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Title:

The spectrum of distributed creativity: Tango dancing and its generative modalities

Authors & affiliations:

Michael Kimmel, University of Vienna, Cognitive Science Hub, Vienna, Austria

Floor van Alphen, Autonomous University of Madrid, Dept. of General Psychology, Spain

Corresponding author details:

michael.kimmel@univie.ac.at

Phone: 0043 1 8109050

ORCID: [0000-0001-5006-975X](https://orcid.org/0000-0001-5006-975X)

The Spectrum of Distributed Creativity:

Tango Dancing and its Generative Modalities

Abstract

As scholars have recently emphasized, creativity is not restricted to the individual mind; it can happen in and through interaction. To evaluate the legitimacy of claims about “distributed creativity”, we propose a compare-and-contrast approach to Argentine tango. Tango is an improvisational leader-follower dance of a formally constrained kind, yet one that also allows for a range of modes of being creative together in real-time interaction. Six dance couples were filmed while improvising and subsequently interviewed. Based on video-vignettes of a few second’s duration, we micro-genetically reconstructed the embodied “give-and-take” between partners, from which creative trajectories emerge. The spectrum of co-creative modalities ranges from creativity realized in interaction, but bearing some mark of the individual, to creativity, in which the interaction itself becomes an operative mechanism. Co-creation can happen in forms guided by a single person, yet jointly executed (“leader creativity”), in subordinate spaces that provide for some individual creative autonomy within a collective dynamic, in parallel or additive creative interaction forms, but also in genuinely multiplicative forms in which self-organizing interaction dynamics become a powerful causal factor that leverages creativity. To accommodate these various modalities, we argue for a dynamic-systemic account, which looks at interdependencies between micro- and macro-levels. Our framework recognizes different degrees of creative autonomy within interaction; it hereby avoids a dichotomy between individualistic accounts and interactionism with a purely collective-level focus.

Keywords

interaction-based creativity, distributed cognition, embodied cognition, emergence, dance improvisation

Introduction

A time-honored prejudice is that creative acts are located in the mind. The traditional psychology of creativity focuses on mental resources of individual creators, for instance in problem solving, variation and selection, or dual pathway theories (Kozbelt, Beghetto, & Runco, 2010; Runco, 2007; Wallas, 1926; Ward & Kolomyts, 2010; Welling, 2007; Boden, 1990; Hennessey & Amabile, 2010). In recent times, “broad” views of creative cognition (e.g., van der Schyff et al., 2018; Glăveanu, 2014a; Malinin, 2019, see survey below) have begun to challenge methodological individualism and the exclusively mental locus of creativity. Proponents of this new paradigm stress how fundamental for creativity it is to engage with entities external to the mind, demonstrating how the ecology offers resources and valuable constraints. This approach extends the operational locus of creativity beyond the cranium or even the organism. Whatever mental ideation happens, its study falls short of a full explanation. Instead, “broad” views shift the inquiry to how the interaction with things, spaces, or other persons evolves over time, considering the causal effects that this real-time dynamic coupling may have – a claim quite a bit stronger than joint brainstorming, collaboration models, or shared external references (Fischer et al., 2005).

Evidently, this perspective shift aims to redress the long-term neglect of the socio-material ecology in creativity studies. Yet, to what extent it can actually replace individualist theories, respectively in which ways the two views might be complementary, is an issue in need of clarification. In an attempt to address this question, we propose not to treat creative engagement with the ecology as a well-defined single mechanism, but empirically investigate possible realizations and modalities of how creativity emerges in and through interaction.

To do so, we will “unpack” the process how dancers of Argentine tango, an improvisational partner dance with a wide range of creative possibilities, improvise together. We collected, analyzed and categorized several dozens of creative improvisational moments of a few seconds’ length, of which this paper reports on a representative selection, showcasing unique properties of each case. This choice of *micro-genetic* methodology provides an instrument to clarify just how interaction

provides mechanisms of “creative emergence”, but also to capture alternative mechanisms at moments at which such interactional causalities do not actually dominate. Specifically, the analysis will report on interaction scenarios in which creative moments literally emerge *between* the dancers, as “broad” views of creativity would expect, but also on several scenarios in which dancers shape a creative moment with greater individual autonomy. On the basis of these comparative sensitivities, a taxonomy of creativity mechanisms will be proposed which suggest the hypothesis of *multiple creativities in interaction*. As a theoretical tool we propose to look at individual- and collective-level aspects in their dynamic interdependencies, while disentangling them analytically.

Our overall objective is to delineate new spaces for dialogue between individualist/mentalistic and interactionist/ecological camps, while providing a constructive critique of both. The paper starts with a review of recent scholarship which shows that individualism lacks scope, but in later sections we will also caution interactionists not to throw out the baby with the bathwater by equating interaction or ecological situatedness with uniform claims about “creative emergence”.

“Broad” Views of Creative Cognition

To orientate the reader, we will first introduce recent “post-mentalistic” perspectives on creativity. These are representative of wider trends in the cognitive sciences associated with post-cognitivist frameworks, which offer overlapping, yet slightly different critiques of prior theories.

Creativity as Embodied and Contextual Activity

To move beyond the “mentalistic” prejudices of a tradition that studies creativity in individual minds, Malinin (2019, p. 10) argues that “a new definition of creativity is needed to describe creativity as situated practice, emerging through person-environment interactions (material/technological as well as socio-cultural).” Her argument is representative of new trends of creativity research that emphasize ecological situatedness and the constitutive role of active dynamic coupling with others or objects. Within this family of new paradigms, creativity is approached as:

- *Embodied and enactive*: Creativity depends on intelligence of the body and requires acting in the world (Davis et al., 2015; Malinin, 2016, 2019). Skilled, active, and continuous embodied engaging is a causally efficacious part of creating as is perception resulting from active manipulation or feedback stimulation.
- *Situated*: Creativity depends on resources that the here-and-now offers and thrives on constraints provided by the situation (Kirsh, 2009). The creative act is not abstract or generalizable; tiny specifics of the situation can impact it in powerful ways.
- *Interactive*: Creativity is a durationally extended and relational activity between the agent and its socio-material ecology (Kirsh, 2014), sometimes expressed as a “transactional agent-environment coupling” (Vallée-Tourangeau, 2014, p. 40).
- *Distributed*: Creativity happens in socio-technical systemic networks that are distributed over minds, bodies, spaces, tools, and other people (Glăveanu, 2014a, 2014b; Sawyer & DeZutter, 2009) and that function through their interplay in ways distributed over time.

Distributed creativity has been proposed as domain-specific extension of Hutchins’s (1995, 2014) influential general concept of *distributed cognition*. Sawyer and DeZutter explicitly suggest that creativity researchers “borrow methodologies and frameworks from those cognitive scientists who have contributed to our understanding of distributed cognition” (2009, p. 81). Glăveanu emphasizes that the “the creative actor exists only in relation to different audiences, the new artefact is connected to existing cultural artefacts, and creative action exploits the affordances of the socio-cultural environment” (2014a, p. 82). With respect to interactional creativity settings (i.e., not arts and crafts contexts), Sawyer (2003) defines this as *collaborative emergence* processes, which he studied in improvisational theater and everyday conversations (Sawyer, 2001, 2003), and which has spawned further work on the collaborative give-and-take in dance improvisation (Kimmel & Hristova, 2021; Kimmel, Hristova & Kussmaul, 2018) and less collaborative forms in martial arts (Kimmel & Rogler, 2018, 2019; Kimmel & Schneider, 2022).

From the distributed perspective, creative acts transcend brain-and-body bound processes, which mentalist/individualist accounts have so long taken for granted. This results in the claim that, since creativity emerges as a *property of a whole system rather than an isolated mind*, the agents and their environment as a system are the proper unit of analysis (see also Malafouris, 2013; Groth, 2016; Baber et al., 2019; Rietveld & Kiverstein, 2014; Sawyer, 2003, 2000, 2006; van der Schyff et al., 2018; Walton et al., 2017; Schiavio & Kimmel, 2021, Torrents et al., 2011; Torrents et al., 2015; Withagen & van der Kamp, 2018).

Empirical Evidence and Theoretical Plausibility

Several types of observations speak in favor of taking these paradigm-shifting claims seriously. To begin with, many first-person reflections of practitioners of arts, crafts, and design emphasize that creativity is a dynamic encounter. They are highly sensitive to the ecology (i.e. what it offers or precludes) and actively engage with the ecology to develop creative directions. For example, Michelangelo is reputed to have said that he “releases the form from the marble” (Ingold, 2014). A popular metaphor is to speak of “conversations” with things or people that give direction to their creative processes. Scholars have recently seconded practitioners in this when they say that materials are “dialogue partners” (Brinck & Reddy, 2020, Ingold 2013, Aktaş 2019). In some recent debates, this position is expressly taken beyond a heuristic metaphor and developed into a serious philosophical claim to the effect that the non-material realm possesses agency (Knappett & Malafouris, 2008). However, the view that things “act” as organisms is criticized by others (Wheeler, 2010) and currently not generally accepted.

Further theoretical reasons for this paradigm-shift have been brought forward by creativity scholars, such as the idea that creativity cannot be reduced to a solitary practice (e.g., Amabile, 1996; Csikszentmihalyi, 1998). According to Sawyer (2006), creativity is embedded in historical and cultural contexts in the sense that insights can often be traced back to previous collaborations. Creativity can also owe to real-time dynamics of social interaction (Sawyer, 2003). In this respect, Glăveanu (2014b) speaks of the advent of a “we” paradigm in research. Another theoretical insight

that fuels the paradigm shift is that creativity can involve difficult to disentangle recursive iterations that move back and forth between exploration in the ecology and idea generation or specification in the mind (Finke et al., 1992; Ward et al., 1998). Engaging with objects and discovering functions through manipulation or generating useful feedback is one example. A look at this iterative and braided process structure would further suggest that embodied action and perception operate integrally with mental functions. The basic prerequisite for all these insights is to move creative process into focus; to speak with Gruber (1989), we need a focus on “continuance” of creative acts, even in their shortest forms.

Overall, scholars have criticized that traditional creativity research remains beholden to methodological individualism and disregards causal effects which emerge from the interaction with the surrounding world. According to Vallée-Tourangeau (2014, p. 27), this oversight has to do with practices of studying creativity in the laboratory, which are not ecologically valid because they do not provide any opportunity of “interacting with external resources”. Malafouris (2014) speaks of “creative thinging”, while Ingold (2014) coined the term of “creative undergoing”. Duncker (1945) spoke of “intelligent fumbling” as early as the mid 20th century.

Furthermore, general studies in embodied and enacted cognition fuel this paradigm shift. The *embodied cognition* scholars claim is that mental activity depends on bodily structures, which shapes abstract concepts or analogies (Lakoff & Johnson, 1999). In the realm of physical intelligence, embodiment research has, furthermore, discovered that solutions to problems need not necessarily happen in the central nervous system, but that intelligent structuration of the body can possess intelligence in its own right (Dawson et al., 2010; Pfeifer & Bongard, 2007). The *enactive cognition* claim means that cognition is for action (Gallagher, 2017) and, in some versions, is a form of action (Engel et al., 2013); it is not a detached mental event alone. Perception is no mere input and action is no mere output of fully developed ideas. Instead perceptual re-afference, the consequences of one’s own actions, supports reasoning. For example, *deictic* cues (Ballard et al., 1997) can provide an external memory bank and spatial arrangements can scaffold attention during

a task (Kirsh, 1995). Engaging with the world can produce rapid and parsimonious problem solving in recursive loops that braid information gathering, deciding, and acting (Beer, 2003; Gray, 2004; Kirsh & Maglio, 1994). Mechanism of *interactivity-based* problem solving (Steffensen, 2013; Steffensen et al., 2016), may include joint solution probing, directed exploration, feedback stimulation, active manipulation, or niche shaping. Interactivity also overcomes the “sandwich view of cognition”, which assumes that cognition is simply a function interposed between perception and action (Hurley, 2001). Instead, we may assume a massively parallel process such that multiple intersecting loops connect agents and their worlds.

Lastly, studies of creativity in sports, dance, and music have demonstrated the analytic utility of dynamic systems tools, which address the evolution of an agent-ecology system integrally through the lens of dynamic equations. They provide a perspective that other methods cannot supply (van der Schyff et al., 2018; Walton et al., 2015). They argue that creativity can be explained with reference to how an agent-environment system *self-organizes* and what emerges from the (often non-linear) interplay of multiple system components. How this self-organization works depends on external constraints that facilitate behavior of novel kinds. Thus, narrowing down certain constraints can speed along productive adaptations (Torrents et al., 2020). Constraints can stimulate behavioral variability (Chow et al., 2011; Davids et al., 2012), “create new contexts in which novel opportunities for action emerge” (Hristovski et al., 2011, p. 196), prompt transitions to new behaviors, structure the search for novelty, and facilitate re-organizing the generative system, or transferring solutions to novel contexts (Orth et al., 2017, p. 5). Notably interpersonal *self-organization*, the mutual constraining dynamics between agents can trigger creative adaptations (Araújo et al., 2006; Łucznik & Loesche, 2017; Torrents et al., 2016; van der Schyff et al., 2018; Walton et al., 2015, Schiavio & Kimmel 2021) and benefit creative breadth in making music together (Walton et al., 2018) or joint dancing (Torrents et al., 2016). Well-chosen external task constraints have been shown to have a similar effect (Torrents, Hristovski, Coterón & Ric, 2016). Related ideas from complexity science relate creativity benefits to operating “on the edge of chaos”

(van der Schyff et al., 2018), poisoning the system in a state that is neither too rigid nor too chaotic. Related, agents can identify productive zones for exploring novelty and utilize systemic disruptions or short-lived system states where small actions result in large qualitative changes (Hristovski et al., 2011).

Implications and Frontiers of Inquiry

To recap, the various “broad” views of creativity lay bare shortcomings of traditional approaches, and in doing so undoubtedly energize creativity research. They indicate that mental processes need to be thought of as sensitive to the socio-material world, that “thinking” in isolation underspecifies creativity, and that interaction dynamics can causally contribute. What is less clear is how generalizable claims are and what the scope of a “post-mentalist” paradigm might be. We would, specifically, point out three problems in need of discussion:

Firstly, where do slogans such as “material engagement”, “creative thinging”, or “transactionality” leave the individual mind as a locus of creative agency? Traditionally oriented scholars will feel that this insufficiently represents creative combinatorial capabilities, the use of imagination, the exploitation of creativity heuristics, or any other aspect of “mental virtuosity” (Stachó, 2018). Such capacities do not become irrelevant just because we move interaction effects into focus or reject methodological individualism.

Secondly, the “new rhetoric” lacks precise enough terminological differentiations. There is an unclear sense of what the key concepts of “distributed”, “transactional”, and related, “emergent”, imply. Do they all mean the same thing and if so, by what exact definition? Should they just be read as a methodological admonition to broaden our analytical approach or to overhaul ontology as well? How should we evaluate the bolder ontological claims stating that socio-material and mental aspects are a priori inseparable?

Thirdly, the empirical basis for strong claims may be less solid than we would like it to be. Qualitative work that analyzes creative processes without sufficient temporal resolution is prone to representing mental and ecological aspects as amalgamated (i.e. it is prone to method artifacts

because micro-differentiations is not be captured), whereas much dynamic systems work is predicated on a methodology that focuses on relational-interactional variables as an a priori choice.

These three frontiers of inquiry – integration, terminology, and empirical validation – call for new approaches. The micro-genetic study reported here tries to fathom a middle ground between the theoretical extremes, by exploring a continuum of different process types. Our specific strategy will be to carefully analyze what the causal origin of a creative aspect is in different particular micro-situations, using a qualitative, highly granular methodology. In this way we wish to push for a *modal* view of multiple interaction-based creativities, a view that offers plenty of common ground between internalist and interactionist camps.

Methods

Tango argentino is an improvisational partner dance which we have both practiced and which offers a wide spectrum of creativity resources and constellations. We approach this practice with the aim to compare and contrast unique micro-moments of creative interaction, based on a detailed qualitative reconstruction of their processual micro-genesis.

Background

Micro-genetic approaches are now growing in popularity in cognitive science and proliferating into creativity scholarship. Observational methods of this type have addressed different kinds of problem solving in experimental settings (Steffensen et al. 2016) This notably includes the *kinenoetic* analysis of problem solving through fiddling (Ross & Valée-Tourangeau 2021). Naturalistic problem solving “on the job” is investigated elsewhere (Steffensen 2013). Complementarily to these 3rd person approaches, there are many 1st person variants of micro-genetic analysis, such as Petitmengin’s (1999) seminal reconstruction the process of intuitive “aha” moments. Similarly, Glaveanu (2014b) interviewed craftspeople using head-mounted cameras. Studies on creativity in dance (Kimmel et al., 2018; Kimmel & Hristova, 2021) or decision making in sports and dance add to this (Gesbert et al., 2017; R-Kiouak et al 2018; Kimmel, 2021).

Data collection

In the present study, unique moments in which creativity arises in dancing constitute our units of analysis. Since new creative forms continually emerge in movement improvisation, it was easy to collect a large number of micro-moments within a reasonable timeframe. In our approximately 17 hours of video footage, hundreds of micro-events were generated by the dancers. About thirty particularly creative ones were selected for closer qualitative analysis. These micro-events span between two and twenty seconds; the majority lie in the range of 5-8 seconds.

To collect data, we recruited ten experienced dancers of *tango argentino* and had them dance in six different pairings (i.e. two of them danced with different partners). All of them were from the Amsterdam region of the Netherlands, had at least 8 years of dance experience and had been a professional performer, teacher, or both. We needed to concentrate our data-collection in Europe as traveling to Buenos Aires wasn't an option and Amsterdam has a very rich tango scene.

Our focus on specific moments was conveyed to the dancers in a briefing. They were asked to tell us about their specific experiences, instead of generalizing about tango or reporting on other events. We then invited each couple to improvise together freely to music of their own choice and filmed them on a tablet computer. Subsequently we asked them to select creative moments for reviewing them in a dialogue with us. This dialogue was directed to creative moments of a few second's length, whose start and end points were defined and which we subsequently dissected in terms of micro-dynamics occurring at the sub-second scale.

Thus, a species of *retrospective verbal protocol* was applied immediately after the dancing (cf. Ericsson & Simon 1980) using the tablet videos as a reference. This was done in front of another, tripod-mounted camera. The dancers revisited the details of each moment at their leisure, if needed repeatedly or in slow-motion. This video feedback method anchored their responses in joint observables and precise timestamps, thus ensuring concreteness and providing intersubjectivity checks between the dancers and the research team.

Interview methods

Rather than having the dancers verbalize freely a dialogical interview method was applied, in which the researcher have a facilitative role, somewhat in the sense of Socratic midwifery. The interview is meant to support the verbalization of aspects of embodied experience through a dialogic method, which was additionally customized to embodied interaction skills in previous studies (Kimmel & Rogler, 2019; Kimmel et al., 2018; Kimmel, 2019, Kimmel & Hristova, 2021, Kimmel & Schneider, 2022). This allows to tap into aspects that may get lost in spontaneous thinking aloud. Our approach is meant to be sensitive to many aspects which would escape purely observational methods, such as muscle activity inside the body, subtle perceptions, imaginations, intentions, or emerging ideas.

Specifically, we applied facilitative techniques from a variant of micro-phenomenology known as *Explication Interviewing* (Vermersch, 1994; Depraz et al., 2003; Petitmengin, 2006; Stern, 2004; Høffding & Martiny, 2016, Valenzuela-Moguillansky & Vásquez-Rosati, 2019). This is a structured dialogic approach which is designed to allow re-immersion into “thin slices” of a particular experience. The interviewer’s role is to help to stabilize attention on the details of the moment and encourage a mindful state. They ensure that responses stay grounded in the perception of context and concrete actions, while firmly discouraging explanations, beliefs, associative memories, or general knowledge. In *Explication Interviewing* open questions are used with a “what” or “how” focus, never “why”. Normally, the dialogue approaches the selected event from multiple angles. The interviewer repeatedly paraphrases so the interviewees can gradually enrich the picture. The recursive questioning counteracts the known dangers of the verbal protocol method (see Bitbol & Petitmengin, 2013) .

Where needed, we also asked the dancers to engage in “quasi-experimentation”. They could repeat and experiment with interaction patterns. We also asked them to change the timing, or explore alternative options to encourage awareness of technical factors and ecological constraints of the situation. This was particularly effective in making them more aware of rapid and automated interaction processes as well as decision constraints.

Analysis

In the subsequent analysis, we referenced verbalizations of the dancers to the respective moments on the timeline, in order to capture the creative event in its evolution. This micro-analytic approach allowed us to reconstruct in detail the embodied “give-and-take” between the dancers, indicating how, from mutual triggering and constraint, a creative trajectory emerges. This involved identifying how each dancers reacted to the other on the basis of *affordances*, i.e. ecological information that points to the range of momentarily available action options (Gibson, 1979).

Once the micro-events had been analyzed, we took a step back for a global picture of our data. We taxonomically grouped them to see what general types we would find (cf. Kimmel et al., 2018). Specifically, we grouped the sampled micro-events into types with respect to how constitutive interaction is for creativity and with respect to the role of individual creative autonomy (a quantitative analysis was not our aims though).

Although our own experience as tango dancers considerably contributed to the interview and analysis (through our embodied know-how and ability to recognize details when reviewing the rapid action on the videos), we did not independently interpret the videos; rather, the expert verbalizations and visual material had to make sense together and were closely cross-referenced.

Tango as a Domain of Study

Before presenting our results, we will provide some further detail on *tango argentino*, a social dance that developed around 1900 in the multi-cultural immigrant societies in Buenos Aires and Montevideo and that is practiced world-wide today. It involves two dancers in a close embrace that improvise together, following the music and circulating with other couples on the dance-floor. The dance is created in real-time between a leader and a follower, under a strict etiquette and defined role responsibilities. For example, shifting of weight from one leg to another and error correction are down to the leader.

The tango system is notable for its quite strict “body grammar” (Kimmel, 2012) when compared to other dances such as *contact improvisation* (Kimmel et al., 2018, Kimmel, 2021,

Kimmel & Hristova, 2021; Łuczniak, 2015; Łuczniak & Loesche, 2017). It is constrained by biomechanics of upright joint locomotion. The formal repertoire includes walking together, rotations around one another or around a joint center, leg displacements and invasions, leg hooks, or axis shifts in a variety of possible interpersonal configurations (Rahmatian, 2018) and with variable element combinatorics, accentuation, and timing.

A stable connection through the upper body, the tango embrace, provides for deep intercorporeal rapport. It allows the dancers to synchronize, move as one unit, and coordinate the aesthetic development. Through this embrace the sensoria are extended into the partner's body, enabling a connection with partner's inner structure ("mutual incorporation": Froese and Fuchs, 2012); this contributes to unambiguous signal transmission with almost zero delay) and allows the dancers to minutely coordinate their movements and synergize.

Argentine Tango, in contrast to ballroom counterparts, is strictly improvisational (Albright & Gere, 2003; Berkowitz, 2010; Mendonça & Wallace, 2007; Torrance & Schumann, 2019). A dance couple negotiate their trajectory in real time through what interaction researchers call *emergent (i.e. un-planned) coordination* (Knoblich et al., 2011). A couple traverses a matrix with very frequent decision points (Kimmel, 2012) that each have multiple follow-up options. Despite there being a leader and a follower, tango exemplifies a kind of two-way interaction known as *co-regulation* (Fogel, 1993) and *participatory sense-making* (van Alphen, 2014; De Jaegher & Di Paolo, 2007; Fuchs & De Jaegher, 2009). Thus, to coordinate in real time and detect creative potentials, dancers in both roles become exceptionally skilled at "reading" affordances (Gibson, 1979) off the collective configuration and dance-floor ecology at each moment. Affordances-based coordination reaches down to the tiniest increments of a single step, for example with respect to how much a leg is precisely extended. The music enters as a "third partner" of sorts with its own action solicitations. It constrains and inspires, shaping how lines of movement are executed, with syncopation, in staccato, as a slow build-up, and so on. Tango culture has different dance and music

styles, which configure the leader-follower system in slightly different ways: some are more open to the follower's creative input than others.

Proficient tango dancers, although they often simply enjoy the music and togetherness, also actively seek improvisational creativity, displaying an interest in aesthetic and expressive effects. Improvisation in general puts less of a premium on exceptional innovation than on “good enough” choices, quickness, continuity, and being in the moment. Tango dancers must often respond creatively to external pressures such as navigating an impasse, incorporating surprises or repairing errors, but they also engage in active problem finding to boost their creativity (Runco, 1994). The interaction plays a key role here: It is known that co-creating, while difficult for novices (Issartel et al., 2017), offers creative opportunities (Torrents et al., 2016). A leader we interviewed stated that the physicality of the follower “gives me such a rich potential to create with – because I don't have to always get it out of my own inspiration. [...] I could do a whole dance just trying to follow her and enlighten that or contrast it” and adds that “her constraint enriches me” in terms of creativity.

Study Results & Typological Considerations

We will now present a selection of cases from our data. Each of the following twelve vignettes was deemed creative by the dancers and exemplifies psychological creativity, or *P-creativity* after Margaret Boden (1990). No claims about historical uniqueness (*H-creativity*) are necessarily being made. The vignettes representatively illustrate types of scenarios in relation to the role that interaction plays for creativity. Accordingly, the results are grouped into four main categories, which define the spectrum of possibilities in tango.

Leader Creativity

In a first type of setting, co-creation is instigated and largely controlled by one participant of the interaction. We call this “leader creativity” and tango is indeed sometimes perceived as its epitome. It refers to moments when the dance emerges from the leader's combinatory power, who envisages and leads a creative pattern, which is executed together with the follower, who contributes in timing and expressive shaping. It is a form of individual micro-ideation and the

mechanisms of the lead ensure that the partner executes her part. So, the creative pattern originates from a leader's intention, either decided in real-time or minimally prior to the moment. It is possible for inspired leaders to create complex combinatory effects of their own movement and the invited movement of the follower, for instance to generate a rhythmical counterpoint effect: “moving her legs off beat and stepping myself on the beat.”

Skeptics might ask whether leaders are really the only creative agents here. After all, small delays, a position being slightly “off”, aesthetic accentuations, or imprecision of part of the follower can shape how the leader executes an idea. Real-time follower feedback can even suggest surprising options while a creative process is underway. It is true that these kinds of interaction effects *can* happen, but equally true they very often remain absent. Often, able followers will actively forestall them by “staying with the lead”, a prized ability and central focus of follower training.

Figure 1

Rapid Combination of Quick Steps by the Leader Whilst the Follower Does a Figure Eight

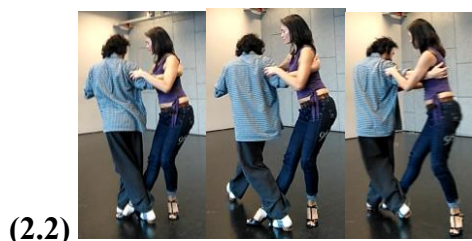


To illustrate, in Figure 1 a dance couple executes multiple small steps to a double-beat rhythm. The two partners execute completely different, yet compatible “micro-moves” with good mutual timing: the leader executes forward steps and tiny rotations facing the follower; the follower is simultaneously led into rapid small rotations in the shape of an 8 (*ochos*). What the dancers consider creative here is the choice and combination of (known) steps in relation to the music; it is largely micro-rhythmic. Although the basic step combinations are somewhat standard, there is subtle creativity in how this combination is fit into the spatial and musical context, in how the rhythm is micro-accentuated through small variations, in how lines are subtly changed and weight is shifted. What makes the example indicative of “leader creativity” is that the creative synergy

originates through, and only through, the leader's decision. He explicitly confirms this and explains that he even micro-plans ahead 3-5 steps. He is confident that thinking ahead like this for about one second can work out; he can effectively control the whole creative synergy. He expects the follower to do her part based on a firm lead with a clear frame. He also emphasizes that he doesn't start the sequence if he cannot expect to succeed in finishing it, although he also stays ready to change trajectory, pause, or repair the interaction.

Figure 2

An Unexpected Leg-crossing (2.1), Leg-shove (2.2) and Resolution Through a Passive Invasion (2.3)



The next example of leader creativity displayed in Figure 2, shows that leaders occasionally invent new step combinations in real time, for example those which neither dancer had tried before. The creative act is triggered by a chance event, an accidentally arising position due to prior mistiming. The leader was preparing for his leg to go under the follower's, but "suddenly my leg was there on top of [her] extended leg", a precarious geometry because the follower's foot is pinned between the leader's legs (Figure 2.1). The leader embraces the error and creatively even

accentuates it: He crosses one leg behind the other, catches the follower's weightless leg in order to push it along the floor to show that something interesting can be done even in that situation. This leg-shove (known as *barrida*) is a frequently used technique, but done like this from behind is highly unconventional (Figure 2.2). The awkward geometry still has not been resolved, so the next moment the leader starts a creative resolution attempt. He extricates his left leg through a big and expressive sideways step to his left (Figure 2.3) while the follower is simultaneously taken along with this movement, "invading" his body space with hers. The leader physically makes her do this. Her left leg is pulled into contact with his thigh, her body follows, and she starts to displace the leader's leg, which receives this energy and ends up flying upwards for spectacular effect. In tango, this passive leg-"invasion" (*passive sacada*) is a familiar interaction technique. At the same time, the leader executed it in an unfamiliar context with a unique history. This made the technique configurationally innovative and an act of technical brinkmanship in response to problem solving pressure: "I kind of lose my balance, but I still find a way [...] to solve it [...] we just created it in the moment, but because it's so unusual, nothing becomes obvious anymore [...] this is completely in the unknown".

This example illustrates two theoretical points. In Figure 2.1 an error and the resulting precarious moment are creatively productive; it seems accurate to claim that the whole interpersonal dynamic makes the sequence possible to begin with. Yet, the response to the challenge is an individual act of the leader, who creatively extends a known technique. Our micro-genetic analysis disentangles the moment of interaction-based challenge from a creative response, which is leader-based and on this basis allows us to ascribe different causal mechanisms to each moment. Furthermore, in relation to Figure 2.3, we must emphasize how the leader "instrumentalizes" the follower's body for a co-creative effect. A creative synergy is realized that the follower has little say in. It massively involves her biomechanics, but not her decision. Her step is a literal extension of his action; it is not self-caused and although it is self-executed she must simply carry out the invasion to stay upright. This makes the "spectacular" fact that she "kicks" his leg away deceptive.

Figure 3*Counterbalance Sideways*

In Figure 3, a leader invents a new micro-form and guides the follower through it. A familiar off-balance technique, a so-called *colgada*, is creatively varied. Normally it involves sending the follower off balance on one leg in a backward direction, while the leader compensates this through leaning back as counterweight. The technical challenge is to form a self-stabilizing joint weight system, so that the leader can rotate around the follower in this position. In our example, a technically more challenging variation is invented by the leader in real time. The ideal interpersonal geometry to start a *colgada* is placing one foot on each side of the follower's standing leg. Instead of creating this position through extra steps, the leader opportunistically decides to use the actual situation in which his feet are both placed next to hers. This geometry is technically more awkward. As a consequence, the follower's weight is sent sideways instead of exactly opposite to the leader's weight, creating an imbalance problem, which the leader had to resolve. The leader finds a dynamic way to create joint stability by sending his weight sideways as well, appropriately counterbalancing the follower and using the rotational momentum. This form-related variation of a standard technique requires a creative technical solution based on known principles of opposed counterweights. This real-time problem solving involves risk and "being aware that in any moment I might need to do a saving movement. So, if we'd lose balance then we would have to do something to avoid falling."

Figure 4*Leg Manipulation*



In Figure 4, the leader employs an unusual “tool” for the lead, as his hand directly manipulates the follower’s leg for creative effect. The leader first sends the follower off-balance to the rear, a *colgada*. He now controls her weight and keeps her from falling. From this position he moves his hand to the follower’s thigh and begins to play with the leg. He creates different wraps of her leg around his thigh (*ganchito*). The thigh is an unusual place to touch, and the leader pushes the boundary of the tango etiquette. The follower, however, accepts this. So, he can play with the free leg because she gives up active control. Both dancers emphasize that the follower could have denied this implicit request by keeping her muscle tone up. The follower agrees to her leg being manipulated, hence deliberately giving up autonomy, yet then contributes to the aesthetic execution of the movement. What this example shows is that some kinds of creative synergy, even when they originate in one person, need the other person’s approval.

Follower Creativity: Sub-autonomous and Supported

In a second general type of setting, an interaction participant operates in a smaller creative space that does not perturb the collective level of the partner system. We call this *semi-autonomous creativity* and its precondition is that the creative sub-space a person occupies at this moment enjoys some autonomy relative to the whole.

In tango, the followers typically have this possibility if they possess enough skill not to restrict the leader’s own creativity. The follower’s creativity strictly operates in the time and space defined by the leader, since followers are canonically not in charge of deciding how steps are

combined over time. Yet, they enjoy much leeway for (temporary) sub-autonomous creative expression. The geometry of the dance provides default positions for this, such as when the follower steps over a leg-stop (*parada*): “he has to wait until my foot is down again to move, otherwise I would trip”. Followers can also do quick, non-perturbing leg adornments *within* the lead. This is illustrated in Figure 5, where a follower “slips in” an adornment kicking her lower leg up very rapidly, being aware that she could harm the leader’s trajectory and step timing.

Figure 5

“Fitting in” an Adornment



What underlies this possibility is that the weight is frequently on a single leg (for a moment) and free legs can operate independently as long as the torso stays where it is. The leader would only feel affected in his creativity if the follower independently changed her weight or moved in space. That is, the biomechanics of interaction define where creative sub-spaces can open in addition to what happens elsewhere in the joint dance system. We may term this semi-autonomous, but perhaps better, *sub-autonomous* follower creativity due to its clear restriction to the follower’s legwork. The adornment needs to be over and done with by the time the leader wants the weight to shift from one leg to another. As long as the follower’s leg movement remains within these bounds, it can exist side by side to what the leader does. One follower explains that the music often suggests such legwork: “I can steal a double time with my adornment, because I don’t disturb him. I can do double things in one beat.”

A closely related form of creativity occurs when the leader gives creative space to the follower for some time and restrains his own aspirations until it is done. We term this *supported individual creativity*. Tango dancers often say the leader’s role is to make the follower “shine” here.

This means that the leader creates enabling conditions for the follower's creativity – which in tango can simply mean doing little of one's own and going into more of a “listening” mode.

Figure 6

Supported Leg Adornments



Figure 6.1 shows a leg adornment in a context where the leader stands relatively still, pivots the follower and provides stability. The follower draws multiple playful small circles with her free (left) leg to accompany the rotation that the rest of her body is undergoing passively. It is a default rule in tango that followers are given time to complete such pivots, especially when this happens to slow music, and they offer a rich space of expressive action. So, the flourish option is “built into” the system before the leader's outer leg is touched and passed. Figure 6.2 is similar, but with a more dynamic leader. The leg-flourish begins as the follower slides her free leg on her other ankle, then lifts it up and draws several small circles in the air with her foot. The leader remains non-invasive and supportive, but he moves in space, orbiting around the follower. She is passively pivoted, but enjoys all the leisure she wants to creative express the free leg. In terms of creativity as whole, the leader's orbiting adds appeal to the follower's circles, so the leader complexifies the effect produced in the follower's creative space through his simultaneous actions. So, even if leaders do nothing very exciting they can aesthetically add to the whole in smaller ways. The type of co-creation discussed next simply amplifies this feature.

Decoupled and Parallel Creativity

In a third general type of setting, participants of the interaction operate in their separate creative spaces. These spaces may be aesthetically complementary, but provide a sizable degree of creative autonomy. In part, this resonates Fischer et al. (2005, p. 485) who define *parallel creativities* as referring to “separately creating elements that are brought together and combined into something new”. As we will see, these autonomous creative aspects can combine at an aesthetic plane and creatively interesting additive effects can arise there. In tango, this kind of physically autonomous process especially occurs in moments of relaxed constraints and of lower speed. Let us begin with moderate forms of parallelism, notably when supported follower creativity is added to by the leader doing creative things within his supporting role.

Figure 7

Exploring Rhythm and Melody

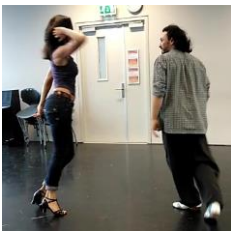


In Figure 7, the follower gets pivoted on one leg by the leader while leaning toward him (an off-balance technique known as *volcada*). The leader moves slowly around the follower. What is creative here lies in the minute, almost still movements the dancers do to accentuate this slow action. The follower is interpreting the lyrical line of the musical melody through some languorous diagonal extension of her torso, with her raised arm adding emphasis. The leader does small steps that keep the rhythm going in a subtle way, thus exploring legwork options. Their individual creative accentuations happen in parallel sub-spaces of the whole, yet in a strongly interconnected way. The dancers are mutually responsive and communicate through the upper body. The leader

“meets” the follower’s upwards extension by expressively lifting himself up, even raising his heels. The follower says the leader was “giving me a longer ‘stay up’ slow line”, which she filled out. The leader makes an interesting comparison: “A bit like with jazz, you give the lead to the other person and they start with the solo [...] I kept something of a support. Of the basics, not a solo, but I kept the basic beat going, while then I said ok what are you putting on top of this basis?” The complementation happens as aesthetically connected, yet the physical impulses are somewhat independent, or as the follower observed “[my movement] was not a response to the lead; it was a response to what he was *doing*. So, I try either to match it, exploring the same, or to make a contrast with it.” The leader confirms: “I didn’t lead her in space. I led her to be in my own place and I kept the embrace, so I didn’t say GO. So, something I did lead. And I did deliberately give my rhythm to her [...] express it to her. Maybe not by how I manipulated her; [but by] deliberately ‘talking’ to her.” It is noteworthy that they both respond to the music, the third player, in different ways here. One dancer draws on the rhythmical, the other on the melodic affordances.

Figure 8

Breaking Contact With an Individual Accent



The last example implies parallel creativities with a high degree of ongoing mutual constraint between the bodies. In contrast to the situation in the previous example, situations in which the tango embrace is broken for a moment of individual action accentuation are more independent in certain respects. In Figure 8, the dancers do a *soltada*, an element in which the dancers break their embrace and begin to rotate around their partner at a small distance. The leader sends the follower a step away from him and into a rotation around her own axis and he rotates around his own axis as well, a small creative aspect. So far, all of this has been decided by the leader. But once she has stepped away the follower becomes more autonomous and uses this

moment for an unusual genre-crossover element from Zook or Salsa: a quick flamboyant sideways flick of her hip in synchronization with the music's rhythmical elements. The dancers meet in an embrace again at a pre-calculated pick-up point, after the leader has given the follower the time she is asking for to do her autonomous movement. Interestingly, although the dancers are physically decoupled, they stay connected through a shared theme of circular movements and know they need to be at a certain meeting point again very soon.

In these last two examples, the dancers each follow their individual creative ideas and act autonomously in doing so. Nonetheless, they obey constraints of mutuality, such as the need to meet in a single spot after the separation. At the same time, they complement each other which gives rise to a higher-level effect that we might call an aesthetic synergy (instead of a biomechanical one). So, creative aspects controlled individually may come together again at the plane of overall effects, which is not only enjoyed by observers, but by the dancers as well.

Emergent Creativity: Non-linear Interaction Effects

In a fourth general type of setting, the interaction dynamic between participants becomes a strong causal factor in its own right. This means that the stream of mutually responsive micro-actions between two participants, their micro-level interplay or “give and take”, becomes the very causal mechanism of (usually unexpected) creative effects. Such creativity can be regarded as a case of strong *emergence* based on the interaction (Sawyer, 2005). The creative causality can neither be attributed to a single person nor a single moment (cf. Ihde & Malafouris, 2019; Sawyer, 2003; Sawyer & DeZutter, 2009; Vallee-Tourangeau, 2014). Therefore, the creative effects are more than the sum of individual actions. We mean this in a stronger sense than in aesthetic synergies. Emergent creativity is characterized by *multiplicative and other non-linear effects of interaction over time* without expectancy about what comes next. We will flesh out the meaning of this in the section Implications for Creativity Theory.

We will now illustrate different emergent creativity constellations in tango. We begin with a type involving by and large, *convergent* dynamics. This phenomenon is characterized by a mutual

dynamic of “yes, and...” (instead of “no, but...”), which extends or develops the partner’s actions. In convergent dynamics, the partners smoothly pick up on each other, including, of course, exploiting *serendipitous* starting points provided by the partner (cf. Ross & Vallée-Tourangeau, 2021). Convergent co-creation exhibits biomechanical continuity or thematic coherence between the partners.

One way of being convergently creative in tango, especially with slow music, is to explore a *theme* together, that is, a general idea on its possible realizations. A shared theme can be defined as an exploration interest, but also as a self-imposed constraint, reflecting the importance of constraints for stimulating creativity (Torrents et al., 2020). As the leader in our next example said: “I believe in the constraint (as creative tool) very much. [...] The limitations of tango often become prisons. But if you choose the constraint, then it opens something.”

Figure 9

Exploring the Diagonal



Note In (9.1) the follower expresses interest in a diagonal in both its directions. In (9.2) a diagonal focus is enacted by the leader in a chain of rotations from corner to corner. In (9.3) final aesthetic emphases of the diagonal are made.

In the example of Figure 9, the shared theme was “how to maintain a diagonal trajectory”, to which both dancers contributed over several seconds. Interest in this theme was initiated through a subtle hint by the follower who gazed into the diagonal, looking beyond their position as a couple into space and overstaying the previous position as the leader turned them both around by 180 degrees. This makes the leader aware of her interest: “by her suddenly putting the attention on the diagonal [I] suddenly start to realize oh we’re walking in a diagonal.” Her lingering in the diagonal a little is recognized as an ostentatious signal by the leader: “which for me emphasizes a line in that direction and then she comes back and really turns quite specifically around to go in that same diagonal.” In other words, the follower imparts a geometric idea to the leader which he picks up on and develops creatively through a series of steps: a chain (*cadena*) of rotations around a joint center. This takes several seconds as they move along the diagonal line towards the other end of the room. The creative aspect here consisted of multiple rotational patterns in sequence, in relation to the music and in relation to creating variations of the same theme. The overall creative inspiration, as far as the trajectory is concerned, stems from the follower, yet the leader implements it in a creative way of his choice. Her creative role develops in a way that reflects the basic leader-follower logic of tango, yet gives her subtle power to propose aesthetic interests. It is the flexibility of the lead and the leader’s attentional responsiveness that gives the follower leeway to request things through *how* she moved. Note that this is also a good example of a creative development of higher-timescale (meso-structural) patterns, that is, wider *creative lines* emerge composed of several dozen micro-elements. The creative aspect lies in the fact that these elements are similar, but vary a basic theme, and that they are part of one larger directional movement, the diagonal. The dancers treat this theme as a temporary constraint, which gives them a productive general focus within which to explore how to vary elements of a specific type.

Figure 10*Double Leg-wrap*

In Figure 10, the dance couple does a leg-wrap with their free legs, which emerges dynamically from a mix of convergent and divergent micro-interactions. This happens on a much shorter timescale than in the last example: The creative moment begins as the partners step forward alongside each other. With the impulse of this movement, the leader kicks his free outer leg forward. The follower's free outer leg moves forward in a circular movement, while he pulls her whole body towards his hip into minimal weight sharing. Both dancers turn their torsos slightly towards each other while doing this. Their combined movements change their overall geometrical configuration so that the leg trajectories of the dancers are no longer parallel, but can now intersect. The next fraction of a second the leader's free leg drops back from the kick, meets the follower's thigh and scoops her leg up. A somewhat unexpected situation emerges in which each leg is wrapped around and into the other. The micro-dynamics of how the double wrap emerged are interesting to consider. The leader says he was expecting her leg to come up faster and higher, so their legs could meet in the air and lightly hook into each other. But she came up slower and lower, as she had autonomously decided to "try something different" and "see what comes out". She had minimally tampered with the ideal coordination to create a little, yet interesting perturbation. As a consequence, the leader unexpectedly found the follower's leg underneath his own and had to react creatively to this surprise. Since they were balanced enough not to have to step backwards straight away he decided to scoop her leg up, which in turn challenges her. He reports that the difference in timing and height "suddenly wakes me up [...] brings me back to my senses [...] And then I start to challenge her, by doing something unexpected". By embracing the leg wrap, the next creative

problem is created down the line. The entangled legs up in the air make the balance of the dancers precarious, a situation which the leader resolves by regaining ground through a “final” tango pose – a classic. He makes a creative virtue of a necessity here. To sum this up, the follower initially subverted a tango habit through her timing, which triggered a challenge that suggested a new possibility, the unusual leg wrap, which then led to a balance problem that was creatively resolved a moment later. One thing triggered the next and a brief instance of ever so slight divergence by the follower created these fruitful challenges for the leader.

Emergent co-creation can equally involve more strongly *divergent* forms of give-and-take. That is, not only *stricu sensu* collaborative behavior makes for productive co-creation. Divergent behavior, within bounds, can do so too. Divergence, as we understand it, ranges from creative effects based on small challenges as in our last example, via creative effects that emerge by repairing something or co-opting a glitch, down to a partner introducing constraints or even deliberate perturbations as a challenge, as well as creative effects based on deliberate aesthetic counterpoint (although we shall see that the latter is somewhat special).

Figure 11

Interrupted Footwork, Reshaping Into a Leg-wrap



The first example of this kind, in Figure 11, involves a deliberate surprise by the leader, which inspires the follower to create a form that one would not expect to see it in the specific context. It begins with the dancers in a sort of T position and the follower creating a rapid succession of the small steps backwards and forwards as embellishments. The leader's leg is stuck out forward in a *parada* position (literally a “stop”). He stays in place and gives her time. The leader says: “I noticed her decision [to make the adornment]. I didn't lead anything and she started

to do it for herself. So, she was completely saying wait for me I'm going to do this." The follower is about to step forwards again, when the leader interrupts her by making a sideways step. Since the follower must stay with the leader, she feels "called back by him" and moves her previously immobile body axis along with him. The forward leg is whipped back which provokes an adornment in which her leg flies up in front of her body and wraps itself around her other thigh (known as *voleo*). She allows for this super-quick adjustment midway in her step and elaborates into something aesthetic. Both dancers agree that the follower's initial behavior was a moment of creative risk taking. The leader emphasizes he counted on her readiness to resolve this creatively. The follower says that, alternatively, she could have frozen, but the option she picked ensured a degree of continuity. A central aim of hers is to "maintain a flow of this energy [that] you don't want to disrupt, you don't want to go against. [...] I would try to work within my frame of the music and my partner." Once the *voleo* is in process, the leader's interruption ceases and he accompanies her rotation with his arms, recognizing that "she is asking for time". To sum up, the creative effect has its origin in the clash of the dancers' individual intentions. One dancer messes with the partner's physical dynamics, who then picks up the perturbation fluidly and makes something aesthetic of it. This kind of co-opting of irritations or errors is a well-documented improvisation mechanism (Berliner, 1994; Sawyer, 2003). Hence, the leg adornment is not initiated by the leader, nor is it the follower's plan at first; it is a split-second decision resulting from the need to continue, a creative problem solving in response to a challenge emerging from their give-and-take a moment earlier.

Figure 12

Going Down Together



Our last example, in Figure 12, is less about clashing intentions or physical interference and divergent in a somewhat different sense. In terms of how the dance is composed over time it develops a thematic counterpoint at an aesthetic-expressive level which contrasts with a moment of high-up tiptoeing that happened earlier in the dance. After the leg manipulation analyzed in Figure 4, the follower goes into a sideways split and then a deep forward lunge: “I started to go down, as a contrast with [the dance-partner]. A conscious artistic decision [... earlier on] he initiated it by starting to dance on his toes. [...] I went into the opposite, as a form of conversation.” For realizing this aesthetic contrast the follower serendipitously amplifies a small detail she notices in the immediate lead. The leader acknowledges having “missed something of my own lead. Apparently, I went a bit more down and she made me realize that.” The follower picks up on this subtlety and adds to it, explaining her aesthetic rationale as follows: “Taking this option to go lower is part of making a whole composition. If an opportunity comes along I’ll accentuate because we are already making very pronounced differences between high and low [in the last moments of the dance].” Thus, an unintended byproduct of his lead surprises him, but he immediately rises to the occasion. Her descending invites him along so he lunges as well. To sum up, the example is interesting since the follower exploits what is physically given, as she skillfully picks up on a small affordance provided by the partner, which she uses serendipitously. In this she acts convergently as far as biomechanics are concerned to initiate something aesthetically divergent at a higher timescale. As the leader comments, “repeating themes is a way to create a story”.

To recap, our fourth main category of co-creation spans quite different examples in which the give-and-take and mutual iterative scaffolding between partners lets them move towards something creative at a low timescale. It is no longer possible to say that the leader is the origin of the creative event, nor does the creative happen in separate autonomous spaces of either dancer. Mutual responsiveness between leader and follower is the causal basis. Dynamic systems theorists would say that the system dynamic “self-organizes” based on small effects like perturbations, minimal geometry changes or timing delays, or amplified movements to create a unique creative

trajectory. We shall discuss this topic forthwith after drawing some general conclusions from our contrast-and-compare approach.

Disposition, Styles, Meta-regulative Choices, and Physicality

One thing that struck us was the diversity of approaches to tango dancing in general, which impact the kind of creativity we see. Our data suggests that creative events are constrained by individual dispositions, on top of interpersonal factors of compatibility and “chemistry”. Dancers can determine how and by which mechanism they seek creative effects. These can be situational choices, but they often also follow general goals of “what tango is about for me”, a kind of high-level framing intentionality that cannot directly determine the creativity we see, but constrains it.

For example, dancers place different emphases with respect to musicality or technical complexity; risk taking, experimentation or rule-breaking; dancing in biomechanically more interdependent ways (open or close embrace); degrees of individual creative autonomy, or the allowability of theatrical effects. Dancers who are familiar with many different modalities of dancing may effectively act as “system managers” who act in a meta-regulative capacity and, depending on context, partner and whim, make some of these choices quite deliberately.

Furthermore, we have seen different views of the role distribution. A dancer, who reported that he sought utmost formal precision, a quite directive and a super-clear lead, emphasizes that “if [the follower does] something that disconnects [from me], that’s very dangerous”. Another leader, who mentioned his background in contemporary dance, picks up on the follower more responsively. He even states that if you feel “something else is on their mind, expressed with the body, try to follow her” and that it’s “a bit like what sculptors say, [...] they have to follow their material. Each material has its own character, you can’t go against it. Because you just ruin the piece of marble.” Thus, a very traditional stance contrasts to a more contemporary tango philosophy in which emergence is accepted, instead of preempted or controlled for. We might even say that different ways of regulating creative autonomy in couples follow from such dispositions.

We interviewed dancers who demonstrated different degrees of boundary pushing of the tango genre: some are quite adamant about “correctness”, and others play with and even subvert the genre somewhat, such as the leg handling example discussed earlier. Tango dancers also differ in their creative techniques. Some use the tango canon; others transcend it by exploring what other forms its principles could generate. Yet others employ creativity techniques from outside of tango, such as from contemporary dance. One leader has worked with choreographers and emphasizes he uses theatrical tools like stepping out of his role as a dancer, becoming his own person for a moment, making everyday gestures, or incorporating the surrounding material: “I often use things that are in the space, other people, the wall, a chair, the floor”. He also mentions using imaginations such as standing on the side of a cliff as “constraints that I impose upon myself and I try to make as real as possible. [...] For me it’s real tango, but taking tango out of the classical [frame].”

Furthermore, dancers differ with respect to how important they think novelty is in relation to enjoying rapport and musicality. As one leader says, “if we would want to enjoy we would do much less [...] is creativity that important?” A follower comments that she is gratified by “a lot of personal sparks, personal chemistry [...something] more spiritual, and musicality [...] More is happening than the total sum of the parts. You do things and something happens on another level too.”

Related, we find marked differences in the emphasis dancers put on musical expression. How individual dancers “hear” the music and what to make of it differs greatly, even in a single couple. One follower observes that there was something like a fight with the partner: “I get in my [own] tango modus, especially with [particular upbeat music]. And I go less with [my leader]”. The leader comments: “Because she has a lot of knowledge and background and she is quite strong, she directs a lot when she is in her frame of mind. I feel she wants to be dancing [this music] in a certain way. And I don’t want to do it her way. I wanted her to first to connect to me and not to her idea of tango.” Interestingly, the dance couple that demonstrated divergent physicality based on interrupted footwork (see Figure 11) also commented how the specific kind of music, which is, for

them, about tension and its release, encourages behavior in which partners mutually challenge each other. Thus, music may be a direct source of creative divergence.

Overall, the analysis underwrites how much the domain-specific physicality (i.e., how bodies synergize and communicate) shape creative potentials. Physicality cannot be tidily separated from creativity, and often effects of interaction regulation or technical execution (for example, small perturbations or timing delays) trigger something creative. This resonates claims about self-organizing biomechanic dynamics (Hristovski et al., 2011). Notably, emergent effects can be due to impulses that synchronously “blend”. This depends on rapid physical communication within an embrace, a *closed loop coupling* set-up that provides immediate in-process feedback and allows dancers to exploit this in real-time to influence ongoing actions. In tango, there is a certain limitation to this based on dancers retaining some biomechanical independence at (almost) all moments (“staying in axis”). More dramatic physical “blending” effects would be seen, for example, in the contemporary dance known as contact improvisation, in which there are no fixed forms and exceptional degrees of freedom for individual exploration. Kimmel and Hristova (2021) report on a peculiar give-and-take dynamic between two dancers with micro-moments of independent parallel actions, rapidly evolving into “blended” effects through physical entanglement. The dancers impact each other in unpredictable ways and generate new problems together constantly. We need to pay close attention to how the quickly alternating mixes of exploratory freedom and coupling-based constraint give rise to unpredictable novelty. The take-home message is that physical forms of creative behavior are subject to a specific embodied set-up. The space it provides for physical synergizing determines the possibilities of structural coupling between bodies.

Towards a Modal Theory of Improvisational Creativity

The selected vignettes nicely illustrate the fact that dancing together can involve different loci, degrees, and mechanisms of joint creativity. Thus understood, co-creation is a *spectral phenomenon* of creative process types (also see Sawyer, 1996; Torrance & Schumann, 2019).

Distinctions About Improvisational Creativity

Modalities of being creative can be distinguished from different angles. To begin with, what we single out as “creative” can be form-related or configurational, but it can also be dominantly qualitative (e.g. in the kinaesthetic “feel”) and be about how something is done, for example in terms of dynamics or musicality or a particular way of aestheticizing a movement. It can graft a known pattern to a new context or invent a new pattern. Some creativity is thematic-interpretive or tells a “story”. More generally, creative “lines” that emerge through the serial combination of elements contrast with creative assemblies of new “micro-forms” at a given moment. Yet another important distinction is whether we can locate the creative aspect in a single person’s behavior (e.g. a leg action) or whether it lies in the collective configuration or dynamic (Kimmel et al., 2018).

A different way of carving up the creativity spectrum is to ask whether creativity is self-created or externally stimulated and responding to adaptive pressures, down to outright “survival creativity” (Torrance, 1988). The dominant activity consists of creative problem solving whereas self-created improvisational exploration and self-induced experimentation can use problem finding as a creativity mechanism (cf. Runco, 1994).

Yet another distinction depends on whether creativity remains within the traditional constraints of the domain or pushes its boundaries. Torrance and Schumann (2019) distinguish safe-end and risky-end forms of improvisational creativity, whereas Kimmel et al. (2018) speak of *genre-creativity*, say, tango and salsa crossovers. Jazz researcher Berliner (1994) differentiates convergent and divergent forms (see earlier discussion), but also brings to the fore dominance patterns in ensembles which can fluctuate over time. Kimmel and Hristova (2021) similarly emphasize that interaction can be convergent or divergent and argue that this is an embodied analogue to “convergent/divergent thinking” in interacting with the socio-material ecology.

The typological aspect foregrounded by our analysis is how interaction causally contributes to creativity, i.e. the evolving embodied “give and take” between persons. Kimmel and Hristova (2021) draw a global distinction with respect to whether leaders are individually creative or whether creativity is an emergent property of the interaction. This distinction pertains to the “locus of the

creative”, or more appositely, to its localizability in individuals. When interaction dynamics are constitutive for something creative, making it more than the sum of its contributing behaviors, then we cannot speak of localizability any more. Against this background, we have proposed to contrast (a) leader creativity, (b) sub-autonomous and assisted forms of follower creativity, (c) parallel or semi-decoupled creativity, and (d) emergent forms of co-creation, where the “transactional” interactive dynamics provides creative impetus in a number of possible ways. Creativity types (a)-(c) can be more readily parceled out and attributed to individual contributions, although they may additively create collective effects; whereas type (d) constitutively require the process of give-and-take for the creative to emerge and involves multiplicative effects. Thus, leader creativity sits at the individualistic end of the co-creative spectrum where, albeit contextually fitting, “mental virtuosity” (Stachó, 2018) is the dominant resource. Emergent interaction forms, the opposite end of the spectrum, place a greater premium on something we might analogously term “ecological-dynamic virtuosity”, the skill of creatively exploiting emergent dynamics (Kimmel et al., 2018). Many of the advanced dancers in our study find this form of interaction-based creative genesis something very attractive, rather than disruptive. We may link this to a general generative mechanism known as *soft assembly* (Kello & Van Orden, 2009), for which micro-components are “mixed and matched” in creative ways while complementing the partner’s action at each moment (for a more detailed argument see Kimmel, 2021; Schiavio and Kimmel, 2021).

Forms and Contexts of Emergence

Let us consider our modal theory of co-creation in light of Sawyer’s (2003) notion of *collaborative emergence*. The assumption is that interaction processes leverage creativity through mutually responsive behavior and that, as a consequence, individual improvisers must stay in touch with an evolving macro-scopic reality as they act. A “structured, but ephemeral emergent”, the state of the co-evolving social ecology (2003, p. 86f) arises as individual actions, actions of others, genre constraints, and the prior interaction history intersect. The social “emergent” is evidently a source of constraint, but if circumspectly handled, it is also a source of creative power.

Any improvised social interaction produces an “emergent” of some sort, yet how emergent *creativity* is a slightly different matter. Our study demonstrated not only differences between convergent and divergent creative emergence, but weaker and stronger forms of the phenomenon as well. In the weaker forms the originator of the creative is dominantly the leader. While both partners execute the creation the leader retains much control of the emergent dynamics. Even stronger creative emergence displays interesting differences. This ranges from relatively additive question-response dynamics to “blended” effects with genuinely multiplicative features, as in the double leg wrap dynamics in Figure 10 or in the perturbation-based *voleo* in Figure 11. On major source of such creatively multiplicative outcomes is the real-time *co-modulatory influence* by the partner that changes the quality of what a person is doing (Kimmel & Rogler, 2018). Examples include when a jazz bandleader subtly counteracts a solo of another bandmember or when the same person amplifies and extends what the other is doing.

A central lesson from our taxonomy is that we need to ask whether a creative pattern dominantly originates in one person, in parallel actions, or in emergent coupling effects of both persons. Therefore, it may be concluded that all forms of tango creativity distribute the *execution* of a collective action, but not all distribute *creative genesis*.

Creative Autonomy Within Emergence

More generally, the creative “emergent” has to be seen in light of possible forms of coordination (De Jaegher, Peräkylä & Stevanovic, 2016) and degrees of individual creative autonomy. This suggests reflections on the concept of autonomy. Theorists of participatory sense-making (De Jaegher and Di Paolo 2007) emphasize, first, that individual agents are always autonomous, and second, that interaction systems establish a kind of autonomy in its own right due to its capability for establishing self-organizing dynamics. The autonomous control of interacting individuals is never complete, but also never disappears completely vis-à-vis the macro-systemic dynamics.

In a system with asymmetric roles such as tango, decision autonomy tends to be limited for tango followers, yet physical autonomy remains enormous, a crucial precondition for successful improvisation. Followers retain autonomous control of the “how”, the timing and accentuation, less so the “what”, the trajectory of the couple (although they may subtly influence it). Meanwhile, we have also shown that competent followers can “stake out” their own loci of creative autonomy (in sub-autonomous and supported functions). Finally, we may point out that creative autonomy can make itself felt in subtle ways through predilections, exploration interests, preferred movement forms, locations of creative investment, and things to try when the chance arises, like adornments.

The general lesson here is this: Rather than interpersonal emergence rendering creative autonomy irrelevant, we should ask in what ways autonomy is configured vis-à-vis the interpersonal sphere. Thus, we can say that even a co-creative system as constrained as tango involves layers where shared/coupled activities sit co-exist with loci of creative autonomy.

Implications for Creativity Theory

Given that we find this spectrum of modes in co-creation, what theoretical and conceptual implications does this suggest in regard to “broad” views of creativity?

From Methodology...

A methodological commitment to a relational and situated style of analysis is clearly fundamental to any serious analysis of co-creation. This traces how evolving ecological constraints constrain and fuel creativity. This relational emphasis is evident in Hutchins’ work, who first coined the notion of “distributedness” to posit a stance that traces how information flows in a social or socio-technical system and how its exchange produces emergent feats. He emphasizes that “[d]istributed cognition is not a kind of cognition; it is a perspective on all of cognition [...] the perspective itself makes no empirical claims” (2014, p. 36, p. 37). Since a distributed perspective can address different forms of cognition, co-creation can be “distributed” in different ways, ranging “from relatively predictable and constrained, to relatively unpredictable and unconstrained” (Sawyer & DeZutter, 2009, p. 82) as well as allowing for many other distinctions. Similarly,

although Vallée-Tourangeau (2014) takes a stronger methodological view, the term “transactionality” can be given a methodological reading. This is likely how the philosopher John Dewey originally intended the term when he proposed a meta-theory of behavioral research based on the relational analysis of durational events (among other things in his famous book with Arthur Bentley: Dewey & Bentley, 1949).

Meanwhile, a key point is that a situated-relational analysis must not degenerate into an exclusive focus on macro-systemic causalities, which would invert the reductionistic flaws of methodological individualism and conceal aspects of creative autonomy (see above). Rather, the task is to evaluate mental and individual aspects against the backdrop of the momentary ecological constellation. Whether or not creative outcomes can be attributed to an individual’s action or not considerations of how repertoire, combinatoric virtuosity, and creative imagination shape improvisational decisions remains relevant. So an important question is how individual aspects “plug into” the interaction dynamic, hence how micro-ideas are fit into the relational “give-and-take”. Rather than making the macro-relational level the sole analytic locus, we should try to look at micro- and macro-levels in their dynamic interdependencies.

...To Ontology

Should the terms distributedness or transactionality be also read as ontological claims about creativity? A conceptual analysis suggests that scholars with a relational and ecological outlook may not be fully aligned on the specifics. Some accounts, such as Glăveanu and Sawyer’s seem to be open to partially individualistic parlance. To quote Glăveanu (2015), the “inherent potential” for co-agency “is not always realised to its fullest” (p. 253) and, thus, “sociocultural theory is not opposed to individual-level or cognitive theories of creativity” (Glăveanu, 2020, p. 348). Similarly, Sawyer (2005) takes a middle position in which individuals are ontologically irreducible while accepting that emergent causalities cannot always be reduced to the former and that collective dynamics can follow their own laws. Other scholars, such as Ingold and Malafouris, offer decidedly stronger and more generalizing claims.

We side with the former positions and would especially criticize the latter views for their tendency to use metaphorical shorthands that globally characterize the nature of creativity “as such”. An example is to exclusively locate creativity “between” agent and ecology. Replacing a metaphor such as creativity “in” the head with another just as coarse one, namely “in between”, is of no great help. Instead, creativity should be understood as an emergent product of relational field dynamics. Similarly, metaphors such as “inseparable linkage” of minds, bodies, and materials (e.g., Ihde & Malafouris, 2019) seem inappropriate, as we are not talking about any material connection, but a coupling *dynamic* that can be full or selective, momentary or continuous, tighter or looser, that can de-couple briefly, or even cease. Speaking of “entanglement” (ibid.) is somewhat less reifying, but ultimately fails to distinguish degrees of dynamic coupling or types of creative autonomy within interaction just as much. Overall, space or substance metaphors provide little analytic grip on dynamics. In fact, their relatively static connotations sit uneasily with (more appropriate) process-ontological metaphors such as temporally extended “lines” (Ingold, 2015).

We suspect that these views would amalgamate different our empirical spectrum into a simple global assessment. After all, they all happen in situated interaction, are jointly realized, and embodied coupling dynamics mediates them in *some* way. However, these three criteria in isolation cannot vindicate strong generalized conclusions, as we will argue next.

Is Coupling Constitutive for Co-creation?

A claim of inseparable entanglement between agent and ecology can imply two things: (a) that ecological and mental causation of creativity are *analytically non-decomposable*; a view which a micro-genetic perspective quickly proves wrong; or (b) that they are *causally non-decomposable*, such that coupling dynamics are constitutive for explaining creativity; a serious philosophical position that nevertheless seems flawed when generalized to all forms of creativity. It overlooks that interaction can have a mere contextual rather than a genuinely enabling or constitutive role (De Jaegher et al., 2010). The problem is analogous to saying that all cognition literally extends from

mind to environment just because people are engaged in dynamic couplings with the latter, known as the “coupling-constitution fallacy” (Adams & Aizawa, 2010).

Constitutiveness is clearly no *a priori* matter when it comes to creativity: On our spectrum of tango creativity, interaction is constitutive at the pole of emergent forms of creativity, but hardly at the opposite pole of leader creativity. So, comparative sensitivities warn us against conflating a general dynamic-relational stance with claims about the causal role of interpersonal dynamics. We would argue that interaction is constitutive of creativity if, and only if, there are (a) multiplicative or otherwise non-linear creative effects that emerge from its coupling dynamics and (b) if this emergence is actively embraced, instead of suppressed. Kimmel and Hristova (2021) propose appealing to genuinely “transactional” creativity mechanisms only when agents creatively modulate, augment, or transform each other.

Towards a Systemic Model

To advance this debate further we will now sketch a systemic model of the relationship between individual and collective dynamics. Analyzing micro-macro interdependencies in this fashion requires the presupposition that a co-creative system is an field composed of temporary informational and physical linkages between elements with defined weights and connectivity, which can change at each moment (for example, the position and embrace of dancers can change). This assumption allows us to reconstruct information flows between micro- and macro-systemic levels and clarify how their causal cross-influences play out at a specific moment.

The framework of *coordination dynamics* (e.g., Araújo et al., 2006; Araújo & Davids, 2011; Warren, 2006; Torrents et al., 2021) provides us with tools to conceptualize this: The basic hierarchical set-up of a co-creative system comprises two behavioral systems nested in a shared relational system. Meaningful interpersonal action depends on *synergies* between individuals, which are ongoingly negotiated through informational and physical coordination. The coordinative patterns are not pre-defined, but assembled on the spot; yet the system remains coherent, meaning that individual aspects are interdependently adapted in those respects that define the macro-systemic

meaning (such as moving together as a connected unit in tango). The coordinative system is constrained at individual levels (such as posture) and interpersonal levels (such as the embrace). However, several individual aspects (such as what a dancer's free leg does) operate freely for the moment.

The agency of individuals impacts the collective level by *selectively* passing information or forces to it. A collective dynamic emerges, which in turn constrains the individuals, which is to say that it can in return exert *downward causation*. This is known as *circular causality* (e.g., Fuchs, 2020). In some situations, but by far not all, macro-systemic properties can severely constrain individuals, for example, “bring them in line” to conform to a collective trend. They can also amplify small effects, create happy accidents, or disturb previous coordination patterns in challenging ways, which individuals in turn need to handle. The coupling of system components via downward causation and its repercussions recursively “cycling up” again can generate non-linear phenomena; when this happens this explains why emergence leverages creativity, as dynamic systems studies emphasize (e.g. Hristovski et al., 2011).

The nature and degree of circular causalities, however, remains a case-based matter (see Sawyer, 2005) depending on settings, roles, and rules, which influence how non-linear things get. Emergence from micro to macro can be additive (and thus relatively decomposable) or create a multiplicative whole with new qualities; downward causation can be weak or strong and, moreover, it can frequently be blocked or actively embraced: competent agents can decide what they do with it to a certain extent. The notion that circular causalities depends on these variables makes room for multiple forms in which the entwinement between micro- and macro-levels can play out. Part of this is how a co-creative system is configured. Leader-follower settings display coupling that is stronger in one direction than in the other; in the extreme case this becomes unidirectional coupling (de Poel, 2016, p. 2). So, other co-creation systems are slightly unlike tango in their basic constellation.

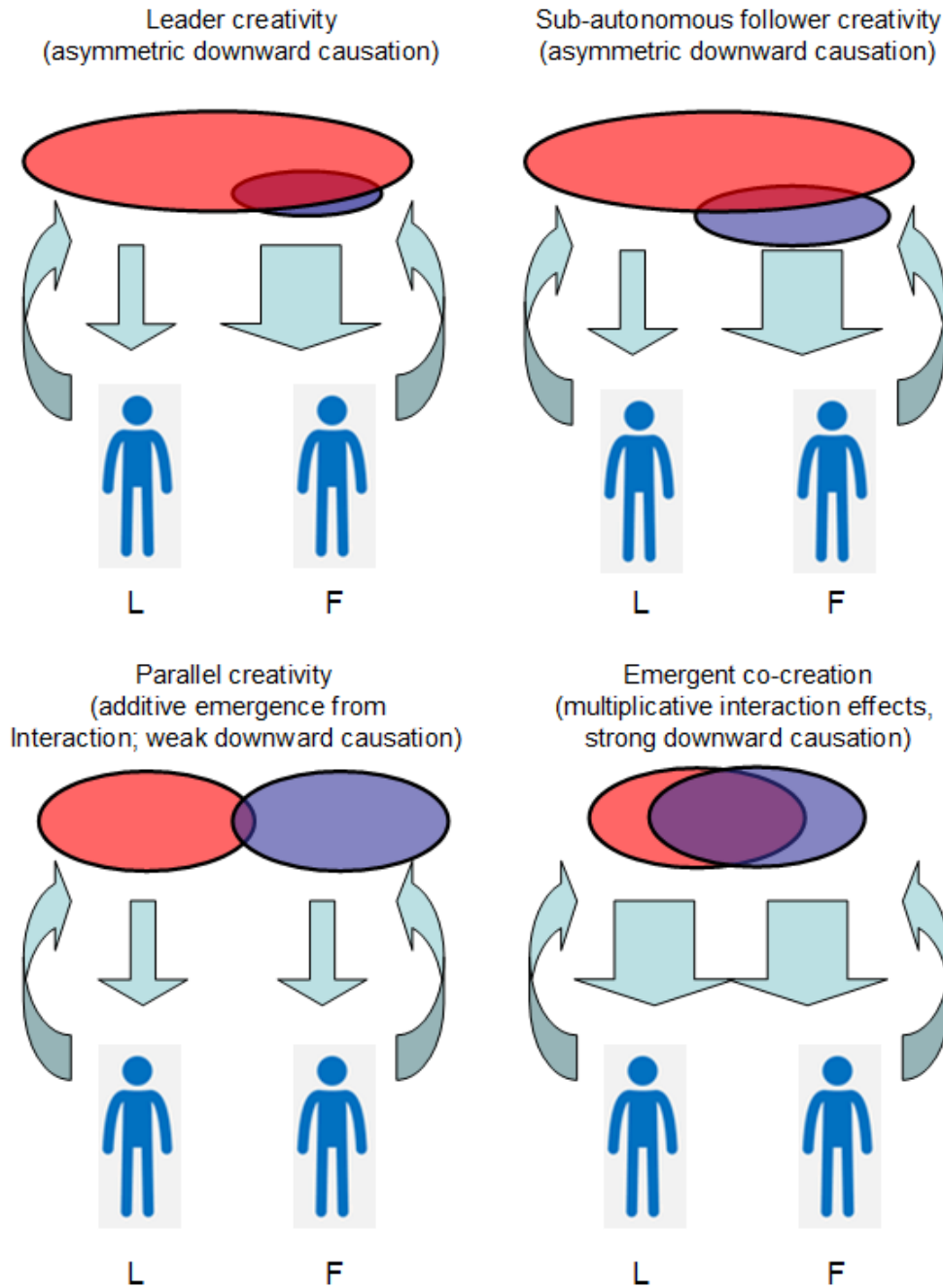
With these conceptual tools, we can now re-interpret our tango-based typology in terms of different circular causality arrangements in the micro-macro interplay. Figure 13 visualizes the

system arrangements: In *leader creativity* there may be little interaction-based emergence to begin with that would create non-linear effects. If small perturbations (which could be potentially creative) occur, the leader may control for downward causation through physical means of the lead, rather than exploit these. Followers, in contrast, are exposed to full-scale downward causation from a macro-scope system. Next, *subordinate and parallel forms of co-creation* are “encapsulated” in a subspace of what happens “together”, since dancers skillfully avoid communicating the subspace dynamics to the higher system level (although emergent effects at an aesthetic plane can occur, which are additive in the sense of involving no invasive biomechanical causalities). Lastly, strongly *emergent modes of co-creation* are based on intense circular causalities with multiplicative effects that let new creative qualities arise, which cannot be attributed to either participant. To a large extent, this may require that agents actively embrace and exploit downward causation for creative momentum. Hence, while micro- and macro-levels of analysis are never completely dissociated, dynamic interdependencies between them can be of significantly different kinds. This ranges from partners acting as mere framing constraints for autonomous creativity, via mild co-constraints on mutual timing and coherence, to direct physical mutual interference in ongoing actions. Creative modes thus depend on interconnectivity patterns, which display more or less selective couplings.

An appealing way ahead is to re-conceptualize co-creation through the lens of a coordination dynamic framework. In light of this, system dynamics of different kinds can be described. This in turn suggests that we may speak of transactional mechanisms in an ontological sense, but should reserve this to more restrictive conditions, namely a particular system interconnectivity that supports recursive feedback loops, which create strong downward causation, and the agent’s active encouragement/ exploitation of these effects for creative ends.

Figure 13

Multiple Co-creative Modalities Based on How Circular Causality of the Interaction System With Leader (L) and Follower (F) is Configured



Note The Circle Size Represents the Degree of Creative Contribution. The Colors Represent Creative Qualities: Red and Blue = Person-based Qualities, Purple = Emergent Qualities.

Concluding Remarks

This paper provided a typologically oriented contribution to the debate about “distributed creativity” and collaborative co-creation based on improvisational dancing in Argentine tango. Our strategy was to carefully reconstruct the micro-genesis of selected dance events of short duration in order to determine the causal origin of creative synergies. We illustrated a spectrum of

constellations in which action as such is socially distributed, yet which also display significant finer distinctions concerning the origin of creativity. This includes whether exploration or adaptive responses to external challenges drive creativity, whether risk-taking or boundary-pushing dominate, whether individuals creatively converge or diverge, and – our present main focus – to what extent interpersonal interaction dynamics are constitutively causal for creativity. In this regard, our micro-genetic analysis traced how interacting individuals may “scaffold each other towards novelty”, yet also illustrated mechanisms through which individual exploration interests and micro-ideas afford greater creative autonomy.

A modal theory of the spectrum of co-creation was presented, which points to four general improvisational modalities: (a) leader-guided creativity, (b) assisted and subordinate forms of follower creativity, (c) parallel and semi-decoupled forms of creativity, and (d) emergent forms with multiplicative creative effects arising from the interpersonal dynamics. All four have in common that creative synergies match the immediate situation (*situatedness*) and are created spontaneously. However, the four modes differ in terms of creative autonomy; some creative effects merely happen *in* interaction, yet dominantly reflect individual design, while other constitutively arise *through* interaction itself. At the pole of leading the follower becomes a creative “extension” of the leader; individual creative ideation goes hand in hand with joint execution. Thus, jointness of action *may, but need not* equal jointness of creativity. This suggests that there are quite different ways in which co-creation can unfold in interpersonally distributed cognition. We thus espouse a modal approach, which points to *multiple co-creative modalities*. In broad terms we expect this claim to apply to other interaction domains, even though every domain has its peculiarities such as the prevalence of “leader creativity”.

Within this basic stance, we urge that ontology be constructed in typologically sensitive ways that represent the empirical spectrum. Much inspiring work that critiques traditional reductionisms provides little traction in differentiating co-creative constellations or degrees of creative autonomy. In particular, several catchy metaphors remain ontologically too undifferentiated

and risk conflating interaction regulation with creativity, which intersect without being identical (i.e., not everything that is “entangled” has to do with creativity). More importantly, we must hold apart a relational, situated analysis of process dynamics from empirical claims about self-organizing creative emergence. As we have seen, multiplicative creative effects apply to some micro-interactions, but not others.

To advance the debate we have sketched a systemic framework, which considers how the interplay of individual and interactive facets of a creative system is configured and evolves. It analyzes the selective interdependencies between individual action and the macro-scopic dynamic that emerges through coupling. This systemic approach is neither individualistic in the traditional sense, nor aligns with forms of interactionism that attempt reduction to macro-systemic causalities. A nuanced analysis of systemic constellations can fathom the rich intermediate ground between schools of thought in creativity research and contribute towards brokering a dialogue.

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