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PhD Thesis Abstract

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GESTURAL COMMUNICATION IN 2- TO 6-YEAR-OLD CHILDREN: CONNECTIONS WITH PRETEND PLAY AND COMMON GROUND

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Short abstract

In this thesis we investigated the ability of 2- to 6-year-old children to produce iconic and pointing gestures in different communicative contexts. We also analyzed how gestural communication is related with pretend play and the common ground between communicative partners. The main contribution of this thesis is that we brought important insights into how gestural communication develops during the preschool years. In addition, we illustrated how the ability to iconically gesture and to engage in pretend play are related in young children. We also described which components of pretend play still develop in preschool children. Moreover, we discovered that children adapt their co-speech gestures as a function of common ground. The results of the current thesis contribute to an increased understanding of the social-cognitive mechanisms involved in the production of co-speech and pantomime gestures and provide important insights into young children's symbolic and communicative development.

Key terms: iconic gestures, pantomime, co-speech gestures, pretend play, role play, common ground, communicative development, referential communication, narrative development

Chapter 1
General introduction

Gestural communication

Gestures are body movements that do not involve the manipulation of objects and do not – at least not directly - lead to physical changes in the external word (Cartmill, Beilock, & Goldin-Meadow, 2012). Most of the times, the hands and the arms are used to produce gestural movements, but in some cases, movements of the head, facial expressions, or whole body movements are involved in the production of a gestures. Through iconic gesture, we can draw the shape of our thoughts: we can recreate images of the actions, objects or events we are communicating about. As Tomasello (2008) shows, when we gesture, we can bring into the context of communication referents that are perceptually absent, but that we want the recipient of our message to imagine with us, in a process of joint cognition.

These symbolic movements offer a window into the speaker's thinking, memories, and into his perspective about the world. Adults gesture very often while they speak and it seems that this is a universal phenomenon, although the specific language a person speaks can influence the way he gestures (Kita & Özyürek, 2003). Adult listeners effortlessly grasp the meaning of speakers' gestures, as shown by studies that have found that listeners incorporate the information that appears only in speakers' gestures, but nowhere in the verbal message. In this way, by using gestures, the comprehension of the verbal message increases, ambiguous messages are clarified, and ideas that cannot be verbally articulated are communicated.

In recent decades, a wealth of research has shown that gestural communication plays a beneficial role in adult communication (e.g., McNeill, 1992), in the language acquisition of pre-verbal children (e.g., Iverson & Goldin-Meadow, 2005; Tomasello, Carpenter, & Liszkowski, 2007) and in the learning of older children (e.g., Goldin-Meadow & Wagner, 2005). Because rich gestural communication is

possible even in the absence of language, some theorists have argued that gestural communication – and particularly iconic gestural communication - might occupy a privileged position in the evolution of language, because it could have been used by our early hominid ancestors to communicate complex ideas, before vocal language was constructed (Donald, 1994; Tomasello, 2008). Gestures are seen by many as the missing link between action and language, both ontogenetically (e.g., Iverson & Goldin-Meadow, 2005; Tomasello et al., 2007) and phylogenetically (Arbib, 2005; Corballis, 2009; Donald, 2005; Tomasello, 2008).

The *Iconic-Metaphoric-Deictic-Beat Quartet* (McNeill, 1992) is the most used taxonomy for distinguishing between different types of gestures. This model distinguishes between four main types of gestures:

(1) **Iconic gestures** are used to visually illustrate aspects related to concrete elements (i.e., actions associated with them, or their form) (Goldin-Meadow & Wagner, 2005; McNeill, 1992). They can describe actions, objects or relations that are not currently available, but that the speakers are capable to recreate with their hands so that the recipient can understand them.
(2) **Metaphoric gestures** are used to illustrate abstract elements and relations.
(3) **Deictic gestures** usually involve pointing the index finger toward a specific object or location in the environment.
(4) **Beat gestures** are very simple up and down, or back and forth movements, used to highlight the prosody of the discourse or to draw attention to specific words in the discourse (Cartmill et al., 2012; McNeill, 1992, 2005).

Although these gestures are usually used together with speech, they are also used in pantomime. It is important to keep this in mind, because in this thesis we will look at iconic gestures produced with (co-speech iconic gestures) or without speech (pantomime iconic gestures).

Different types of gestures have different developmental pathways, with pointing dramatically decreasing in frequency as children become proficient language users, and iconic gestures being produced more and more when they communicate. As their discourse becomes more elaborated and they start using longer sentences, with complex syntactic structures, beats and metaphoric gestures also increase their frequency in children's gesture repertoire (Cartmill et al., 2012; McNeill, 1992). Still, there are many unanswered questions about the mechanisms involved in gesture development during childhood, and more studies are needed in order to understand how children start gesturing at adult levels. Findings about children's gestures support the claim that, by looking at how children gesture we can increase our understanding of children's language development, their use symbols, their ability to tell stories, and their acquisition of new concepts.

Pretend play

Pretend play is one of the most fascinating abilities that emerge during the second year of life. Pretending involves the transformation of the current reality ("the suspension of here and now") to create a new, imagined reality (Lillard, 1993, Garbey & Brendt, 1975).

Pretending comprises a vast area of behaviors which can be classified as: object substitution (e.g., pretending that a box is a bed), attribution of pretend proprieties (e.g., pretending that a doll is eating, that she is sleepy or sad), playing the role of an imagined character, and inventing imaginary objects and friends.

Research suggests that children start to engage in pretend play by 18 months of age, and between 24 to 30 months children's engagement in pretend becomes more robust (Leslie, 1987; Bates, 1979; Haight & Miller, 1993, Lillard, 2007). Two-year-olds spend around 5-20% of their time pretending, and during the next years this amount of time doubles (Lillard, 2007). By 4 years of age, pretend play reaches its peak and children start to engage in socio-dramatic play with peers, where they invent and negotiate complex scenarios in which each child plays a particular character (see Lillard, 2010 for more details).

Chapter 2
STUDY 1: EXPLORING THE CONNECTION BETWEEN ICONIC GESTURE AND PRETEND PLAY IN YOUNG CHILDREN

Introduction

Iconic gesturing involves using our hands or arms to recreate images of the actions, objects or events we are communicating about. Iconic gestures are gestures that visually resemble the objects and actions they represent (McNeill, 1992). Iconic gestures can be considered symbolic actions, because they stand for something else. On the other hand, in pretend play, objects and actions are used as symbols in order to recreate a certain script/scenery. But besides using objects as symbols, pretend play also involves re-enacting iconic representations of actions. For example, a child may gesture drinking from an imaginary glass to express his desire to drink water. In the context of a game, the same child could pretend to drink from a shoe. In both situations, the child re-enacts the iconic representation of the action of drinking (with or without an object in hand). Iconic representations of actions are therefore used in both iconic gestural communication and pretend play.

Pretend play, iconic gesturing and language are without doubt a reflection of our ability to use symbols in our social interactions. Here we suggest that pretend play and iconic gesturing may be related especially because they both rely on iconic representations of actions, as opposed to verbal language, that is based on arbitrary mappings of symbols to referents (see Figure 1). Besides that, both abilities have been shown to undertake important development in the second and third year of life. Given this, there is a good possibility that they are underlined by common social-cognitive mechanisms. Based on the current empirical evidence and in accordance with the similar theoretical assumptions made Tomasello (2008), it seems that pretend play comes before iconic gesturing in ontogeny. In the second year of life children are more likely to engage in pretend play than to iconically gesture (Tomasello, 2008), and so we could stipulate that for children it is easier to reenact iconic representations when using object symbolically, than when empty handed. Within this perspective, pretend play could be considered a prerequisite of iconic gesturing, and objects could be scaffolds that facilitate the re-enactment of an iconic representation of action.
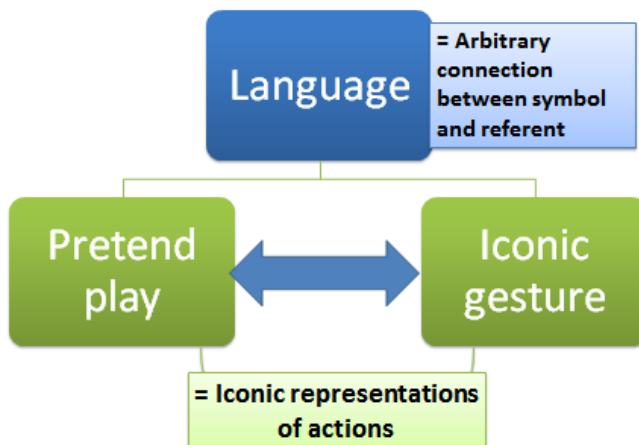

Figure 1. Depiction of the relations between different symbolic systems

In the current study we wanted to first address the more general question regarding the nature of the relation between iconic gesturing and pretend play. Although some have theorized that there is a connection between iconic gesturing and pretense (e.g., Tomasello, 2008) this is the first experimental investigation about the relation between these two abilities. In this study, we investigated this connection by analyzing under what circumstances are children more likely to gesture. We were particularly interested to see whether engaging in pretend play would facilitate children's gestural production. In this study, two-and-a-half-year-old children engaged in an interaction with an adult that demonstrated different instrumental or pretense actions on objects and who then gave them the possibility to act on the objects as well. A priming paradigm was created in order to analyze whether children will spontaneously gesture more to explain how to use some objects after those object were presented to them in pretend play as opposed to instrumental action. The crucial question was therefore whether children will iconically gesture more for the objects they experienced in pretend play as opposed to the objects they experienced in instrumental action.

Method

Participants

38 children (19 girls) aged between 2 years and 7 months and 2 years and 11 months ($M=$ 2 years and 9 months, $SD=$ 1.3 months) participated in this study. Children were mostly from middle-class families and were recruited from different kindergartens in the city of Leipzig, Germany.

Materials and setting

Each child participated in three experimental conditions, and in each condition 3 sets of objects were used:

Instrumental condition		Real objects were used instrumentally to reach a goal (e.g. E1 watered a plant).
Pretend conditions	Usual	A wooden block was used to pretend a familiar action (e.g. pretending to eat from a bowl with a stick).
	Unusual	A real object was used to perform an unusual action (e.g. pretending a phone is an ice-cream).

Procedure

1. Demonstration phase

E1 demonstrated instrumental versus pretend actions, with 3 objects presented in each condition (see Figure 2).
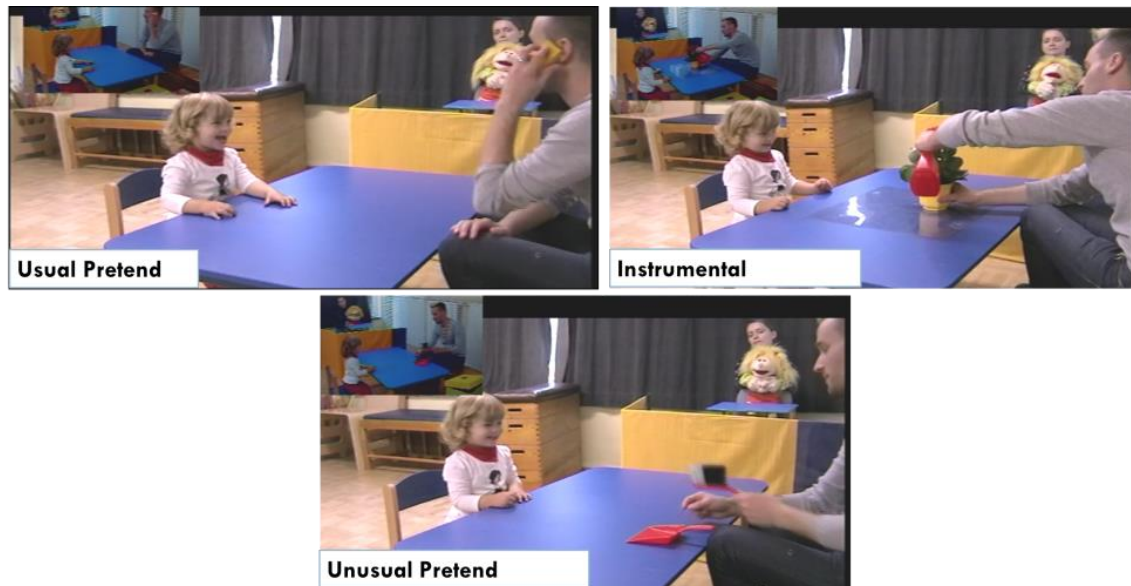
Figure 2. An example of one trial presented in each condition: *Usual pretend:* E1 pretended that a wooden block was a phone and had an imaginary conversation. *Instrumental:* E1 watered a real flower, placed in a pot (there was water in the watering can). *Unusual pretend (Crazy):* E1 pretended to hammer an imaginary nail with the brush.

2. Object use phase:

After each demonstration, children were given the opportunity to examine and manipulate the demonstrated objects themselves, but were not given any specific instruction on what to do with the objects.

3. Test phase: Children were then asked to show to a puppet (played by E2) that did not understand German how to use the objects. Because the puppet was sitting behind a barrier with the objects in her hands, children could not reach her and take the objects themselves to demonstrate how to use the objects. As such, the only way to solve this communicative puzzle was to use iconic gestures to explain the actions.

Coding

For each trial, a child received one point if he produced an iconic gesture that was visually similar to the action that had to be performed by the puppet. We also coded whether the child used the objects when they were given to him and whether he produced simultaneous speech together with his gestures.

Results

Children's gestural production after observing instrumental vs. pretend action

We found no significant differences between the three conditions, $(\chi^2(2) = .22, p = .89, ns)$, with children gesturing at very similar levels in the three conditions.

In average children gestured in 41% of the trials. 29 % of the children did not produce any iconic gestures, and the rest produced at least one gesture. 18 % of the children gestured in all the nine trials.

Gesture's Relation with speech

85% of the children accompanied their gesture with speech in at least one trial. When talking, children most often described the actions that should be performed with the objects or the location or direction of the actions to be performed (e.g., "*open/aufmachen*", "*down here/ hier unten*", in 87% of trials with speech accompanying gestures) and sometimes included deictic verbal expressions with their gestures (e.g., "*like this/so*", in 25% of the trials with speech accompanying gestures).

Imitation of the experimenter's actions

The extent to which children imitated the actions performed by E1 differed between the three conditions ($\chi^2(2)= 39.25$, *p*< .0001. Children were significantly less likely to imitate in the unusual pretend condition (*M*= 1.34) compared to the usual pretend (*M*= 2.37, *p*< .01) and instrumental condition (*M*= 2.61, *p*< .0001).

Conclusions

In this study we sought to investigate if engaging in pretend play with objects will lead children to iconically gesture more when communicating about the actions that had to be performed with those objects. Our results failed to confirm our hypothesis, as children seemed to gesture at the same levels regardless of our experimental manipulation. Although children's performance in this task was not at ceiling, with most of the children gesturing in just 42 % of the trials, we found that our pretense manipulation did not explain the variation in gesture performance

Regarding children's imitation of conventional versus unconventional actions, our results suggest an interesting contrast. Children imitated to the same extend when presented with conventional instrumental or pretend actions. But when presented with the unconventional pretend actions, their imitation level decreased significantly (by 54 %), and they either demonstrated the conventional action or they refused to act on the object altogether. This result confirms previous findings that suggest that before 3 years of age, children are reluctant in performing object substitutions with unconventional objects (Striano et al., 2003; Bretherton, O'Connell, Shore, & Bates, 1984; Golomb, 1977).

Regarding the relation between gestures and the accompanying speech, it was found that the majority of children used speech when they gestured. This is an interesting finding, because children were instructed that the puppet they were communicating with doesn't speak their language. The fact that they still talked highlights that speech and iconic gestures are closely connected in 2 ½ year-olds, and so, it is difficult for them to use gesture in isolation from speech.

Chapter 3
STUDY 2. GESTURAL COMMUNICATION AND PRETEND PLAY IN PRESCHOOL CHILDREN

Our main objective in this study was to explore the relation between iconic gesturing and pretend play in preschool children. In order to investigate which specific aspects of pretend play and gesturing are related with each other, we assessed different aspects of children's pretense and gestural communication. For assessing children's ability to use iconic gestures we look at preschoolers' ability to create pantomime and co-speech gestures but also at whether their performance improves when the experimenter offers scaffolds for their gestures. With regards to pretend play, we investigate four main dimensions of pretense: object substitution, role play during pretense, communication during pretense and elaboration during pretense**.**

Our second objective was to investigate the developmental trajectories of iconic gesturing and pretend play during the preschool years. Therefore, taking in consideration that we will measure these abilities at different age points, we are also interested in analyzing the two abilities separately, to detect changes associated with age in the way children gesture and engage in pretend play.

Method

Participants
Fifty-one typically developing children (28 girls) participated in this study and were assigned to three different groups, according to their age. 17 children were in the 4-years-olds age group, 17 children were included in the 5-year-olds age group, and 17 children were included in the 6-year-olds age group. Children were selected from kindergartens in Cluj-Napoca, a middle-sized city in Romania.

Design
A cross-sectional design was used to test children's pretend play and iconic gesturing abilities at different points in development. All children were tested in two separate testing sessions, separated by at least two days. In one occasion children were administered the pantomime task, and in the other occasion children were presented with the pretend play task. The order in which the two tasks were administered was counterbalanced between participants.

Procedure

Gesture production task
This task was the same as that used in our previous study (Study 1), but a few changes were introduced with regards to the type of objects used and the implication of E1 in the procedure. As such, half of the objects used in this task needed more than one action step to be successfully operated. In addition, we also used scaffolding when children failed to produce iconic gestures. Children were verbally instructed to gesture ("*Show her with your hands*") each time they didn't gesture, and if that was not enough to elicit their iconic gestures, they also received one separate trial of modeling in which E1 demonstrated an iconic gesture towards the puppet (just once throughout the procedure).

Pretend play task

The child was presented with a stuffed dog named Bobi, and then a cardboard house was placed on the table (see Figure 1). During the procedure, the house could be rotated on the table so that the location of the game could be switched to the three different rooms of the house. Table 1 describes each section of the pretend play scenario.

Figure 1. Materials used in the Pretend play task.

Table 1. Sections of the pretend play task

Sections of the pretend play task	Objects and scenario
Section 1. **Spontaneous object substitution with miniature objects**	Set 1: bathtub, soap, towel Set 3: tea cups, teapot
Section 2. **Spontaneous object substitution with similar objects**	Set 2: box, cloth Set 4: wooden cube, table
Section 3. **Spontaneous pretend with objects with weak perceptual similarity or with imaginary objects.**	Set 5: a big tray containing four different small wooden pieces (a cylinder, a cube, a stick and a pyramid), a small box containing several woolen ribbons, a plastic food container, and a small white cloth. The child is presented with these objects and then Bobi (played by E1) asks for something to eat.
Section 4. **Elicited pretend with objects with weak perceptual similarity or with imaginary objects**	Set 6: Bobi (E1) asks for a banana, a glass of water, cake, a fork, spaghetti, a paddle and a fishing rod
Section 5. **Spontaneous role play**	Set 7: Gigi the sheep comes to visit. E1 leaves Bobi on the table and takes Gigi's role. We measured whether the child takes Bobi's role spontaneously to welcome Gigi into his house.

Section 6. **Role play**	Set 7: Gigi. We measured the consistency with which the child keeps playing Bobi's role throughout this whole section and the extent to which he talks and acts in Bobi's name.
Section 7. **Elaboration**	Set 3 to 7. We measured whether the child performed self-initiated original pretense actions (e.g., the child puts a candle on the cake, prepares a soup on the stove, pours imaginary cheese on top of the spaghetti, using the white cloth as a rug or as a tablecloth) or whether he communicates in speech a new play idea.
Section 8. **Communication score**	Set 1 to 7. We measured to what extend the child communicated throughout the whole pretend play task.

Results

Gestural production

29% of the 4-year-olds pantomimed in at least half of the trials, while 82% of the 5-year-olds and 88% of the 6-year-olds did so. We found that age had a significant effect on the number of pantomime gestures produced: $F(2,48) = 17.62$, $p< .0001$. 4-year-olds produced significantly less pantomime gestures compared to both 5-year-olds ($F(2,48)= 3.42$, $p <.01$) and 6-year-olds ($F(2,48) = 4.06$, $p< .0001$)(see Figure 2). The production of co-speech gestures did not differed significantly in the three age groups ($H(2)= 3.38$, ns).
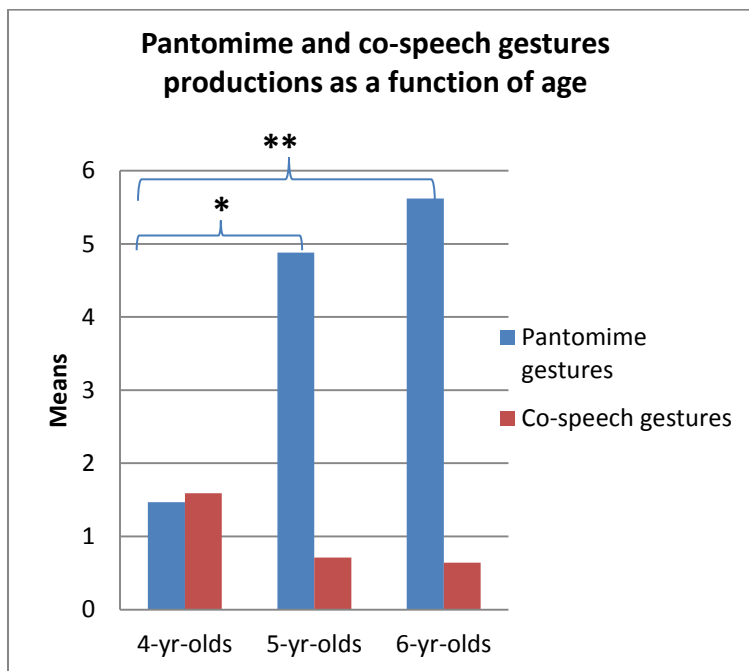

Figure 2. Spontaneous gesture production as a function of age, ** $p<.0001$, * $p<.01$

If we looked at the gestures produced spontaneously (both co-speech and pantomime), without explicit encouragements to gesture, then 4-year-olds still produced significantly less gestures than the 5-year-olds ($H(2)= 3.24$, $p< .01$) and the 6-year-olds ($H(2)= 4.48$, $p< .0001$).

When we considered all the possible gesture types together (both spontaneous and elicited pantomime and co-speech gestures, we found that overall the rate of gesturing increased significantly with age ($J=568.5$, $p< .01$). Pairwise comparisons revealed that only the difference between the 4-year-olds and 6-year-olds was marginally significant ($J= 207.5$, $p =.025$, *ns)* at the adjusted level of significance $p= 0.0176$.

The pantomime score was correlated with other measures of gestural production: positively with gestures' precision ($r =.45$, $p< .001$) and negatively with the number of co-speech gestures ($r = -.57$, $p <.0001$).

Pretend play

Older children had higher scores at the Role play measure $F(2,48) = 20.51$, $p< .0001$. The differences between 4-year-olds and 5-year-olds were significant ($F(2,48) =1.53$, $p< .0001$) as were the differences between 4-year-olds and 6-year-olds ($F(2,48) = 2$, $p< .0001$).

We found significant age differences in the Elaboration score: $H(2) = 16.88$, $p< .001$. 4-year-olds had a similar performance with 5-year-olds ($H(2) = .58$, *ns*), but had a significantly lower score than 6-year-olds ($H(2) = 18.38$, $p<. 001$). In addition 5-year-olds had a significant lower Elaboration score than 6-year-olds ($H(2)= 17.79$, $p <.001$).

We also found significant differences for the Communication scores between 4-year-olds and 6-year-olds ($U=220$, $p<. 001$) (see Figure 3 for a detailed description of these differences).
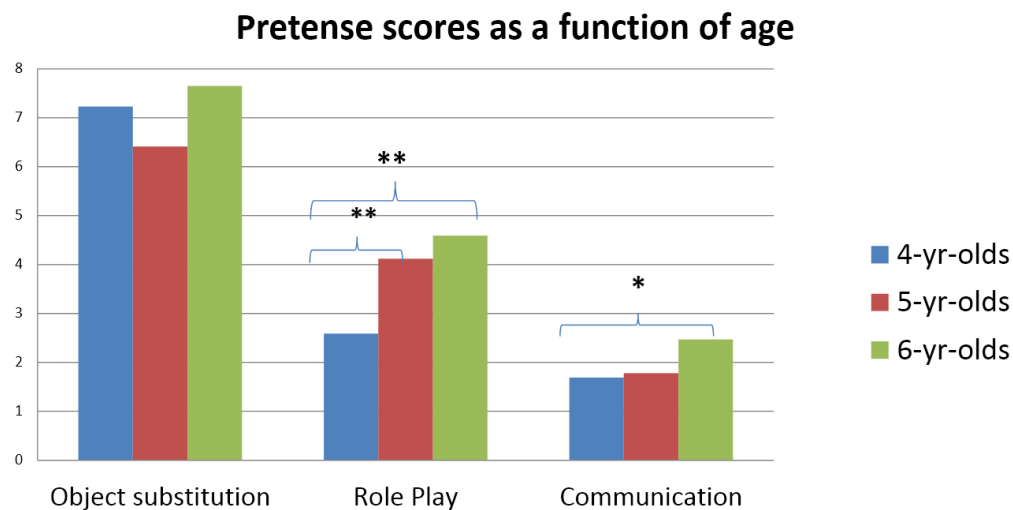
. ** p < .0001, *p<.01

Figure 3. Age differences in the pretend play measures

The communication score was correlated with other measures of pretend play: the object substitution score ($r = .29$, $p<.05$), the role play score ($r = .30$, $p<.05$) and the elaboration during pretense score ($r = .48$, $p<.0001$).

We further tested a regression model with age and Role play as predictor variables for the Pantomime score. We found that both age and Role play predicted the number of pantomime gesture produced, predicting 58% of the variance in the pantomime score (see Table 2 for more details). However, role play predicted significantly more of the variance in the pantomime score than the age variable did ($p < .0001$).

Conclusions

Our results suggest that during the preschool years children's ability to produce pantomime and to engage in pretense undertakes important changes.

First we found that 6-year-olds were able to consistently produce pantomime gesture, on the spot and without the need to receive explicit suggestions to do so. 5-year-olds, although they produced pantomime gestures at similar levels with the 6-year-olds, were at a transition point in their need to receive scaffolding in the form of modeling in order to understand that pantomime must be used. This suggests that only at 6 years of age we can talk of a fully developed ability to produce pantomime gestures without the need for any type of scaffolding from an adult.

They were less consistent in using one type of gesture, using co-speech gestures and pantomime gestures to similar extends and, overall, at reduced levels. However, in their case, verbal modeling in the form of explicit instructions to gesture was beneficial for their performance. When both spontaneous gestures and verbally elicited gestures were considered together, 4-year-olds looked more similar with the other groups, as only the difference with the 6-year-olds remained significant. This suggests that 4-year-olds do not lack the ability to pantomime altogether, but rather their problem is at the performance level, and as such they are less knowledgeable about the conditions in which this behavior is appropriate.

Second, regarding pretend play, we found that during the preschool years children's abilities to communicate during pretense, to engage in role play and to elaborate all develop. By 6 years of age all this abilities reach a high level. This suggests that by 6 years of age there is a peak in children's ability to engage in social-interactive pretense. We found that children's communicative abilities were related with their levels of elaboration, role play and object substitution, confirming the connection reported in literature between language development and pretend play.

Lastly, regarding the connections between pretend play and gesturing, we discovered a strong link between role play and pantomime. When both role play and age where considered together, we managed to explain a significantly bigger amount of the variance (58 %) that with either of the variables alone.

Chapter 4
THEORETICAL REVIEW: COMMON GROUND IN ADULTS' AND CHILDREN'S COMMUNICATION

In **Chapter 4** we introduce the term of common ground and we propose a review of the literature that investigates this aspect of human communication. We start by analyzing the role common ground plays in adults' verbal communication and then we also review the studies that looked at how common ground is reflected in adults' co-speech gestures. In the last part, we review the evidence about how infants and young children use shared experiences and conceptual pacts in their communication with others. The purpose of this review is to critically discuss the literature that investigates common ground as well as the different methodologies that can be used to investigate this issue. With this overview we set the stage for finding the best ways to investigate common ground in preschool children, which is the focus of the next chapter.

Chapter 5
STUDY 3: CHILDREN ADAPT THEIR CO-SPEECH GESTURES AS A FUNCTION OF COMMON GROUND

Human communication is built upon a common ground, namely the knowledge and experiences that are shared between participants in a communicative act. When starting a conversation we use perspective taking to make inferences about the other person: the knowledge, assumptions or beliefs the other person does and does not have. This shared information, what interactants "know together" forms the common ground between conversational partners and plays an important role into how a conversation unfolds. Before the conversation starts, participants acknowledge the common ground they have with their interlocutors. As such adults adjust their speech as well as their gestures according to the knowledge they share with their communication partners: by attenuating what is mutually shared with their partners and instead focusing on offering more details about what is not part of the common ground (Galati & Brennan, 2010; Gerwing & Bavelas, 2004; Jacobs & Garnham, 2007).

While the effect of common ground on adults' communication, seen as both speech and gesture, has been tackled with in previous research, there are no studies investigating this issue in children. Studies about how children use gestures when they share common ground with their communicative partners are limited to the pointing gestures used by preverbal infants. But gestures remain an important channel of communication even after the use of pointing dramatically decreases and children learn to use verbal language to communicate. Advancements in speech production are accompanied by the increased use of iconic and beat gestures. As such, the more developed the language ability, the more gestures will be produced during speech. That is why we consider that more insight could be gained about children's communication of common ground if we consider not only speech production but also the co-speech gestures that so often accompany speech.

As such, the aim of the current study is to provide a first step in understanding if children take into consideration common ground when they select what to convey in their verbal and gestural communication with others. In particular, we want to see if children adjust their speech and co-speech gestures to the information they share with their interlocutors. Two questions are of main interest: (1) Will children produce longer and more detailed stories for an unknowledgeable listener? and (2) Will children produce more gestures when they speak about experiences that are not shared with their interlocutor as common ground? To answer these questions, we asked each child to narrate a previous event in two experimental conditions: (A) The *Common-ground condition (E1-Cg),* to the adult (E1) who previously participated in the same event together with the child and (B) in the *No-common-ground condition (E2-Ncg)*, to the adult (E2) who was absent during the event unfolding. We predict that in the case where there is common ground between a child and their partner, we will observe attenuation in both their speech and gestural production.

Method

Participants

The participants were 37 typically developing 6-year-old children (17 boys).

Design

In the first phase of the experiment, common ground was established between the Experimenter 1 and each child by having them play together three sets of games. Then in the second phase, children had to talk about how they just played both to E1 and E2. The order in which the games were played was aleatory for each child. We used a within subject design in which each child narrated twice how they played: once to E1 (the *Common ground condition E1-CG*) and once to E2 (the *No common ground condition E2-NoCG*). The order of the conditions was counterbalanced between participants.

Procedure

1. Shared play phase

During the familiarization phase, E2 and the child played together so that they get to know each other. E1 then entered into the room with a present bag that contained some surprise toys. E2 announced that he has to leave, and as such he can't stay to see what's inside the bag. At that point, the shared game phase began. Common ground was established during this phase, by having each child play together with E1 a set of three different games. For each game E1 proposed to make a contest to see: who catches more fish (see Figure 1), who throws more disks on the neck of the duck, and who makes the spinning disk fly higher.

FISHING GAME

DUCK GAME

FLYING PROPELLER TOY

Figure 1. The three games used during the shared play phase

2. Test phase

After approximately 10 minutes of play E1 took the bag with the toys and said that she has to check with the teacher that gave her the toys if they can keep them longer. Meanwhile she handed to the child a board that contained pictures of the games (that was in the bag with toys from the beginning) and

asked the child to explore it. When E1 came back she explained that the teacher said she needs the toys back so she had to return the bag with toys, but they can keep the board with pictures to play with it for a while. Then E1 said she has an idea of how they could play next and fixed the board on the back of a chair using the duct tape that was already placed on top of the board. Afterwards, she put the chair in front of the table, facing the child. At that point, the test phase begun. Each child was asked to narrate about the games they just played with in two conditions: once to E1 (*Common ground* condition- E1-Cg) and once to E2 (*No Common ground* condition- E2-NCg).

Coding

Children's speech and gestures were transcribed from the videos using the ELAN software (Brugman & Russel, 2004), see Figure 2. We first transcribed the speech, and for each child we computed the number of words used and the duration of speech in seconds. We then coded for representational gestures (iconic and metaphoric) and pointing gestures. In the end, for each two stories children produced we computed the rate of representational and pointing gestures per 100 words but also per minute of speech.
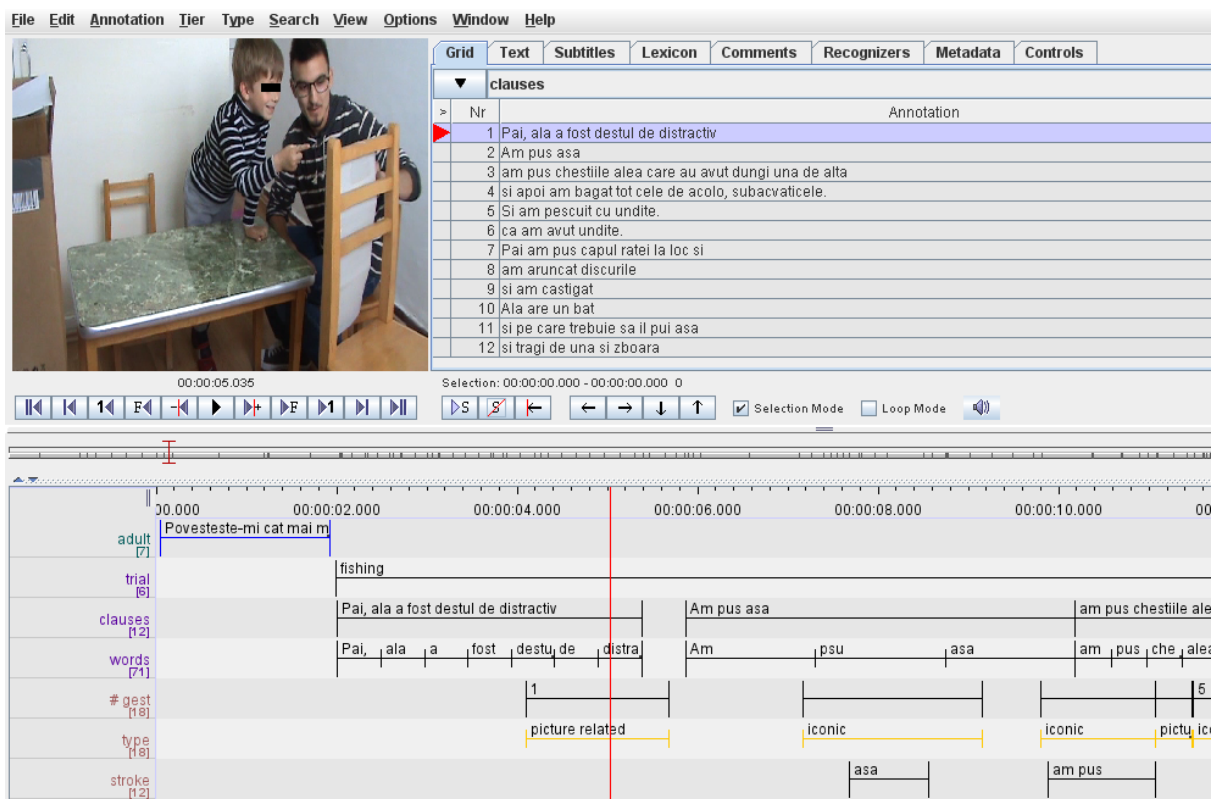
Figure 2. Capture of an Elan annotation file.

Results

Children produced longer stories in the *No common ground condition* (M = 87.89 words) than in the *Common ground condition* (M = 50.05 words) and this difference was significant when we compared speech duration in seconds, $F(1,36) = 34.06$, $p = .000$, and in the number of words $F(1,36) = 49.17$, $p = .000$.

Most of the representational gestures that children produced were iconic gestures, with a few instances of metaphoric gestures. Children also produced an increased number of picture related

pointing gestures, which can be explained by the fact that in the test session we used a board with pictures of the games they had to narrate about. An Anova with repeated measures revealed that children produced more representational: $F(1,36) = 12.36$, $p < .001$ and pointing gestures: $F(1,36) = 44.96$, $p < .0001$ per 100 words in the *No-common- ground* condition (see Figure 2).

Figure 5. Rates of gesturing in the two conditions. **p< .001 and *p< .0001
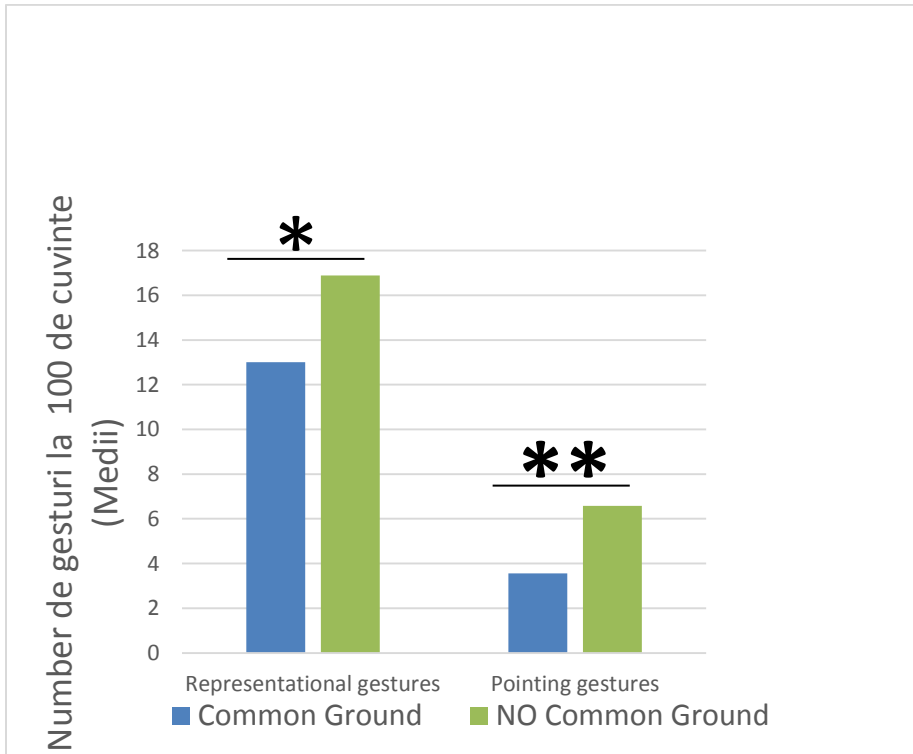
Conclusions

In this study we set out to investigate how common ground shapes children's communication. We used a multimodal view of communication which considers that in order to have a more complete image of children's ability to communicate it is important to analyze both verbal and gestural productions. After experimentally establishing common ground between each child and the first experimenter, we asked children to narrate about the events they just experienced to a knowing recipient (the first experimenter) but also to an unknowing one (the second experimenter). We then compared the two narrations each child produced by analyzing children's speech (the duration of the story in seconds and the total number of words produced in each story) and gestures (representational and pointing gestures). There were two main findings in our study. First, children told shorter stories to knowing partners than they did to unknowing ones. Second, children gestured at lower rates when their listener was E1, with whom they shared common ground, compared to the situation when they were narrating to E2. Overall, these findings demonstrate an attenuation in children's communication when there is common ground between interactants. These results provide the first experimental evidence that children adapt their speech and gestures as a function of common ground. Our findings highlight the social-communicative function of children's co-speech gestures, by showing that children adjust their gestures to the informational needs of their conversational partners.

Chapter 6
General discussion

Answers to our research questions

1. How does the ability to communicate using iconic gestures develop?

The major goal of this thesis was to fill in this gap in the literature and hence to illuminate our understanding of how the ability to iconically gesture develops.

To accomplish this goal we included in our studies children that were in the age range in which the ability to gesture knows accelerated developmental changes, in parallel with language development (Colletta et al., 2015, 2010; Mayberry & Nicoladis, 2000), namely the time frame between two-and-a-half to six years of age. We started this endeavor by acknowledging the need to investigate gestures in their natural context: conversation. With a few exceptions (Behne, Carpenter, & Tomasello, 2014; Colletta et al., 2015, 2010; Namy, Vallas, & Knight-Schwarz, 2008) most of the recent research has studied iconic gestures outside their communicative context, considering them as isolated experimental stimuli (Namy et al., 2008; Stanfield, Williamson, & Özçalişkan, 2014; Stefanini, Bello, Caselli, Iverson, & Volterra, 2009; Tolar, Lederberg, Gokhale, & Tomasello, 2008). Therefore, **an important goal of the current research was to design tasks that would capture gestures within the natural context of communicative exchanges.** We were able to accomplish this goal and to design these types of tasks for all our experiments, and because of this we consider that we also managed to capture 2- to 6-year-olds' ability to gesture as they would in their day to day life.

In Study 1 we found that 81 % of the two-and-a-half-year-old children produced at least one iconic gesture and, overall, children gestures in 41 % of the trials. **This suggests that although most of the 2 ½ - year-old children have the ability to gesture iconically, the ability to produce them consistently and whenever it is necessary still develops.**

In study 2 we followed up our questions of how children's ability to gesture iconically changes with age by conducting a cross-sectional study with preschoolers. We used a similar task with that introduced in study 1, but we classified children's gesture as pantomime if the child didn't simultaneously talk and as co-speech gestures if the child talked.

The findings from study 2 suggest that in 6-year-olds the ability to produce pantomime gestures spontaneously is fully developed. 5-year-olds also reach similar levels to 6 year olds, but some of the children still needed a demonstration of the fact that the puppet understands pantomime gestures. **We found that 4-year-olds still use verbal language with half of their gestures, thus producing co-speech gestures in a pantomime task, while 5-year-olds and 6-year-olds used pantomime gestures, and only rarely produced co-speech gestures.** However, overall, 4-year-olds produce significantly less iconic gestures (both pantomime and co-speech gestures, unless they are repeatedly reminded to use their hands. This suggests that **at 4 years of age children do not yet have the ability to consistently and spontaneously use pantomime gestures when the communicative context requires it.** When they received verbal scaffolding, 4-year-olds gestured at similar levels with the older children. This suggests that 4-year-olds do not lack the ability to use iconic gestures in communicative situations

altogether, but perhaps they are less knowledgeable about the conditions in which this behavior is appropriate and they are less proficient in producing pantomime gestures consistently.

In study 3 we get a different perspective about the use of iconic gestures in communicative situations. In this study we were interested to study **6-year-old children's production of co-speech gestures while they narrate a short story**. We discovered that **by 6 years of age, children already produce a very increased amount of co-speech gestures, especially in the case when they have to narrate an event rich in spatial-motoric representations.** Overall the results of this study bring important empirical evidence for the emerging claim supported by gesture researchers that co-speech gestures play a pivotal role in human communication, and therefore considering human communication by looking only at speech overlooks an essential part of this process.

2. Is there a connection between iconic gesturing and pretend play?

We first attempted to answer this question in study 1. Based on the existing literature we predicted that pretend play could be a prerequisite of iconic gesturing. We failed to find support for this hypothesis, and based on our results we suggested that a different methodological approach is needed in order to answer our research questions.

Therefore in study 2 we took a step back and tried to document this relation by investigating first whether the relation between the two abilities might be a correlational one. For this we measured different components of pretense and iconic gesturing.

From our analysis in which we included the different components of the two abilities a strong association emerged between pantomime and role play. This connection held even when the contribution of age was taken in consideration. Our regression model suggested that age and role play together explained 58 % of the variation in the pantomime score. However, significantly more of this variation was explained by role play alone. The strong association we found between the two abilities suggests that the connection between role play and pantomime is not explained only by a general developmental progress, but there is a strong possibility that the two may be underlined by common internal processes. Further investigations, especially longitudinal and training studies are needed in order to shed more light on this issue.

3. How does pretend play develop during the preschool years?

During the preschool years children's engagement in pretend play reaches its peak, meaning much more than playing with dolls and pretending that X is Y. Pretense becomes a highly cooperative activity during which children are very motivated to share pretense intentions with their peers, to invent stories and adventures in imaginary places, or to play the role of imaginary characters. That is why capturing such behaviors in the lab is a challenging task. We aimed to answer this challenge by proposing an interactive task, in which the experimenter engages fully in pretense and makes his own contribution to the game, while offering the child the chance to contribute as well. Moreover, we aimed to look not only at object substitution and pretend play with objects, but also to measure children ability to engage in role play, to communicate during pretense, and to elaborate by coming with original contributions to the game. Our results showed that while by four years of age children have no difficulties with object substitution, there were significant developmental changes across the other components of pretend play. **We found that pretense communication, pretense elaboration and role play undertake important developmental changes throughout the preschool years. By 6 year of age children's level of performance in these three types of pretend play reaches a very high level.** What these measures have in common is the fact that they all involve an increased ability to share

pretense intentions with the play partner. These results provide evidence for the claim that by 6 years of age there is a peak in children's ability to engage in social-interactive pretense.

4. Does common ground have an effect on how children use co-speech gestures?

In study 3, we wanted to investigate if 6-year-old children **adapt their speech and gestures as a function of the knowledge share with their interlocutors.** More specifically, we wanted to find out whether, similarly with adults, children will produce more gestures when they speak about experiences that are not shared with their interlocutor as common ground. Children were asked to narrate a previous event to a person that shared knowledge about that event, but also to a person that did not shared knowledge about that event. We measured their verbal and gestural productions and observed a significant attenuation in children's speech and gestures when there was common ground between them and their recipients. This effect was found for representational gestures (iconic and metaphoric gestures) and for pointing gestures as well.

These results provide evidence that children adapt their speech and gestures as a function of common ground. Our findings emphasize that children also use co-speech gestures to illustrate information that would be useful for a particular partner. Our findings thus bring strong support the idea that children gesture for their partners, and not only for their own benefit. In other words, our findings offer the first empirical evidence that **6-year-olds' co-speech gestures do not serve only cognitive functions, but important social-communicative functions as well**.

Contributions

Overall, this thesis illuminates our understanding of the conditions under which children use pantomime and co-speech gestures. Our analysis of children's gesture and pretense contributes to a better understanding of the symbolic development of 2- to 6-year-old children. Our findings also show the importance of looking at children's gestures for a better understanding of how they adapt their communication according to different social factors.

There are four main **contributions this thesis brings to the gesture literature**:

1. We designed three tasks to measure 2 ½ - to 6- year-old children's natural ability:
- to pantomime
- to produce co-speech gestures when narrating a previous event
- to engage in pretend play during the preschool years

2. We provided an overview of the developmental trajectories of iconic gesturing and pretend play of 2 ½ - to 6-year olds children.

3. We illustrated how the ability to iconically gesture and to engage in pretend play are related in young children.

4. We offered the first insights into the social-cognitive mechanisms involved in the production of co-speech gestures.

Final remarks

Understanding the ontogeny of the ability to pantomime can illuminate our understanding of children's symbolic and communicative development and of their deliberate use of iconic gestures. Given that it is suggested that pantomime gestures played a pivotal role in language evolution, together with the fact

that these gestures are also used by our primate cousins, we believe that developmental and comparative studies of pantomime production will contribute to a better understanding of how the human social mind and language evolved.

Co-speech gestures are overwhelmingly produced together with speech, and what is fascinating about them is their strength of visually depicting complex meanings in a fast and simple way. Understanding the development of co-speech gesturing offers a whole new perspective of communicative development. The mechanisms behind the production of co-speech gestures and the functions that gestures serve in different contexts could be better understood if we continue to investigate how children of different ages use gestures while they speak.

Perhaps even more importantly, co-speech gestures offer an alternative modality to measure cognitive processes in general. In a time when technology for measuring brain activity still suffers important developments, analyzing human gesture offers us the possibility to have a look at the human mind with the naked eye, because, as McNeill (1992, p. 12) argues, "gestures are like thoughts themselves".

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