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Early motor copying behaviours: analysis of their functions and relationship with language

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Introduction

The ability to initiate early motor copying behaviours is one of the most powerful tools we have for eliciting, establishing and participating in social interactions. Copying behaviours have a highly affective nature and produce the feeling of being in tune with the other person (Meltzoff, 2007; Meltzoff & Marshall, 2018). The study of these copying behaviours during the first year of life has been labelled the study of “early imitation” and has generated, and continues to generate, important debates about the origin, nature and function of such behaviours. In this paper, we will try to justify that the two most important variables in categorising this early imitation are the type of copying behaviour and its function. We will explain that, under the term *imitation*, two different types of copying behaviours have been considered, and that their function will depend on the purpose of the behaviour in the child's relationship with the environment.

Accordingly, copying behaviour, can be classified as proper *imitative behaviours*, which involve a voluntariness in action (Tomasello & Carpenter, 2005; Jones, 2009), and *mimetic behaviours*, which consist of the spontaneous and unconscious tendency to copy the behaviour of others (de Klerk, Lamy-Yang, & Southgate, 2018). Thus, mimetic behaviours are very early in development (de Klerk Lamy-Yang, & Southgate, 2018;

Heiman & Tjus, 2019; Isomura & Nakano, 2016), although they are maintained throughout the individual's life (Campos & Nieto, 2017). Imitation, which is no longer an echo-automatic but a goal-oriented action, and implies a different processing of action (Thoermer et al., 2013), emerges later. It is reported that motor imitation before reaching a year and a half old seems to be scarce (Horne & Erjavec, 2007; Jones, 2007), although it starts being observed around 6-8 months old (Oostenbroek et al., 2016; Thoermer, Woodward, Sodian, Perst, & Kristen, 2013).

The function of copying behaviours can be understood in a double sense. On the one hand, in relation to the function that this type of behaviour has in the child's development, in an ontogenetic sense, and the function that each of these behaviours, at the time it occurs, fulfils in the service of the child's interaction with other people and/or objects, in a microgenetic sense. In relation to their ontogenetic function, it has been pointed out that copying behaviours serves to different essential aspects in child development: cultural propagation, learning from observing social agents, affinity and also, as a precursor of theory of mind (see Meltzoff & Williamson, 2013).

These functions on the child's development are related to the aim that copying behaviours can fulfil in each act of the child's relationship with the environment. On the one hand, the child can copy actions in order to learn how to perform them -instrumental function-, on the other hand, the child can copy actions of another person in order to relate to him/her -social function- (Uzgiris, 1981).

Traditionally, the function of copying behaviour is defined either by the context in which it occurs or the use or non-use of an object.

Regarding the context, it has been compared *elicitation context* versus *interactive play context*, identifying the instrumental function with an elicitation context, and the

social function with an interactive play context (McDuffie et al., 2007; Ingersoll, 2008; Ingersoll & Meyer, 2011).

Another line of works has linked functions to whether or not the child makes use of an object in his or her copying behaviour (Dohmen et al, 2013). If there is an object, it is assumed that the focus is on the object and, therefore, on learning how to use it; if there is no object, the focus is on the person, and the function always seems to be social.

Both the works that assume that the context marks the function and those that assume that the function is given by the topography or the use or lack of use of an object, seem to see the function as a stable and externally determined characteristic. However, this does not seem compatible with the idea of imitation being constructed in interaction.

In relation to this transition from a definition of function based on characteristics of the child's own behaviour, to a definition based on characteristics of dyadic interaction, more attention has recently begun to be paid to variables linked to that interaction.

Even though the advantage of control in elicited imitation studies is recognized, the importance of also paying attention to spontaneous imitation (Kokkinaki & Vitalaki, 2013), of taking care of ecological validity by recording behaviour in a more naturalistic social context (Hanika & Boyer, 2019), and of the emotional climate generated through an interaction (Kim et al., 2018; Miller & Gros-Louis, 2017; Markodimitraki & Kalpidou, 2021) has been emphasized. The great value of experimental settings is their control over test conditions, which allows for causal inferences about mechanisms (see Meltzoff 2007; Meltzoff & Marschall, 2018; Meltzoff & Williamson, 2013) but may limit the baby's intention to interact (Markodimitri & Kalpidou, 2019). The effects on the duration of attentional engagement have been found to depend on the sensitivity of the experimenter (Miller & Gros-Louis, 2017). The climate generated in the dyad during the interaction

increases the probability that the infant engages in copying behaviours (Kim et al., 2018; De Klerk, Bulgarelli, Hamilton & Southgate, 2019; Saucius, Zlakowska, Pearsson, Lenninger & Madsen, 2020). Therefore, it seems that it is essential to attend to interaction variables, such as engagement and emotional bonding in the dyad, which would promote copying behaviours.

Since there is a bidirectional relationship between the ability to engage in dyadic interactions with the other and the ability to engage in copying behaviours, it is to be expected that copying behaviours are also related to the child's communicative abilities. In fact, an analysis of this literature clearly shows the connection that has been established for decades among imitation, communication and language (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter, Tomasello, & Striano, 2005; Snow, 1989) and that continues to be studied today. However, there are also studies, such as the one by Rogers et al. (2003), in which no correlation was found between imitation and language.

In some cases, this relationship has been found between motor imitation and just one of the linguistic competences: either receptive language (Hanika & Boyer, 2019) or expressive language (McEwen et al., 2007; Stone, Ousley, & Littleford, 1997).

The current study

In this work, we carried out a longitudinal study to analyse early copying behaviours in 9- to 15-month-old infants. For this purpose, we used an elicited imitation task inserted in a semi-structured play situation in which the occurrence of spontaneous copying behaviours was also possible. The ecological validity of the situation was rigorously taken into account, and a positive emotional climate was fostered. Specifically, we proposed three objectives: 1) studying copying behaviours; 2) studying their functions, analysing the situation and interaction in which the copying behaviour appears, and comparing these

functions in the chosen situation vs. spontaneous situation; and 3) studying the relationship between copying behaviours and linguistic development. Within the first objective, the presence of both mimetic and imitated behaviours at the three points of testing was hypothesized. It is expected, of course, that imitated behaviours progressively increase with age. As for the evolution of mimetic behaviour, this study took as a reference the stability found in the co-actions of the IMEs (Markodimitraki & Kalpidou, 2021) and hypothesized a stable pattern across the three developmental moments. With regard to the second objective, the study of functions, it was expected that different functions would be found in both the elicited and spontaneous contexts. According to our hypothesis, it would be neither the type of movement or action (Dohmen et al., 2013) nor the situation (McDuffie et al., 2007; Ingersoll, 2008; Ingersoll & Meyer, 2011) that would define the function; it would be the variables related to the interaction itself. Finally, the third objective was to study the relationship between copying behaviours and language. As mentioned, the heterogeneity of the results of the previous studies is high. For this reason, we consider this as an exploratory objective. Analyse whether the introduction in the analysis of the different types of copying behaviour and their functions show different results in relation to measures of language production and comprehension.

Methods

Participants

The initial sample consisted of fifteen Spanish infants (nine girls) from monolingual Spanish-speaking homes were videotaped at three different ages: 9, 12 and 15 months (± 10 days). The Spanish version of the Battelle Developmental Screening Test (De la Cruz & González, 1996) was administered to all the participants before every session. Two infants were excluded due to detection of motor delay in one case and generalised

developmental delay in the other. The final sample consisted of thirteen Spanish children (eight girls). This allowed us to work with a total sample of 39 recorded interactions. This study was part of a longer longitudinal study. Families were contacted through several community childcare facilities. The thirteen children followed a typical development, and their acquisition of motor milestones was within the normal range. They were all born at full term after uncomplicated pregnancies and normal deliveries. Six participants were firstborn children, and three were secondborn. Longitudinal studies with very young children in natural contexts have certain limitations regarding the sample size (e.g., Capobianco et al., 2017; Kokkinaki & Pratikaki, 2014; Mathew & Manjula, 2016; Murillo, Ortega, Otones, Rujas, & Casla, 2018; Prommin, Bennett, Keeratisiroj, & Siritaratiwat, 2020). However, the density of the data obtained and the analysis conducted allow the extraction of suggestive conclusions from relatively small sample.

Materials

Elicited Copying Behaviours Task-ECBT

A task of eight activities was designed based on the battery developed by Dohmen et al. (2013), which was itself based on the classic elicited imitation task, MIS (Stone et al., 1997). With these eight activities, the aim was to elicit nine imitated behaviours and one mimetic behaviour. The task was developed within a semi-structured play interaction in a familiar environment for the child based on the semistructured play situation of Murillo et al. (2018). A primary caregiver (mother or father) sat close to the baby. The experimenter sought to generate a playful and emotionally positive climate (Kim et al., 2018) and was very receptive to the child's attempts to communicate or interact. The eight activities were introduced by inserting them into the interaction. All items were modelled three times, and the child was offered the opportunity to perform the behaviour (e.g.,

“Now you”), except in item 1, in which mimetic behaviour is elicited and the child is not encouraged to execute it. A description of the task, coded items, materials and sequence in which the task was executed can be seen in Table 1.

MacArthur Communicative Development Inventories (MCDI-I; Spanish version López-Ornat et al., 2005)

The infants’ parents also completed the MacArthur Communicative Development Inventories (MCDI-I; Spanish versión López-Ornat et al., 2005) at each of the three observation points.

--Add table 1 about here--

Procedure

Testing took place at the child’s home or in a familiar room at their day-care centre. The observation site remained constant for each child throughout the study. Sessions were conducted within a margin one week on either side from the day they turned 9, 12 and 15 months old. The session was taped with a video camera.

The child, a parent and a female experimenter were in the room during the task. The parent was asked to sit in a chair or on the floor close to the child and the experimenter. The experimenter guided the play situation by introducing the materials and starting the ECBT activities following the order specified in Table 1. In each activity, the child was given time to express their interest and make requests, so their communication and play initiatives were favoured. Materials were removed before moving on to the next activity.

The estimated duration of each session was approximately 10 min, although the session was adapted to the attention span and motivational state of each child.

After each session, we asked the parents to complete the Spanish version of the MacArthur Communicative Development Inventories (MCDI-I; López-Ornat et al., 2005)

Data coding

Together with the ECBT, an observational code was designed that could be used for both elicited and spontaneous behaviours. Information on two components was collected: 1) *copy behaviour type* and 2) *copy behaviour function*.

Type. There were two types of copy behaviours: *mimetic* and *imitated*. To code behaviour as *mimetic*, the behaviour had to be a co-action where the copy of an expressive behaviour overlapped with the completion of the model's expressive action (Kokkibaki, 1998; Markodimitraki & Kalpidou, 2021). A fast and short behaviour. In turn, *imitation* was a deliberate and intentional behaviour. The child showed goal persistence (Bruner, 1973). It involves a turn-taking where pause between turns was no longer than 10 s (Markodimitraki & Kalpidou, 2021).

Function. As we saw, there are two clearly established and differentiated functions of imitation: social and instrumental (Uzgiris, 1981). In order to categorize both functions, an analysis of the interaction of each situation in which a copying behaviour appeared was carried out. Once it has been identified that the copying was an imitative behaviour, it was categorized as having a *social function* on the basis of the following indicators: the imitated action was directed at or offered to the interlocutor and attention was directed to the search for an emotional reaction and not focused on imitation and/or the presence of a referential gaze from the evaluator to the object, which was accompanied by smile. *Instrumental function* was indicated by the focus being on the action and on the movement during its execution. There should be no eagerness to share the action or its

effect, and eye contact with the evaluator/mother/father, if established, should appear motivated by a desire for feedback. In addition, a third category was added, which included those behaviours that, as hypothesized in the theoretical frame, began with a clear motivation for learning/experimentation and, in the course of the interaction, changed to a social function, giving them an *instrumental function that changes to a social one*.

On the other hand, in relation to mimetic behaviours, it was decided to categorize these behaviours as having a *social-mimetic function*, as is attributed to them in the literature, when there were clear indicators in the interaction that these behaviours had generated a social-emotional effect in the interaction (e.g., a social smile). In the event that the interaction was not affected by any of these rapid copying behaviours, movements that were either not perceived or did not modify the partner's response (e.g., moving the lips when seeing another person blow) were categorized as having a *neutral-mimetic function*.

In summary, the two components were categorized as follows: 1) type: mimetic or imitated; 2) function: neutral-mimetic (M), social-mimetic (M-S), instrumental imitation (I), socio-communicative imitation (SC), or instrumental imitation that changes to social (I-S).

After each ECBT activity, all observed copying behaviours were coded. For each of them in addition to the type and function, it was identified whether it was an *elicited* copying behaviour (one of the ten ECBT's copying behaviours- see table 1) or *spontaneous* copying behaviour (any other copying behaviour, not belonging to the ECBT, shown by the baby that arose in the interaction).

Reliability

Two independent observers coded 30.8% of the recordings, including five different children and four recordings for each age in the study. The agreement on copying vs. no copying behaviour was 87.7% ($n=139$, $k=.750$), that for elicited vs. spontaneous behaviour was 100% ($n= 88$, $k=1.000$), that for copy behaviour type was 94.7% ($n= 75$, $k=.888$) and that for copy behaviour function was 85.3% ($n= 75$, $k=.806$).

Ethics

The present study was conducted according to guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent for each child before any assessment or data collection. This study was approved by the Ethical Committee at the Autonomous University of Madrid-Spain (CEI 52-958).

Data analysis

The repeated-measures ANOVAs conducted for analyses based on the observer frequencies of mimetic and imitated behaviours across the three developmental moments and effect sizes are reported as η_p^2 . To analyse the differences between copy behaviour functions, comparisons were made using the statistical chi-square test. Descriptive analyses (percentages) of each of the items by age and a specific analysis of the change in the functions through the age of the most imitated item were carried out. Correlations between copy behaviours and language (MCDI-I; López-Ornat et al., 2005) were carried out with the Pearson correlation coefficient.

The Statistical Package for the Social Sciences (version 23.0) was used for all statistical analyses.

Results

The results are structured according to the proposed objectives: (1) the analysis of type (mimetic and imitated behaviours) across three measurement moments; (2) the analysis of the functions by comparing elicited and spontaneous situations; and (3) the analysis of concurrent and prospective correlation between language and type of copy behaviour and function.

Frequency of total mimetic and imitated behaviours recorded at 9, 12 and 15 months

To analyse the appearance and frequency of mimetic and imitated behaviours and their evolution across the three measurement moments, two repeated measures ANOVAs were conducted. It was found that while imitated behaviours increased significantly from 9 to 15 months of age ($F_{[1,12]} = 12,667$, $p = .004$; $\eta_p^2 = .514$), mimetic behaviours remained stable across the three measurement moments ($F_{[1,12]} = 0,325$, $p = .579$; $\eta_p^2 = .026$). See figure 1.

--Add figure 1 about here--

Correlations between mimetic and imitated behaviours

Correlations were found between mimetic behaviours at 9 months of age and mimetic behaviours at 15 months ($r = .658$, $p = .014$).

Analysis of the functions of copying behaviours

Significant differences were found in functions of copying behaviours between the two situations at the three measurement moments ($\chi^2 = 23,233$, $df = 4$, $p = .000$, 9 months; $\chi^2 = 25,694$, $df = 4$, $p = .000$, 12 months; $\chi^2 = 48,863$, $df = 4$, $p = .000$, 15 months). The frequencies of each function in elicited and spontaneous situations can be seen in Figures 2 and 3. In elicited situations, the most characteristic function was the instrumental

function (I) while in spontaneous situation, the mimetic function (M) was the most frequent. This pattern was found in the 3 measurement moments, reaching a significance level of $p < .05$. At 15 months, the imitated behaviours with instrumental that turns into social (I-S) function reaches a significant value with respect to the M function ($p < .05$).

--Add figure 2 about here--

--Add figure 3 about here--

Concurrent and prospective correlations between copying behaviours (by function) and measures of language development

Analysed mimetic and imitated behaviours with language measures (MCDI-I; López-Ornat et al., 2005), prospective correlations were found at 9 months and concurrent and prospective correlations were found at 12 months. Specific, at 9 months mimetic behaviours correlated positively with verbal production at 12 months ($r = .707$, $p = .007$); and imitation with I-S function at 9 months correlated positively with verbal production at 15m ($r = .667$, $p = .035$). However, at 12 months a negative correlation was found between imitated behaviours and language comprehension, both concurrently ($r = -.669$, $p = .012$) and predictively at 15 months ($r = -.735$, $p = .015$). When analysing the functions of the copying behaviours, we saw that it is the imitations with I-S function that were correlated with the measure of language comprehension. At 12 months, the infants who were showing more imitations with I-S function, were the ones with the lowest comprehension scores at both 12 months ($r = -.582$, $p = .037$) and 15 months ($r = -.753$, $p = .012$).

Discussion

Differentiating copying behaviours

In this study, our first objective was to identify and analyse early copy behaviours following their development between 9 and 15 months of age. Regarding our hypotheses, it was expected that imitation, a intentional and goal-directed behaviour (Bruner, 1973), would increase with age (Young, Rogers, Hutman, Rozga, & Ozonoff, 2011); however, based on the results of the *co-actions* of Markodimitraki and Kalpidou (2021), more stability was expected in relation to mimetic behaviours.

The first result that we consider it important to emphasize is that it is possible to differentiate and encode both types of copying behaviours in infants between 9 and 15 months of age based on objective indicators. Second, it should be noted that the results show us different developmental patterns of these behaviours. As expected, imitated behaviours increase significantly from 9 to 15 months, but this is not the case with mimetic behaviours, which show greater stability. Perhaps mimetic behaviours serve in some way as a precursor or enhancer of imitation behaviours (Campos & Nieto, 2017).

Copying behaviours and functions

The second objective of this work was to study the functions of these behaviours through an analysis of the interaction that occurs between the child and the adult and to not assume that functions are externally determined by the type of movement or use of objects (Dohmen et al., 2013; Young et al., 2011) or by different characteristics of the experimental situation (McDuffie et al., 2007; Ingersoll, 2008; Ingersoll & Meyer, 2011). We started from the hypothesis that different functions would emerge in elicited and spontaneous contexts. This was the case, but significant differences in the frequency of these functions were found by the type of situation presented at the three ages. The most frequent copying behaviours are imitations with instrumental function, especially in younger children at 9 and 12 months of age. In this study, we followed the children from

the age of 9 months, to 12 months and up to 15 months. It is likely that at 9 months the actions we proposed to them were more novel than they were at 15 months. It is to be expected that at 9 and 12 months children are more focused on learning the action than on sharing it with the experimenter. However, these same younger children are able to perform imitations with social function spontaneously. In the elicited situation, the evaluator executes the behaviour she intends to elicit and introduces a pause, thus putting the focus on the action, favouring the instrumental function of the imitation, especially in those infants who are not yet as competent in the motor action. It is therefore possible that some of the interpretations that have been made from studies that only incorporate an elicited imitation situation can be partially complemented by other studies that include spontaneous imitations. For example, in relation to the sequence of appearance, it has been assumed that instrumental imitation with objects comes earlier in a child's development than the imitation of socially relevant gestures (Young et al., 2011). However, sometimes the actions presented to the child are unfamiliar to him/her. When the child has acquired good motor behavioural control, he/she is more likely to be able to perform imitations with a social function. This process even seems to be possible, at times, during the execution of the action itself. From a micro-genetic analysis, it seems that imitation may appear to have an instrumental function, but while the child is executing that imitation, it changes her or his attention or focus from her or his action with the object to a socially directed action.

In relation to the functions of mimetic behaviours, the mimetic behaviour elicited by the ECBT (blowing gesture) always had a neutral effect in the interaction. However, during the play situation, in which the climate and interaction were very carefully planned, with the evaluators trained to be very expressive and warm, numerous spontaneous mimetic behaviours occurred, and among them, mimetic behaviours that had

an observable effect in interaction were also identified. There are manual gestures (e.g., slight movements with the hand when observing how the evaluator shakes hers), facial movements (e.g., opening his or her mouth), and mimetic smiles that appear and fade without there being a change in the gesture or the gaze of either the child or the evaluator.

However, there are also smiles that, triggered as echoes, that is, as *co-actions*, within the interaction, are intensified and become triggers of playful comments or an exchange of directed smiles. These behaviours, as mentioned above, are found at the three developmental moments studied and they show very similar frequencies. The power of mimetic behaviours in interactions is firmly established (for a review, see Chartrand & Lakin, 2021; Fischer & Hess, 2017). They seem to be already present at 4 months of age (de Klerk, Lamy-Yang, & Southgate, 2018), and without doubt, they are copying behaviours. However, they are by nature different behaviours and seem to show different developmental patterns. To improve our understanding of both them and their relationship with other developments, it seems important that they can be analysed separately.

Copying behaviours, functions and their relationship with language

In relation to the third objective, as has been reported in the literature, we find a relationship between some copying behaviours and measures of expressive and receptive language. However, it is interesting that differences appear according to age. At 9 months, we found prospective correlations with verbal production, not only with imitated behaviours but also with mimetic behaviours. Children who at 9 months produce more mimetic and imitated behaviours are those who show more verbal production three and six months later. The potency of these copying behaviours could be explored as a positive indicator of the development of verbal production. From this analysis, it could be interpreted that we focus on development as self-determined, however, we can also make

a different interpretation. The fact that at 9 months an infant performs mimetic behaviours and is able to show imitated behaviours could in turn be producing an effect on the social interaction between infant and caregiver. At 12 months, interestingly, the relationship seems to be the opposite with respect to other linguistic competence. Those children who at 12 months have lower levels of comprehensive language are the ones who are engaging in more imitative behaviours, especially imitations with an instrumental function that becomes social. It is possible that the child who understands less is for that reason engaged in less verbal interactions and more reliant on imitative behaviours. These less verbal interactions could in turn contribute to the concurrent and prospective effect on the level of verbal comprehension. In summary, a differential effect of copying behaviours on age-mediated interaction could be hypothesised. At 9 months, a mimetic and mimicking infant might lead to more verbal interactions. However, if at 12 months the infant shows a lower level of responsiveness to verbal interactions, but produces imitations that convey social interaction, the interactions that are directed at him or her could be less verbal and more action-mediated. Such interactions may in turn contribute to slower development in verbal comprehension. In what is likely to be a two-way relationship, it can also be hypothesised that it may be the adult who directs more joint action-centred interactions, once the infant is able to take part in such interactions (but not before), that offer less verbal input to the infant and thus impact on his or her language comprehension skills.

Limitations

To our knowledge, this study is the first that tries to identify and analyse in a comparative way the appearance and development of mimetic and imitated copying behaviours and also to examines the possible role and function that these behaviours fulfil from an

analysis of the interaction in which they are taking place. While the novelty of this approach and the detailed coding of the imitation and mimicry functions are strengths of this research, a note of caution regarding the interpretation of the findings is in order. First, while we consolidated previous instruments to design the elicited imitation task, we had to develop an observation code for the analysis of the functions without having previous studies to guide this work. Second, our sample size was small. Longitudinal studies in natural contexts have certain limitations regarding the sample size.

In the future, we plan to replicate this study with a larger sample of infants and include another sample of other developmental trajectories. We are also interested in taking a broader approach to study copying behaviours in mother-infant interactions.

Conclusions and implications

This study tries to advance the understanding of early copying behaviours. These behaviours are born in interaction, and therefore, it seems necessary to look for their meaning in that interaction. However, copying behaviours, even imitation behaviours, do not appear to be a unitary construct. Thanks to the incorporation of two types of situations in a task prevailing an interactional context, it was possible to reliably identify different functions of copying behaviours through observable indicators in the interaction. The results also seem to suggest the possibility that the relationship between copying behaviour and language is dynamic and neither univocal nor unidirectional.

This is just a modest study that attempts to show the power of research on early copying behaviours by introducing a different approach to such research. Behaviours of a highly affective nature constitute a powerful tool that infants have to elicit, establish and participate in social interactions—a cornerstone of development that is built through

interaction and that, therefore, cannot be studied independently of variables in the interactive context itself.

Disclosure statement

No potential conflict of interest was reported by the authors.

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TABLE 1 Elicited Copying Behaviours Task-ECBT

Item	Description	Materials	Scoring
Bubbles_1 ¹	Soap bubbles are blown, ensuring that the child observes the evaluator's action while blowing the applicator stick.	Bubble bottle with applicator stick	The child makes a blowing gesture with her or his lips while the evaluator is blowing.
Bubbles_2 ²	After the three demonstrations of bubble-making, the applicator stick is offered to the child by bringing it to her or his lips.	Bubble bottle with applicator stick	The child approaches the applicator stick and reproduces the movement of making a blowing gesture with her or his lips.
Bottle ²	The closed bottle of bubbles is offered to the child.	Bubble bottle with applicator stick	The child tries to open the bubble bottle by pulling or turning the lid.
Wind-up toy ²	The toy is operated by turning the handle, ensuring that the child sees the movement of the hand; the toy is then offered to the child.	Wind-up toy	The child tries to operate the mechanism by bringing her or his hand to the handle.
Drum ²	An upside-down toy plate is hit with a plastic spoon, associating the movement with the onomatopoeia "pom, pom, pom", and the spoon is then offered to the child.	Toy plate and toy spoon	The child reproduces the action by hitting the plate with the spoon at least once.
Toy cup ²	The evaluator pretends to drink from an empty toy cup, and then the cup is offered to the child.	Toy cup	The child reproduces the action by bringing the toy cup into the correct position (bring it to her or his lips).
Train ²	A toy cup is turned upside down and moved, associating the movement with the onomatopoeia "chu, chu, chu".	Toy cup	The child reproduces the action of moving the toy cup into the correct position.
Tongue ²	The evaluator sticks out her tongue while making the sound "mmmm".	-	The child opens her or his mouth, and the tongue can be seen.
Hands-Palms ²	The evaluator pats her face.	-	The child directs her or his hand to the face and gives at least one touch.
Nose ²	The evaluator touches the tip of her nose and associates the movement with the onomatopoeia "pii".	-	The child touches the tip of her or his nose.

¹Mimetic behaviour; ²Imitated behaviour

FIGURE 1 Mean frequencies of mimetic and imitated behaviours across the three developmental moments.

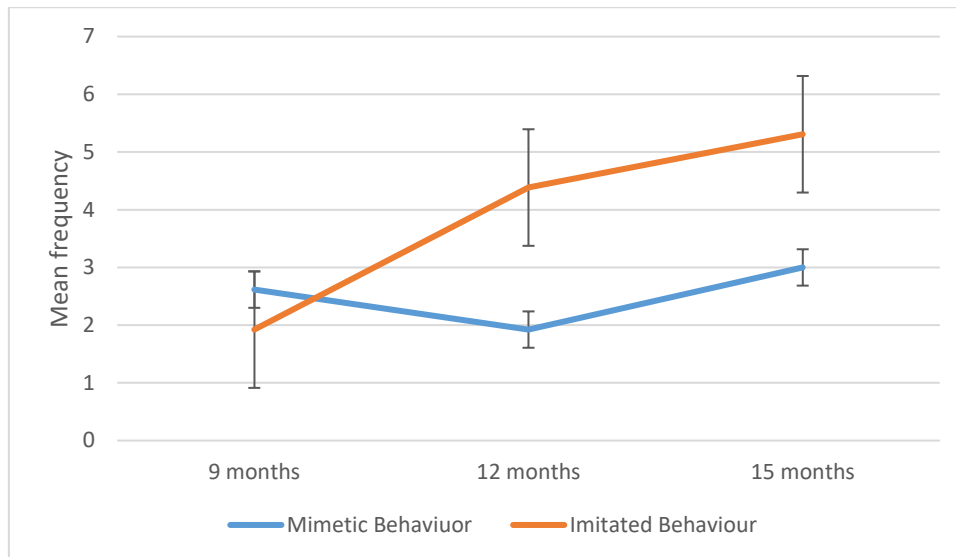


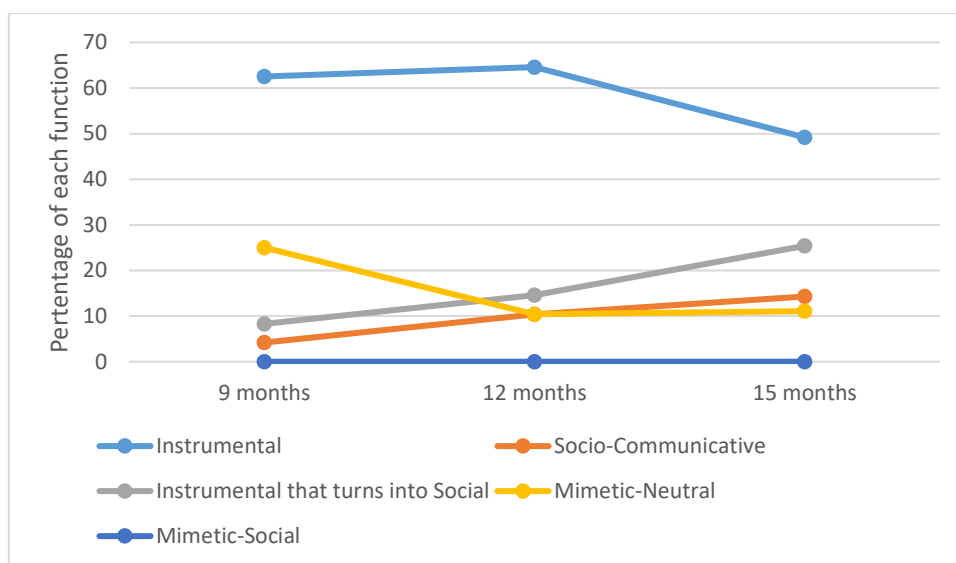
FIGURE 2 Types of copying behaviours functions across age: elicited situation.

FIGURE 3 Types of copying behaviours functions across age: spontaneous situation.