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Title
Rhythmic ostensive gestures: How adults facilitate infants´ entrance into early triadic interactions

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Abstract
For decades, the literature on the emergence of triadic interactions considers the end of the first year of life as the time when children become able to communicate with others intentionally about a referent. Prior to that, children only relate in dyads, either with someone else or with an object. However, several researchers claim that referents are not naturally given in human communication and that they need to be established in interaction with others.
In this study, we focus on earlier triadic interactions initiated by adults, when young babies still require an adult to bring the material world within their reach. In these early triadic interactions, ostensive gestures (with the object in the hand) are one of the first means of enabling the establishment of shared reference. Such gestures are easier to understand since sign (gesture) and referent (object) coincide. We conducted a longitudinal study with 6 babies filmed at 2, 3 and 4 months old in interaction with their mothers and a sounding object (a maraca). We analyzed different communicative initiatives by the adult and the child's responses.
The results show that children come to understand the adult's communicative intention gradually through interaction. Adults include children in organized communicative "niches" based on ostensive actions, both through ostensive gestures and demonstrations of the use of the object. Consequently, the first shared understandings between adult and child take place around the object and its uses. Rhythm is a powerful tool used to structure the interaction. Eventually, adults provide space to children to actively interact with the sounding object themselves. These results highlight the importance of considering ostensive actions as a communicative tool that favors joint attention and action. They also bring some light to the interdependence between a child who actively perceives and acts, and the structured situation that the adult organizes for them.

Keywords
early triadic interactions, ostensive gestures, rhythm, joint actions, self-directed gestures.

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Introduction

Triadic interactions: do they only emerge at the end of the first year, or are they initiated from the beginning of life?

In the last decades, it has been widely accepted that the first triadic interactions (adult-infant-object) only appear at the end of the child's first year of life. This idea has been claimed with different emphases. According to the influential research of Bates, Camaioni & Volterra (1975), children produce their first intentional communicative behaviors to someone else *about* the world at around 9 months. This coincides with Trevarthen's statements about secondary intersubjectivity (1999, 2003), referring to the developmental milestone where children are able to share attention, affect and emotions, and action involving objects with other social partners (Malloch & Trevarthen, 2009; Trevarthen, 2008). Before that, during the phase of primary intersubjectivity, intentional uses of objects and child-adult interactions are established separately, in a dyadic manner (Trevarthen & Hubley, 1978).

A similar approach can be found in Tomasello's "9-months Revolution" (2004, 2008) referring to when children initiate intentional communication. They get "attuned" to adults' attention and behaviors, so they become able to understand and consider other people as intentional agents (see also Brinck, 2004; Goubet, Rochat, Maire-Leblond & Poss, 2006; Tomasello, Carpenter & Liszkowski, 2007; Zlatev & Andrén, 2009). Prior to the end of the first year, Tomasello distinguishes - in Vygotski's sense - between lower and higher psychological functions. What is innovative in this approach is that the "natural" line of development becomes cultural earlier, when the first triadic interactions with intentional communicative behaviors take place, instead of with language

emergence, as for Vygotski. However, the natural line of development (without culture) that prevails before that implies a double problem. Firstly, from a sociocultural perspective, where are the higher functions rooted if all of what flows underneath is natural? The distinction between the biological and the social worlds underestimates the presence of the surrounding culture from birth. In fact, children´s interactions - both with someone else and with an object - cannot be separated from their cultural properties (see discussion in Rodríguez, 2006). Secondly, joint attention does not spontaneously develop as an individual cognitive capacity. Rather, the adult has some influence on the child from birth that affects his/her cognitive and communicative development. If this assumption is reasonable, then we need to explore what that "cognitive influence" is.

The common denominator in all these studies is that, before triadicity appears, children are assumed to relate only in dyads: first with someone else, and from some point around 4 months old, also with objects (Tomasello, 2004, 2008; Trevarthen, 2003; Trevarthen & Hubley, 1978). Thus, adults and objects are not linked psychologically for children *before* they are able to communicate intentionally about something in the world. Surprisingly, in these studies objects are apparently self-animated for the child (e.g. appearing and disappearing on a small stage in front of the infant, or pending from the ceiling), as opposed to their conventional behavior when someone moves the object by his/her own will.

However, this interpretation has not always met with unanimity. Some classical and contemporary authors refer, in different ways, to triadic interactions from the first months of life where the adult takes the initiative and intentionally meets the child and the world in a communicative act (Costall, 2013; Fogel, 1993; Rodriguez, 2006; Vygotski, 1984/1996). These are not triadic in the sense of when the child intentionally communicates with the other about an object, they are "more basic" triadic interactions where the adult intentionally meets the child and the world in a communicative act.

In this regard, Vygotski's arguments were not always loyal to the distinction between lower (natural) and higher (cultural) psychological functions. In a very rarely cited work, *The first year* (1984/1996), Vygotski refers to the "complete biological inability" of the infant to relate the world alone:

"[…] child's first contact with reality (even when it meets the most elementary biological functions) is socially mediated. [...] Objects appear and disappear from the visual field of the child by will of adults, and are moved through space in the arms of others. Any change in posture, even to simply turn the baby around, is intertwined with social situation […]" (1984/1996, p. 285).

Thus the adult would be from the beginning of life an ambassador between a child who is profoundly social and the world. Culture is introduced with no need to wait for the emergence of language. In line with this, Bronckart (2012) pointed out that in Piaget's studies of sensorimotor stages - so detailed in describing child-object interactions - an adult was in fact present in almost all observations. However, neither communication nor the adult's role as a guide was ever considered in Piaget's analyses as contributing to cognitive development.

Some other contemporary authors have no doubt that there are early triadic interactions. For Fogel (1993), the child is immersed in webs of communication with others from a very early age, and co-action in relation to the object plays an important role. The object favors interaction, as a shared referent between mother and child. In the first months of life, it is the mother who acts on the object, while the child receives her communicative initiatives. Later on, the child will progressively acquire the necessary skills in order to use the object themselves, becoming the intentional agent of the communication. In both cases, adult and child share the same focus of attention (hence, of communication): the object as a referent. Furthermore, Costall (2013) emphasizes the place that the object occupies in the interactions between subjects. From early on, children

are immersed in “niches" of interaction where people use objects as communicative vehicles, acting as active participants, and not mere passive recipients (Rosmanith, Costall, Reichelt, López & Reddy, 2014).

Therefore, there are some classic and contemporary voices that refer to *other kinds of triadic interactions* which appear much earlier in development than when intentional communication emerges, laying the grounds for joint attention in contexts of joint action. To understand these early triadic interactions implies considering adults’ communicative mediators when communicating with children *with* and *about* the objects, which will be discussed in the next section.

Ostensive gestures and ostensive uses of objects as a mediators for early triadic interactions

At this point it seems reasonable to think that children do not suddenly communicate intentionally with others about the world, but that there are a wealth of occasions through which they are gradually introduced to the world through the communicative initiatives of adults. From the Pragmatics of the Object perspective (Rodríguez & Moro, 1998) this role of the adult as a mediator between the child and the world has been emphasized. Based on this perspective, signs constitute a leading role in adult-child interaction, where the object also has a prominent place as a communicative tool. Several studies have been carried out according to this perspective (Rodríguez, Basilio, Cárdenas, Cavalcante, Moreno-Núñez, Palacios & Yuste, 2017) analyzing the emergence and development of different semiotic systems in children during the first two years of life. These include: first canonical uses of objects in children aged 7 to 13 months (Rodríguez & Moro, 1999; Moro & Rodríguez, 2005); the first symbolic uses of objects (Cárdenas, Rodríguez & Palacios, 2014; Palacios & Rodríguez, 2014); the emergence of self-ostensive gestures and pointing with a self-regulatory function (Rodríguez & Palacios, 2007). All these studies agree that

children's entry into the different semiotic systems occurs in interaction with others (Dimitrova & Moro, 2013), which enables them to use the same communicative tools later on. However, these studies only addressed ages from 7 months onwards, which leaves open the question of whether these strategies and processes are also present in the emergence of more basic semiotic systems.

In a study with infants aged 2 to 6 months, in interaction with the adult and an object that can be used to make a sound, Moreno-Núñez, Rodríguez & Del Olmo (2015) found that from the earliest months of life the adult is an intentional agent that introduced the world to the infant. Adults used very specific interventions to bring the world closer to children when it is still out of their reach, segmenting the material world into different objects and performing ostensive actions (gestures and uses of objects) with these objects. Children, from 2 months, were already sensitive to those ostensive actions, evidenced by the child's sustained attention towards the adult's action, stable eye contacts, and emotional behavior such as smiles or body movements.

Accordingly, to talk about triadicity in the first months of life also implies granting a major status to the adult's ostensive gestures (Rodríguez, Moreno-Núñez, Basilio & Sosa, 2015). Following Eco (1977), ostensive gestures - those in which the hand is holding the object - are the first instance of active significance, the first gestures that allow the establishment of an intentional relationship between the world and the other. In addition, ostensive gestures present lower semiotic complexity – given that sign and referent coincide – than other gestures such as pointing - where sign and referent differ -, which have traditionally received much more attention as the supposedly quintessential gesture of shared reference. Moreover, Moreno-Núñez et al.'s study (2015) highlighted that adult's ostensive actions in the first triadic interactions are closely related to rhythm. These authors suggested that rhythm may be a very basic semiotic system as it provides the interaction with a structure that allows adult and child to engage in their first "communicative agreements" about the

use of the object (e.g. to grasp what the adult is showing/offering). Rhythm, together with sound, has been extensively studied in early ages by researchers interested in dyadic mother-infant interactions. We will address those studies in the section below.

Rhythm and sound in first mother-infant interactions

Several studies (Nelson, 2001) have provided empirical evidence of the presence of rhythm in biology (such as breathing, heart rate regulation and blood pressure). These "natural" rhythms lack any intentionality, but they form an important element in the infant's development. From the prenatal stage, biological rhythms and the rhythm of language - through the mother's own voice - may be the first things listened to. From birth, rhythm keeps being present in different and multimodal forms, as it can be perceived acoustically, visually and tactically - e.g. the infant's agitation or sucking movements (Lecanuet, Fifer, Krasnegor & Smotherman, 1995).

Several authors have addressed how rhythm facilitates development, providing a structure to build on. For example, Piaget (1936/2007) described the presence of rhythm in an infant's sucking movements — both while being fed, or on its own. Additionally, Kaye (1986) noted the importance of pauses during sucking, in which "there would be previous rhythmic components that could play a significant role in the origin of regularities that lead to the rules" (Rodríguez, 2006, p. 47). These pauses open spaces of interchange between the adult and the child, promoting shifts in the interaction which result on the establishment of regularities and conventions that are later essential for communication. Therefore, these rhythmic behaviors are not just excellent organizers in children's individual performances, but they also play an important role in interactions with others (Español, 2007; Tafuri, 2006).

Numerous studies consider rhythm as a constitutive element of the dyadic interaction itself (Brazelton, Kozlowski & Main, 1974; Bullowa, 1979). To Perinat (1993),

rhythm includes the communication itself, setting a basic level in which both agents simply accept each other as such. These ideas are closely connected with Wallon's discourse on tonic-postural dialogue, which emphasizes the functional role of emotions in human development. For Wallon, biology is socially oriented (1951/1985), while both body and postures are considered as privileged places where the newborn's first emotions are expressed. Thus, at the beginning of human life emotional sensitivity apparently connects with motor reactions, and increases in arousal are resolved in movements, screams or vocalizations of the infant that affect the adult (Santiago, 2010). Thereby, according to Wallon, these tonic-emotional reactions by the infant become the first signs of cognitive development.

In this sense, Colwyn Trevarthen's studies on musicality in early interactions (1999, 2003, 2008) stand out. They affirm that the synchrony between the rhythms of both protagonists – which colors gesture production and other communicative expressions – allows interpersonal coordination. From the first months of life, the playful interactions between adult and child are served by a series of rhythmic and musical components, greatly favoring joint immersion in a shared communicative process (Reddy & Trevarthen, 2004; Trevarthen, 1998).

In addition, recent studies performed in hospital settings with infants at risk (Del Olmo, Rodríguez & Ruza, 2010; Del Olmo, Rodríguez, Ruza & Carrasco, 2015; Loewy, Stewart, Dassler, Telsey & Homel, 2013) have shown that acting consistently with biological rhythms – e.g., respiratory and heart rates or the intensity of movements – helps to offer an appropriate stimuli and sound response to enable a better adult-infant interaction (Del Olmo, Ruza, Carrasco & Rodríguez, 2008). Further, several clinical studies on musical mother-child interactions have reported that singing to babies by mothers from different cultures share several features in common, such as repetitions, rhythmic patterns, rhymes and alliterations (Bergeson & Trehub, 2007; Jaffe, Beebe,

Feldstein, Crown, Jasnow, Rochat & Stern, 2010; Trehub, 2003; Smith & Trainor, 2008), while infants show extended periods of sustained attention and reduced body movements.

However, most of these studies address subject-subject dyadic interactions, while little is known about the role of rhythm in triadic interactions. Rhythmic-sonorous - i.e. sound-making - actions initiated by the adults are involved in early triadic interactions from the first months of life (Moreno-Núñez et al., 2015), where rhythm may serve as a basis for the establishment of the first communicative encounters between adult and child. The first triadic interactions initiated by the adults become meaningful thanks to the structure that the rhythm incorporates to adult's uses of the object. Rhythm acts as a form of expression between adult and infant before the emergence of gestures and/or the language.

Thus, this study has three goals that involve the examination of: (1) the gestures and uses of objects produced by adults with communicative-educational intention towards the children; (2) children's responses to the early triadic interactions initiated by adults; and (3) the development of interaction with an object with rhythmic and sound-making possibilities.

Methods

Participants and procedures

We observed 6 children[1] (3 male, 3 female) in their own homes in Madrid province, Spain. Children were video-recorded at 2, 3 and 4 months of age in unstructured observations during playful triadic interaction (mother-child-object). They were placed in a comfortable position, where they could look easily at the adult's face. Children were recorded for a minimum of 5 minutes by the same researcher and with the same object, a maraca (see next section). Parents were provided with the object and were instructed to play with their child as they normally would. No specific instructions were provided on

[1] The six children are named in this paper Tamara, Laura, Lucía, Javier, David and Gabriel (not their real names).

how to use the object, in order to leave dyads to engage themselves through their own strategies and so that interchanges remained as spontaneous as possible. However, the conventional use of the maraca involves social rules that presumably would be part of the uses by adults (e.g. shaking the maraca).

Materials

The maraca used in this study (see Table 1) was designed specifically for children in their first year of life. This object was chosen because it is easy to grasp by infants — due to its size and weight— and allows sound-making uses, which is of course also its conventional use. It was also expected to favor triadic interactions as the adult performs communicative actions related to the use of this object (i.e. gestures or demonstrations of the use of object), involving rhythmic, sonorous and melodic - through the mother's voice - components.

Table 1
Object description

Object	Object in use	Description of the object
		Small maraca. Its conventional use is to shake it as a rattle, making sound with it. Its size and ergonomics make it easy for the infant to hold. This may constitute one of the first musical instruments for the infant, introducing him or her to a rhythmic and sonorous world.

Data Analyses

In order to further characterize early triadic interactions we took a qualitative approach for behavioral coding, analyzing all cases microgenetically by real time coding of adult's communicative mediators (based on Rodríguez & Moro, 1998). We performed the data coding process in two stages for both adults and children. First, we transcribed

all the communicative initiatives of adults and children's responses using ELAN software (EUDICO Linguistic Annotator, 2011) and selected for analysis the sequences or periods of time when child and adult were acting together with the maraca. To differentiate one sequence from another, we required either the presence of a pause/gap of at least 3sec, or a change in the focus of the joint action.

Second, we looked at the *communicative initiatives of adults* and *children's patterns of response* to adults' actions. For the ***adult*** behaviors, we identified the ***communicative mediators*** employed and categorized them as: (a) *Verbal utterances*, just indicating when verbalizations were produced to accompany the action with the maraca. (b) *Uses of the* object/maraca. (c) *Gestures*. Later, we identified the **type of uses of the** object/maraca by determining if they were clearly performing the conventional sounding use in an organized manner, which incorporate ostensive, rhythmic and sonorous components. The uses of the maraca identified are presented here according to their increasing complexity:

- *Immediate Demonstration.* Adult directs or involves the child - joint action - in the cultural use of the maraca. They could be performed:
    - *With child's hand*, placing the object on it and performing the use.
    - *Percussing* the maraca against child's body.
- *Distant Demonstration.* Adult performs a complete or incomplete conventional use of the maraca *for* the child.

In addition, **adults' gestures** were coded according to their semiotic level. Only *ostensive gestures* were observed (i.e., showing or giving gestures).

Regarding the ***children***, we determined their ***patterns of response*** to the interaction initialed by adults by identifying the following indicators: (a) *Attention to adult's action*, when the infant clearly looks — and listens — to adult's use of the maraca. (b) *Emotional expression*, through smiling, laughing, or showing moderated and evident bodily agitation, which denotes excitement. (c) *Verbal utterances*, noting the vocalizations

produced by the infants. (d) *Uses of the* object/maraca. (e) *Gestures*. We then identified the **type of uses of the** object/maraca by determining the children's progressive extent or degree of conventional use. Children's uses of the maraca identified are presented here according to their increasing complexity:

- *Grasps following adult's initiative.* Adult places the maraca on child's hand (giving gesture), so the infant is able to grasp it.
- *Tries to grasp.* Child directs his/her hands to the object acted on by adult, anticipating the grasp.
- *Grasps.* Child grasps maraca on his/her own initiative.
- *Shakes.* Child performs a rudimentary (proto-conventional) use of the maraca by him/herself, inhibiting hand and arm movements in order to sound the object. These movements are imprecise due to the infant's immature motor development.

Moreover, we identified some **children's self-directed ostensive gestures** by determining if the object was clearly presented to themselves as an attentional act, sustaining the gaze towards the maraca. These self-directed ostensive gestures differ from a mere exploration since they involve stopping the action in order to contemplate the object.

Additionally, 33% of cases — randomly selected — were coded by three independent observers to evaluate inter-coder reliability. Each observer was provided with the coding scheme and the specific descriptions of its categories, as well as the protocol sheets, where the sequences to be coded were indicated. Inter-coder agreement was excellent - Krippendorff's Alpha = 0.832 (Cicchetti, 1994).

Frequencies, binomial tests and proportion comparisons were calculated using IBM SPSS Statistics for Windows v21. We performed chi-square and column proportions tests to assess whether there is any relationship across the three age points of observation, first

between children's and adult's uses of objects, and second between their gesture production. We used an alpha level of .05 for all statistical tests.

Results

Communicative mediators employed by adults

In this study the adult communicative initiatives share certain characteristics that need to be addressed (see Table 2). First, it is noticeable how adults do not use indexical or symbolic gestures when communicating with the children with the maraca. Thus, adults first and preferably present the object and/or offer it to the infant, instead of using pointing as the basis of shared reference.

Table 2
Absolute frequencies of adults' uses of maraca and ostensive gesture

	Communicative Mediators	Uses of object/maraca			Ostensive Gestures	
	Subcategory	ID Hand	ID body	DD	Showing	Giving
Age in months	2 months	33	34	157	37	39
	3 months	47	7	108	37	43
	4 months	43	16	103	36	59

Adults rely primarily on distant demonstrations (shaking the maraca for the children) which, nevertheless, decrease over time. Immediate demonstrations – either by placing the object in the infant's hand or touching his/her body with the maraca – are also present and very frequent in all three sessions.

Static showing gestures (non-sounding) by the adults are relatively few in number. Nonetheless, as pauses or silences they help to provide structure to the adult's action and so, to the organization of the interaction, providing a space for the infant's response. This is also reflected in an aspect of adult's giving gestures, namely granting the use of the object to the child after their communicative initiative.

A more detailed breakdown of these findings is presented in Table 3, which addresses the individual differences observed among participants. Adults bring into play a series of communicative mediators with the maraca in front of the infant. Regarding ostensive gestures, both showing and giving gestures are present in adult's interventions in a similar percentage, although showing (static) gestures are less frequent. At 2 months of age, adults do not just place the object between the infants' and their own gazes, but "give them life" by placing them in the convergence of semiotic networks – sing, move the object, use it and speak to the infant –, making them the center of attention. The object is not the "external context" of the interaction, but part of it. It is placed as a communicative tool favoring the emergence of communicative spaces between the child and the adult. We can observe also a general trend towards the decreasing use of the object by the adult, which coincides with a progressively more active participation of the infant throughout the three sessions.

Table 3
Adults' uses and ostensive gestures with the object/maraca

		Tamara's mother			Laura's mother			Lucía's mother		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
Uses of MARACA	ID Hand	2	3	1	–	8	13	4	5	3
	ID body	4	–	1	4	5	7	18	2	6
	DD	20	26	15	44	25	21	23	9	18
Ostensive Gestures	Showing	6	6	6	17	14	3	5	10	5
	Giving	6	4	6	1	6	17	9	4	13
		Javier's mother			David's mother			Gabriel's mother		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
Uses of MARACA	ID Hand	6	11	10	2	3	1	19	17	15
	ID body	2	–	1	1	–	1	5	–	–
	DD	28	19	13	25	11	19	17	18	17
Ostensive Gestures	Showing	4	3	3	3	–	14	2	4	5
	Giving	11	9	11	3	2	3	9	18	9

Among the adults' uses of objects, immediate demonstrations denote less complexity as they are made simply in order to get the child engaged in the interaction. Adults place the maraca more often on the child's hand rather than "strike" it against their body (except Lucía's mother). Distant demonstrations could be sub-divided into two categories based on their structure (Table 4). Thus, there are distant demonstrations *with a complex structure* level —which incorporates frequent pauses; and *unstructured* distant demonstrations, that is, the pauses just occur at the end of the performance. Children pay attention more easily to structured distant demonstrations, than to unstructured ones that extends longer in time, hindering the child from engaging in the adult's proposal.

Table 4

Frequencies of adults' rhythmic-sonorous distant demonstrations: structured unstructured

		Tamara's mother			Laura's mother			Lucía's mother		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
R-S Distant Demonstrations	Structured	11	16	13	30	14	15	16	8	17
	Unstructured	9	10	2	14	11	6	7	1	1
		Javier's mother			David's mother			Gabriel's mother		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
R-S Distant Demonstrations	Structured	12	14	9	19	9	17	12	12	12
	Unstructured	16	5	4	6	2	2	5	6	5

Structured distant demonstrations represent rhythmic-sonorous demonstrations par excellence, those that are most effective in attracting the child's attention. Unstructured distant demonstrations are not as effective, although they also incorporate rhythm and sound. Probably because of their lack of an organized structure, they are less frequent and generally decrease over the three sessions, denoting an awareness by adults of them not being as efficient for engaging the infant as the structured rhythmic-sonorous distant demonstrations.

A chi-square test of independence was performed to examine the relation between structured and unstructured distant demonstrations over time. Findings show that this relation was significant, X^2 (2, 368) = 8.66, p =.013. Although the proportion of unstructured demonstrations at 2 months of age is greater than the proportion of structured demonstrations, the situation is reversed at 4 months old - at 3 months of age there is no discernible difference in the proportions of structured and unstructured rhythmic-sonorous distant demonstration. Thus, we observed that the adults decrease their unstructured uses of objects as children grow up, favoring the structured demonstrations that seems to be more efficient to get the infants' attention.

To a greater or lesser extent, all adults are active in providing their child with a significant situation regarding the conventional uses that they perform with the maraca. They all offer the child a situation of shared intentionality, which organizes the activity from a rhythmic-sonorous and pragmatic point of view. According to children's responses, adults identified the more effective communicative mediators, favoring them throughout the three sessions. Infants are sensitive to this type of presentations and structures, as shown by the presence of sustained attention, movements and vocalizations. However, as the child grows up, the frequency of adults' interventions decreases, resulting in progressively longer pauses that await a response from the infant.

Children´s patterns of response to rhythmic and sonorous actions of adults

A good indicator for the effectiveness of the ostensive actions that we addressed in the previous section is to measure the child's attention to the adult's communicative proposals. In Figure 1 we present the evolution of this category, considered as the child staring at (but also listening to) the adult's action. The percentage of attentional time is calculated here in relation to the total duration of the session. In Figure 1, we observe a general trend towards decreasing the attention over the sessions, with some slight

variation in some children between 3 and 4 months of age, depending on the attractiveness of what the adult was presenting and how she did it.

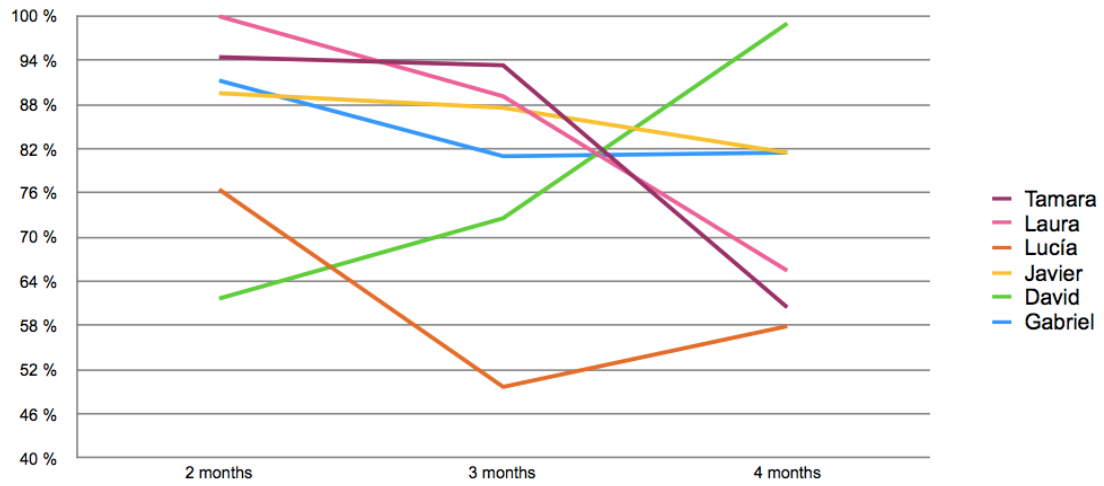

Figure 1

Percentage of children's attention to adults' uses and gestures with the object/maraca

Nevertheless, the case of David stands out since his levels of attention demonstrate the opposite evolution compared to the rest of the participants. This fact can be explained in relation to the actions of his mother. In T1 (2 months-old), distant demonstrations were not located between the gazes of child and adult – previously connected – and, therefore, they were not as effective as occurred with the other children. David did not turn his head in the direction of where the sound came from. Nonetheless, his mother became aware of the type of actions that "engaged" the infant, promoting them and discarding the ineffective ones. This resulted in a significant increase of David's attention towards his mother's actions.

As observed in Table 5, almost all adults place the maraca on the child's hand from 2 months of age (T1). This constitutes the infant's first contact with the object, and similar actions would be the infant's earliest contacts with the material world.

Table 5
Children's uses and ostensive gestures with the object/maraca

		Tamara			Laura			Lucía		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
Uses of MARACA	Grasps following adult's initiative	3	3	3	–	6	6	3	7	4
	Tries to grasp	–	–	8	–	–	19	–	–	14
	Grasps on his/her own initiative	–	–	7	–	–	18	–	–	10
	Shakes	–	–	5	–	–	4	–	–	5
Ostensive Gestures	Self-ostensive gesture	–	–	2	–	–	13	1	7	3
		Javier			David			Gabriel		
		2 months	3 months	4 months	2 months	3 months	4 months	2 months	3 months	4 months
Uses of MARACA	Grasps following adult's initiative	1	3	5	1	2	–	9	12	4
	Tries to grasp	–	4	13	–	3	10	–	1	2
	Grasps on his/her own initiative	–	1	7	–	3	2	–	1	2
	Shakes	–	1	3	–	10	1	–	4	1
Ostensive Gestures	Self-ostensive gesture	–	–	2	–	–	–	–	–	–

Later, from 3 months (T2), the children easily understand the meaning of the adult's ostensive gestures as "grasp it" and "do something" with the maraca – showing it to themselves, or shaking it. At this age some children extend their open hand towards the object shown by the adult (adult's showing gesture), in a sort of anticipation of what is going to happen afterwards (adult's giving gesture). Furthermore, we observed some of the first proto-conventional uses of the maraca performed by baby boys at T2 (Javier, David and Gabriel), and by all children at 4 months (T3).

At 4 months old, adults are much more efficient at engaging the infant with their ostensive presentations of the maraca. Some of these interventions end effectively with the child holding the maraca, but it depends upon the adult yielding the object to the child. Children are not yet experts on the use of the object, but they are able at least to inhibit their movements to a certain extent, which leads to sounding the maraca. Notwithstanding, those proto-conventional uses are still quite basic, gaining accuracy over time. Regarding

children's gestures, as expected no showing gestures towards the other appeared in our data, where we only identified self-directed showing ostensive gestures arising at about 4 months old - only Lucía performed self-ostensive gestures on the three times of observation.

Two chi-square tests of independence were performed to examine: (1) the relation between adults' and children's uses of objects over time; and (2) the relation between adults' and children's gestures over time. The relation between adults' and children's uses of objects was significant, X^2 (2, 779) = 113.62, p <.001; as well as the relation between adults' and children's gestures X^2 (2, 279) = 13.78, p =.001. Thus, both adults' and children's uses of objects and gestures are dependent, so a column proportions test was performed to determine which variables are responsible for this relationship. Findings show that the proportion of adults' uses of objects and gestures at 2 months of age is greater than the proportion of children's uses of objects and gestures. However, at 4 months of age the situation is reversed, when the proportion of children's uses of objects and gestures is greater than in adults. At 3 months of age there is no discernible difference in the proportions of adults' and children's uses of objects and gestures.

These data statistically support the hypothesis that adults decrease their own uses of objects and gestures production as children grow up, coinciding with the infants increasing their uses of the maraca and ostensive gestures (although these are still self-directed gestures). Therefore, adults progressively yield for of action to children as they acquire more complex cognitive and motor skills that enable them to participate actively in the interaction.

Microgenetic analyses of the interactions adult-infant-object

Microgenetic analyses are a very useful tool to examine and explain in detail the subtle changes of the developmental processes. In order to illustrate how some of the different sequences of interaction with the maraca were developed, we randomly selected one of the triads (Lucía, her mother and the maraca) to address their interactions microgenetically (see Figures 2 to 4)[2]. The exact age of the infant in each session is stated following the scheme years;months,days. This analysis enable us to observe the developing responses of the child in depth when the adult performs a certain action.

- We used microgenetic graphs to represent the interaction between adult and child in all the three sessions. These graphs represent the session duration on their *x* axis (5 minutes) while the participants' actions are depicted on their *y* axis (where the top section is for the infant, and the bottom section for the adult). According to the categories of the study, the infant's responses to the adult's action are indicated for uses of object - *grasps following adult's initiative, tries to grasp* (anticipation), *grasps* on his/her own initiative, and *shakes* (proto-conventional use of the object) - and gestures - *self ostensive gestures* - as well as the infant's *vocalizations*, *emotional expressions* and *attention* to the adult's action. For the adults, we focused on their uses of objects - *immediate demonstrations* (with infant's hand and against his/her body), and *distant demonstrations* - and gestures *–ostensive gestures* of showing and giving. The presence of adult's *language* when accompanying action is also noted.

[2] The interactions of an additional randomly selected triad (Javier, his mother and the maraca) are discussed in the Appendix 1.

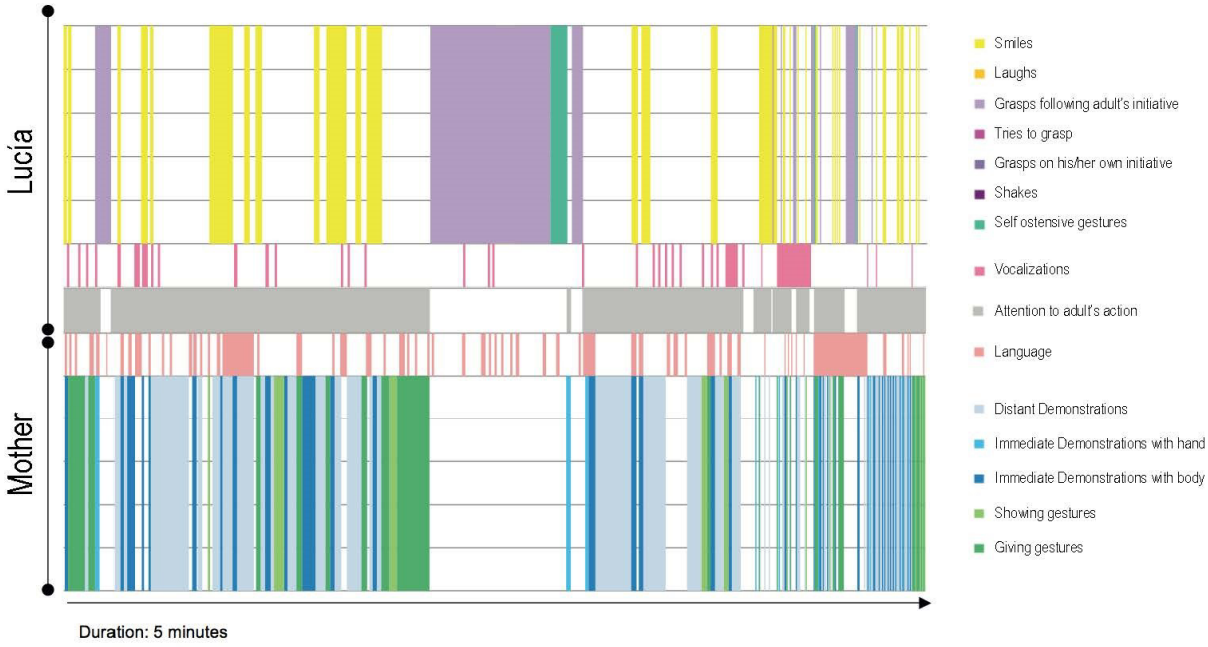

Figure 2
Microgenetic graph – 2 months. Lucía, 0; 2,7

In Figure 2 we can observe how, at 2 months old, although Lucía did not have many resources to participate in the interaction, there was almost a continuous attention to her mother's communicative proposals. Lucía also smiled in several occasions at her mother, favoring a positive engagement. We present her first grasps of the object, all following the mother's initiative, who at a certain point gave the maraca to the infant. These interchanges introduce Lucía into the triadic interaction. At this age, the mother used a variety of communicative mediators with ostensive components in order to present the object to Lucía. However, giving gestures were still quite sporadic, so Lucía did not get involved as much as when she was able to grasp the maraca.

At 3 months (see Figure 3), it is striking how the mother started to space her interventions much more. These pauses in the interaction resulted in Lucía's entry into the interaction, still very influenced by her mother since she placed the maraca in Lucía's hand. We observed Lucía's first self-ostensive gestures, as part of the exploration of the

"piece of the material world" that she had been given. As generally occurred with all the participants, Lucía's mother decreased her immediate demonstrations.

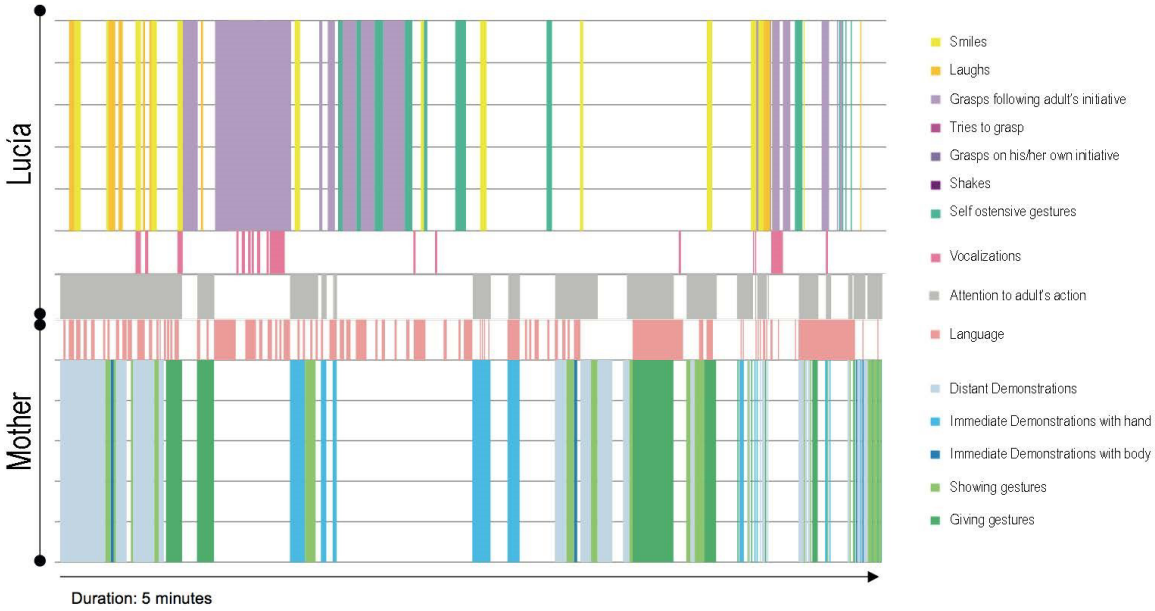

Figure 3
Microgenetic graph - 3 months. Lucía 0; 3, 4

Finally, at 4 months, as Figure 4 clearly shows, Lucía progressively began to use the object more actively. She anticipated her mother's giving ('*tries to grasp*') and — still in a very basic way— shook the maraca. The situation entails a first entrance for the infant into the object's proto-conventional use. Meanwhile, her mother used the object more briefly than on previous occasions, changing her intervention into support for Lucía's active exploration of the object.

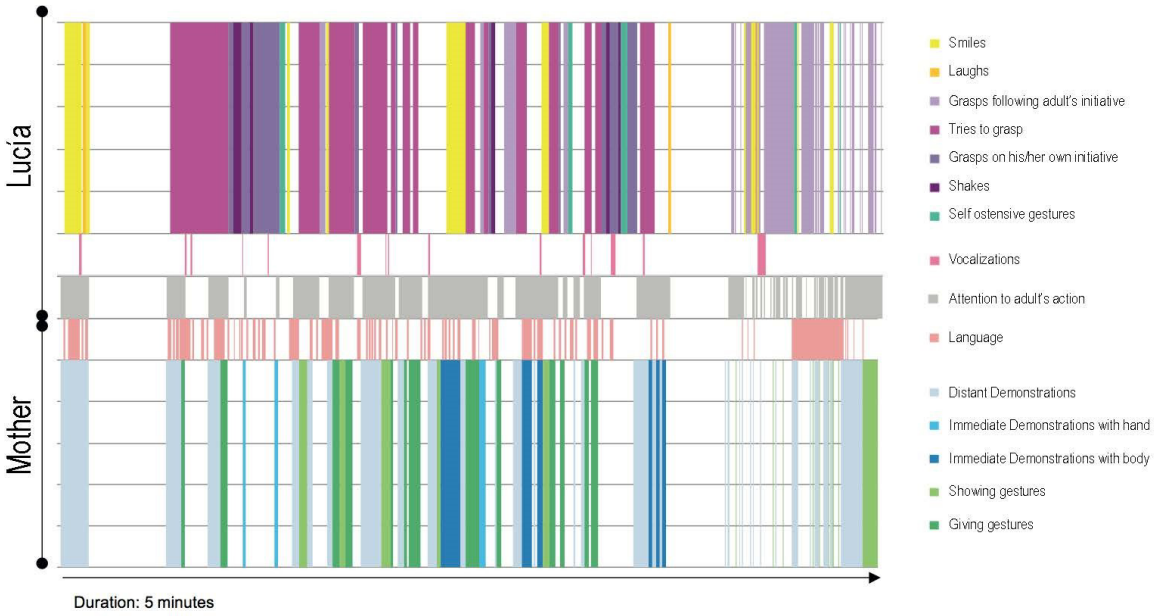

Figure 4
Microgenetic graph – 4 months. Lucía 0;4,6

Discussion

The results of this study highlight three fundamental and frequently overlooked features of the development of triadic interactions: (1) that there can be *early* triadic interactions from the second month of life, though different from those which occur by the end of the first year as the communicative intention here comes from the adult, (2) that the adult includes the infant in organized communicative niches based on ostensive actions, both through demonstrations of the use of objects and through gestures (showing and giving); and (3) that these ostensive actions imply a marked rhythmic character, which brings structure and facilitates child's interaction with the adult and an object.

At present, ostensive gestures are not commonly considered as a gesture. However, the high frequency in our results of adult's ostensive productions supports the thesis that ostensive gestures occupy a privileged place in development that precedes (both in comprehension and production) other gestures, such as pointing. In our study, adults never used pointing gestures to generate shared reference with children at this age, which is

striking if we consider the huge importance that has been given to pointing in Developmental Psychology in recent years.

Thus, we highlight the necessity of distinguishing between ostensive and indexical gestures within the larger category of deictic gestures. Ostensive gestures should be considered gestures in their own right since they allow the adult to reduce ambiguity about the referent — as the referent (object) occupies the hand that performs the gesture (sign). In addition, the fact that all uses of the maraca that the adult performs towards the child have an ostensive semiotic nature (as for the demonstrations of the use of object) further emphasizes this point.

Adult's ostensive gestures allow the first levels of agreement between adult and infant. Before the child understands what the object is, he/she establishes conventions with the adult at a much lower level — e.g. to look at what the adult is presenting. Therefore, to speak only in terms of joint attention is not enough, since that attention is essentially promoted by the joint action that the adult constantly initiates (Shotter & Newson, 1982). Adult's organized action allows the child to attend and to be situated in the world around him/her. However, we cannot ignore the fact that objects are meaningful thanks to their conventional uses and as such they cannot be separated from their cultural background. Thus, Gibson's seminal concept of affordances (Gibson, 1979), which claims that the world is perceived not only in terms of object shapes and spatial relationships, but also in terms of object *possibilities for action*, needs to be reconsidered beyond the ecological approach, and towards a more elaborated theory which includes the intentional affordances that are learned through social interactions (Sinha, 1988, 2015; Tomasello, 2004).

At 2 months, the child is still barely sensitive to the adult's shifts of action with the object to right or left (although this changes in the next sessions), but we often observed the adult placing the object on the imaginary line that connects the infant's and

her own gazes, i.e. where dyadic interaction is already established. With these initiatives, the adult brings the child a space of possible action. As Reddy (2012) notes, action and posture have much to do with the response provoked in the other, favoring interaction. She also refers to Peter Wolff's studies with two months old infants (1987), which showed that children are more likely to smile when they are directly watched by the other. This highlights the importance of eye contact that the adult pre-sets with the infant, establishing a connection that later allows the adults to place the object within. Adults seem to notice that the imaginary space between their gazes is extremely attractive for the infant and so a very good place in which to act upon the object.

At 3 and 4 months, adults increasingly space their actions relative to the previous session, adding progressively longer pauses between their interventions. They adjust themselves to the children's responses, according to their interpretation of the infant's capabilities. The child is now able to grasp the object and, therefore, to do something with it. Pauses in the action of the adults mean less regulation of the whole activity, giving space to the children to control the object themselves.

Between 2 and 4 months of life, triadic interactions *are made of* rhythm, which is used by the adults to organize the interaction. The maraca used in this study is a sounding object, which means that, when an adult performs a distant demonstration of its use and then stops, the silences that derive from pauses create long rhythmic-sonorous sequences of interaction. Adults' gestures also incorporate tempo and intensity, which varies depending on the communicative intention.

The adult's patterns of rhythmic and sonorous interaction are characterized by recurrent pauses, varying their frequency (depending on the age, attention or emotional responses of the child). Additionally, the adult's rhythmic structured sequences seem to progressively follow the child's responses over time, making them effective in getting the infant engaged in common grounds of very basic mutuality, thanks to the space provided

during pauses. They also progressively dropped the unstructured rhythmic-sonorous interventions throughout the three sessions, in which the child seems to be less interested. The adults constantly connected with the responses observed in the children, attuning the rhythmic-sonorous interaction to the infant's responses, some of which were also rhythmic in nature (e.g., the infant's body movements). Rhythm acts as the organizer of the adults' patterns of interaction, favoring not only the emergence but also the continuity of triadic interactions.

In consequence, according to our results, adults' ostensive actions are effective in the interaction with infants from early on: at 2 months, the child "understands" these adult's ostensive gestures as something that can be attended to, resulting in long periods of sustained attention, smiles, and body movements. The children are clearly engaged in the interaction, do not cry and are apparently interested in the initiatives of adults. Later, from 3 months onwards, the adult's ostensive actions also transform the object into something to grasp. The children then direct their open hand to the object in an ostensive way, anticipating that the adult will then give it to them. As some other studies have previously shown (Dupertuis & Moro, 2016; Moro & Rodríguez, 2005), infants are able to use toward themselves the signs previously employed by the adult to include them in the uses of objects. These self-directed ostensive gestures differ from merely exploring the object since they are attentional acts (along the lines of what Piaget called perceptive acts) which imply a pause in the action in order to contemplate the object. At 4 months, the first proto-conventional uses of the object are present in all the children, that is, shaking the maraca, though still in a fairly rudimentary way due to the children's still developing motor control of arms and hands

These results challenge some widely accepted statements about children's early development. For example, we observed the first intentional grasping motions from 2 months old when supported by adults, while Corbetta & Thelen (1999) argue that they

only occur from 5 months of age. Nevertheless, our findings are aligned with some other researchers who assert that referents are not naturally given in human communication but need to be established in interaction with others (Costall, 2013; Rodríguez et al., 2015). Thus, we highlight the need to analyze development from the interdependence between a child who actively perceives and acts, and the structured communicative situation presented by the adult.

Infants become involved in adult's presentations with a mediating object from the first months of life –which includes an important rhythmic and sonorous aspect–, questioning the idea that triadic interaction only occurs from 9 months of age, when the child communicates intentionally. This study describes "other kinds of triadic interaction" where the first places of consensus between adult and infant are set in a coherent and structured interchange arising from the adult's initiative. Further investigation is required to explore in more detail the nature and evolution of these early triadic interactions to the point where children themselves assume the communicative intention. Also, cultural comparative studies are required to seek further evidence that joint attention doesn't spontaneously develop as an individual cognitive capacity but is learned in contexts of joint action. In addition, more specific research is needed focusing on musical aspects, specifically on describing rhythmic and sonorous patterns in adult-infant-object interactions and how they develop in these early ages.

Conclusions

Altogether, the consideration of the triangular interaction among adult, infant and object is crucial to lay down some grounds for the emergence of triadicity in the first months of life. Children's relationship with the world is necessarily mediated by adults, as claimed by Vygotski (1984/1996) and also stressed from the Pragmatics of the Object perspective (Rodríguez & Moro, 1998), differing from the idea of the solitary child who

cognitively develops and constructs knowledge in his/her own. Thus, the distinction between lower and higher psychological functions does not stand up to the assumption that infants are unable to relate the world alone. However, adult´s influence on the child's cognitive and communicative development needs to be more fully explored. In this sense, signs could contribute to mediation in the triadic relationship (Rodríguez, Moreno-Núñez, Basilio & Sosa, 2015), where adult's ostensive gestures would play a pivotal role during the first months of age.

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