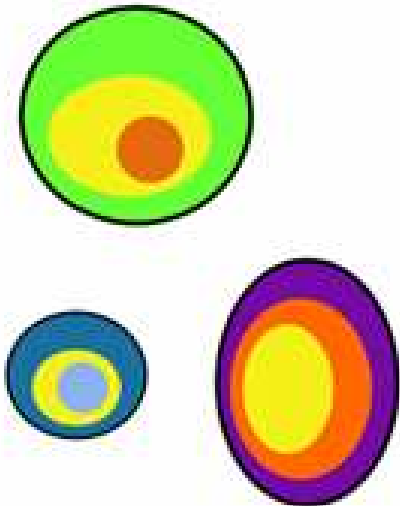


Acquisition of prosody at the babbling stage in Catalan

Prosodic, gestural, and pragmatic considerations

PhD Project



Núria Esteve Gibert

Supervisor: Pilar Prieto Vives

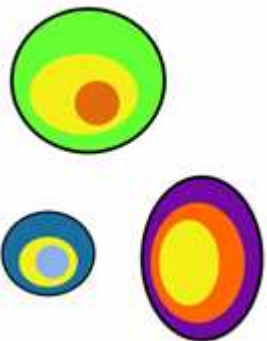
Universitat Pompeu Fabra

Object of analysis

The early acquisition of prosody and gestures by Catalan-speaking infants during the babbling stage.

Focus on three main topics:

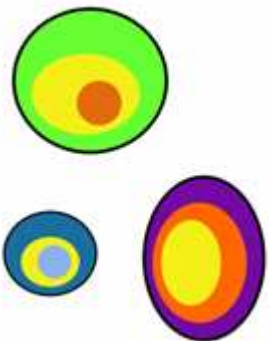
1. How prosody and gestures are used by children to communicate intentionally at the babbling stage.
2. The alignment between prosody and gesture before children are able to speak and its comparison with adults.
3. The relation between prosody and gestures from a perceptual point of view at the babbling stage.



Prior work

The children's use of prosody to communicate intentionally

- **Marcos (1987)**. Distinct pitch range depending on the function (1;2-1;10):
 - Pitch range is higher for repeated requests than for initial requests for objects.
 - Pitch range is higher for initial requests for objects and for co-operation than for labeling.
 - Pitch range when giving and showing is in an intermediate rank between requests and labeling.
- **Papaeliou, Mindakis, & Cavouras (2002)**. Prosodic patterns differ when communicating from when expressing emotions (0;7-0;11):
 - Vocalizations with communicative functions were shorter, with lower $f(0)$ values, and had greater intensity than vocalizations expressing emotions.
- **Papaeliou & Trevarthen (2006)**. Different prosodic patterns of communicative and investigative vocalizations (0;7-0;11):
 - Communicative vocalizations had a higher mean and maximum $f(0)$ than investigative vocalizations.
 - Communicative vocalizations had higher standard deviation of $f(0)$ than investigative vocalizations.
 - Communicative vocalizations had shorter duration than investigative vocalizations.

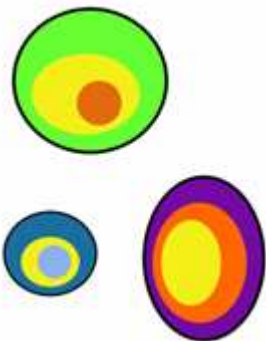


Do babbling children use prosody as a tool not only to indicate the communicative status of the vocalizations but also to express specific pragmatic meaning?

Prior work

The children's use of gestures to communicate intentionally

- **Bates, Camaioni, & Volterra (1975).** Children's gestures are not communicative:
 - They only serve children's own benefit in an individualistic problem-solving way.
 - Children's gestures are not communicative but adults interpret them as being so.
- **McNeill (1992).** Right after birth, children's gestures are not communicative. It is not until the age when children have completely developed the theory of mind, i.e., around four years of age, that they use gestures as communicatively as adults.
- **Tomasello *et al.* (2007).** Children's gestures are communicative:
 - Children point to direct others' attention to entities within a joint attention frame, even with absent entities.
 - Three distinct motives behind infants' pointing gestures: to inform, to request, and to express.
- **Liszkowski (2008).** Children's gestures are communicative:
 - At around 0;9 children give and show objects to the others and they seem to cooperate and bring objects to the attention of others. At this age, however, it may be that children are only interacting with others in a non-referential way, simply with the purpose of establishing social contact.
 - At 1;0 children refer to present or absent entities by pointing, indicating that they understand that others will attend to their gesture, that they can attract their attention, and understand the shared background.



Do babbling children use gestures to communicate their intentions? Do they use gestures in combination with prosodic patterns to this end?

Prior work

Synchronization between gesture and speech

- **McNeill (1992).** Gestures and speech form a single system because:

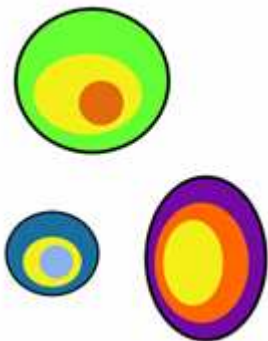
- Gesture occur with speech in 90% of the cases.
- Gesture and speech are semantically and pragmatically co-expressive.
- Gesture and speech develop together in children.
- Gesture and speech break together in aphasia.
- **Gesture and speech are phonologically synchronous**

The stroke of the gesture precedes or ends at, but does not follow, the phonological peak syllable of speech.

- **McNeill (1992).** Gestures phases: preparation, pre-stroke hold, stroke, post-stroke hold, retraction

- **Butcher & Goldin-Meadow (2000).** The development of co-speech gestures from the one-word stage to the two-word stage:

- The production of gesture with respect to the total number of comm. acts is around 20% and remains stable across ages.
- At the end of the one-word period, children produce gestures mainly in combination with speech, such as adults do.
- Children start synchronizing gesture and speech at the beginning of the two-word period.

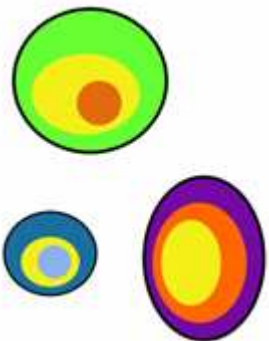


Do Catalan-babbling children follow this developmental stages? How is the temporal alignment between stroke and pitch peak in comparison with adults?

Prior work

Children's ability to determine intentions in co-speech gestures

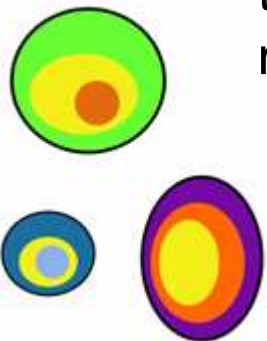
- Behne, Carpenter, & Tomasello (2005). At 1;2 children can infer the intention behind an adult's communicative act relying on cues such as ostensive gazing or pointing to the location.
- Aureli, Perucchini, & Genco (2009). At 1;4-1;8, children can recognize two different social intentions in a pointing gesture, depending on the common ground involved: informative pointing gesture and declarative pointing gesture.
- Liskowski (submitted). At 1;0, children can understand and produce informative pointing in a hiding-finding game.



Is prosody a cue for children to understand the intentionality behind a pointing gesture?

Goals of the dissertation

1. To investigate whether gestural and prosodic cues signal the emergence of intentional communication at the babbling stage.
2. To study the integration of gesture and speech at the stage when children are still not able to speak, focusing on the alignment of the two modalities, and comparing results with adult data.
3. To investigate whether prosodic cues are a tool that children use to understand the different meanings behind a pointing gesture.



Theoretical framework

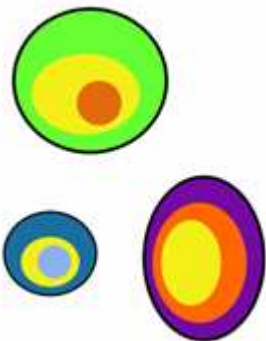
The study of prosodic development

- **Autosegmental Metrical model:** describing the intonation system when children are in the 25-word period (Frota & Vigário, 2008; Prieto et al., in press).



Babbling children do not produce pitch accents or boundary tones

- **At the babbling period, analysis of phonetic features:**
 1. **Pitch direction:** In cross-linguistic studies, to compare children's productions with adult's productions in languages with a typical contour direction (DePaolis et al., 2008; Vihman & DePaolis, 1998; Whalen et al., 1991)
 2. **Pitch range:** In early children's productions, to investigate whether children control it in an adult-like manner, i.e. if they use it to distinguish between semantic meanings of the utterances (Marcos, 1987; Snow, 2006; Papaeliou & Trevarthen, 2006; Esteve-Gibert & Prieto, submitted).
 3. **Duration:** In cross-linguistic studies, to find adult-like patterns such as final lengthening in French (DePaolis et al., 2008; Hallé et al., 1991; Levitt & Utman, 1992) and to investigate if children use it to distinguish between semantic meanings (Papaeliou & Trevarthen, 2006; Esteve-Gibert & Prieto, submitted).



Theoretical framework

The study of intentional development

Theory of speech acts

(Austin,1962; Searle,1969)



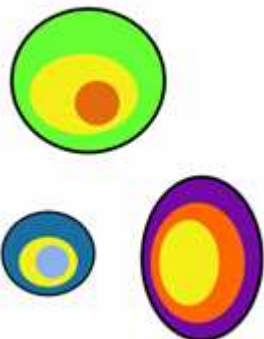
All speech acts can be divided in two:

1. A propositional content (or locution)
2. Performative content (or illocution).

In language development...

- Bates et al. (1975). Children follow these developmental stages:

1. A perlocutionary stage. The child has a systematic effect on his listener without having an intentional control over that effect.
2. An illocutionary stage. Performative content: the child intentionally uses nonverbal signals to convey requests and to direct adult attention to objects and events. Two main performative acts: imperatives and declaratives.
3. A locutionary stage. Propositional content: the child constructs propositions and utters speech sounds within the same performative sequences that he previously expressed nonverbally.



Theoretical framework.

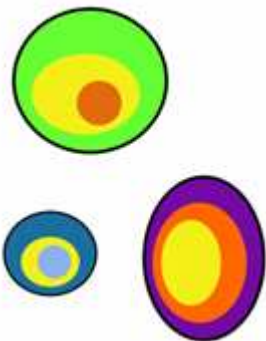
The study of intentional development

Theory of mind →

The ability to attribute mental states (pretending, desires, intents, belief, knowledge) to oneself and others, and to understand that others have mental states that are different from one's own

In language development...

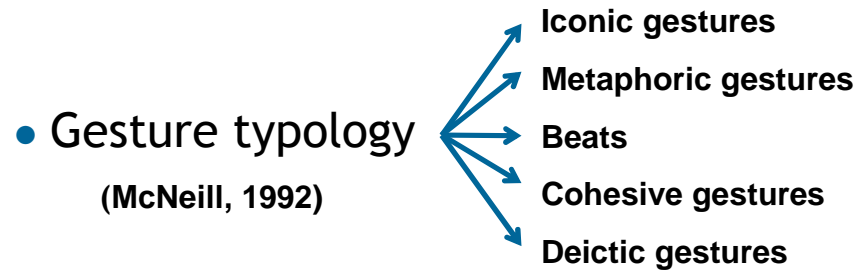
- At 0;3-0;6 infant point towards objects but their gestures are not communicative because they do not understand intentions, attention, or shared attentions.
- At 0;9-1;0 infants begin to use communicative gestures (mostly deictic gestures) to actively direct adult attention to outside entities in triadic interactions (Tomasello et al., 2007). These interactions are the joint attentional frame that enables the understanding of intentions in communication (Behne et al., 2005).
- At 1;0-1;3 children can determine what others know and are aware of the information they share with another person in a joint attentional frame (Tomasello et al., 2007).
- At 1;6 children understand that people's actions are goal directed and intentional (Bellagamba & Tomasello, 1999)



The difference between **human infants and chimpanzees** is that infants use their deictic gestures (and especially pointing) not only for imperative purposes (to obtain a desired object or event) but also for declarative purposes (to share with another person interest or attention to some object or event) (Tomasello & Camaioni (1997).

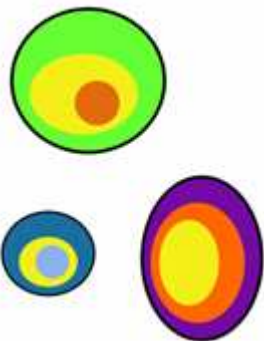
Theoretical framework

The study of gesture development



In gesture development:

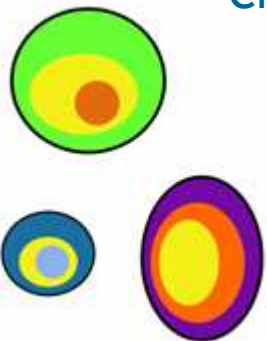
- **Right after birth.** Gestures are non-communicative.
- **At 0;8-0;10.** Emergence of **deictics** (pointing, giving, showing, or requesting) and **gestural routines** (clapping hands, kissing, or waving good-bye).
- **At 1;0.** Mostly **pointing** gestures, and emergence of **object-actions** (brushing to the hair for a comb).
- **At 1;4-1;8.** Mostly **pointing** gestures, and object-actions become **iconics**.
- **At 3;0-5;0.** Increasing of **iconic** gestures.
- **At 5;0.** Emergence of **beats** and **metaphoric** gestures.



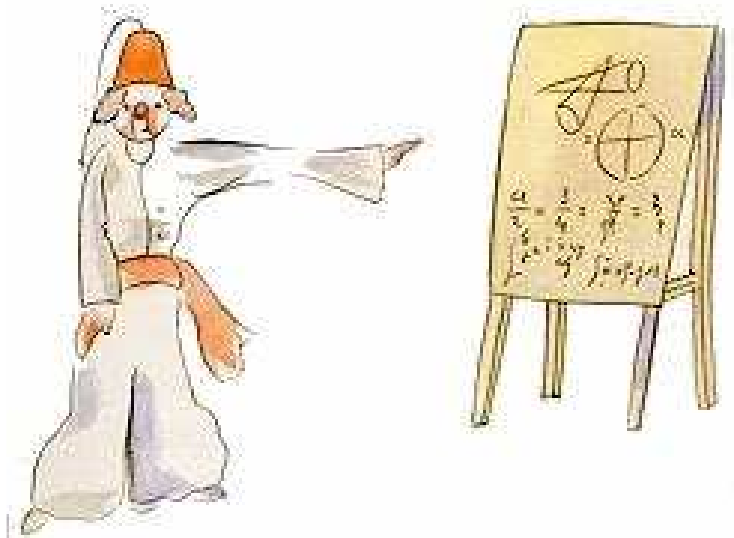
Hypothesis

1 hypothesis → 1 chapter

- Chapter 1.** Language does not start with the first words; it is already functioning by means of the communicative use of gestures and prosody. Following [Papaeliou & Trevarthen \(2006\)](#), we hypothesize that children use prosodic and gestural cues to indicate the communicative status of a vocalization and also to express specific pragmatic meanings such as discontent, requests, responses to stimuli, or general statements.
- Chapter 2.** Infants produce co-speech gestures and are able to synchronize gesture and speech in an adult-like manner before the two-word stage, even though previous studies suggest that children do not integrate gesture and speech in an adult-like way until the two-word stage ([Butcher & Goldin-Meadow 2000](#)).
- Chapter 3.** We hypothesize that children are able to understand other's communicative intentions behind gestures relying on prosodic cues. Given that in language development, most language abilities are first understood than produced, we assume that children understand communicative intentions before they can produce them.



Experimental studies



Chapter 1

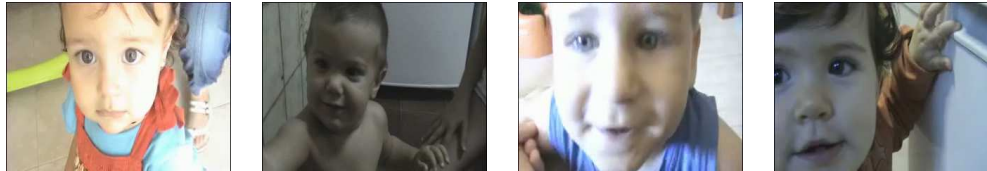
Hypothesis 1. Children use prosodic and gestural cues to indicate the communicative status of a vocalization and also to express specific pragmatic meanings such as discontent, requests, responses to stimuli, or general statements.

Chapter 1

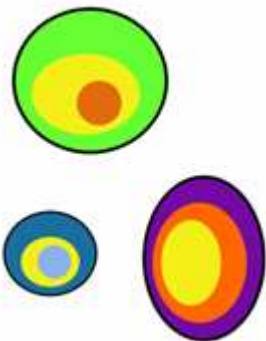
Materials

Are gesture and prosody the communicative cues used by babbling children?

- Four monolingual Catalan-babbling children recorded from 0;6 to 2;0 (and still in progress).



- Recorded weekly for 30 minutes per session, at their homes and while playing normally with their parents.
- Data selected for the analysis: vocalizations produced by children with or without gestures at 0;7, 0;9, and 0;11.

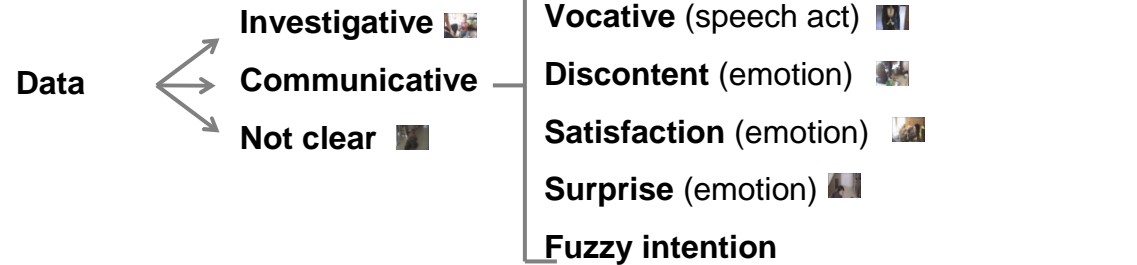


	0;7	0;9	0;11	TOTAL
Àngela	147	168	265	580
Biel	227	191	385	803
Martí	138	252	449	839
TOTAL	512	611	1099	2,222

Chapter 1

Codification

1. Pragmatic analysis



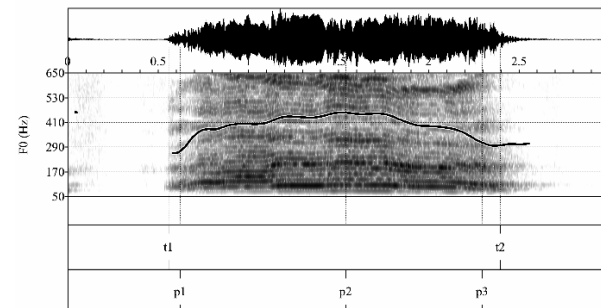
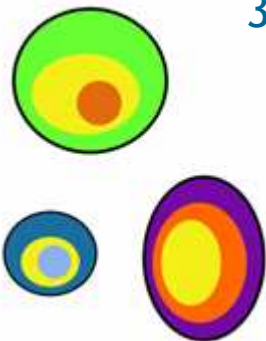
Are gesture and prosody the communicative cues used by babbling children?

2. Gestural analysis

- **Gaze:** gaze to parent, gaze to object, absent gaze, or no gaze (in case that the child's is not visible).
- **Facial gesture:** furrowing brows, eyebrow raising, smiling, no specific facial gesture.
- **Manual gesture:** manipulating object, extending arm(s), moving/shaking arms, pointing, no specific manual gesture.

3. Acoustic analysis

- **Duration:** distance from the last point in the $f(0)$ line to the first point in the $f(0)$ line.
- **Pitch range:** distance from the highest point in the $f(0)$ line to the lowest point in the $f(0)$ line.

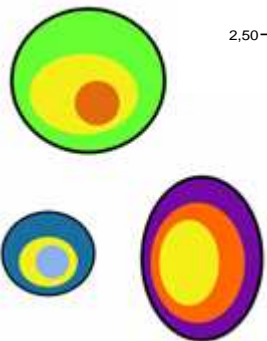
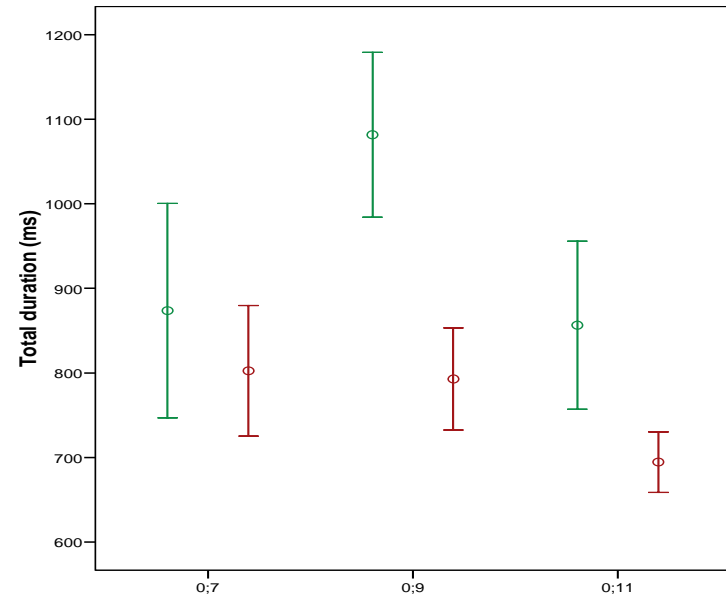
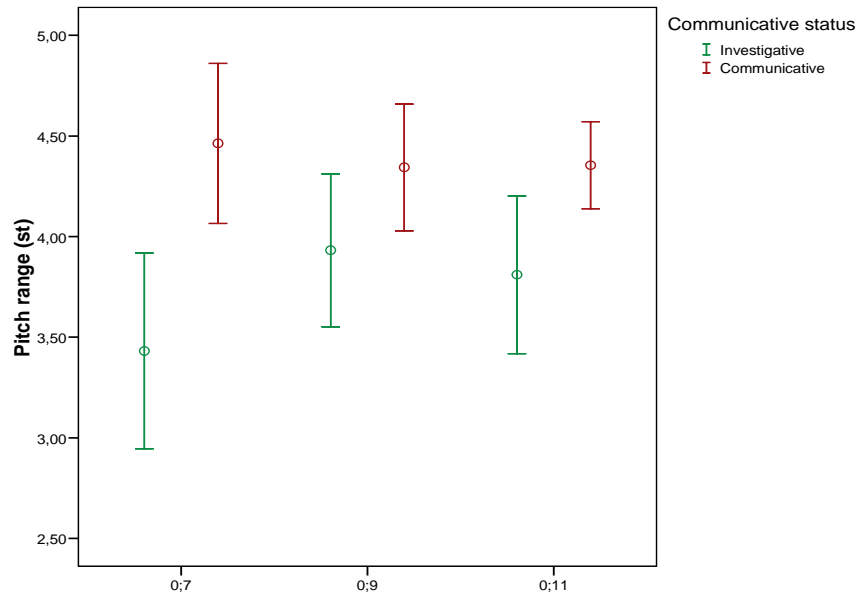


Chapter 1

Summary results (1/3)

- Pitch range and duration are significantly affected by the communicative status of the vocalization.

Are gesture and prosody the communicative cues used by babbling children?

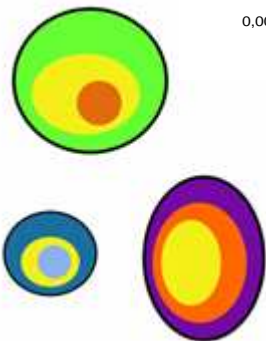
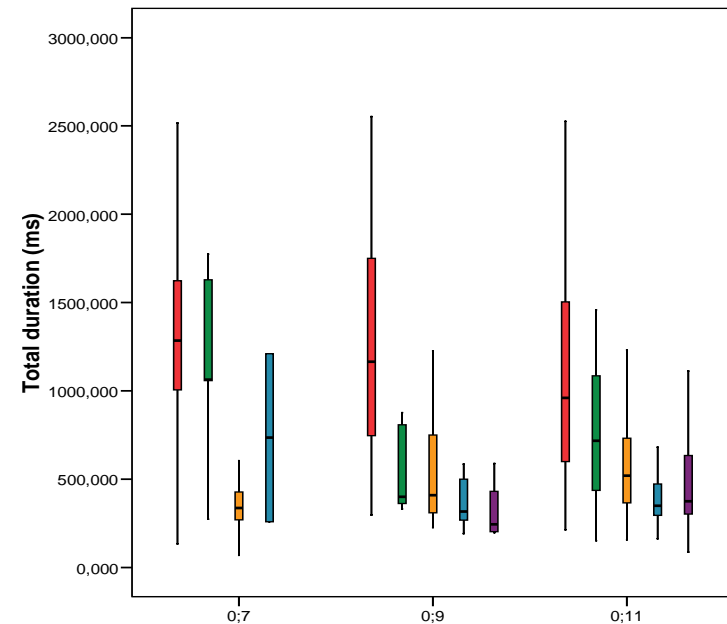
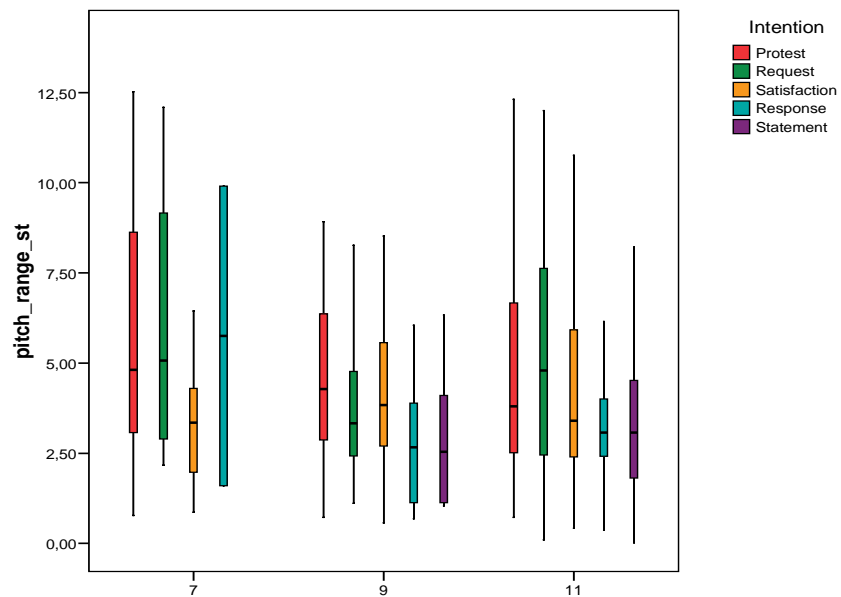


Chapter 1

Summary results (2/3)

- Pitch range and duration are significantly affected by the specific pragmatic intention displayed.

Are gesture and prosody the communicative cues used by babbling children?



- Significant effect of intention in pitch range ($F(4,528)=3.407$, $p=.009$)
- Significant effect of age in pitch range ($F(2,528)=3.692$, $p=.026$)

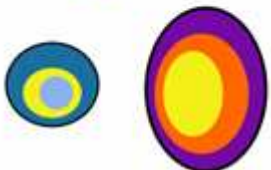
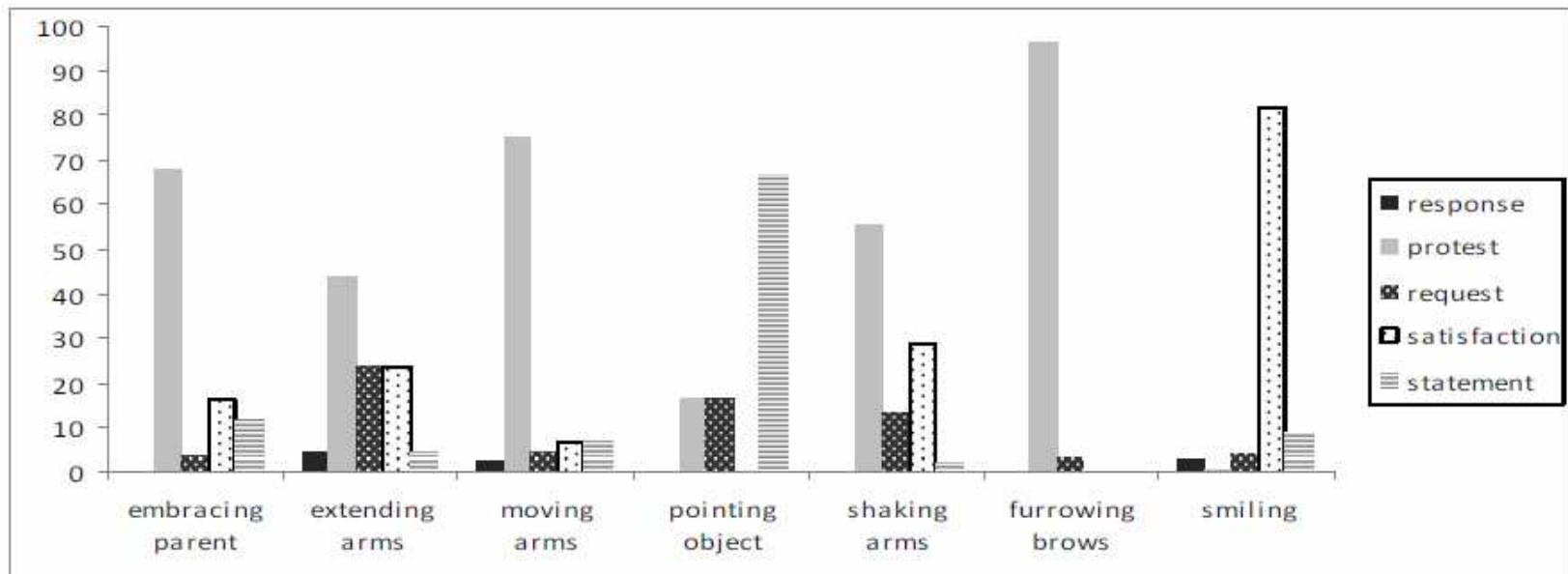
- Significant effect of intention in duration ($F(4,528)=41.252$, $p<.001$)

Chapter 1

Summary results (3/3)

- High correlation of certain gestures with specific pragmatic intentions

Are gesture and prosody the communicative cues used by babbling children?



Chapter 2

Hypothesis 2. Infants produce co-speech gestures and are able to synchronize gesture and speech in an adult-like manner before the two-word stage.

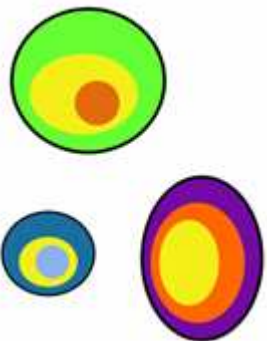
Chapter 2

How children compared to adults phonologically synchronize gesture and speech, and if they do it before what is suggested in previous studies.

2.1. A control study with adults to investigate their synchronization between gesture and speech.

The stroke of the gesture precedes or ends at, but does not follow, the phonological peak syllable of speech.

2.2. A study with children to investigate the emergence of co-speech gestures, to see whether they synchronize gesture and speech in an adult-like manner, and when they start doing so.

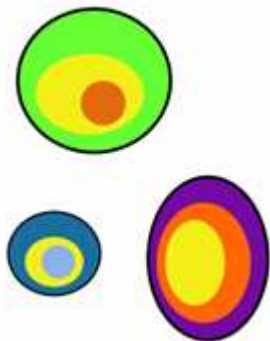


Chapter 2.1

Materials

Control study
with adults to
investigate the
synchronization
between gesture
and speech

- 15 adult Catalan-speakers (pilot results with 5 participants)
- Pointing-naming task with 12 different target words: /pá/, /papá/, /pápa/, /tá/, /tatá/, /táta/, /má/, /mamá/, /máma/, /ná/, /naná/, and /nána/.
- In total, 720 items will be analyzed: 12 target words x 4 repetitions x 15 people



RECORDA...

Imagina't que has d'indicar la localització d'un objecte a algú perquè s'hi pugui fixar i que, alhora, has d'anomenar-lo.



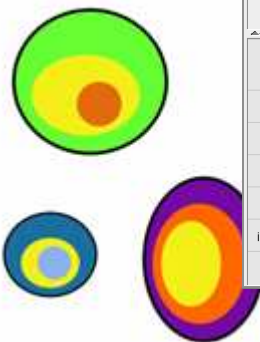
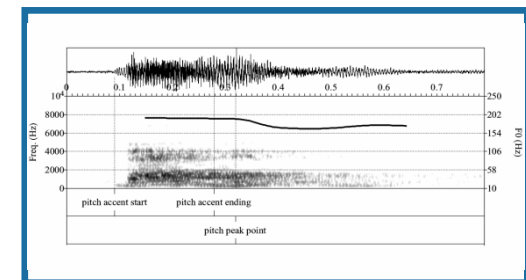
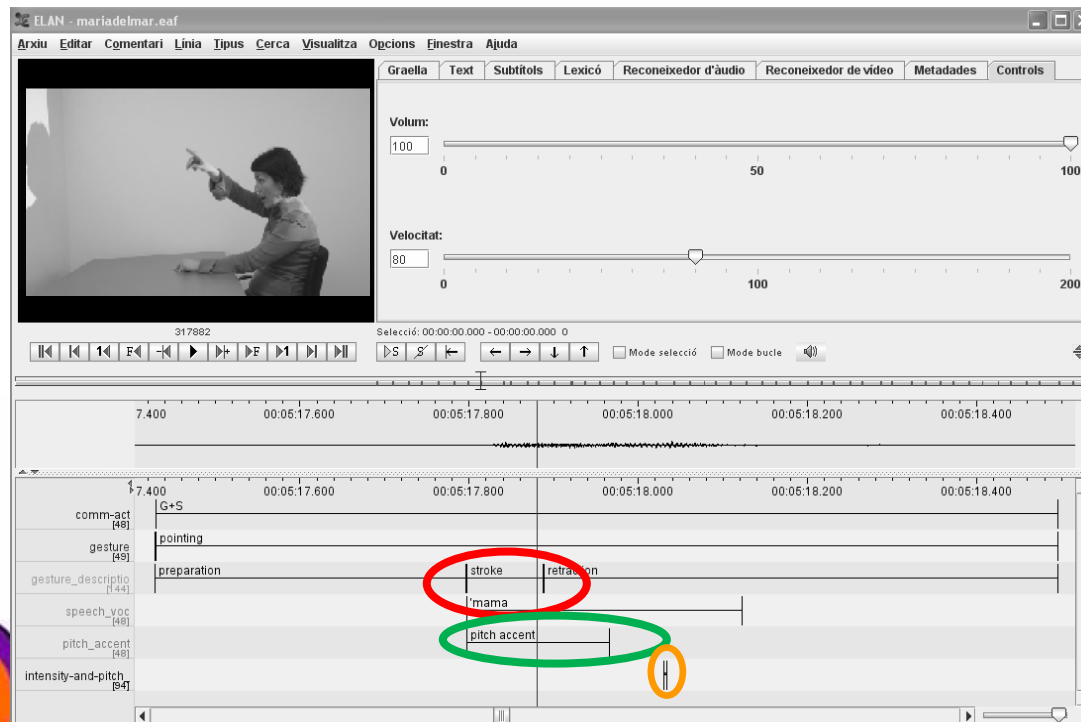
tata

Chapter 2.1

Codification

- Annotation of co-speech pointing gestures in terms of:
 1. Gesture phases: preparation, stroke, retraction
 2. Position of pitch accent and pitch peak

Control study with adults to investigate the synchronization between gesture and speech



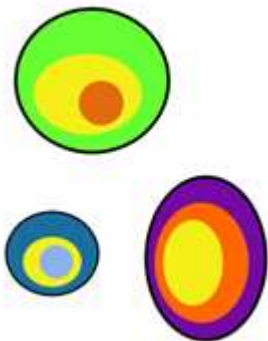
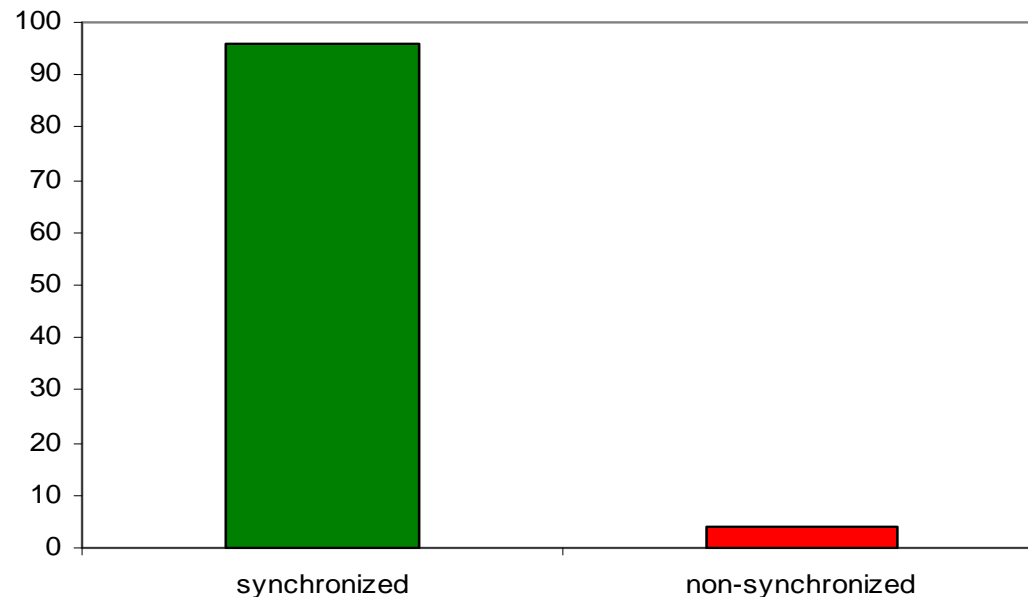
Chapter 2.1

Preliminary results (1/2)

- Adult speakers align the stroke of the gesture with the pitch accent and pitch peak in 98% of the cases.
- No significant differences were found between monosyllabic and disyllabic words, and neither on the position of the pitch accent in disyllabic words.

Control study with adults to investigate the synchronization between gesture and speech

gesture and speech combinations in adults

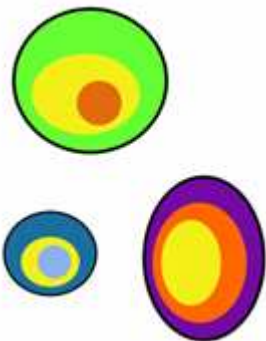
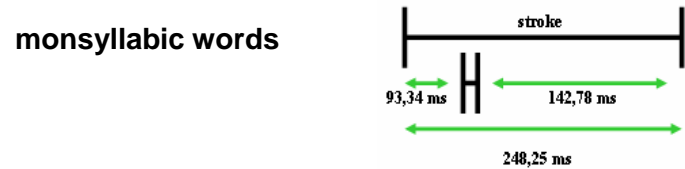
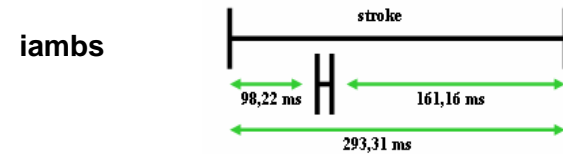
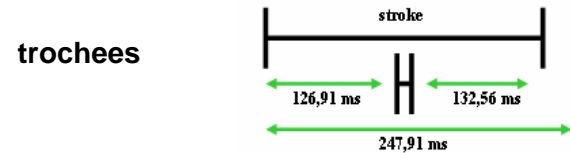
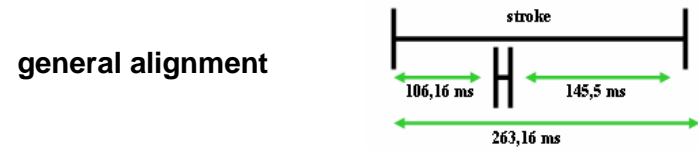


Chapter 2.1

Preliminary results (2/2)

- The pitch peak tends to align with the beginning of the stroke.

Control study with adults to investigate the synchronization between gesture and speech

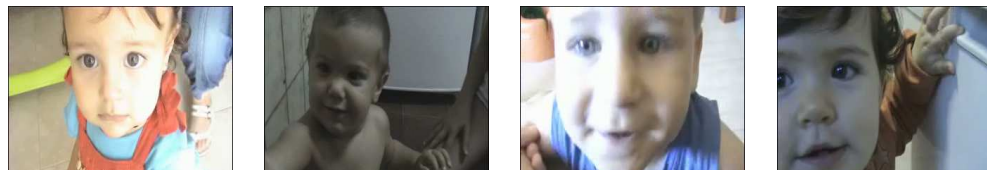
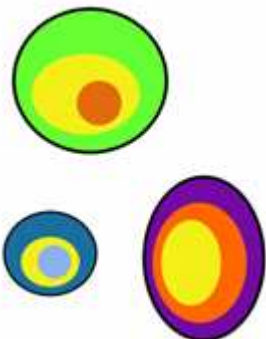


Chapter 2.2

Materials

Study with children to investigate the emergence of co-speech gestures and their alignment

- Four monolingual Catalan-learning children recorded from 0;6 to 2;0 (and still in progress) at their home while playing with their parents.
- Recorded weekly/biweekly for 30 minutes per session, at their homes and while playing normally with their parents.
- Data selected for the analysis: visual and vocal speech acts produced by children at 0;11, 1;1, 1;3, 1;5, and 1;7.

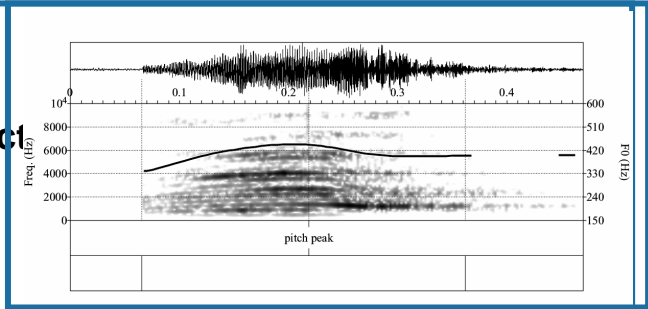


Chapter 2.2

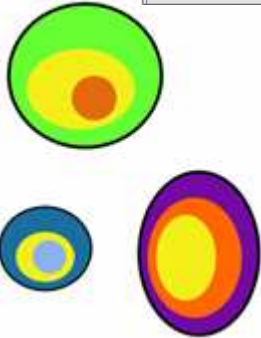
Codification

Study with children to investigate the emergence of co-speech gestures and their alignment

Nr	anotació	Temps Inicial	Temps Final	Durada
16	pointing	00:11:23.023	00:11:25.000	00:00:02.980
17	pointing	00:11:41.103	00:11:42.750	00:00:01.650
18	pointing	00:12:29.569	00:12:33.880	00:00:04.320
19	pointing	00:10:66.203	00:10:00.000	00:00:06.600
20	pointing	00:19:36.459	00:19:37.840	00:00:01.390
21	extending arm	00:22:22.568	00:22:33.510	00:00:00.950
22	pointing	00:24:36.023	00:24:38.300	00:00:02.280
23	pointing	00:24:39.723	00:24:41.410	00:00:01.690
24	pointing	00:24:41.410	00:24:43.160	00:00:01.760
25	pointing	00:24:44.223	00:24:45.740	00:00:01.520
26	pointing	00:24:45.793	00:24:47.000	00:00:02.000
27	pointing	00:24:51.343	00:24:51.980	00:00:00.640



preparation, stroke, retraction
 sized gesture, deictic gesture, iconic gesture



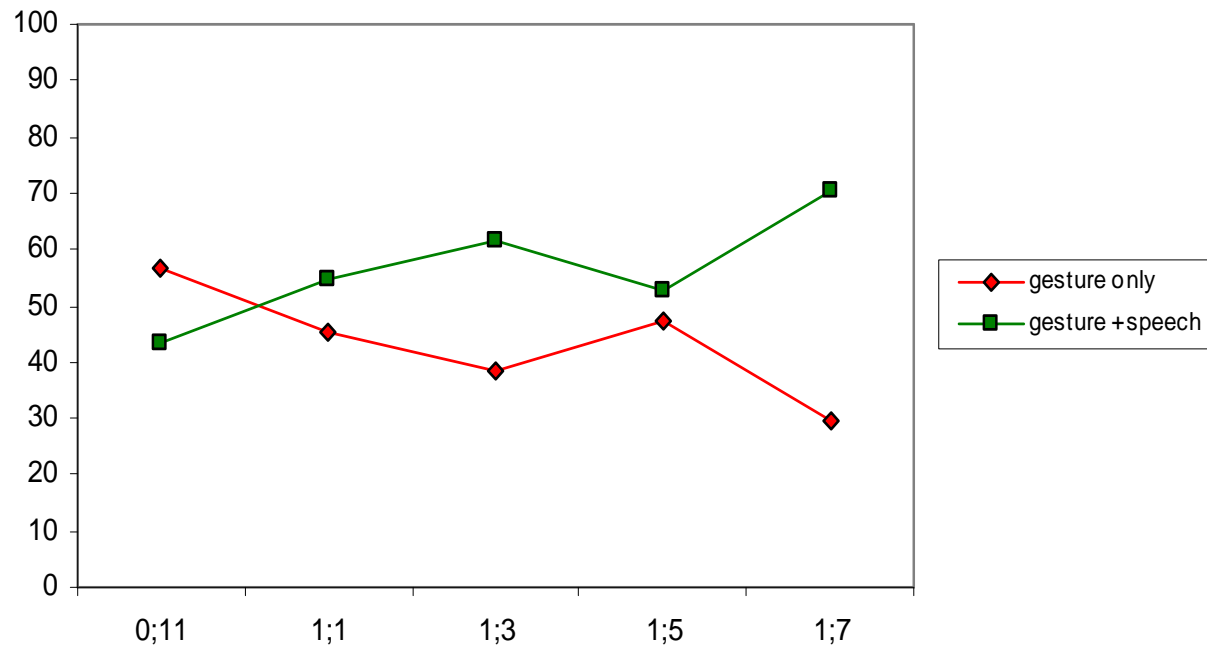
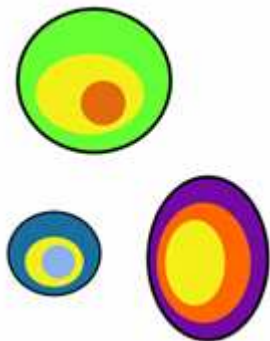
example

Chapter 2.2

Preliminary results (1/3)

- At 0;11 'gesture-speech' combinations represent 43,26% of the communicative acts containing gesture.
- At 1;1 'gesture-speech' combinations represent 54,8% of the communicative acts containing gesture.
- At 1;3-1;7: higher proportion of 'gesture-speech' combinations.

Study with children to investigate the emergence of co-speech gestures and their alignment



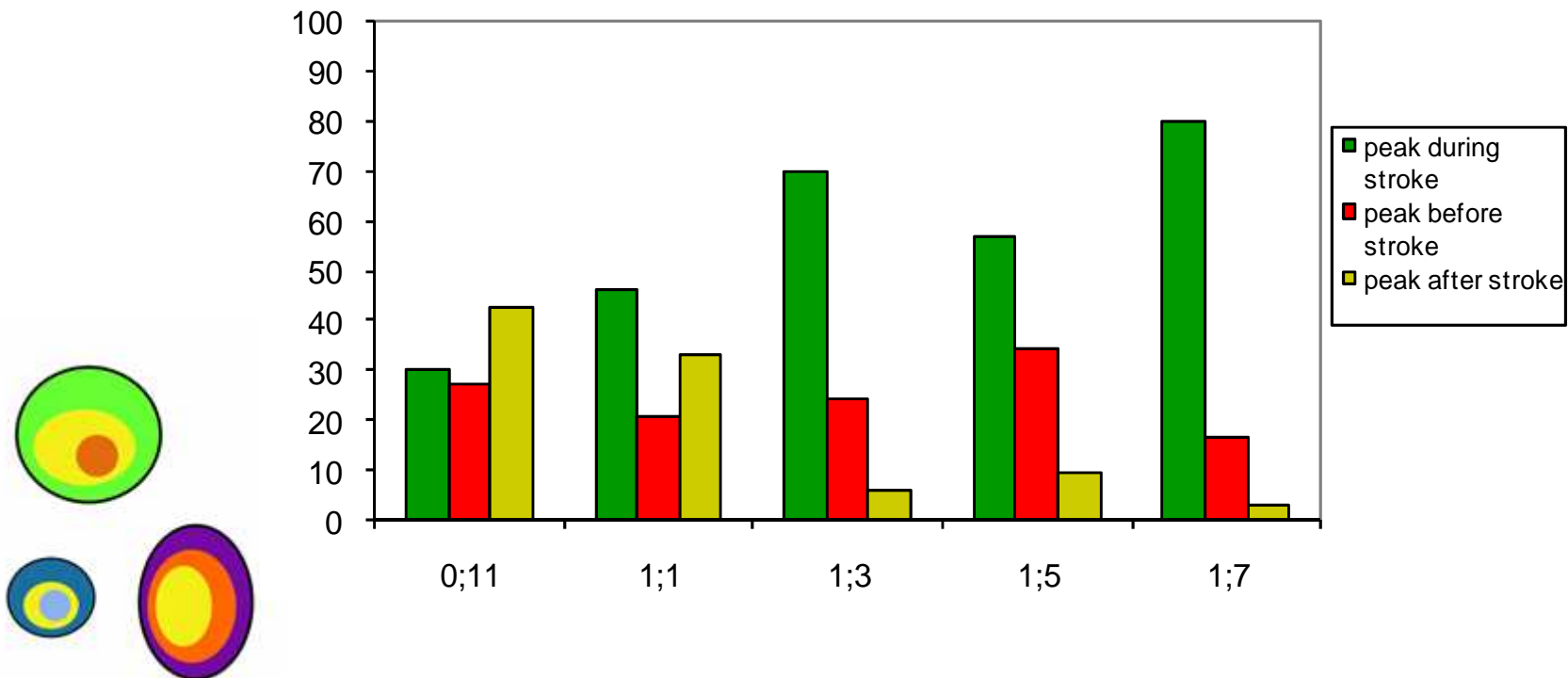
Chapter 2.2

Preliminary results (2/3)

- At the late babbling stage and early one-word period, children already produce a higher proportion of synchronized 'gesture-speech' combinations than unsynchronized ones.

Study with children to investigate the emergence of co-speech gestures and their alignment

speech and manual gesture combinations in children

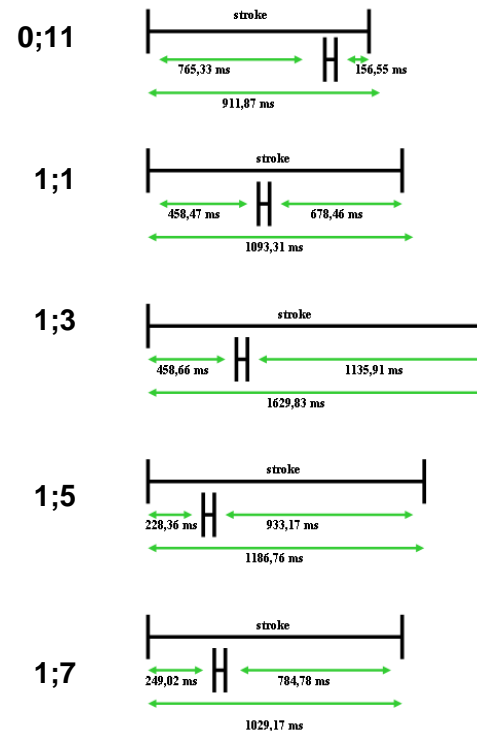
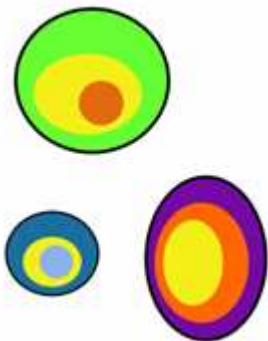


Chapter 2.2

Preliminary results (3/3)

- At the babbling period, the pitch peak tends to be aligned at the end of the stroke of the deictic gesture.
- At the late babbling stage and the one-word period, the pitch peak has moved to the left and it is aligned at the beginning of the stroke.

Study with children to investigate the emergence of co-speech gestures and their alignment



Chapter 3

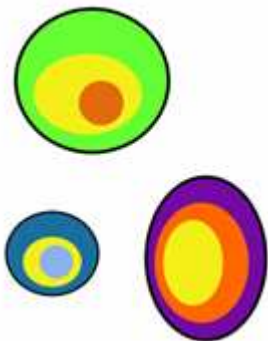
Hypothesis 3. Infants are able to understand other's communicative intentions behind gestures relying on prosodic cues.

Chapter 3

First proposal

Do children comprehend intentions behind gestures relying on prosodic cues?

- **Research question.** When parents use a specific request prosody while pointing to an object, do children increase their comprehension of the speech act in comparison with the case when the pointing gesture is accompanied by neutral prosodic contours?
- **Prediction.** When the experimenter uses a requestive intonation, the babbling child will respond better to the request than when using the neutral intonation. And this will happen even more often when using the insistent requestive intonation



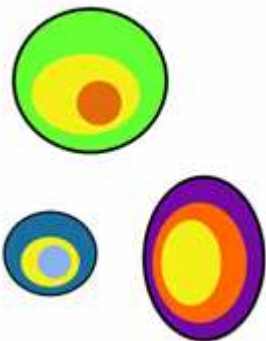
Study in collaboration with the research group “Communication Before Language”, based in The Max Planck Institute for Psycholinguistics and coordinated by Prof. Ulf Liszkowski.

Chapter 3

First proposal

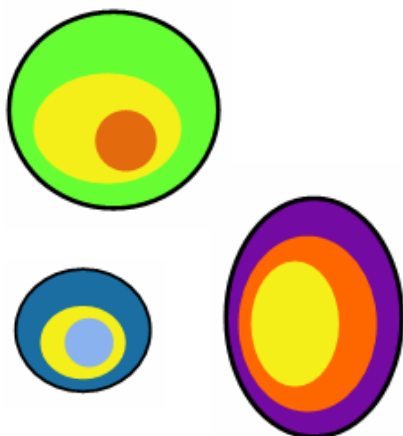
Do children comprehend intentions behind gestures relying on prosodic cues?

- For Catalan, different intonation contours could be used:
 - Neutral intonation (H* L%) 🗣️
 - Requestive intonation (L* HL%) 🗣️
 - Insistent requestive intonation (H* LHL%) 🗣️
- Eye-tracking system
- Cross-linguistic comparison between languages: Catalan, Spanish, or Dutch



Working schedule

June 2011	<ul style="list-style-type: none"> • Submission of the Ph.D. project. • Oral presentation of results of the second part of chapter 2 (alignment in children) in the conference <i>Phonetics and Phonology in Iberia (PaPI)</i>, held in Tarragona.
July 2011 to October 2011	<ul style="list-style-type: none"> • Correction of an article submitted in the <i>Journal of Child Language</i> with results from chapter 1 (gesture and prosody to communicate intentionally), according to the revision proposed by the journal. • Presentation of results of the second part of chapter 2 (alignment in children) in the conference AMLaP (Architectures and Mechanisms for Language Processing), to be held in Paris, France. • Presentation of results of the second part of chapter 2 (alignment in children) in the conference GESPIN (Gesture and Speech in Interaction), to be held in Bielefeld, Germany.
November 2011 to January 2012	<ul style="list-style-type: none"> • Writing the results of the second part of chapter 2 (alignment in children) with results and comments obtained from the conferences.
February 2012 to March 2012	<ul style="list-style-type: none"> • Gathering the complete sample of first part of chapter 2 (alignment in adults).
April 2012 to Mai 2012	<ul style="list-style-type: none"> • Writing the results of the complete chapter 2 (alignment in adults and alignment in children).
June 2012 to July 2012	<ul style="list-style-type: none"> • Preparation of materials for chapter 3 (children's understanding of intentions in pointing).
September 2012 to December 2012	<ul style="list-style-type: none"> • Research stay in the Communication Before Language Group (Max Planck Institute for Psycholinguistics) to collaborate in the study of chapter 3.
January 2013 to April 2013	<ul style="list-style-type: none"> • Analysis of results from the study of chapter 3. • Writing chapter 3.
Mai 2013 to July 2013	<ul style="list-style-type: none"> • Writing the Ph.D. dissertation.
September 2013	<ul style="list-style-type: none"> • Dissertation defense.



Moltes gràcies!!!

