:00 pm]]]. ('5:00 pm' modifies 'to pick me up').
- 'The bus passenger was wearing a safety belt' / 'The bus passenger was beaten by someone'. Lexical ambiguity: *to belt* means 'put a belt on' in the first reading and 'to hit' in the second reading.

### Exercise 3

- Different senses (all the tests come out positive for distinctness). Although these two senses are not very close, they are related: both denote goal-oriented dynamic and durative events that involve (or may involve) competition. The sense 'run in a race' links both these meanings.

- b. Different senses according to all the tests. The word is homonymous, because both senses are not related (and, as a matter of fact, they have different etymology: sense 1 stems from the French *meche*, and sense 2 from the Old English *gemæcca*).
- c. Different senses of a polysemous word. Both senses are clearly related although sense 1 ('angry') denotes a transient state and sense 2 denotes a more prolonged (or even permanent) state.
- d. Different senses belonging to two different syntactic categories: sense 1 is nominal and sense 2 is verbal. Both senses are related: sense 1 usually encodes the spatial goal (e.g., of mail delivery or a trip), and sense 2 encodes the event of directing one's attention or effort toward a particular issue. This is a case of t-polysemy.
- e. The two meanings are distinct and the word is homonymous because they are not related (in spite of having the same origin: the Latin *cāsus*).

#### Exercise 4

- a. Regular, inherent polysemy. The semantic relation between both senses is 'Action/Subject of the action', and it is also present in *replacement* ('act of replacing/ person or thing that replaces'), *consolation* ('act of consoling/ something that consoles'), etc.
- b. Selectional polysemy: *cigarette* is interpreted as 'cigarette-smoking event' when combined with the adjective *fast*, because the latter only modifies event-denoting expressions.
- c. Irregular polysemy based on the metaphor 'Argument is a Commercial transaction', where the truth is the purchased object.
- d. Regular, inherent polysemy based on the relation 'Action/Results of the action'. Other similar words: *construction*, *creation*, *signature*, *deposit*, etc.
- e. Selectional polysemy: *hear* requires a direct object typed as Sound, and *dog* is interpreted as 'sound emitted by a dog'.

## A.7 Chapter 7

#### Exercise 1

- a. accuse: [HUMAN/ORGANIZATION/HUMAN GROUP] accuses [HUMAN/ORGANIZATION/HUMAN GROUP] of [EVENT]
- b. amend: [HUMAN/ORGANIZATION/HUMAN GROUP] amends [DOCUMENT/PROPOSITION]
- c. accomplish: [HUMAN/ORGANIZATION/HUMAN GROUP] accomplishes [DYNAMIC EVENT]
- d. apologize: [HUMAN] apologizes to [HUMAN] for [EVENT]
- e. park: [HUMAN] parks ([VEHICLE]) (in/at [LOCATION])  
the last two arguments are optional
- f. patrol: [HUMAN/HUMAN GROUP/VEHICLE] patrols [LOCATION]

#### Exercise 2

- a. **fall**(x): [phys\_obj(x) ∧ (become(lower(y)))]  
**drop**(x,y): [animate(x) ∧ phys\_obj(y) ∧ cause(x, (become(lower(y))))]
- b. **give**(x,y,z): [animate(x) ∧ animate(y) ∧ entity(z) ∧ cause(x, (become(z(at(y)))))]  
**take**(x,y): [animate(x) ∧ entity(y) ∧ cause(x, (become(z(at(x)))))]
- c. **walk**(x): [animate(x) ∧ legs(y) ∧ has(x, y) ∧ moves(x) ∧ uses(x, y)]  
**stroll**(x): [animate(x) ∧ legs(y) ∧ has(x, y) ∧ moves(x) ∧ uses(x, y) ∧ manner\_of\_moving(z) ∧ leisurely(z) ∧ way\_of\_moving\_of(z, x)]  
**race**(x) [animate(x) ∧ moves(x) ∧ uses(x, y) ∧ manner\_of\_moving(z) ∧ fast(z) ∧ way\_of\_moving\_of(z, x)]

- d. **liquid**(x): [substance(x) ∧ liquid(x)]  
**tea**(x): [substance(x) ∧ liquid(x) ∧ made\_from\_tea-plants(x) ∧ used\_as\_beverage(x)]  
**digestif**(x): [substance(x) ∧ liquid(x) ∧ alcoholic(x) ∧ aids\_digestion(x)]  
e. **student**(x): [human(x) ∧ studies\_in\_school(x)]  
**apprentice**(x): [human(x) ∧ learns\_practical\_skills(x)]

## Exercise 3

$$\begin{array}{ll}
 \text{a. } \left[ \begin{array}{l} \text{car}(x) \\ \text{QS} = \left[ \begin{array}{l} F = \text{phys\_obj}(x) \\ C = \text{parts\_of}(w,x) \\ T = \text{transport}(x,y) \\ A = \text{build}(z,x) \end{array} \right] \end{array} \right] & \text{b. } \left[ \begin{array}{l} \text{squirrel}(x) \\ \text{QS} = \left[ \begin{array}{l} F = \text{animal}(x) \\ C = \text{---} \\ T = \text{---} \\ A = \text{---} \end{array} \right] \end{array} \right] \\
 \\
 \text{c. } \left[ \begin{array}{l} \text{beer}(x) \\ \text{QS} = \left[ \begin{array}{l} F = \text{liquid\_substance}(x) \\ C = \text{ingredients\_of}(w,x) \\ T = \text{drink}(y,x) \\ A = \text{brew}(z,x) \end{array} \right] \end{array} \right] & \text{d. } \left[ \begin{array}{l} \text{lamp}(x) \\ \text{QS} = \left[ \begin{array}{l} F = \text{phys\_obj}(x) \\ C = \text{parts\_of}(w,x) \\ T = \text{light}(x,y) \\ A = \text{assemble}(z,x) \end{array} \right] \end{array} \right] \\
 \\
 \text{e. } \left[ \begin{array}{l} \text{president}(x) \\ \text{QS} = \left[ \begin{array}{l} F = \text{human}(x) \\ C = \text{---} \\ T = \text{govern}(x,y) \\ A = \text{appoint}(z,x) / \text{elect}(z,x) \end{array} \right] \end{array} \right]
 \end{array}$$

## Exercise 4

- mountainous region*: constitutive
- synthetic fabric*: agentive
- sour fruit*: formal
- natural light*: agentive
- skilled instructor*: telic
- big house*: formal
- sugar cane*: constitutive
- fishing rod*: telic
- brick house*: constitutive
- sunburn*: agentive
- shopping bag*: telic
- work stress*: agentive

## Exercise 5

- old friend*: 'an old person who is somebody's friend' (*old* modifies the FQ of *friend*) / 'a person who has been somebody's friend for a long time' (*old* modifies the TQ of *friend*)
- criminal lawyer*: 'a criminal who is a lawyer' (*criminal* modifies the FQ of *lawyer*) / 'a lawyer specializing in criminal law' (*criminal* modifies the TQ of *lawyer*)
- lavender cupcake*: 'lavender colored cupcake' (*lavender* modifies the FQ of *cupcake*) / 'cupcake that has lavender as one of the ingredients' (*lavender* modifies the CQ of *cupcake*)
- new book*: 'new PHYSICAL OBJECT' / 'newly written book (new INFORMATION)'. *Book* is a dot object PHYSICAL OBJECT•INFORMATION.
- long quiz*: 'long document (long INFORMATION)' / 'long quiz EVENT'. *Quiz* is a dot object INFORMATION•EVENT.
- finish the book*: 'finish reading the book' (*finish* refers to the TQ of *book*) / 'finish writing the book' (*finish* refers to the AQ of *book*)
- welcome the appointment*: 'welcome the EVENT of someone being appointed' / 'welcome the HUMAN who has been appointed'. *Appointment* is a dot object EVENT•HUMAN.

## Exercise 6

- a. *bottle*: CONTAINER•CONTENT, contain(CONTAINER, CONTENT)  
 b. *letter*: PHYS\_OBJ•INFO, contain(PHYS\_OBJ, INFORMATION)  
 c. *window*: APERTURE•PHYS\_OBJ, contain(APERTURE, PHYS\_OBJ)  
 d. *orange*: TREE•FRUIT, fruit\_of(FRUIT, TREE)  
 e. *dinner*: FOOD•EVENT, consume(EVENT, HUMAN, FOOD)  
 f. *concert*: MUSIC•EVENT, perform(EVENT, HUMAN, MUSIC)  
 g. *date*: EVENT•HUMAN, meet(EVENT, HUMAN, HUMAN)

## A.8 Chapter 8

### Exercise 1

<p>a. <b>accuse</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human/organization \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human/organization \end{array} \right] \right] \\ ARG_3 = \left[ z = \left[ \begin{array}{l} CAT = PP(of+NP/VP\_GER) \\ SEM\ TYPE = event \end{array} \right] \right] \end{array} \right]$	<p>b. <b>amend</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human/organization \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = document/proposition \end{array} \right] \right] \end{array} \right]$
<p>c. <b>accomplish</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human/organization \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = dynamic\ event \end{array} \right] \right] \end{array} \right]$	<p>d. <b>apologize</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = PP(to+DP) \\ SEM\ TYPE = human \end{array} \right] \right] \\ ARG_3 = \left[ z = \left[ \begin{array}{l} CAT = PP(for+DP/VP\_GER) \\ SEM\ TYPE = event \end{array} \right] \right] \end{array} \right]$
<p>e. <b>park</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = vehicle \end{array} \right] \right] \\ ARG_3 = \left[ z = \left[ \begin{array}{l} CAT = PP(in/at+DP/AdvP) \\ SEM\ TYPE = location \end{array} \right] \right] \end{array} \right]$	<p>f. <b>patrol</b></p> $AS = \left[ \begin{array}{l} ARG_1 = \left[ x = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = human/human\ group/vehicle \end{array} \right] \right] \\ ARG_2 = \left[ y = \left[ \begin{array}{l} CAT = DP \\ SEM\ TYPE = location \end{array} \right] \right] \end{array} \right]$

### Exercise 2

- a1. Location argument introduced by lexical preposition *in*.  
 a2. Location adjunct introduced by lexical preposition *in*.  
 a3. Adjunct introduced by lexical preposition *in*, ambiguous between **location** ('the microwave is the place where we left the poultry to defrost') and the **instrument** ('we used the microwave to defrost the poultry').  
 b1. Goal argument introduced by lexical preposition *in*.  
 b2. Location adjunct introduced by lexical preposition *in*.  
 b3. Theme argument introduced by grammatical preposition *in*.  
 c1. Beneficiary adjunct introduced by lexical preposition *for*.  
 c2. Theme argument introduced by grammatical preposition *for*.  
 c3. Beneficiary adjunct introduced by lexical preposition *for*.

### Exercise 3

- a. Three possible interpretations: (1) *Mike* is the Agent argument of the agentive role of *picture*: TAKE(*Mike*, *the\_picture*); (2) *Mike* is the person represented on the picture, which is encoded in the formal role of *picture*: REPRESENTATION\_OF(*the\_picture*, *Mike*); (3) *Mike* owns the picture (relation of alienable possession).
- b. Two interpretations derived from the AS of the base V *translate*: (1) *Nabokov* is the Agent of *translate* and *translation*; (2) *Nabokov* is the Theme of *translate* and *translation* ('translation of Nabokov's work').
- c. Two interpretations: (1) *Mary* is the Agent argument of the agentive role of *supper*: COOK(*Mary*, *supper*); (2) *Mary* is the Agent argument of the telic role of *supper*: EAT(*Mary*, *supper*).
- d. Two interpretations derived from the AS of the base V *destroy*: (1) in *Rome's destruction of Carthage*, *Rome* is the Agent of *destroy* and *destruction*; (2) in *Rome's destruction by the Gauls*, *Rome* is the Theme of *destroy* and *destruction*.
- e. The constitutive role of *edge* encodes a whole-part relation with *the river*: PART\_OF(*the\_edge*, *the\_river*).
- f. There are several possible interpretations: (1) *Mike* is a member of the team and the part-whole relation is encoded in the constitutive role of *team*: PART\_OF(*Mike*, *the\_team*); (2) *Mike* is the alienable possessor of the team; (3) other interpretations not related directly to the lexical meaning of *team* (e.g., *Mike* is a fan of the team).
- g. *Speed* is an inherent attribute of moving objects. When applied to a referential argument (e.g., *Ferrari*), it yields a specific value: SPEED(arg<sub>val</sub>, *Ferrari*).
- h. The nominal *concern* is derived from the stative V *concern*. *Mary* is the Experimenter argument of both the base V and the N.

**Exercise 4**

- a. Quality (attribute) interpretation: 'how strong the neural connections are'.
- b. Quality (value) interpretation: 'strong areas'.
- c. State interpretation: 'the state of the muscles being weak'.
- d. Quality (value) interpretation: 'sign of being a weak person'.
- e. Quality (attribute) interpretation: 'how happy you are'.
- f. State interpretation: 'smile of feeling happy'.
- g. State interpretation: 'the state of the beach being empty'.
- h. Event interpretation: 'another sloppy action'.
- i. Quality (value) interpretation: 'the intern has the quality of being sloppy'.

**A.9 Chapter 9****Exercise 1**

- |                   |   |
|-------------------|---|
| a. Activity       | f. Accomplishment                             |
| b. Achievement    | g. State                                      |
| c. Achievement    | h. Semelfactive (if the boy yawned just once) |
| d. Activity       | or activity (if he yawned repeatedly)         |
| e. Accomplishment |   |

**Exercise 2**

- |   |   |
|---|---|
| a. Event culmination                    | d. Event course from the onset to the speech time |
| b. Resultant state                      |   |
| c. Onset of a state ('I began to know') | e. Event course of a state                        |



- f. The whole event from the onset to the culmination
- h. The event course has a duration of two hours, not including the culmination
- g. Resultant state

### Exercise 3

- a. Achievements are usually incompatible with the progressive, but *come* is one of the verbs that can be conceptualized as having a preparatory phase associated with them.
- b. Achievements are instantaneous, and with the *in* adverbial they get a preparatory phase interpretation.
- c. States are usually not compatible with the progressive because they are not dynamic, but in this case *love* is interpreted as a temporary predicate meaning, roughly, 'enjoy'.
- d. Activities cannot have an ongoing interpretation in present simple, the only available reading for this sentence refers to ability ('our baby can swim').
- e-f Achievements are not compatible with *for* adverbials because they are instantaneous, but they can get a resultant state interpretation (as in (e)) or a habitual interpretation (as in (f)).

### Exercise 4

- a. *Drink*: individual-denoting nominal that refers to the Theme of the base verb.
- b. *Drink*: event-denoting nominal (*after* is only compatible with events).
- c. *Baker*: individual-denoting nominal that refers to the Agent of the base verb.
- d. *Sleep*: event nominal derived from the state verb *sleep*.
- e. *Writing*: event nominal derived from the activity verb *write*.
- f. *Writing*: individual-denoting nominal that refers to the result of the event denoted by the base verb.

### Exercise 5

- a.  $E=R=S$
- b.  $S<E<R$
- c.  $S<R=E$
- d.  $R<E<S$  (if she called before S);  $R<S<E$  (if she hasn't called before S);  $R<S=E$  (if she is calling at S, while the sentence is being uttered).
- e.  $R<E<S$
- f.  $S<R<E$

### Exercise 6

- a. The future auxiliary *will* introduces an epistemic judgment about a present event: 'This most certainly is John'.
- b. 3 possible interpretations of the verbal predicate: epistemic ('there is a possibility that she does it'), deontic ('she is allowed to do it'), and abilitative ('she is able to do it').
- c. In this context *threaten* introduces epistemic modality: 'something undesirable is likely to happen soon'.
- d. The auxiliary *should* yields two possible interpretations: deontic ('they have the obligation of being here by noon') or epistemic ('it is probable that they are here by noon').
- e. In unreal conditionals, past perfect denotes a non-factive past event ('you did not do it in the past, but if you did you'd have regretted it').
- f. The non-factive verb *suggest* introduces the present subjunctive form *see* (instead of the indicative *sees*), which denotes what the speaker believes to be a desirable state of affairs rather than an objective fact.

## A.10 Chapter 10

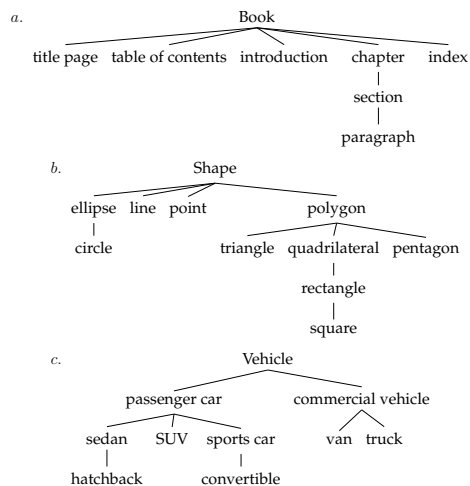
### Exercise 1

- suitable for, friend of
- become (*He became rich*), turn (*The shirt turned yellow*)
- superior (*superior to my car in size*)

### Exercise 2

- shared features: ANIMATE, B\_SET, FUNCTIONAL; contrasting features: *fraternity* (NATURAL), *government* (ARTIFICIAL)
- shared features: INANIMATE, HOMOGENEOUS; contrasting features: *blood* (NATURAL), *serum* (ARTIFICIAL)
- shared features: PROPERTY, ARTIFICIAL; contrasting features: *synthetic* (HOMOGENEOUS), *damaged* (ATOMIC)
- shared features: DYNAMIC, NATURAL; contrasting features: *look for* (HOMOGENEOUS), *find* (ATOMIC)
- shared features: DYNAMIC, NATURAL; contrasting features: *observe* (HOMOGENEOUS), *examine* (B\_SET), *blink* (ATOMIC)

### Exercise 3



### Exercise 4

- contradiction (*fail* and *pass* are oppositely valued co-hyponyms in the category TEST RESULT)
- incompatibility (*black* and *red* are two of the co-hyponyms belonging to the hypernym *color*)
- troponymy (*strangle* is a specific means of killing)
- converseness (if A *borrowed* something from B, then B *lent* something to A)
- contrariety (it is a gradable opposition wherein both terms cannot be simultaneously true, but they can be simultaneously false: *\*This quiz is easy and hard* / *This quiz is neither easy nor hard*)
- contrariety (*soft* and *hard* are two extremes of a gradable opposition in the category MALLEABILITY)
- reversibility (*hire* and *lay off* involve change leading to two opposite resultant states: 'someone has a job' and 'someone doesn't have a job')

- h. contrariety (it is a gradable opposition wherein both terms cannot be simultaneously true, but they can be simultaneously false: \**This pond is deep and shallow*/ *This pond is neither deep nor shallow*)

#### Exercise 5

- die* and *pass away* are synonyms in the sense 'go out of existence'. 'Someone/something died'  $\leftrightarrow$  'Someone/something passed away'
- young* and *new* are synonyms in the sense 'recently come into existence'. For this sense, it holds that 'Someone/something is young'  $\leftrightarrow$  'Someone/something is new'. They are not synonymous in the other senses, e.g., *new friend* is not synonymous with *young friend*, and *new neighbor* is not synonymous with *young neighbor*.
- Diligent* and *accurate* are not synonymous although their meanings are related. The main sense of *diligent* is 'constant and earnest in work' and *accurate* is 'free from mistakes' or 'not making mistakes'.
- buck* and *dollar* are synonyms when the former means 'dollar'. For this sense, it holds that 'This is 10 bucks'  $\leftrightarrow$  'This is 10 dollars'. They are not synonymous in other senses, e.g., *buck* as 'male deer'.
- begin* and *commence* are synonyms in the sense 'start' (both transitive and intransitive). 'Something began'  $\leftrightarrow$  'Something commenced'
- Washington, D.C.* and *capital of the USA* are coreferential expressions (they refer to the same real-world entity), but they are not synonyms.

#### Exercise 6

The meaning for none of these compounds is fully compositional. First of all, the stem *man* is not referring to the same kind of entity: in most cases, it is 'individual human, Homo sapiens', but in *caveman* it refers to a different subspecies (Neanderthal) and in *snowman* it refers to an inanimate object vaguely resembling a person. Also, the relationship between the first and the second stem varies. In most cases, it refers to the function a person is fulfilling, through the name of the occupation (*businessman*, *craftsman*, *salesman*, *showman*), the professional group (*clergyman*, *craftsman*, *policeman*), the typical tool (*cameraman*, *gunman*), and more vague and strongly lexicalized associations (*doorman*, *seaman*). In *snowman* and *caveman*, the relationship is of a constitutive kind: 'man made of snow', 'man living in a cave'.

## A.11 Chapter 11

#### Exercise 1

- The basic spatial meaning of *turn to* is 'change direction or position in order to face something', as in (a1): [ANIMATE] turns to [PHYSICAL OBJECT]. The meaning in (a2) is 'change the subject or focus': [HUMAN] turns to [ABSTRACT/PROPOSITION]. In both cases the event type is achievement.
- The basic spatial meaning of *approach* is 'come near to' (an achievement), as in (b1): [PHYSICAL OBJECT] approaches [LOCATION/PHYSICAL OBJECT]. The meaning in (b2) is 'deal with something' (a process): [HUMAN] approaches [ABSTRACT/PROPOSITION]. The meaning in (b3) is 'be close to' (a state): [ABSTRACT/DIMENSION] approaches [QUANTITY].
- The basic spatial meaning of *reach* is 'arrive at' (an achievement), as in (c1): [PHYSICAL OBJECT] reaches [LOCATION/PHYSICAL OBJECT]. The meaning in (c2) is also spatial but stative 'extend to': [PHYSICAL OBJECT] reaches [LOCATION/PHYSICAL OBJECT]. The meaning in (c3) is 'achieve, gain through effort' (an achievement): [HUMAN] reaches [EVENT].

**Exercise 2**

- a. 'postpone drinking our coffee': ARTIFACT  $\implies$  EVENT
- b. 'arrived at the location of the party': EVENT  $\implies$  LOCATION
- c. 'regret getting the tattoo': REPRESENTATIONAL ARTIFACT  $\implies$  EVENT
- d. 'heard sounds of the explosion': EVENT  $\implies$  SOUND
- e. 'prefer drinking green tea': ARTIFACT  $\implies$  EVENT
- f. 'before questioning the son': ANIMATE  $\implies$  EVENT

**Exercise 3**

- a. The basic meaning of *fry* is 'cook in fat or oil', as in (a1). In (a2), it acquires the meaning 'create by frying'. The creation meaning is possible because the agentive value of the argument *omelet* makes explicit reference to the semantic type of the predicate: an *omelet* comes into being through the process of *frying*. Alternatively, a creation construction 'Agent CAUSES Theme to EXIST by doing V' can be posited to account for the latter meaning, which takes the head verb as one of its components.
- b. When combined with ANIMATE complements, such as *fish* in (b1), *kill* means 'cause to die'. With EVENTS, such as *conversation* in (b2), *kill* means 'end'. Both meanings are subsumed under a more general sense, 'cause to not exist', which manifests itself differently depending on the semantic type of the verbal complement: 'cause an animate entity to not exist' is 'cause to die', and 'cause an event to not exist' is 'end'.
- c. Both examples can be analyzed as cases of subject-induced co-composition: the more general meaning is stative ('be in contact with', as in (c1)), and the more specific meaning is causative ('become in touch with', as in (c2)). The former is acceptable with any subtype of PHYSICAL OBJECT as the subject and the latter only with ANIMATE subjects, since agentivity is required to carry out a causative event. In a construction-based approach, the stative construction 'Theme IS in contact with Ground' is a part of the causative construction 'Agent CAUSES the Theme to BE in contact with Ground'.
- d. The basic meaning of *waltz* is 'move in a waltz step or rhythm', as in (d1), where it heads a manner-of-motion predicate. The direction PP *into the room* in (d2) makes reference to a motion predicate in its agentive role and to the resultant state of being located at the goal argument in its formal role: 'by waltzing, Sam came to be in the room'. Alternatively, a directed motion construction 'Agent COMES TO BE at the Goal by moving in a V manner' can be posited, which takes the head verb as one of its components and contributes the Goal argument to the sentence.

**Exercise 4**

- a. *friend*: true, close, loyal, real; *love*: true, unconditional, undying, everlasting, deep
- b. *love*: blind, crazy, overwhelming; *reaction*: severe, violent, visceral, extreme; *enthusiasm*: unbridled, boundless, childlike, boyish
- c. *fear*: experience, feel, have; *hope*: harbour, hold; *admiration*: profess
- d. *violence*: unleash, trigger; *war*: trigger, start, launch, spark; *discussion*: open, launch, initiate, spark, prompt, generate.
- e. *guilt*: assuage, ease, relieve, absolve, mitigate; *rumor*: deny, dispel, refute, dismiss, debunk; *riot*: suppress, quell.

# Appendix B Online resources

---

## GENERAL LINKS

**The Linguistic Data Consortium (LDC):** open consortium of research centers that creates and distributes a wide array of language resources [<https://www ldc.upenn.edu/>]

**Wikipedia Linguistics Portal:** [<https://en.wikipedia.org/wiki/Portal:Linguistics>]

## LEXICAL DATABASES AND LEXICONS

**Brandeis Semantic Ontology (BSO):** large Generative-Lexicon based ontology [<http://batcaves.org/bsobrowser/index.php>]

**Corpus Pattern Analysys (CPA):** lexicographical corpus-based technique that associates verbal senses with usage patterns, defined through the syntactic category of the selected arguments, their semantic type and semantic role in the predicate [<https://nlp.fi.muni.cz/projekty/cpa/>]. See also the *Pattern Dictionary of English Verbs* [<http://www.pdev.org.uk/>]

**FrameNet:** relational verbal database inspired in the Frame Semantics theory. Each kind of situation (a *frame*) is represented through the *lexical units* that instantiate it, a list of semantic arguments involved in the frame description, and its relationship with other frames. See sec. 6.4.2. [<https://framenet.icsi.berkeley.edu/>]

**VerbNet:** online English verbal lexicon, inspired in Levin (1993), wherein verbs are organized in classes based on their meaning and their syntactic behavior (semantic and syntactic selectional constraints on the arguments). [<http://verbs.colorado.edu/~mpalmer/projects/verbnet.html>]

**WordNet:** relational database where word meanings are defined through synsets, sets of words that are, roughly, synonymous with the defined word. Relations between different words and groups of words are determined in terms of hyperonymy, entailment, and meronymy. See also *EuroWordNet* [<http://projects.illc.uva.nl/EuroWordNet/>] and *MultiWordNet* [<http://projects.illc.uva.nl/EuroWordNet/>]

## MODERN THEORETICAL FRAMEWORKS

**Cognitive Linguistics:** International Cognitive Linguistics Association [<http://www.cognitivelinguistics.org/>]; The UK Cognitive Linguistics Association [<http://www.uk-cla.org.uk/>]; Interdisciplinary Center for Cognitive Language Studies, University of Munich [<http://www.en.kognitive-sprachforschung.uni-muenchen.de>]; Cognitive Cultural Studies (CogWeb), UCLA [<http://cogweb.net/>]; Conceptual Metaphor Home Page by George Lakoff

[<http://www.lang.osaka-u.ac.jp/~sugimoto/MasterMetaphorList/MetaphorHome.html>].

**Combinatory Categorical Grammar:** University of Edinburgh CCG website [<http://groups.inf.ed.ac.uk/ccg/>]

**Construction Grammar:** [<http://www.constructiongrammar.org/>], [<https://www.llas.ac.uk/resources/gpg/141.html>] (by William Croft). Berkeley Construction Grammar by C. Fillmore and P. Kay (last updated in 1997) [<http://www1.icsi.berkeley.edu/~kay/bcg/ConGram.html>]. Fluid Construction Grammar: open-source computational construction grammar formalism [<https://www.fcg-net.org/>]

**Generative Lexicon:** GL tutorials [<http://gl-tutorials.org/>]. James Pustejovsky [<http://jamespusto.com/>]

**Head-Driven Phrase Structure Grammar:** Stanford University website [<http://hpsg.stanford.edu/>]; Ohio State University website [<http://www.ling.ohio-state.edu/research/hpsg/>]

**Meaning-Text theory:** Observatoire de linguistique Sens-Texte (OLST) [<http://olst.ling.umontreal.ca>]

**Natural Semantic Metalanguage (NSM):** Griffith University website authored by Cliff Goddard [<https://www.griffith.edu.au/humanities-languages/school-humanities-languages-research/natural-semantic-metalanguage-homepage>]

**Role and Reference Grammar:** Robert D. Van Valin, University at Buffalo [<http://www.acsu.buffalo.edu/~rrgpage/rrg.html>]

## CORPORA AND CORPUS QUERY SYSTEMS

**British National Corpus (BNC):** University of Oxford website [<http://www.natcorp.ox.ac.uk/>]; Brigham Young University website [<https://corpus.byu.edu/bnc/>]

**Corpus of Contemporary American English (COCA):** Brigham Young University website [<https://corpus.byu.edu/coca/>]

**Sketch Engine:** a corpus tool which takes as input a corpus of any language and generates a set of summaries regarding the word's contextual behavior. [<https://www.sketchengine.co.uk/>]

## Appendix C Glossary

---

**accomplishment:** event type defined as dynamic, telic, and durative. The telos is usually defined relative to the entity affected by the action denoted by the verb: *Mike built a house* (the result is a new house), *The water froze* (the water becomes frozen), etc. [6.3.3]

**achievement:** event type defined as dynamic, telic, and instantaneous: *arrive, reach the summit, sit down, die, faint*, etc. [6.3.3]

**activity:** event type defined as dynamic, atelic, and durative (e.g., *work, run, drag, read, dance*). Activities do not have a built-in culmination, but it does not mean that they cannot stop in time and be **bounded**, as in *John worked for three hours*, which is bounded and atelic. [6.3.3]

**adjunct:** see **argument**.

**agentive quale:** see **qualia structure**.

**agreement:** mechanism whereby syntactically related words share certain syntactic features. For example, in *I am right here/ We are right here* the subject and the verbal predicate agree in number and person. [2.2]

**Aktionsart:** see **aspect**.

**ambiguity:** property of words and other linguistic expressions of having more than one meaning. **Lexical ambiguity** arises when a word has two or more meanings, e.g. *seal* as ‘marine mammal’ and as ‘tool for validating documents’. **Syntactic ambiguity** or **structural ambiguity** emerges when the same sequence of lexical items corresponds to several different syntactic structures (e.g., *I bought red pencils and notebooks*). **Semantic ambiguity** is the presence of multiple interpretations, regardless of the absence of structural or lexical ambiguity (e.g., *John’s picture is the best*). [6.5.1]

**antonymy:** sense relation of oppositeness, where where two words denote opposites of each other relative to a scale. See also **incompatibility, contrariety, contradiction, converseness**, and **reversibility**. [10.5]

**archilexeme:** see **lexical field**.

**argument:** a formal parameter of a logical relation or a natural language sentence. If it is the only parameter, then we say that it *saturates* the whole expression, i.e., makes it complete. In the context of **argument structure**, the term *argument* can be used in a broad sense, to refer to all the components of a predicate (both required and optional) minus the head, or in a narrow sense, to refer to the required components only (as in ‘*She gave us lunch*’). Non-required predicate components are called **adjuncts**, they modify the “core event description” with additional information, often referring to specific circumstances of time, place, manner, etc. (as in ‘*She gave us lunch at noon*’). Some arguments can be phonologically unexpressed, i.e., **implicit** or **default**. **Implicit arguments** are syntactically and semantically real, and their syntactic features are visible on the verb when they have to agree. E.g., in the Spanish sen-

tence *Quiero helado* (lit. '[I] want-PRES.1PERS.SG. ice cream'), the implicit first-person singular subject (i.e., *I*) agrees with the verb. Semantically, these invisible arguments refer to specific entities in the context. The **default arguments** are semantically incorporated by the verb: e.g., *Mary ate hastily* conveys that Mary has had a meal or, more in general, ingested something edible. The specific content of the default arguments cannot be deduced from context and it is debatable whether they are present in the syntax. Since they duplicate the meaning of the predicate, they are inherently *uninformative* (??*Mary ate {food/ a meal}*), and they only yield acceptable sentences if further specified (e.g., *Mary ate healthy food*). See also **argument structure**. [8.2]

**argument structure:** lexical structure encoding what context a word is compatible with, i.e., the number and kind of *arguments* a *predicate* takes. The constraints imposed by the predicate on its arguments are called **selectional requirements**: these include the syntactic category of the argument (**categorial selectional requirements**); and its semantic type (**semantic selectional requirements**). See also **valence**. [2.3, 6.3.2, 8]

**artifactual type** or **functional type:** lexical type encoding created entities or artifacts (*beer, umbrella*), as well as related properties (*broken, useful*), and events (*fix, spoil*), which are associated with a purpose or function. In addition to FORMAL and CONSTITUTIVE roles, artifactual types have specific information referring to their origin and intended function, which is encoded in the AGENTIVE role and the TELIC role, respectively. [7.4, 10.4]

**aspect:** linguistic category encoding the internal temporal structure of events. Aspectual distinctions encoded as a part of the verbal meaning are called **lexical aspect**. The terms **Aktionsart** and **event type** are often used as synonyms of **lexical aspect**, but they can also refer to the aspectual properties expressed by the predicate as a whole, not just the verb. Grammaticalized aspectual meanings conveyed through explicit grammatical markers are referred to as **grammatical aspect**. Grammatical aspect is usually encoded in the verbal inflection. See also **event** and **event structure**. [6.3.3, 9.2, 9.3]

**attribute value matrix (AVM):** feature structure that consists of the name of the described object (e.g., *cat*), its type (WORD), its attributes (e.g., SYNTACTIC CATEGORY and SEMANTICS) and the corresponding values ('Noun' and 'ANIMATE'), all enclosed by square brackets and split in columns. The feature value can be *atomic* (i.e., unstructured) or *complex* (consisting of another attribute-value pair). See also **typed feature structure** and **reentrancy**. [3.4, 6.3.1]

**basic level category:** a 'privileged' taxonomic level of categorization, which has been claimed to be more salient because it is information-rich: the members of basic level categories have many attributes in common (e.g., the members of the category DOG) and at the same time they share very few attributes with the members of other categories of the same taxonomic level (e.g., DOGS with CATS, GIRAFFES, and other members of the MAMMAL category), which makes them easily distinguishable. [5.5]

**boundedness:** aspectual feature that distinguishes events that have come to an end (e.g., *Mike built the house* or *Mike built the house for two years*) from events that last indefinitely within the relevant time period (*Mike was building the house* or *Mike is in Boston*). [6.3.3]

**clause:** sentence-like unit embedded in a bigger sentence (e.g., 'I think that [<sub>S</sub> you are wrong]'). [2.2]

**co-composition:** in the Generative Lexicon theory, compositional mechanism activated when there is an explicit reference to the predicate or to the predicate's semantic type, within the argument's lexical entry (e.g., its qualia structure). Co-composition is bidirectional: the pred-



icate applies to the argument and the argument affects the meaning of the predicate beyond its contribution as an argument to the phrase, as in the creation predicates *paint a portrait* or *bake a cake*. [3.7, 11.4]

**coercion or type shifting:** an operation that works dynamically in the composition of a phrase, converting an argument to the type expected by its predicate or function, where otherwise their combination would result in a type conflict. **Aspectual coercion** arises when a verb's lexically-specified event type undergoes modification under the influence of other predicate components (e.g., 'John came to visit his grandfather/ John came to visit his grandfather for 20 years'). In cases of **complement coercion**, the predicate imposes the required semantic type to a complement that does not comply with its semantic constraints (e.g., *finish the beer* interpreted as 'finish *drinking* the beer'). In the Generative Lexicon model, **coercion by exploitation** is a compositional mechanism wherein the selectional requirements are satisfied by a part of the argument's semantic typing (as in *The fire burnt the book*, where the predicate *burn* selects for one of the component semantic types of the dot object *book*, i.e. the type PHYSICAL OBJECT). See also **co-composition**. [3.7, 6.5.1.3, 11.3, 11.4]

**compositionality:** an essential property of complex linguistic expressions of being built up systematically, following the syntax of the sentence step by step, and using only the interpretations of its subparts to create the interpretation of the larger expression. The meaning of a complex expression is **compositional** if it is determined by the meanings of its component parts and their syntactic arrangement [4.2.2, 11]

**concept:** a mental representation consisting of bundles of similarities we extract from instances of entities, events, and properties that we have encountered in our experience. *Conceptualizing* something means coming up with a mental representation that allows us to categorize similar but not identical elements of experience as belonging to the same class. [4.3.2]

**conceptual meaning or cognitive meaning:** that component of semantics that governs the way we interpret language and expresses those aspects of linguistic meaning that are used in the service of forming inferences and reasoning with language. See also **connotative meaning** [4.3]

**conceptual structure:** in Conceptual Semantics, the part of human cognition that embraces all the grammatically relevant aspects of meaning: quantification, predicate-argument structures, taxonomic categorization, temporal and causal relations, social relations, etc. Conceptual Structure classifies linguistic expressions according to their conceptual category (Object, Event, State, Action, Place, etc.) and a function-argument pairing if there is one. [5.3]

**connotative meaning, connotation or associative meaning:** that component of semantics that does not affect the denotation of a linguistic expression but which conveys our emotional attitude towards the entity denoted by it or our evaluation of it. Connotation is inextricably related to the sociolinguistic dimension of language variation, in particular to the register (e.g., the word *pal* has a colloquial or informal connotation as compared to the neutral term *friend*). See also **conceptual meaning** [4.4]

**constituent:** group of words that functions as a single syntactic unit within a bigger structure and is sensitive to certain syntactic operations. Two kinds of constituents are *phrases* and *clauses*. [2.2]

**constitutive quale:** see **qualia structure**.

**construction:** in Construction Grammar, a form-meaning pair such that some aspect of its form

or some aspect of its meaning is not strictly predictable from its component parts or from other previously established constructions. [3.6]

**contradiction:** binary **incompatibility**, i.e., sense relation holding between the subtypes of the same supertype if there are only two subtypes. Contradictory terms are mutually exclusive (i.e., they cannot be simultaneously true or false): e.g., all ENTITIES are either ANIMATE or INANIMATE, and no ENTITY is both ANIMATE or INANIMATE. See also **incompatibility** and **contrariety**. [10.5]

**contrariety:** non-binary **incompatibility**, i.e., sense relation holding between the subtypes of the same supertype if there are more than two subtypes. Two contrary terms cannot be simultaneously true but they can both be false, e.g., a tree cannot be simultaneously *tall* and *short* but it can be neither *tall* nor *short*. See also **incompatibility** and **contradiction**. [10.5]

**conventional attribute:** stable conceptual association that some words evoke, which may not be encoded in the lexical entry but which quite often affects the compositional interpretation of those words (e.g., ‘cows *moo* / dogs *bark* / frogs *croak*). [6.4.3]

**converseness:** relation holding between two relational terms that can be used to describe the same situation viewed from two different perspectives. Formally, two words,  $w_1$  and  $w_2$ , are *relational converses* of each other, if for two entities,  $x$  and  $y$ , it holds that “ $x$  is  $w_1$  with respect to  $y$ ” and “ $y$  is  $w_2$  with respect to  $x$ ”, e.g., ‘The sofa is *in front of* the TV’ entails ‘The TV is *behind* the sofa’. See also **reversibility**. [10.5]

**corpus** (plural: *corpora*): a collection of linguistic elements (usually texts) selected and ordered according to explicit linguistic criteria in order to be used as a representative sample of the language. [1.6.1, Appendix B]

**count noun:** common noun referring to *individuals*, i.e., discrete, bounded entities: *girl*, *class*, *letter*, etc. See also **mass noun** and **individuation**. [2.3.3, 10.4]

**decomposition:** method of analysis that consists in breaking down complex objects into more basic subcomponents. **Lexical decomposition** emerges from recognizing that lexical meaning is complex and as such it can be analyzed in terms of smaller, *sublexical* components which can be studied independently from each other and which allow connecting the meaning of different words in a systematic fashion. [3.2, 7.2]

**definition:** a paraphrase describing the meaning of a word or one of its senses if the word is polysemous. The most common kind of definition is the **definition by genus proximum et differentia specifica** (e.g., *chalet* is ‘a small house where people go for vacations’): the defined word is located in a broader class (the *genus*: *house*) and is subsequently differentiated from the other members of this class by listing its distinguishing features (the *differentiae*: ‘small’ and ‘where people go for vacations’). [6.2.1]

**derivational morphology** (also **lexical morphology** or **word formation**): processes that operate over a base morpheme, to derive words with possibly different syntactic categories, along with related but distinct meanings. [10.6]

**derivational paradigm:** set of all the lexemes that share the same root. [10.6]

**dot object** or **complex type:** lexical type that encodes an inherent relation between two or more types or *aspects*. **Dot** (•) is the type constructor that creates a complex type  $a•b$  from any two types  $a$  and  $b$ : *bottle* [CONTAINER•CONTENT], *lamb* [PHYSICAL OBJECT • SUBSTANCE], *university* [LOCATION • HUMAN GROUP • ORGANIZATION], etc. [6.5.1.3, 7.4]

**durativity:** aspectual feature that distinguishes events that last for some time (e.g., *Mike built the house*) and instantaneous events (e.g., *Mike exploded the balloon*). [6.3.3]

**Dynamic Event Structure:** see **event structure**.

**dynamicity:** aspectual feature that distinguishes events that involve some kind of change and events that do not. **Static events** do not involve change, e.g., *know, love, be tall, be sick*. By contrast, **dynamic events** are perceived and described as changing in time: e.g., *John {ran/was running}* (John's location in time changes), *John is working*, etc. [6.3.3]

**empirical data:** information based on experience. **Naturally occurring data** are acquired through observation of already existing information (e.g., in *linguistic corpora*). **Naturally elicited data** are based on the linguistic intuition of the scholar and are acquired through *introspection*. **Experimentally elicited data** are obtained as a result of questions or tasks proposed by the experimenter to a group of native speakers. [1.6]

**entailment:** relation between two propositions where the truth of the first guarantees the truth of the second, e.g. 'Karen has a blue car.' entails 'Karen has a car.' [4.2.1]

**event:** any kind of situation or happening denoted by the predicate. [3.7, 6.3.3, 9.2, 9.3]

**event structure:** definition of the event type of lexical items and predicates in terms of ordered subevents or phases. In the Generative Lexicon framework, the **Dynamic Event Structure** integrates the ES with temporal information in order to represent the attribute modified in the course of the event (the location of the moving entity, the extent of a created or destroyed entity, etc.) as a sequence of states related to time points or intervals. [3.7, 6.3.3, 9.2, 9.3]

**event type:** see **aspect**.

**evidentiality:** strategy used by the speaker to indicate the various sources of epistemic judgments about a proposition. The reliability of information coming from first-hand experience (visual and auditory perception, e.g., '*I saw it raining last night*') is usually considered higher than that acquired from other sources (hearsay, logical inference, or information based on external sources, e.g., '*I hear it rained all night yesterday*'). [9.5]

**extension** or **reference:** specific entities in the world designated or referred to by a linguistic expression. See also **intension**. [4.3.1]

**factive:** a complement-selecting predicate that triggers a presupposition that the embedded proposition is true: e.g., *Mike forgot that Mary paid him back*, presupposes that Mary paid him back. The presupposition holds also under negation: i.e., *Mike didn't forget that Mary paid him back*. See also **implicative**. [9.5]

**formal quale:** see **qualia structure**.

**frame** (also called **scene** or **script**): schematic representation of the typical properties of an action or an object, and its spatial, temporal and functional interaction with things usually associated with it. [3.6, 6.4.2]

**function application:** mechanism of combining an unsaturated function of predicate with its argument. The language for expressing function application is called *lambda calculus* ( $\lambda$ -calculus). See also **argument** and **predication**. [11.2]

**functional predicate:** a predicate returning a unique value for a given argument, e.g., *father* in *John is Mary's father*, because Mary can only have one father. See also **relational predicate**. [6.3.2, 8.4]

**grammatical relation:** link between two syntactic *constituents* that determines their syntactic

behavior (position in a phrase, agreement, etc.). Grammatical relations include traditional notions such as *subject* and *object* (direct and indirect), and also a number of other relations, such as *modifier* and *modified*. [2.2]

**headedness:** property of syntactic constituents of having a *head*, which projects these constituents and determines their syntactic and semantic properties. When applied to the **event structure**, *headedness* refers to the relative prominence of subevents within a complex event. The headed subevent is the focus of interpretation and is the ‘syntactically highlighted’ part of the event denoted by the predicate. See also **phrase** and **event structure**. [2.3, 9.3.1]

**homonym:** **homonyms** are words having the same sound and/or spelling but different, unrelated meanings. Homonyms sharing pronunciation but not the graphic form are called **homophones** (e.g., the verb *flew* and the noun *flu*). Homonyms having the same graphic form but different pronunciation are called **homographs** (e.g., the noun *lead* and the verb *lead*, pronounced as /led/ and /li:d/, respectively). [1.2, 6.5.1.2]

**hyperonymy** and **hyponymy:** sense relations between a general term and a more specific term where a **hypernym**, *A*, has a more specific term (the **hyponym**), *B*, as its subtype: ‘*B* is a kind of *A*’ (e.g., *girl* is a kind of *human*). **Troponymy** is a hypernymic relation between two verbs where one of the verbs identifies the *manner* in which the activity denoted by the other verb can be performed, e.g., *slice* and *saw* are troponyms of *cut*. See also **inheritance hierarchy**. [10.4, 10.5]

**image schema:** kind of representation frequently adopted in cognitive linguistic frameworks, which express recurring dynamic patterns of our perceptual and bodily experiences and interactions. Image schemas can represent many kinds of conceptual domains and configurations, from simple static elements and spatial settings, to complex dynamic relations involving force and abstract non-spatial constructs (e.g., possession, information transfer, social interactions). [6.4.1]

**imperfective aspect:** a kind of grammatical aspect that allows one to focus on different subparts of the event, its intermediate stages and its progress, but without including the beginning and the end (e.g., *Mike was building the house*). See also **perfective aspect**. [6.3.3]

**implicative:** a predicative construction that gives rise to entailments and may also carry presuppositions. There are *two-way implicatives*, such as *forget to* and *remember to*: e.g., *John forgot to shave* entails that he did not shave, while *John didn’t forget to shave* entails that he did shave. There are also *one-way implicatives*, such as *force to* and *prevent NP from*, which yield an entailment only under one polarity: e.g., *John forced Mary to leave* entails that Mary left; but *John didn’t force Mary to leave* doesn’t say whether she left or not. See also **factive**. [9.5]

**Inclusiveness Condition:** grammatical principle postulated within Minimalism which stipulates that syntax is only allowed to rearrange lexical properties, and no new objects may be added in the course of syntactic computation. [3.3]

**incompatibility:** sense relation holding between any two types which are subtypes of the same supertype or hypernym. Incompatible types have no members in common: e.g., the three ontological subtypes (ENTITY, PROPERTY, and EVENT) share no members. See also **contradiction** and **contrariety**. [10.5]

**individual-level property:** inherent property of an individual, which usually persists in time and is associated with this individual during all or most of its existence (e.g., *smart*, *respectful*, *friendly*). See also **stage-level property**. [7.3, 9.3.4]

- individuation:** process whereby we identify an entity and distinguish it from other entities. See also **count noun** and **mass noun**. [2.3.3, 10.4]
- inference:** process of reasoning where a conclusion is formed on the basis of the evidence or knowledge one has available to hand. Language-based inference is inference where the evidence and the conclusion are packaged as linguistic expressions. [4.2.1]
- inflectional morphology:** processes that operate over a lexeme to derive its different grammatical forms. [10.6]
- inflectional paradigm:** set of all the inflectional forms of a given lexeme. [10.6]
- inheritance hierarchy:** classification of the members of a domain into different types or classes, and subtypes or subclasses, based on properties that those members share. The properties that are associated with any particular type are inherited, from its supertype. In a **multiple inheritance hierarchy**, each lexical type can have multiple supertypes, e.g., the word *dancer* has ANIMATE as its supertype in the ontological subhierarchy, the supertype ARTIFACT in the functional subhierarchy, and ATOMIC in the individuation hierarchy. A special case of inheritance hierarchy in linguistics is the **taxonomy**. Taxonomy relates different semantic types in terms of class membership, often referred to as the IS-A relation or **hypernymic relation**. See also **hyponymy**. [3.4, 7.4, 10.2]
- intension** or **sense:** mental representation, definition, or set of criteria that something has to conform to in order to be able to be referred to by a given linguistic expression. See also **extension**. [4.3.2]
- interpretable feature:** in the Minimalist framework, semantically interpretable features have conceptual content and play a role in semantic interpretation. E.g., the number feature is interpretable on nouns (e.g., *woman-women*, *table-tables*), but it is **uninterpretable** on determiners (*this table* / *those tables*) and verbs (*The woman laughs* / *The women laugh*). [3.3]
- interpretation function:** a formal link (i.e., a function) between a linguistic expression and its meaning. [4.3.3]
- iteration:** aspectual feature that distinguishes events composed of several distinct events (e.g., *The ball bounced along the road* or *Mike visited his parents every Sunday*) and events composed of just one single event (e.g., *The baby sneezed once*). [6.3.3]
- lexeme:** abstract linguistic unit, which represents all the information we associate with a lexical item out of context, i.e., its inherent features. The lexeme comprises all the morphological variants (**word forms**) a word displays in context. [1.4]
- lexical competence:** the part of linguistic competence that enables the speakers to recognize and use words. [1.7]
- lexical decision task:** a procedure used in psycholinguistic experiments that involves measuring how quickly a person decides whether a combination of letters is a real word or not. [1.6.3]
- lexical entry:** a formalized representation of all the information we need in order to be able to use words in context, which includes their form (pronunciation and spelling) as well as their semantic and syntactic features. [1.2, 6]
- lexical field** (also called **semantic field** and **conceptual field**): a group of lexemes which share contiguous semantic content and which are mutually opposed by means of minimal distinctive features (Coseriu, 1977). The set of features shared by all the lexemes in a lexical field, or an actual word presenting these features, is called **archilexeme**. [3.2]

- lexical function:** correspondence ( $f$ ) that associates a lexical item  $L$  (the argument of the function) with a set of lexical items  $f(L)$ , which are the values of  $f$ . [11.5]
- lexical rule:** a rule that captures productive morphological, semantic and syntactic relationships between lexical entries and allows deriving one lexical entry from another. A lexical rule usually has the format ' $X \Rightarrow Y$ ': for any input lexical entry consistent with the description ' $X$ ', there exists an output lexical entry with the description ' $Y$ '. [3.4, 10.6, 11.4]
- lexical semantics:** the study of the meaning of words and the semantic relations that exist between the words as opposed to phrasal and sentential meaning. [4.2.2]
- Lexicalist Hypothesis:** hypothesis, put forward in Chomsky (1970), according to which morphological regularities are encoded in the lexicon and the rules used to derive words are different from the syntactic rules that derive phrases and sentences. [3.3]
- lexicalization:** process of turning concepts or linguistic features into words, e.g., the set of features [HUMAN, MALE, ADULT, NOT MARRIED] is lexicalized through the word *bachelor* in English. This term is also used to refer to **sense specialization**, a property of lexemes of being used with just one of their potential meanings. E.g., the verbal lexeme *bottle<sub>V</sub>* is solely used with the meaning 'put something into a bottle', and not 'hit someone with a bottle' or 'turn something into a bottle', among other possible meanings. [3.3, 4.3.2, 10.6]
- lexicon:** a collection of words. **Mental lexicon** is the knowledge speakers and hearers have about the words in a language. A **sense-enumerative lexicon** is a lists of words wherein each lexical entry represents a different word, and each lexical entry is structured as a list of senses. [1.2, 3.7, 11.4]
- linguistic sign:** an arbitrary conjunction of acoustic form (i.e., sounds) and conceptual meaning. [3.2, 3.6]
- literal meaning:** the kind of meaning that can be interpreted in strict correspondence to what every element within an expression means within a neutral setting. **Non-literal meaning** emerges when the literal interpretation is either impossible, simply false, or when the speaker wishes to convey something beyond the mere compositional interpretation of her words. [4.5]
- mass noun:** common noun referring to unindividuated stuff: *gas, money, beer*, etc. See also **count noun** and **individuation**. [2.3.3, 10.4]
- meaning postulate or lexical axiom:** specification of some formal association that holds between one term in the language and another, typically consisting of two propositions related by lexical entailment. E.g.,  $\forall x[daisy(x) \rightarrow flower(x)]$ : 'if something is a daisy, then it is a flower' (the hyponym *daisy* entails the hypernym *flower*). [5.2]
- Merge:** in Minimalism, a syntactic operation that combines words and complex syntactic objects in order to create larger syntactic objects. [3.2]
- meronymy and holonymy:** part-whole sense relations. A word,  $w_1$ , is said to be a **meronym** of a word,  $w_2$  (its **holonym**), if and only if  $w_1$ 's type,  $A$ , forms a part-of  $w_2$ 's type,  $B$  (e.g., a *finger* is a part of the *hand*). [10.5]
- metaphor:** meaning extension mechanism that allows interpreting one concept in terms of another, with the assumption that there is some salient association between the two (e.g., '*time is money*', '*the classroom was a zoo*', etc.). A metaphor often makes use of a concept that we can easily understand (coming from human perception or bodily experience) in order to represent a more complex or more abstract notion. [4.5, 6.4.1, 11.3, 11.4, 11.5]

- metonymy:** meaning extension mechanism that allows one to refer to an entity with the name of another entity, if both entities are closely related (physically, causally, and otherwise), in particular when one of the entities is an attribute of the other (e.g., ‘We had to fire the lead *violin*’, ‘The *green shirt* behind you is making me nervous’, etc.). [4.5, 11.3, 11.4]
- model:** in logic and formal semantics, a simplified structured copy of the world that reflects linguistically relevant aspects of the situations referred to by words and sentences, where we are able to check the truth or falsity of linguistic expressions after they have been translated into a suitably expressive logic. Theories of meaning that follow this approach are called **model-theoretical semantics**. [5.2]
- modality:** semantic category that allows the speaker to express her/his attitude towards the content of a proposition. **Epistemic modality** expresses the degree of confidence that the speaker has in the state of affairs expressed by a particular utterance (e.g., ‘He is *certainly* around’ vs. ‘He is *possibly* around’). **Deontic modality**, on the other hand, expresses an attitude towards how a state of affairs should be, with respect to social and ethical norms, and encodes various degrees of obligation, permission, and responsibility (e.g., ‘You *must* return the car’ vs. ‘You *can* return the car’). **Mood** is the verbal grammatical category encoding modality. [9.5]
- mood:** see **modality**.
- morpheme:** the smallest linguistic unit with a lexical or grammatical meaning. Morphologically simple words can have just one morpheme (*sun*, *get*, *black*) and morphemes can be smaller than a word (e.g., *un-*, *believ* and *-able* in *unbelievable*). [1.6, 10.6]
- multiword expression (MWE):** expression that can be either syntactically or morphologically complex (i.e., can be subdivided into smaller lexical units) but whose meaning is more or less fixed and is interpreted as idiomatic rather than literal. MWE includes a wide range of expressions that vary according to their degree of lexical specification and syntactic fixedness: phrasal verbs, light verb constructions, collocations, conversational formulae, proverbs, etc. [3.6, 11.5]
- natural type:** lexical type encoding naturally occurring entities (*rock*, *tiger*), properties (*big*, *flat*), and events (*rain*, *fall*), not associated with a specific purpose or function. Natural types have **formal** and **constitutive** features, but they are *underspecified* with respect to **telic** and **agentive** features. [7.4, 10.4]
- non-literal meaning:** see **literal meaning**.
- overgenerate:** a syntactic rule or set of rules is said to overgenerate when it produces unacceptable word combinations. The lexicon is the main source of the constraints that prevent syntax from overgenerating. [2.3]
- paradigmatic relations:** “vertical” relations holding between elements compatible with the same linguistic context and mutually replaceable in that context, e.g., the relation between the nouns *incident* and *ceremony* in *We witnessed that {incident/ ceremony}*. See also **syntagmatic relations**. [3.2]
- perfective aspect:** a kind of grammatical aspect that allows one to view an event in its entirety and describe it as completed (e.g., *Mike built the house*). See also **imperfective aspect**. [6.3.3]
- phrase:** constituent built up around a lexical item (the *head*) belonging to a particular syntactic category, such as nominal phrase (*old houses*, *picture of John*), adjectival phrase (*proud of you*), prepositional phrase (*in the city*), etc. [2.2]
- polarity:** grammaticalized expression of assertion or negation in natural language. [9.5]

**polymorphism:** ability of an object to take on many forms. In linguistics, a predicative expression (e.g., a verb) is said to be **syntactically polymorphic** if it can appear in different syntactic contexts with its arguments. **Semantic polymorphism** arises when a word can be interpreted in different but related ways, depending on the type of the argument it takes. [11.3]

**polysemy:** a kind of lexical ambiguity whereby a lexeme has two or more semantically related meanings (e.g., the senses ‘the act of running’ and ‘strong current of water’ of the noun *race*). **Transcategorical polysemy (t-polysemy)** relates lexemes belonging to different syntactic categories (e.g., the nominal lexeme *race* meaning ‘the act of running’ and the verbal lexeme *race* meaning ‘compete in a race’). When the same kind of semantic relationship is present in more than one pair of senses, we are dealing with **regular polysemy** (e.g., the CONTAINER/CONTENT alternation in nouns that denote some kind of container: *bag*, *cup*, *bottle*, etc.). **Inherent polysemy** arises at the level of lexical-semantic structure of words (e.g., as in the CONTAINER/CONTENT examples above). **Selectional polysemy**, by contrast, emerges when the word itself is not polysemous, but in context its basic meaning is further specified or modified due to contextual influences, most frequently exerted by the selecting predicate (as in ‘John enjoyed his *coffee*, where the *coffee* is reinterpreted as ‘event of drinking coffee’). [1.2, 3.2, 6.5.1.2]

**predication:** semantic act of applying a property to an individual or establishing a relation between individuals. [6.3.2]

**presupposition:** relation between two propositions where both the assertion and the negation of the first entails the second, e.g., both ‘John stopped working out’ and ‘John didn’t stop working out’ presuppose ‘John was working out before’. [4.2.1, 9.5]

**productivity:** capacity of a rule or mechanism to be applied automatically whenever the relevant conditions are met. For example, placing the adjective before the modified noun is a productive syntactic rule in English: {*big/red/fast/American*} *truck*. [2.2]

**Projection Principle:** a core property of natural language grammar in the Principles and Parameters framework. The Projection Principle stipulates that syntactic structures are projected from the lexicon and that lexical features must be preserved at every syntactic level, including Logical Form. [3.2]

**proposition:** logical term used to refer to the information conveyed by a sentence, and which can be judged as true or false. A proposition is what we get after assigning reference to all the referring expressions in a sentence and filtering out those elements that do not affect the truth conditions of the sentence. [4.2.1]

**prototype:** the most prominent or central member of a category. The prototype has all or most of the features that define the category. E.g., an apple is a more prototypical example of the category FRUIT than a kiwi. [5.5]

**qualia structure:** structured representation of the relational force of a lexical item put forward in the Generative Lexicon framework. The qualia structure is made up of qualia roles, which are used to decompose the lexical meaning of words along four dimensions. **Formal:** basic semantic typing (the *is\_a* relation, e.g., *fence* is a kind of ‘barrier’); features that distinguish the object within a larger domain (orientation, shape, dimensionality). **Agentive:** factors involved in the origin of an object (e.g., ‘build’ for *fence*). **Telic:** purpose or function of the object (e.g. ‘separate/ prevent from entering or leaving’ for *fence*). **Constitutive:** relation between an object and its proper parts (e.g. ‘wood/metal’ for *fence*), or between an object and what it is part of. [3.7, 6.3.4, 7.4, 10.4]



- recursion:** repeated application of a rule that allows a sequence to contain an instance of itself, thus contributing to the generation of potentially infinite word chains (as in embedded clauses: [<sub>S</sub> I thought that [<sub>S</sub> you forgot that [<sub>S</sub> the exam is next Friday]]]). [2.2]
- redundancy rule:** a rule specifying which features are predictable given others, e.g., [+Human] → [+Animate] (the feature [+Human] entails [+Animate]). [3.3]
- reentrancy:** property of the feature structures. A value is *reentrant* if it is shared by at least two attributes in the structure. See also **typed feature structure** and **attribute-value matrix**. [3.4, 6.3.1]
- relational predicate:** a predicate that can have multiple values for a given argument, e.g., *neighbor* in *John is Mary's neighbor* ('neighbor(John, Mary)'), because Mary can have many neighbors. See also **functional predicate**. [6.3.2, 10.3]
- reversibility:** sense relation between two terms that involve change in two opposite directions, which leads to two opposite resultant states. It is particularly salient in motion verb antonyms (*come-go*, *rise-fall*) and directional adverbials (*into-out of*, *left-right*), but it can also be detected in non-spatial expressions (*do-undo*, *tighten-loosen*). See also *converseness*. [10.5]
- root:** morpheme carrying the most significant aspects of semantic content for a lexical item, and which cannot be reduced into smaller constituents. Morphologically simple words have only a root (e.g., *sun*, *get*, *black*), while in morphologically complex words the root is combined with other morphemes (*smell-y*, *get-s*, *black-en*, etc.). [10.6]
- scale:** a set of ordered degrees representing a specific attribute (size, position, price, etc.). **Incremental** or **scalar** predicates denote situations where the action expressed by the verb does not affect the entity denoted by its argument as a whole but rather one if its specific properties, which is being progressively altered as the event unfolds. Some of the most typical scalar properties are *physical extension* (as in the *incremental theme predicates*: *John ate an apple* or *John wrote a novel*), *spatial location* (e.g., *John crossed the street*), and also various properties encoded by deadjectival *gradual achievement predicates* (e.g., *John cooled the wine*). [6.5.2, 8.2.2, 9.3]
- selectional requirements:** see **argument structure**.
- semantic construal:** in Cognitive Linguistics, the strategy whereby the speaker chooses one of the many perspectives on describing a situation. Some of the main types of construal are *specificity*, *focusing*, *prominence*, and *perspective*. [5.4]
- semantic role:** linguistic description, encoded as a part of the predicate's *argument structure*, of the specific relationship played by each participant in an event (e.g., *Agent*, *Patient*, *Theme*, *Experiencer*, *Goal*, etc). In generative grammar, the notion of **thematic role** ( $\theta$ -role) is purely syntactic. Unlike semantic roles, the thematic roles are only assigned to the arguments selected by the predicate, never to the adjuncts. [2.2, 6.3.2, 6.4.2, 8.3.1]
- semantic type:** the kind of entity denoted by a lexical item or phrase (PHYSICAL OBJECT, EVENT, ANIMATE, LOCATION, etc.), in particular linguistically relevant semantic distinctions which may affect other components of grammar (syntax, morphology, etc.). [2.3, 7, 10.4]
- semelfactive:** event type defined as instantaneous, dynamic, and atelic. Semelfactives usually express a single occurrence of events that tend to happen in sequences: e.g., *blink*, *cough*, *tap*, *knock*. [6.3.3]
- stage-level property:** property of an individual, linked to external circumstances or to specific temporal and spatial coordinates. Stage-level properties change in and over time and are

- usually transient in nature. (e.g., *hungry, tired, upset*). See also **individual-level property**. [7.3, 9.3.4]
- state**: event type defined as stative, durative, and atelic. States last in time but don't involve change and therefore don't culminate; e.g., *love, resemble, know, be sad*. [6.3.3]
- synonymy**: sense relation of identity between two words that denote classes of entities which totally overlap (i.e., have the same members). The synonyms entail each other: e.g., 'His *spine* is injured' entails 'His *backbone* is injured', and 'His *backbone* is injured' entails 'His *spine* is injured'. [10.5]
- syntactic category**: a group of lexical items presenting morphological, syntactic and semantic similarities. The main syntactic categories are: *verb, noun, adjective, adverb, preposition, determiner, quantifier, conjunction* and *complementizer*. [2.3]
- syntactic rule or well-formedness rule**: abstract principle licensing certain word combinations and ruling out others. [2.2, 3.2]
- syntagmatic relations**: "horizontal" relations acquired by linguistic elements when "chained together" in a word or a phrase, e.g., the relation between the determiner *these* and the noun *girls* in the phrase *these girls*. See also **paradigmatic relations**. [3.2]
- taxonomy**: see **inheritance hierarchy**.
- telic quale**: see **qualia structure**.
- telicity**: aspectual feature that distinguishes events that reach a natural culmination (their *telos*) and events that do not. E.g., the event denoted by *John read* does not have a natural result (i.e., is *atelic*) but that denoted by *John read the book* does (the book has been read through), and it is therefore *telic*. [6.3.3]
- tense (or verbal tense)**: linguistic category that locates events in time and relative to other events and time points, usually through tense morphemes and auxiliary verbs. [6.3.3, 9.4]
- tensor**: type constructor, symbolized as  $\otimes$ , which adds CONSTITUTIVE ( $\otimes_C$ ), AGENTIVE ( $\otimes_A$ ) and TELIC ( $\otimes_T$ ) relations to the head FORMAL type. [7.4]
- thematic role (or  $\theta$ -role)**: see **semantic role**.
- theta-criterion ( $\theta$ -criterion)**: principle introduced in generative syntax in order to guarantee the correct association of the arguments listed in the lexical entry of the predicate with specific syntactic positions. The  $\theta$ -criterion stipulates that each argument bears one and only one  $\theta$ -role, and each  $\theta$ -role is assigned to one and only one argument. [8.3.1]
- transitive verb**: a verb having more than one argument (usually **bivalent**), e.g., *break, steal, love*, etc. **Intransitive verbs** are **monovalent**, i.e., they have just one argument (the syntactic subject): *faint, fall, laugh*, etc. **Ditransitive verbs** are **trivalent**, i.e., they have three arguments (usually a subject, a direct object, and an indirect object): *give, promise, hang*, etc. **Avalent** or **impersonal** verbs require no arguments at all, e.g., the *weather*-verbs in Spanish and Italian: *llueve* 'it rains', *anochece* 'it gets dark', *trueno* 'it thunders', etc. [8.3.2]
- tronymy**: see **hyperonymy** and **hyponymy**.
- truth condition**: condition under which a proposition is true. [4.2.1]
- truth value**: for a proposition, its status of being true or false. [4.2.1, 4.3.3]
- typed feature structure**: data structure indicating what values are associated with a particular attribute (or property) for an object. E.g., for the object PERSON, the attribute LAST\_NAME can

have as its values *Smith, Titov, Chen*, etc.; the attribute GENDER can have as its values *male* and *female*, and so on. See also **attribute-value matrix** and **reentrancy**. [3.4, 6.3.1]

**unaccusative verb**: intransitive verb whose syntactic subject displays the prototypical properties of direct objects of transitive verbs, which usually have the semantic role of Theme or Patient (*leave, fall, die*, etc.). [8.3.2]

**underspecification**: absence of specification of words and other linguistic expressions with respect to certain features (semantic, syntactic, phonological, etc.) that enables them to participate in different syntactic structures and, as a consequence, in different operations of semantic composition [3.7, 6.5.2]

**unergative verb**: intransitive verb whose syntactic subject displays the properties of prototypical subjects of transitive verbs, which are usually agentive (*work, run, dance*, etc.). [8.3.2]

**unification**: in HPSG, a mechanism ensuring that, when two AVMs are combined, all syntactic and semantic constraints encoded in the feature structure are satisfied. Two or more feature structures can be unified unless they contain conflicting feature types or different values for the same feature. [3.4].

**Uniformity of Theta Assignment Hypothesis (UTAH)**: principle introduced in generative syntax in order to guarantee the correct association of the arguments listed in the lexical entry of the predicate with specific syntactic positions. The UTAH stipulates that identical thematic relationships between items are represented by identical underlying structural relationships between those items. [8.3.1]

**Universal Grinder**: linguistic mechanism whereby count nouns become mass, as in ‘There was *cracker* all over the floor’. See also **Universal Packager**. [2.3.3, 11.4]

**Universal Packager**: linguistic mechanism whereby mass nouns become count, as in ‘We ordered two *teas* and three *beers*’. See also **Universal Grinder**. [2.3.3]

**valence** or **syntactic valence** (also called **arity**): indication of the number of required arguments associated with distinct predicates. See also **argument structure**. [6.3.2, 10.3]

**word**: a meaning-form pairing used in forming a sentence in a language and intuitively recognized by native speakers as the basic unit of meaningful speech. The word is assumed to be a basic unit of language, which demarcates the border between morphology and syntax: morphology deals with the internal composition of words and syntax deals with the combination of words. **Orthographic word** is a sequence of letters written consecutively, with no blank spaces. **Phonological word** is a sequence of sounds that behaves as a unit for certain phonological processes, such as stress or accent. **Content (lexical, semantic) words** encode a rich conceptual meaning, related to the real world. Lexical categories include nouns, adjectives, verbs, and most adverbs. **Function words** transfer a much more abstract, language-internal meanings (reference, quantification, predication, etc.). Functional categories include prepositions, conjunctions, complementizers, pronouns, auxiliary verbs, determiners, and quantifiers. [1.3]

**word form**: see **lexeme**.

**X-bar ( $\bar{X}$ ) format**: system of representing the phrase structure that assumes that all lexical categories project phrases made up by three projection levels, yielding the following schema: [XP [Specifier- $X'$   $X'$ [ $X^0$  Complement- $X^0$ ]]]. The combination of a head  $X$  (or  $X^0$ ) with its complement forms an X-bar constituent (called *intermediate projection* and noted as  $\bar{X}$  or  $X'$ ) and

the combination of  $X'$  with a specifier forms the phrase or *maximal projection* (noted as  $XP$ ,  $\bar{X}$ , or  $X''$ ). See also **constituent**, **headedness**, and **phrase**. [3.3]

## References

- A. Rumshisky, V. Grinberg, J. P. (2007). Detecting selectional behaviour of complex types in text. In *Proceeding of the Fourth International Workshop on Generative Approaches to the Lexicon*, Paris, France. University of Geneva.
- Adams, D. (2012). *The Hitchhiker's Guide to the Galaxy*. Pan Books.
- Adams, V. (2014). *Complex words in English*. Routledge.
- Aikhenvald, A. (2004). *Evidentiality*. Oxford University Press.
- Aitchison, J. (2012). *Words in the mind: An introduction to the mental lexicon*. John Wiley & Sons.
- Akmajian, A., Farmer, A. K., Bickmore, L., Demers, R. A., and Harnish, R. M. (2017). *Linguistics: An introduction to language and communication*. MIT press.
- Alexiadou, A. (2001). *Functional structure in nominals: nominalization and ergativity*, volume 42. John Benjamins Publishing.
- Alexiadou, A. and Grimshaw, J. (2008). Verbs, nouns and affixation. *Working Papers of the SFB 732, Incremental Specification in Context*, 1, 1–16.
- Allan, K., editor (2013). *The Oxford handbook of the history of linguistics*. OUP Oxford.
- Amoia, M. and Gardent, C. (2006). Adjective based inference. In *Proceedings of the Workshop KRAQ'06 on Knowledge and Reasoning for Language Processing*, pages 20–27. Association for Computational Linguistics.
- Anderson, S. R. (1982). Where's morphology? *Linguistic inquiry*, pages 571–612.
- Apresjan, J. D. (1974). Regular polysemy. *Linguistics*, 12.
- Arche, M. J. (2006). *Individuals in time: tense, aspect and the individual/stage distinction*, volume 94. John Benjamins Publishing.
- Arche, M. J. and Marín, R. (2015). On the edge. In *Romance Linguistics 2012: Selected papers from the 42nd Linguistic Symposium on Romance Languages (LSRL), Cedar City, Utah, 20-22 April 2012*, volume 7, page 261. John Benjamins Publishing Company.
- Arche, M. J., Fábregas, A., and Marín, R. (2014). Argument structure and aspect in adjectives and participles: Where are we? *Lingua*, 149, 95–117.
- Aristotle (1998). *The Metaphysics*. Penguin Classics.
- Armstrong, S. L., Gleitman, L. R., and Gleitman, H. (1983). What some concepts might not be. *Cognition*, 13(3), 263–308.
- Aronoff, M. (1976). *Word Formation in Generative Grammar*. Cambridge, Massachusetts: The MIT Press.
- Aronoff, M. and Anshen, F. (1998). Morphology and the lexicon: lexicalization and productivity. In A. Spencer and A. M. Zwicky, editors, *The Handbook of Morphology*, pages 237–247. Oxford: Blackwell.
- Aronoff, M. and Fudeman, K. (2011). *What is morphology*, volume 8. John Wiley & Sons.
- Asher, N. (2011). *Lexical meaning in context: A web of words*. Cambridge University Press.
- Asher, N. and Lascarides, A. (1995). Lexical disambiguation in a discourse context. *Journal of semantics*, 12(1), 69–108.
- Asher, N. and Pustejovsky, J. (2013). A type composition logic for generative lexicon. In J. Pustejovsky, P. Bouillon, H. Isahara, K. Kanzaki, and C. Lee, editors, *Advances in Generative Lexicon Theory*, pages 39–66. Springer.
- Atkins, B. S. and Rundell, M. (2008). *The Oxford guide to practical lexicography*. Oxford University Press.

- Atkins, B. T., Kegl, J., and Levin, B. (1988). Anatomy of a verb entry: from linguistic theory to lexicographic practice. *International Journal of Lexicography*, 1(2), 84–126.
- Babonnaud, W., Kallmeyer, L., and Osswald, R. (2016). Polysemy and coercion—a frame-based approach using ltag and hybrid logic. In *Logical Aspects of Computational Linguistics. Celebrating 20 Years of LACL (1996–2016) 9th International Conference, LACL 2016, Nancy, France, December 5–7, 2016, Proceedings 9*, pages 18–33. Springer.
- Badia, T. and Saurí, R. (1998). The representation of syntactically unexpressed complements to nouns. In *COLING-ACL'98*, pages 1–10.
- Baker, M. (1988). *Incorporation*, University of Chicago press. Chicago: The University of Chicago Press.
- Baker, M. C. (2003). *Lexical categories: Verbs, nouns and adjectives*, volume 102. Cambridge University Press.
- Barker, C. (2011). Possessives and relational nouns. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 2, pages 1109–1130. Walter de Gruyter.
- Batiukova, O. (2009a). Aplicaciones lexicográficas de la teoría del lexicon generativo. In E. De Miguel, S. U. Sánchez Jiménez, A. Serradilla Castaño, R. A. Radulescu, and O. Batiukova, editors, *Fronteras de un diccionario: las palabras en movimiento*, pages 233–270. Cilengua. Centro Internacional de Investigación de la Lengua Española.
- Batiukova, O. (2009b). La teoría del léxico en los nuevos diccionarios. In E. De Miguel, editor, *Panorama de la lexicología*, pages 487–516. Ariel.
- Batiukova, O. and de Miguel, E. (2013). Tratamiento lexicográfico de verbos de movimiento con significado amplio. In *Estudios de lingüística: investigaciones, propuestas y aplicaciones*, pages 439–451. Tecnolingüística, Valencia.
- Batiukova, O. and Pustejovsky, J. (2013). Informativeness constraints and compositionality. In R. Saurí, N. Calzolari, C.-R. Huang, A. Lenci, M. Monachini, and J. Pustejovsky, editors, *6th International Conference on Generative Approaches to the Lexicon*, pages 92–100.
- Beauseroy, D. (2009). *Syntaxe et sémantique des noms abstraits statifs: des propriétés verbales ou adjectivales aux propriétés nominales*. Ph.D. thesis, Nancy Université.
- Bertinetto, P. M. (1986). *Tempo, aspetto e azione nel verbo italiano: il sistema dell'indicativo*, volume 4. Presso l'Accademia della Crusca.
- Bhat, D. S. (1994). *The adjectival category: criteria for differentiation and identification*, volume 24. John Benjamins Publishing.
- Bloch-Trojnar, M. and Malicka-Kleparska, A., editors (2017). *Aspect and Valency in Nominals*. Berlin/Boston: Walter de Gruyter.
- Bloomfield, L. (1933). *Language*. New York: Henry Holt.
- Blutner, R. (1998). Lexical pragmatics. *Journal of semantics*, 15(2), 115–162.
- Boeckx, C. (2011). *The Oxford handbook of linguistic minimalism*. Oxford University Press.
- Bohnemeyer, J. (1998). Temporal reference from a radical pragmatics perspective: Why yucatec does not need to express 'after' and 'before'. *Cognitive Linguistics*, 9(3), 239–282.
- Bohnemeyer, J. (2004). Nsm without the strong lexicalization hypothesis. *Theoretical Linguistics*, 29(3), 211–222.
- Booij, G. (1996). Inherent versus contextual inflection and the split morphology hypothesis. In *Yearbook of morphology 1995*, pages 1–16. Springer.
- Borer, H. (2005a). *In name only*, volume 1. Oxford University Press.
- Borer, H. (2005b). *The normal course of events*, volume 2. Oxford University Press.
- Borer, H. (2013). *Taking Form*, volume 3. Oxford University Press.
- Bornkessel, I., Schlesewsky, M., Comrie, B., and Friederici, A. D. (2006). *Semantic role universals and argument linking: Theoretical, typological, and psycholinguistic perspectives*, volume 165. Walter de Gruyter.
- Bosque, I. (2004). *Redes. Diccionario combinatorio del español contemporáneo*. Madrid: SM.
- Bosque, I. and Gutiérrez-Rexach, J. (2009). *Fundamentos de sintaxis formal*. Ediciones Akal.

- Bosque, I. and Mairal, R. (2012). Definiciones mínimas. In *Estudios de lingüística española: homenaje a Manuel Seco*, pages 119–132. Universidad de Alicante.
- Bott, O. (2010). *The processing of events*, volume 162. John Benjamins Publishing.
- Boye, K. (2012). *Epistemic meaning: A crosslinguistic and functional-cognitive study*, volume 43. Walter de Gruyter.
- Bréal, M. (1897). *Essai de sémantique: science des significations*. Paris, Hachette.
- Bréal, M. (1900). *Semantics: Studies in the science of meaning*. W. Heinemann.
- Brentano, F. (1975). *On the several Senses of Being in Aristotle*. Rolf George (Berkeley: University of California Press, 1975).
- Bresnan, J., Asudeh, A., Toivonen, I., and Wechsler, S. (2015). *Lexical-functional syntax*, volume 16. John Wiley & Sons.
- Broccias, C. (2013). Cognitive grammar. In T. Hoffmann and G. Trousdale, editors, *The Oxford handbook of construction grammar*, pages 191–210. Oxford University Press.
- Brugman, C. and Lakoff, G. (1988). Cognitive topology and lexical networks. In S. L. Small, G. W. Cottrell, and M. K. Tanenhaus, editors, *Lexical ambiguity resolution: Perspectives from psycholinguistics, neuropsychology, and artificial intelligence*, pages 477–507. CA: Morgan Kaufman.
- Brugman, C. M. (1988). *The story of over: Polysemy, semantics, and the structure of the lexicon*. New York: Garland.
- Bunnin, N. and Yu, J. (2008). *The Blackwell dictionary of western philosophy*. John Wiley & Sons.
- Bunt, H. C. (1985). *Mass terms and model-theoretic semantics*. Cambridge University Press.
- Busa, F. (1996). *Compositionality and the Semantics of Nominals*. PhD dissertation, Brandeis University, Waltham, MA.
- Butt, M. and Geuder, W. (1998). *The projection of arguments: Lexical and compositional factors*. CSLI Publications.
- Cabredo Hofherr, P. (2010). Adjectives. an introduction. In P. Cabredo Hofherr and O. Matushansky, editors, *Adjectives. Formal analyses in syntax and semantics*, pages 1–26. John Benjamins.
- Calzolari, N. (1995). Structure and access in an automated lexicon and related issues. In D. E. Walker, A. Zampolli, and N. Calzolari, editors, *Automating the lexicon*, pages 337–356. Oxford University Press.
- Cann, R. (2003). *Formal semantics: an introduction*. Cambridge University Press.
- Cann, R., Kempson, R., and Gregoromichelaki, E. (2009). *Semantics: An introduction to meaning in language*. Oxford University Press.
- Carlson, G. N. (1977). *Reference to Kinds in English*. Ph.D. thesis, University of Massachusetts, Amherst.
- Carnie, A. (2002). *Syntax: A generative introduction*. Oxford: Blackwell.
- Carston, R. (2010). Lexical pragmatics, ad hoc concepts and metaphor: from a relevance theory perspective. *Italian Journal of Linguistics*, 22(1), 153–180.
- Chao, Y. R. (1968). *A grammar of spoken Chinese*. University of California Press.
- Cheng, L. L.-S. and Sybesma, R. (2005). Classifiers in four varieties of chinese. *The Oxford handbook of comparative syntax*, pages 259–292.
- Chierchia, G. (1998). Reference to kinds across language. *Natural language semantics*, 6(4), 339–405.
- Chierchia, G. and McConnell-Ginet, S. (2000). *Meaning and grammar: An introduction to semantics*. MIT press.
- Chomsky, N. (1957). *Syntactic Structures*. Mouton.
- Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, Massachusetts: The MIT Press.
- Chomsky, N. (1970). Remarks on nominalization. In R. Jacobs and P. Rosenbaum, editors, *Readings in English Transformational Grammar*. Waltham, Massachusetts: Ginn.
- Chomsky, N. (1981). *Lectures on government and binding*. Dordrecht: Foris.
- Chomsky, N. (1995). *The minimalist program*, volume 1765. Cambridge Univ Press.
- Chomsky, N. (2005). Three factors in language design. *Linguistic inquiry*, 36(1), 1–22.
- Chomsky, N. and McGilvray, J. (2012). *The science of language: Interviews with James McGilvray*. Cambridge University Press.

- Cienki, A. (2007). Frames, idealized cognitive models, and domains. In D. Geeraerts and H. Cuyckens, editors, *The Oxford handbook of cognitive linguistics*, pages 170–187. Oxford University Press.
- Clausen, D., Djalali, A., Grimm, S., Lauer, S., Rojas-Esponda, T., and Levin, B. (2010). Extension, ontological type, and morphosyntactic class: Three ingredients of countability. In *handout and extended abstract, Conference on Empirical, Theoretical and Computational Approaches to Countability in Natural Language*, Ruhr-Universität Bochum.
- Cohen, L. J. (1986). How is conceptual innovation possible? *Erkenntnis*, **25**(2), 221–238.
- Comrie, B. (1976). *Aspect: An introduction to the study of verbal aspect and related problems*, volume 2. Cambridge university press.
- Comrie, B. (1985). *Tense*, volume 17. Cambridge University Press.
- Cooper, R. (2007). Copredication, dynamic generalized quantification and lexical innovation by coercion. In *Fourth International Workshop on Generative Approaches to the Lexicon*.
- Copestake, A. and Briscoe, T. (1995). Semi-productive polysemy and sense extension. *Journal of semantics*, **12**(1), 15–67.
- Coseriu, E. (1977). *Principios de semántica estructural*. Editorial Gredos.
- Croft, W. (1990). A conceptual framework for grammatical categories (or: a taxonomy of propositional acts). *Journal of Semantics*, **7**(3), 245–279.
- Croft, W. (2001). *Radical construction grammar: Syntactic theory in typological perspective*. Oxford University Press.
- Croft, W. (2012). *Verbs: Aspect and causal structure*. OUP Oxford.
- Croft, W. (2013). Radical construction grammar. In T. Hoffmann and G. Trousdale, editors, *The Oxford handbook of construction grammar*, pages 211–232. Oxford University Press.
- Croft, W. and Cruse, D. A. (2004). *Cognitive linguistics*. Cambridge University Press.
- Cruse, A. (2000). *Meaning in Language, an Introduction to Semantics and Pragmatics*. Oxford University Press, Oxford, United Kingdom.
- Cruse, D. (1990). Prototype theory and lexical semantics. In S. Tsohatzidis, editor, *Meanings and Prototypes: Studies in Linguistic Classification*, pages 382–402. Routledge.
- Cruse, D. A. (1986). *Lexical Semantics*. Cambridge University Press, Cambridge, England.
- Dahl, Ö. and Velupillai, V. (2005). Tense and aspect. In M. Haspelmath, M. S. Dryer, D. Gil, and B. Comrie, editors, *World atlas of language structures*, pages 266–281. Oxford University Press.
- Dalrymple, M. (2001). *Lexical functional grammar*. Brill.
- Davidson, D. (1967). The logical form of action sentences. In N. Rescher, editor, *The Logic of Decision and Action*. Pittsburgh, University of Pittsburgh Press.
- Davis, A. R. (2011). Thematic roles. In C. Maienborn, K. von Stechow, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 399–420. Walter de Gruyter.
- Davis, S. and Gillon, B. S. (2004). *Semantics: a reader*. Oxford University Press.
- De Miguel, E. (1999). El aspecto léxico. In I. Bosque and V. Demonte, editors, *Gramática descriptiva de la lengua española*, volume 2, pages 2977–3060. Espasa Calpe.
- De Miguel, E. (2009). La teoría del lexicón generativo. In E. De Miguel, editor, *Panorama de la lexicología*, pages 337–368. Ariel.
- De Miguel, E. (2016). Lexicología. In J. Gutiérrez-Rexach, editor, *Enciclopedia de Lingüística Hispánica*, pages 00–00. Routledge.
- De Miguel Aparicio, E., editor (2009). *Panorama de la lexicología*. Ariel.
- De Swart, H. (1998). Aspect shift and coercion. *Natural Language & Linguistic Theory*, **16**(2), 347–385.
- De Swart, H. (2011). Mismatches and coercion. In C. Maienborn, K. von Stechow, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 574–597. Walter de Gruyter.
- Den Dikken, M. (2013). *The Cambridge handbook of generative syntax*. Cambridge University Press.
- Denham, K. and Lobeck, A. (2012). *Linguistics for everyone: An introduction*. Cengage Learning.



- Di Sciullo, A. M. and Williams, E. (1982). *On the Definition of Word*. Cambridge, Massachusetts: The MIT Press.
- Dixon, R. M. (1991). *A new approach to English grammar, on semantic principles*. Oxford University Press.
- Dixon, R. M. (2004). Adjective classes in typological perspective. In R. Dixon and A. Y. Aikhenvald, editors, *Adjective classes: A crosslinguistic typology*, pages 1–49. Oxford: Oxford University Press.
- Dixon, R. M. and Aikhenvald, A. Y. (2003). Word: a typological framework. In R. M. Dixon and A. Y. Aikhenvald, editors, *Word: A cross-linguistic typology*, pages 1–41. Cambridge University Press.
- Djalali, A., Grimm, S., Clausen, D., and Levin, B. (2011). What can be ground? noun type, constructions, and the universal grinder. *Berkely Linguistics Society*.
- Dowty, D. (1991). Thematic proto-roles and argument selection. *Language*, **67**(3), 547–619.
- Dowty, D. R. (1979). *Word Meaning and Montague Grammar: The Semantics of Verbs and Times in Generative Semantics and in Montague's PTO*. Reidel.
- Egg, M. (2005). *Flexible semantics for reinterpretation phenomena*. CSLI, Stanford.
- Engelberg, S. (2011a). Frameworks of lexical decomposition of verbs. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 358–399. Walter de Gruyter.
- Engelberg, S. (2011b). Lexical decomposition: Foundational issues. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 124–144. Walter de Gruyter.
- Erdmann, K. O. (1900). *Die Bedeutung des Wortes*. E. Avenarius.
- Escandell Vidal, M. V. (2007). *Apuntes de semántica léxica*. Cuadernos de la UNED.
- Escandell-Vidal, V., Leonetti, M., and Ahern, A. (2011). Introduction: Procedural meaning. In V. Escandell-Vidal, M. Leonetti, and A. Ahern, editors, *Procedural Meaning*, pages xvii–xlv. Bingley: Emerald.
- Fábregas, A. (2012). A guide to il and sl in spanish: Properties, problems and proposals. *Borealis—An International Journal of Hispanic Linguistics*, **1**(2), 1–72.
- Fábregas, A. (2014). Phrasal spell-out. an argument from haplology. *Linguistic Analysis*, **39**, 83–125.
- Fábregas, A. (2016). *Las nominalizaciones*. Visor Libros.
- Falk, Y. (2011). *Lexical-functional grammar*. Oxford University Press.
- Fellbaum, C., editor (1998). *Wordnet: an electronic lexical database*. MIT Press.
- Ferreira, F. (1994). Choice of passive voice is affected by verb type and animacy. *Journal of Memory and Language*, **33**(6), 715–736.
- Filip, H. (2011). Aspectual class and aktionsart. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 2, pages 1186–1217. Walter de Gruyter.
- Fillmore, C. (1982). Frame semantics. In *Linguistics in the morning calm*, pages 111–137. Seoul: The Linguistics Society of Korea, Hanshin.
- Fillmore, C. J. (1968). The case for case. In *Universals in Linguistic Theory*, pages 1–88. New York: Holt, Rinehart and Winston.
- Fillmore, C. J. and Baker, C. (2010). A frames approach to semantic analysis. In B. Heine and H. Narrog, editors, *The Oxford Handbook of Linguistic Analysis*. Oxford University Press.
- Fillmore, C. J., Kay, P., and O'Connor, M. C. (1988). Regularity and idiomaticity in grammatical constructions: The case of let alone. *Language*, pages 501–538.
- Fodor, J. (2003). *Hume variations*. Oxford University Press.
- Frawley, W., Eschenroeder, E., Mills, S., and Nguyen, T. (2006). *The expression of modality*, volume 1. Walter de Gruyter.
- Fromkin, V., Rodman, R., and Hyams, N. (2018). *An introduction to language*. Cengage Learning.
- Fromkin, V. A. (1971). The non-anomalous nature of anomalous utterances. *Language*, pages 27–52.
- Fromkin, V. A. (1973). Slips of the tongue. *Scientific American*, pages 110–117.
- Gabriel, C. and Müller, N. (2013). *Grundlagen der generativen Syntax: Französisch, Italienisch, Spanisch*, volume 51. Walter de Gruyter.

- Geeraerts, D. (1990). The lexicographical treatment of prototypical polysemy. In S. Tsohatzidis, editor, *Meanings and Prototypes: Studies in Linguistic Classification*, pages 195–210. Routledge.
- Geeraerts, D. (2010). *Theories of lexical semantics*. Oxford University Press Oxford.
- Goddard, C. (2010). The natural semantic metalanguage approach. In B. Heine and H. Narrog, editors, *The Oxford handbook of linguistic analysis*, pages 459–484. Oxford University Press Oxford.
- Goddard, C. and Wierzbicka, A. (2007). Semantic primes and cultural scripts in language learning and intercultural. *Applied cultural linguistics: Implications for second language learning and intercultural communication*, 7, 105.
- Goddard, C. and Wierzbicka, A. (2013). *Words and meanings: Lexical semantics across domains, languages, and cultures*. OUP Oxford.
- Goldberg, A. (1995). *Constructions, A Construction Grammar Approach to Argument Structure*. Chicago: Chicago University Press.
- Goldberg, A. E. (2006). *Constructions at work: The nature of generalization in language*. Oxford University Press.
- Grimm, S. (2012). *Number and individuation*. Ph.D. thesis, STANFORD UNIVERSITY.
- Grimshaw, J. (1990). *Argument structure*. the MIT Press.
- Grimshaw, J. (2011). Deverbal nominalization. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 2, pages 1292–1313. Walter de Gruyter.
- Gruber, J. S. (1965). *Studies in lexical relations*. Ph.D. thesis, Massachusetts Institute of Technology.
- Hale, K. and Keyser, S. J. (1993). On argument structure and the lexical expression of syntactic relations. In K. Hale and S. J. Keyser, editors, *The view from Building 20: Essays in Linguistics in Honor of Sylvain Bromberger*. MIT Press.
- Hanks, P. (2000). Do word meanings exist? *Computers and the Humanities*, 34(1), 205–215.
- Hanks, P. (2013). *Lexical analysis: Norms and exploitations*. Mit Press.
- Harley, H. (2006). *English words: A linguistic introduction*. Blackwell Publishing Ltd.
- Havasi, C., Pustejovsky, J., and Rumshisky, A. (2007). An evaluation of the brandeis semantic ontology. In *Proceedings of the Fourth International Workshop on Generative Approaches to the Lexicon*.
- Hay, J., Kennedy, C., and Levin, B. (1999). Scalar structure underlies telicity in degree achievements. In T. Matthews and D. Strolovich, editors, *Proceesings of SALT IX*, pages 127–144. Cornell University.
- Heim, I. and Kratzer, A. (1998). *Semantics in generative grammar*, volume 13. Blackwell Oxford.
- Hobbs, J. R. (2011). Word meaning and world knowledge. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 740–761. Walter de Gruyter.
- Hoffmann, T. and Trousdale, G. (2013). *The Oxford handbook of construction grammar*. Oxford University Press.
- Hornstein, N., Nunes, J., and Grohmann, K. K. (2005). *Understanding minimalism*. Cambridge University Press.
- Huddleston, R. and Pullum, G. K. (2005). *A student's introduction to English grammar*. Cambridge University Press.
- Husband, E. M. (2010). *On the compositional nature of stativity*. Ph.D. thesis, Michigan State University.
- Jackendoff, R. (1972). *Semantic interpretation in generative grammar*. The MIT press.
- Jackendoff, R. (1975). Morphological and semantic regularities in the lexicon. *Language*, pages 639–671.
- Jackendoff, R. (1983). *Semantics and cognition*, volume 8. The MIT press.
- Jackendoff, R. (1990). *Semantic structures*, volume 18. The MIT press.
- Jackendoff, R. (1991). Parts and boundaries. *Cognition*, 41(1), 9–45.
- Jackendoff, R. (1997). *The architecture of the language faculty*. MIT Press.
- Jackendoff, R. (2002). *Foundations of language: Brain, Meaning, Grammar, Evolution*. OUP Oxford, UK.
- Jackendoff, R. (2007). *Language, consciousness, culture: Essays on mental structure*. MIT Press.
- Jackendoff, R. (2008). Construction after construction and its theoretical challenges. *Language*, 84(1), 8–28.

- Jackendoff, R. (2010). The parallel architecture and its place in cognitive science. In B. Heine and H. Narrog, editors, *The Oxford handbook of linguistic analysis*, pages 583–605. Oxford University Press Oxford.
- Jackendoff, R. (2011). Conceptual semantics. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 688–709. Walter de Gruyter.
- Jackendoff, R. (2013). Constructions in the parallel architecture. In T. Hoffmann and G. Trousdale, editors, *The Oxford handbook of construction grammar*, pages 70–92. Oxford University Press.
- Jackson, H. (2002). *Lexicography: an introduction*. Psychology Press.
- Jacobson, P. (2014). *Compositional semantics: An introduction to the syntax/semantics interface*. Oxford University Press.
- Jakobson, R., Fant, C. G. M., and Halle, M. (1963). *Preliminaries to speech analysis. The distinctive features and their correlates*. Cambridge, Massachusetts: The MIT Press.
- Ježek, E. (2016). *The lexicon: An introduction*. Oxford University Press.
- Ježek, E. and Pustejovsky, J. (2017). Dynamic argument structure. *LiLT (Linguistic Issues in Language Technology)*, 15.
- Johnson, M. (1987). *The body in the mind: The bodily basis of meaning, imagination, and reason*. University of Chicago Press.
- Jurafsky, D. and Martin, J. H. (2009). *Speech & language processing*. Pearson Education International.
- Kamp, H. (1975). *Two theories about adjectives*. Cambridge University Press.
- Kamp, H. and Partee, B. (1995). Prototype theory and compositionality. *Cognition*, 57(2), 129–191.
- Kaplan, R. M. and Zaenen, A. (1995). Long-distance dependencies, constituent structure, and functional uncertainty. *Formal Issues in Lexical-Functional Grammar*, 47, 137–165.
- Kaplan, R. M., Bresnan, J., et al. (1982). Lexical-functional grammar: A formal system for grammatical representation. In J. Bresnan, editor, *Formal Issues in Lexical-Functional Grammar*, pages 173–281. The MIT Press.
- Karttunen, L. (1971). Implicative verbs. *Language*, 47, 340–358.
- Karttunen, L. (2012). Simple and phrasal implicatives. In *Proceedings of the First Joint Conference on Lexical and Computational Semantics-Volume 1: Proceedings of the main conference and the shared task, and Volume 2: Proceedings of the Sixth International Workshop on Semantic Evaluation*, pages 124–131. Association for Computational Linguistics.
- Karttunen, L. (2016). Presupposition: What went wrong? In M. Moroney, C.-R. Little, J. Collard, and D. Burgdorf, editors, *Semantics and Linguistic Theory (SALT) 26*, pages 705–731. Cornell University, Ithaca, NY.
- Kaschak, M. P. and Glenberg, A. M. (2000). Constructing meaning: The role of affordances and grammatical constructions in sentence comprehension. *Journal of memory and language*, 43(3), 508–529.
- Katz, J. J. (1972). *Semantic theory*. Harper and Row.
- Kearns, K. (2000). *Semantics. Modern Linguistics Series*. England: Macmillan.
- Kennedy, C. (2007). Vagueness and grammar: The semantics of relative and absolute gradable adjectives. *Linguistics and philosophy*, 30(1), 1–45.
- Kennedy, C. (2011). Ambiguity and vagueness: An overview. In C. Maienborn, K. von Heusinger, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 1, pages 507–535. Walter de Gruyter.
- Kennedy, C. and Levin, B. (2008). Measure of change: the adjectival core of degree achievements. In L. McNally and C. Kennedy, editors, *Adjectives and adverbs: Syntax, semantics and discourse*, pages 156–182. Oxford: Oxford University Press.
- Kennedy, C. and McNally, L. (2005). Scale structure, degree modification, and the semantics of gradable predicates. *Language*, pages 345–381.
- Kiparsky, P. (1998). Partitive case and aspect. In M. Butt and W. Geuder, editors, *The projection of arguments: lexical and compositional factors*, pages 265–307. Stanford: CSLI.

- Kiparsky, P. and Kiparsky, C. (1970). Fact. In M. Bierwisch and K. E. Heidolph, editors, *Progress in Linguistics*, pages 143–173. The Hague: Mouton & Co.
- Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. *Semantics and contextual expression*, 75115.
- Krifka, M. (1992). Thematic relations as links between nominal reference and temporal constitution. In I. Sag and A. Szabolcsi, editors, *Lexical matters*, pages 29–53. Stanford: CSLI.
- Krifka, M. (1998). The origins of telicity. In S. Rothstein, editor, *Events and grammar*, pages 197–235. Dordrecht: Kluwer.
- Lakoff, G. (1970). *Irregularity in syntax*. Holt, Rinehart, and Winston.
- Lakoff, G. (1987). *Women, fire, and dangerous things*. University of Chicago Press, Chicago.
- Lakoff, G. and Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Langacker, R. W. (2007). Cognitive grammar. In D. Geeraerts and H. Cuyckens, editors, *The Oxford handbook of cognitive linguistics*, pages 421–462. Oxford University Press.
- Langacker, R. W. (2013). *Essentials of cognitive grammar*. Oxford University Press.
- Lara Ramos, L. (1996). Diccionario del español usual en México. *El Colegio de México, México, Centro de Estudios Lingüísticos y Literarios*.
- Larson, R. K. (1988). On the double object construction. *Linguistic inquiry*, 19(3), 335–391.
- Lascarides, A. and Copestake, A. (1998). Pragmatics and word meaning. *Journal of linguistics*, 34(2), 387–414.
- Lehrer, A. (1974). *Semantic fields and lexical structure*. North-Holland Publishing Company.
- Lenci, A., Busa, F., Ruimy, N., Gola, E., Monachini, M., Calzolari, N., Zampolli, A., Pustejovsky, J., Ogonowski, A., McCawley, C., et al. (2000a). Simple linguistic specifications. *Deliverable D2*, 1.
- Lenci, A., Busa, F., Ruimy, N., Gola, E., Monachini, M., Calzolari, N., Zampolli, A., Pustejovsky, J., Ogonowski, A., McCawley, C., et al. (2000b). Simple linguistic specifications. *Deliverable D2*, 1.
- Leonetti, M., Pérez-Jiménez, I., and Gumiel-Molina, S. (2015). *Ser* and *estar*: outstanding questions. In I. Pérez-Jiménez, M. Leonetti, and S. Gumiel-Molina, editors, *New Perspectives on the Study of Ser and Estar*, pages 1–20. John Benjamins.
- Levin, B. (1993). *English Verb Classes and Alternations: A Preliminary Investigation*. University of Chicago Press, Chicago.
- Levin, B. and Hovav, M. R. (1995). *Unaccusativity: At the syntax-lexical semantics interface*, volume 26. MIT press.
- Levin, B. and Hovav, M. R. (2005). *Argument realization*. Cambridge University Press.
- Levin, B. and Rappaport Hovav, M. (1998). Morphology and lexical semantics. In A. Spencer and A. M. Zwicky, editors, *The Handbook of Morphology*, pages 248–271. Oxford: Blackwell.
- Levine, R. D. and Meurers, W. D. (2006). Head-driven phrase structure grammar. *Encyclopedia of Language and Linguistics*, pages 237–252.
- Lieber, R. (1980). *On the Organization of the Lexicon*. Ph.D. thesis, Massachusetts Institute of Technology.
- Lieber, R. (2004). *Morphology and lexical semantics*, volume 104. Cambridge University Press.
- Link, G. (1983). The logical analysis of plurals and mass terms: A lattice-theoretical approach. *Formal semantics: The essential readings*, pages 127–146.
- Löbner, S. (2013). *Understanding semantics*. Routledge.
- Lycan, W. G. (2012). *Philosophy of language: A contemporary introduction*. Routledge.
- Lyons, J. (1977). *Semantics*. Cambridge: Cambridge University Press.
- Marín, R. (2010). Spanish adjectives within bounds. In P. Cabredo Hofherr and O. Matushansky, editors, *Adjectives. Formal analyses in syntax and semantics*, pages 307–331. John Benjamins.
- McCawley, J. D. (1968). Lexical insertion in a transformational grammar without deep structure. *Papers from the Fourth Regional Meeting of the Chicago Linguistic Society*, pages 71–80.
- McNamara, T. P. (2004). *Semantic priming: Perspectives from memory and word recognition*. Psychology Press.

- Mel'čuk, I. (1996). Lexical functions: a tool for the description of lexical relations in a lexicon. In L. Wanner, editor, *Lexical functions in lexicography and natural language processing*, pages 37–102. Amsterdam: John Benjamins.
- Mel'čuk, I. (2006). Explanatory combinatorial dictionary. In G. Sica, editor, *Open Problems in Linguistics and Lexicography*, pages 225–256. Monza: Polimetrica.
- Mel'čuk, I. (1998). Collocations and lexical functions. In A. Cowie, editor, *Phraseology. Theory, Analysis, and Applications*, pages 23–53. Clarendon Press, Oxford.
- Miller, G. A. and Johnson-Laird, P. N. (1976). *Language and perception*. Cambridge University Press.
- Milsark, G. L. (1974). *Existential sentences in English*. Ph.D. thesis, Massachusetts Institute of Technology.
- Minsky, M. (1975). A framework for representing knowledge. In P. Winston, editor, *The psychology of computer vision*, pages 211–277. New York: McGraw-Hill.
- Moens, M. and Steedman, M. (1987). Temporal ontology in natural language. In *Proceedings of the 25th annual meeting on Association for Computational Linguistics*, pages 1–7. Association for Computational Linguistics.
- Montague, R. (1970). Universal grammar. *Theoria*, **36**(3), 373–398.
- Moravcsik, J. M. (1975). Aitia as generative factor in aristotle's philosophy. *Dialogue*, **14**(04), 622–638.
- Moravcsik, J. M. (1991). What makes reality intelligible? reflections on aristotle's theory of aitia. In L. Judson, editor, *Aristotle's Physics: a collection of essays*, pages 31–48. Oxford: Clarendon Press.
- Morgan, J. (1969). On arguing about semantics. *Papers in Linguistics*, **1**, 49–70.
- Müller, S. (2013). Hpsg—a synopsis. In A. Alexiadou and T. Kiss, editors, *Syntax—Ein internationales Handbuch zeitgenössischer Forschung*, page to appear. Berlin: Walter de Gruyter.
- Murphy, M. L. (2010). *Lexical meaning*. Cambridge University Press.
- Nairn, R., Condoravdi, C., and Karttunen, L. (2006). Computing relative polarity for textual inference. In *Proceedings of the fifth international workshop on inference in computational semantics (icos-5)*.
- Nirenburg, S. and Raskin, V. (2004). *Ontological semantics*. Mit Press.
- Nordlinger, R. and Sadler, L. (2004). Nominal tense in crosslinguistic perspective. *Language*, pages 776–806.
- Nunberg, G., Sag, I. A., and Wasow, T. (1994). Idioms. *Language*, pages 491–538.
- Nuyts, J. and van der Auwera, J. (2016). *The Oxford handbook of modality and mood*. Oxford University Press.
- Oakley, T. (2007). Image schemas. In D. Geeraerts and H. Cuyckens, editors, *The Oxford handbook of cognitive linguistics*, pages 214–235. Oxford University Press.
- O'Grady, W. (2005). *Syntactic carpentry: An emergentist approach to syntax*. Routledge.
- Pafel, J. and Reich, I. (2016). *Einführung in die Semantik: Grundlagen—Analysen—Theorien*. Springer-Verlag.
- Palmer, F. R. (2001). *Mood and modality*. Cambridge University Press.
- Parsons, T. (1970). An analysis of mass terms and amount terms. *Foundations of language*, pages 362–388.
- Parsons, T. (1990). *Events in the Semantics of English*, volume 5. Cambridge, Ma: MIT Press.
- Partee, B. (2007). Compositionality and coercion in semantics: The dynamics of adjective meaning. In G. Bouma, I. Krämer, and J. Zwarts, editors, *Cognitive foundations of interpretation*, pages 145–161. Univeräsity of Chicago Press.
- Partee, B. H. (2008). *Compositionality in formal semantics: Selected papers by Barbara H. Partee*. John Wiley & Sons.
- Paul, H. (1891). *Principles of the History of Language*. Longmans, Green, and Co.
- Paul, I. (2014). *Cross-linguistic investigations of nominalization patterns*, volume 210. John Benjamins Publishing Company.
- Pelletier, F. J. (1974). On some proposals for the semantics of mass nouns. *Journal of Philosophical Logic*, **3**(1-2), 87–108.
- Pérez-Jiménez, I., Leonetti, M., and Gumiel-Molina, S. (2015). *New Perspectives on the Study of Ser and Estar*. John Benjamins.
- Pinkal, M. (1995). *Logic and Lexicon: The Semantics of the Indefinite*. Springer.
- Pinkal, M. (1996). Vagueness, ambiguity, and underspecification. In T. Galloway and J. Spence, editors, *Semantics and Linguistic Theory*, volume 6, pages 185–201. Ithaca, NY: Cornell University.

- Pinker, S. (2013). *Learnability and cognition: The acquisition of argument structure*. MIT press.
- Pollard, C. and Sag, I. A. (1994). *Head-driven phrase structure grammar*. University of Chicago Press.
- Pustejovsky, J. (1988). The geometry of events. In C. Tenny, editor, *Studies in Generative Approaches to Aspect (Lexicon Project Working Papers 24)*, pages 19–39. Cambridge, MIT Press.
- Pustejovsky, J. (1991). The syntax of event structure. *Cognition*, **41**(1), 47–81.
- Pustejovsky, J. (1995). *The Generative Lexicon*. MIT Press, Cambridge, MA.
- Pustejovsky, J. (2000). Events and the semantics of opposition. In C. Tenny and J. Pustejovsky, editors, *Events as Grammatical Objects*, pages 445–482. Center for the Study of Language and Information (CSLI), Stanford, CA.
- Pustejovsky, J. (2001). Type construction and the logic of concepts. In F. Busa and P. Bouillon, editors, *The Language of Word Meaning*, pages 91–123. Cambridge University Press.
- Pustejovsky, J. (2008). From concepts to meaning. In P. Van Sterkenburg, editor, *Unity and Diversity of Languages*, pages 73–84. John Benjamins Publishing.
- Pustejovsky, J. (2009). Generative lexicon. In K. Brown and K. Allan, editors, *Concise encyclopedia of semantics*, pages 357–366. Elsevier.
- Pustejovsky, J. (2011). Coercion in a general theory of argument selection. *Linguistics*, **49**(6), 1401–1431.
- Pustejovsky, J. (2012a). Co-compositionality. In M. Werning, W. Hinzen, and E. Machery, editors, *The Oxford Handbook of Compositionality*. Oxford University Press.
- Pustejovsky, J. (2012b). The semantics of functional spaces. In A. C. Schalley, editor, *Practical Theories and Empirical Practice: A linguistic perspective*, pages 307–324. John Benjamins.
- Pustejovsky, J. (2013). Type theory and lexical decomposition. In J. Pustejovsky, P. Bouillon, H. Isahara, K. Kanzaki, and C. Lee, editors, *Advances in Generative Lexicon Theory*, pages 9–38. Springer.
- Pustejovsky, J. and Jezek, E. (2008). Semantic coercion in language: Beyond distributional analysis. *Italian Journal of Linguistics*, **20**(1), 175–208.
- Pustejovsky, J. and Moszkowicz, J. L. (2011). The qualitative spatial dynamics of motion in language. *Spatial Cognition & Computation*, **11**(1), 15–44.
- Pustejovsky, J., Havasi, C., Littman, J., Rumshisky, A., and Verhagen, M. (2006). Towards a generative lexical resource: The brandeis semantic ontology. In *Proceedings of the fifth language resource and evaluation conference*, volume 7.
- Pustejovsky, J., Bouillon, P., Isahara, H., Kanzaki, K., and Lee, C., editors (2013). *Advances in Generative Lexicon Theory*. Springer.
- Quine, W. V. (1960a). *Word and object*. Cambridge, Massachusetts: MIT Press.
- Quine, W. V. O. (1960b). *Word and object*. MIT press.
- Radford, A. (2004). *Minimalist syntax: Exploring the structure of English*. Cambridge University Press.
- Ramchand, G. (1997). *Aspect and predication: The semantics of argument structure*. Oxford University Press.
- Rappaport Hovav, M. and Levin, B. (1998). Building verb meanings. In M. Butt and W. Geuder, editors, *The projection of arguments: Lexical and compositional factors*, pages 97–134. CSLI Publications.
- Rappaport Hovav, M. and Levin, B. (2010). Reflections on manner/result complementarity. In M. Rappaport Hovav, E. Doron, and I. Sichel, editors, *Lexical semantics, syntax, and event structure*, pages 21–38. Oxford University Press.
- Raskin, V. and Nirenburg, S. (1995). Lexical semantics of adjectives. *New Mexico State University, Computing Research Laboratory Technical Report, MCCS-95-288*.
- Ravin, Y. and Leacock, C. (2000). *Polysemy*. Oxford: Oxford University Press.
- Recanati, F. (2004). *Literal meaning*. Cambridge University Press.
- Reichenbach, H. (1947). *Elements of symbolic logic*. New York: Macmillan.
- Rheingold, H. (2000). *They have a word for it: A lighthearted lexicon of untranslatable words & phrases*. Sarabande Books.
- Riemer, N. (2010). *Introducing semantics*. Cambridge University Press.
- Roland, D., Dick, F., and Elman, J. L. (2007). Frequency of basic english grammatical structures: A corpus analysis. *Journal of memory and language*, **57**(3), 348–379.

- Rosch, E. (1973a). On the internal structure of perceptual and semantic categories. In T. E. Moore, editor, *Cognitive development and the acquisition of language*, pages 111–144. Academic Press.
- Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of experimental psychology: General*, **104**(3), 192.
- Rosch, E. and Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive psychology*, **7**(4), 573–605.
- Rosch, E. H. (1973b). Natural categories. *Cognitive psychology*, **4**(3), 328–350.
- Saeed, J. I. (2003). *Semantics*. Blackwell Publishing.
- Sag, I. A., Wasow, T., Bender, E. M., and Sag, I. A. (1999). *Syntactic theory: A formal introduction*, volume 92. Center for the Study of Language and Information Stanford, CA.
- Saint-Dizier, P. (2006). *Syntax and semantics of prepositions*, volume 29. Springer Science & Business Media.
- Sandra, D. (2009a). Experimentation. In D. Sandra, J.-O. Östman, and J. Verschueren, editors, *Cognition and pragmatics*, pages 157–200. John Benjamins.
- Sandra, D. (2009b). Psycholinguistics. In D. Sandra, J.-O. Östman, and J. Verschueren, editors, *Cognition and pragmatics*, pages 288–368. John Benjamins.
- Saussure, F. d. (1959). Course in general linguistics, edited by Charles Bally and Albert Sechehaye, in collaboration with Albert Riedlinger. translated by Wade Baskin. *New York: Philosophical Library*.
- Saussure, F. d. (1966). Course in general linguistics, edited by Charles Bally and Albert Sechehaye, in collaboration with Albert Riedlinger. translated by Wade Baskin.
- Schank, R. C. and Abelson, R. P. (1977). *Scripts, plans, and knowledge*. Hillsdale, NJ: Lawrence Erlbaum.
- Selkirk, E. (1982). *The Syntax of Words*. Cambridge, Massachusetts: The MIT Press.
- Sinclair, J. (1991). *Corpus, concordance, collocation*. Oxford University Press.
- Smith, C. S. (1991). *The parameter of aspect (Studies in Linguistics and Philosophy, 43)*. Dordrecht: Kluwer.
- Smith, C. S. (2011). Tense and aspect: time across languages. In C. Maienborn, K. von Stechow, and P. Portner, editors, *Semantics: An international handbook of natural language meaning*, volume 2, pages 2581–2608. Walter de Gruyter.
- Smith-Stark, T. C. (1974). The plurality split. In *Chicago Linguistic Society*, volume 10-1, pages 657–672.
- Speaks, J. (2016). Theories of meaning. In E. N. Zalta, editor, *The Stanford Encyclopedia of Philosophy*. Stanford University, Center for the Study of Language and Information.
- Spivey, M., Joanisse, M., and McRae, K. (2012). *The Cambridge handbook of psycholinguistics*. Cambridge University Press.
- Starke, M. (2010). Nanosyntax: A short primer to a new approach to language. *Nordlyd*, **36**(1), 1–6.
- Starke, M. (2011). Towards an elegant solution to language variation: Variation reduces to the size of lexically stored trees. *Unpublished ms.: Universitat Autònoma de Barcelona*.
- Starke, M. (2014). Cleaning up the lexicon. *Linguistic analysis*, **39**(1–2), 245–255.
- Steedman, M. (1996). *Surface Structure and Interpretation*. MIT press.
- Steedman, M. (2000). *The syntactic process*. MIT press.
- Stolz, T. (2001). Singulative-collective: Natural morphology and stable classes in Welsh number inflexion on nouns. *STUF-Language Typology and Universals*, **54**(1), 52–76.
- Tenny, C. L. (1994). *Aspectual roles and the syntax-semantics interface*, volume 52. Springer.
- Tonhauser, J. (2007). Nominal tense? the meaning of guaraní nominal temporal markers. *Language*, **83**(4), 831–869.
- Trier, J. (1931). *Der deutsche Wortschatz im Sinnbezirk des Verstandes: die Geschichte eines sprachlichen Feldes. 1. Von den Anfängen bis zum Beginn des 13. Jahrhunderts*. Winter.
- Tyler, A. and Evans, V. (2001). Reconsidering prepositional polysemy networks: The case of over. *Language*, pages 724–765.
- van Gelderen, E. (2017). *Syntax. An Introduction to Minimalism*. John Benjamins.
- van Sterkenburg, P. (2003). *A practical guide to lexicography*, volume 6. John Benjamins Publishing.
- Van Valin, R. D. (2005). *Exploring the syntax-semantics interface*. Cambridge University Press.

- Van Valin, R. D. (2013). Lexical representation, co-composition, and linking. In J. Pustejovsky, P. Bouillon, H. Isahara, K. Kanzaki, and C. Lee, editors, *Advances in Generative Lexicon Theory*, pages 67–107. Springer.
- Van Valin, R. D. and LaPolla, R. J. (1997). *Syntax: Structure, meaning, and function*. Cambridge University Press.
- Vendler, Z. (1967). *Linguistics in philosophy*. Ithaca: Cornell University.
- Verkuyl, H. J. (1989). Aspectual classes and aspectual composition. *Linguistics and philosophy*, **12**(1), 39–94.
- Verkuyl, H. J. (1996). *A theory of aspectuality: The interaction between temporal and atemporal structure*, volume 64. Cambridge University Press.
- Verkuyl, H. J. (2005). Aspectual composition: surveying the ingredients. In H. J. Verkuyl, H. de Swart, and A. Van Hout, editors, *Perspectives on aspect*, pages 19–39. Springer.
- Vikner, C. and Jensen, P. A. (2002). A semantic analysis of the english genitive. interaction of lexical and formal semantics. *Studia Linguistica*, **56**(2), 191–226.
- Warren, P. (2012). *Introducing psycholinguistics*. Cambridge University Press.
- Weisgerber, J. L. (1927). *Die Bedeutungslehre-ein Irrweg der Sprachwissenschaft?* Winter.
- Werning, M., Hinzen, W., and Machery, E. (2012). *The Oxford handbook of compositionality*. Oxford University Press.
- Wierzbicka, A. (1985a). *Lexicography and Conceptual Analysis*. Ann Arbor: Karoma.
- Wierzbicka, A. (1985b). Oats and wheat: The fallacy of arbitrariness. *Iconicity in syntax*, pages 311–342.
- Wierzbicka, A. (1987). *English speech act verbs: A semantic dictionary*. Academic Press, Australia.
- Wierzbicka, A. (1996). *Semantics: Primes and universals*. Oxford University Press, UK.
- Wilson, D. and Carston, R. (2007). A unitary approach to lexical pragmatics: relevance, inference and ad hoc concepts. In N. Burton-Roberts, editor, *Pragmatics*, pages 230–259. Palgrave Macmillan.
- Winston, M. E., Chaffin, R., and Herrmann, D. (1987). A taxonomy of part-whole relations. *Cognitive science*, **11**(4), 417–444.
- Wulff, S. (2013). Words and idioms. In T. Hoffmann and G. Trousdale, editors, *The Oxford handbook of construction grammar*, pages 274–289. Oxford University Press.
- Zaenen, A. (2006). Unaccusativity. In K. Brown, editor, *Encyclopedia of Language and Linguistics*, pages 217–224. Elsevier Science.
- Zaenen, A., Maling, J., and Thráinsson, H. (1985). Case and grammatical functions: The icelandic passive. *Natural Language & Linguistic Theory*, **3**(4), 441–483.
- Zwarts, J. (2010). A hierarchy of locations: Evidence from the encoding of direction in adpositions and cases. *Linguistics*, **48**(5), 983–1009.