



# Gestures, signs and words in the acquisition and development of language

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***01-P01 - Artificial life models of the evolution of language***

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***01-R03 - Mirror neurons and communication***

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***01-B05 - Cross-cultural, cross-linguistic and atypical aspects on Words, Gestures and Signs in the acquisition and development of language***

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***01-V07 - Words, gestures, and signs in the acquisition and development of language***

**Principal Investigator: Virginia Volterra (Project Leader)**

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# OMLL Project: main points

- Robustness of the use of gestures
- Continuity between gesture and speech
- Similarities and differences in early communicative development

# Theoretical framework

Speech and gesture may draw on underlying brain mechanisms common to both language and motor functions through the *mirror neuron system* (Rizzolatti & Arbib, 1998)

Motor representations are essential for linguistic representations in speech

Gesture and speech are linked to and co-evolve in the ontogeny of language

# **New evidence on the link between action, gesture and word from a developmental perspective**

- Indirect observation: Parental Reports (age: 8-17 months)
- Direct observation at home: longitudinal data (age: 10- 22 months)
- Direct observation with a structured task : picture naming (age: 2 –7 years)

# Parental Questionnaire: MacArthur-Bates CDI

To collect data on early linguistic development, to compare data from different populations and languages (40 different languages).

## Italian version and Swedish version

(Caselli, Rinaldi, Stefanini, 2004; Berglund et al., 2005)

**“Words and Gestures”**  
for children aged  
8-17 months

**“Words and Phrases”**  
for children aged  
18-36 months

### Section I

- General questions about sentences comprehension

### Section II

- General questions about frequency of word imitation and labeling.
- 408 item vocabulary checklist divided into 19 semantic categories. The parent can specify which words the child understands and which words the child uses and understands.

### Section III

- 63 Action / Gestures checklist divided into 5 categories

## Deictic Gestures

Points at some interesting object or event

## First communicative gestures

Shrugs to indicate “all gone”

## Games and routines

Plays Peekaboo

## Actions with objects

Puts telephone to ear

## Pretending to be a parent

Puts to bed (a doll or a stuffed animal)

## Imitating other adult actions

Cleans with cloth or duster

A. PRIMI GESTI COMUNICATIVI		
	SI	NO
10. Sottile per far capire che qualcosa scotta	<input type="radio"/>	<input type="radio"/>
11. Davi il dito sulla guancia per indicare che una cosa è buona	<input type="radio"/>	<input type="radio"/>
12. Alza le spalle/struga le braccia per indicare che una cosa non c'è più	<input type="radio"/>	<input type="radio"/>

B. GIOCHI E ROUTINES		
Il vostro bambino fa qualcuna di queste cose?		
	SI	NO
1. Gioca a nascondine ("cucci-cucci")	<input type="radio"/>	<input type="radio"/>
2. Batte le mani ("bata-bata")	<input type="radio"/>	<input type="radio"/>
3. Da le borse	<input type="radio"/>	<input type="radio"/>
4. Fa le carozze	<input type="radio"/>	<input type="radio"/>
5. Batte	<input type="radio"/>	<input type="radio"/>
6. Manda un bacio	<input type="radio"/>	<input type="radio"/>

C. AZIONI CON OGGETTI		
Il vostro bambino fa o cerca di fare qualcuna di queste azioni?		
	SI	NO
1. Mangia con un cucchiaino o una forchietta	<input type="radio"/>	<input type="radio"/>
2. Davi da un recipiente che contiene liquidi	<input type="radio"/>	<input type="radio"/>
3. Si pettina o si spazzola i capelli	<input type="radio"/>	<input type="radio"/>
4. Si lava i denti	<input type="radio"/>	<input type="radio"/>
5. Si pulisce il viso o le mani con una salvietta	<input type="radio"/>	<input type="radio"/>
6. Si mette il cappello	<input type="radio"/>	<input type="radio"/>
7. Si mette le scarpe o le calze	<input type="radio"/>	<input type="radio"/>
8. Stacca con una palette	<input type="radio"/>	<input type="radio"/>
9. Posa la testa sulla mano o su un cuscino, chiudendo gli occhi	<input type="radio"/>	<input type="radio"/>
10. Chiude a ruota le porte o gli sportelli	<input type="radio"/>	<input type="radio"/>
11. Prende un aspirapolvere e lo fa volare	<input type="radio"/>	<input type="radio"/>
12. Pula il telefono all'orecchio	<input type="radio"/>	<input type="radio"/>
13. Annusa i fiori	<input type="radio"/>	<input type="radio"/>
14. Spinge la automobile	<input type="radio"/>	<input type="radio"/>
15. Lancia la palla	<input type="radio"/>	<input type="radio"/>
16. Venna nei liquidi da un contenitore all'altro	<input type="radio"/>	<input type="radio"/>
17. Mescola con un cucchiaino dentro una tazza o una ciotola	<input type="radio"/>	<input type="radio"/>

C. FACENDO FINTA DI ESSERE LA MAMMA O IL PAPA'		
Ripetiamo qui alcune azioni che il bambino a volte compie con delle bambole o con degli animali giocattolo. Vi preghiamo di segnalare quelle che avete visto fare al vostro bambino.		
	SI	NO
1. Li mette a letto	<input type="radio"/>	<input type="radio"/>
2. Li copre con le coperte	<input type="radio"/>	<input type="radio"/>
3. Li imbrocca con un cucchiaino	<input type="radio"/>	<input type="radio"/>
4. Da loro da bere	<input type="radio"/>	<input type="radio"/>
5. Li pettina	<input type="radio"/>	<input type="radio"/>
6. Li accarezza	<input type="radio"/>	<input type="radio"/>
7. Li spinge sulla carrozzina	<input type="radio"/>	<input type="radio"/>
8. Li bacia	<input type="radio"/>	<input type="radio"/>
9. Li bacia e li abbraccia	<input type="radio"/>	<input type="radio"/>
10. Prende e mette loro le scarpe, le calze o il cappellino	<input type="radio"/>	<input type="radio"/>
11. Pulisce loro la faccia o le mani	<input type="radio"/>	<input type="radio"/>
12. "Pupa" con mamma giocattolo	<input type="radio"/>	<input type="radio"/>
13. Li picchia	<input type="radio"/>	<input type="radio"/>

E. IMITANDO LE AZIONI DELL'ADULTO		
Il vostro bambino fa o cerca di fare azioni di questo tipo?		
	SI	NO
1. Spazza con la scopa	<input type="radio"/>	<input type="radio"/>
2. Batte le stoviglie nella lavastoviglie e la gira	<input type="radio"/>	<input type="radio"/>
3. Batte con un martello	<input type="radio"/>	<input type="radio"/>
4. Usa il telecomando	<input type="radio"/>	<input type="radio"/>
5. "Scriva" a macchina o su computer	<input type="radio"/>	<input type="radio"/>
6. "Lugge" i libri, sfoglia le pagine	<input type="radio"/>	<input type="radio"/>
7. Passa l'aspirapolvere	<input type="radio"/>	<input type="radio"/>
8. Annusa le piante	<input type="radio"/>	<input type="radio"/>

# Request pointing





Telephone/to phone



Sleeping



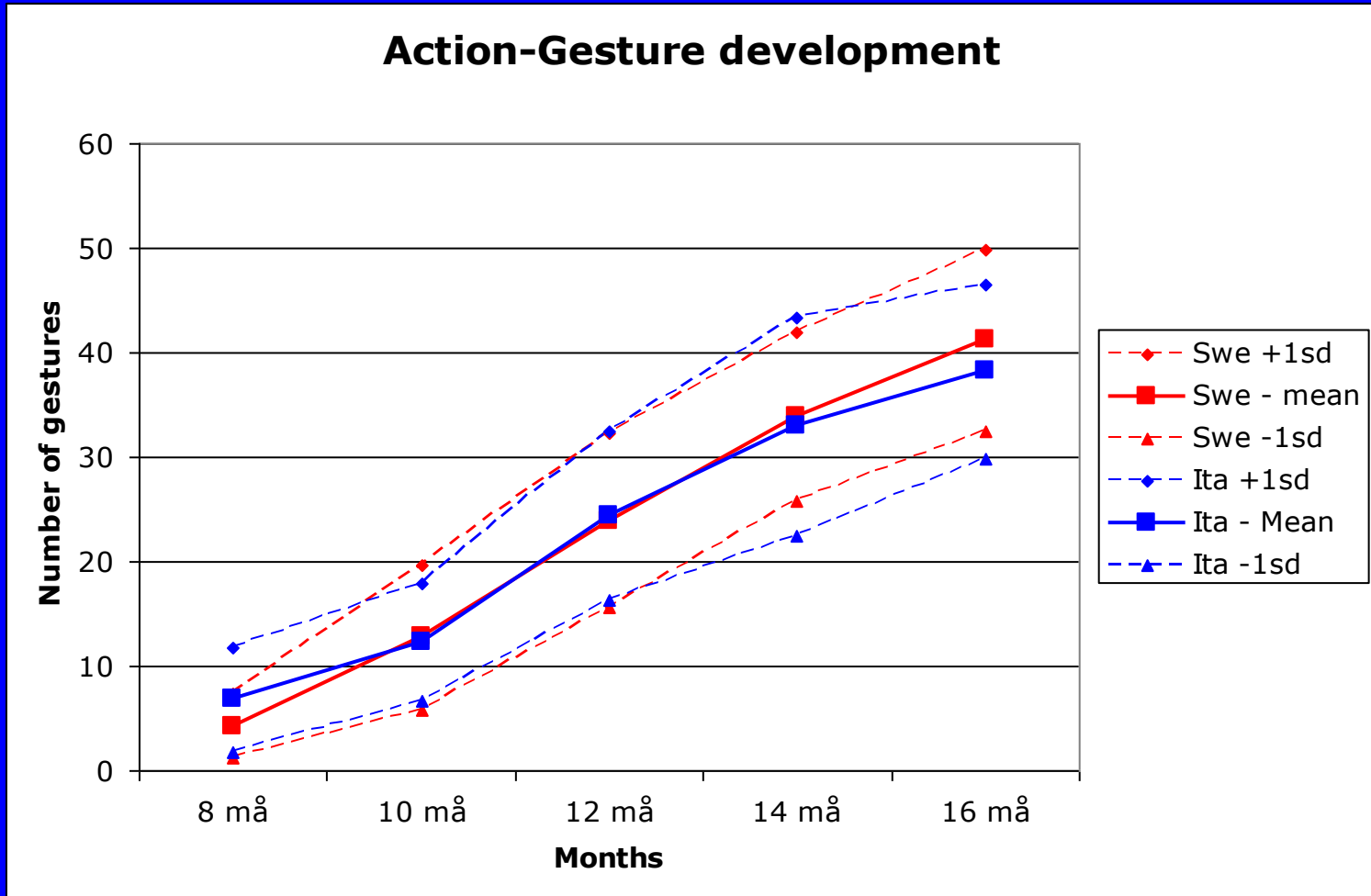
Ciao



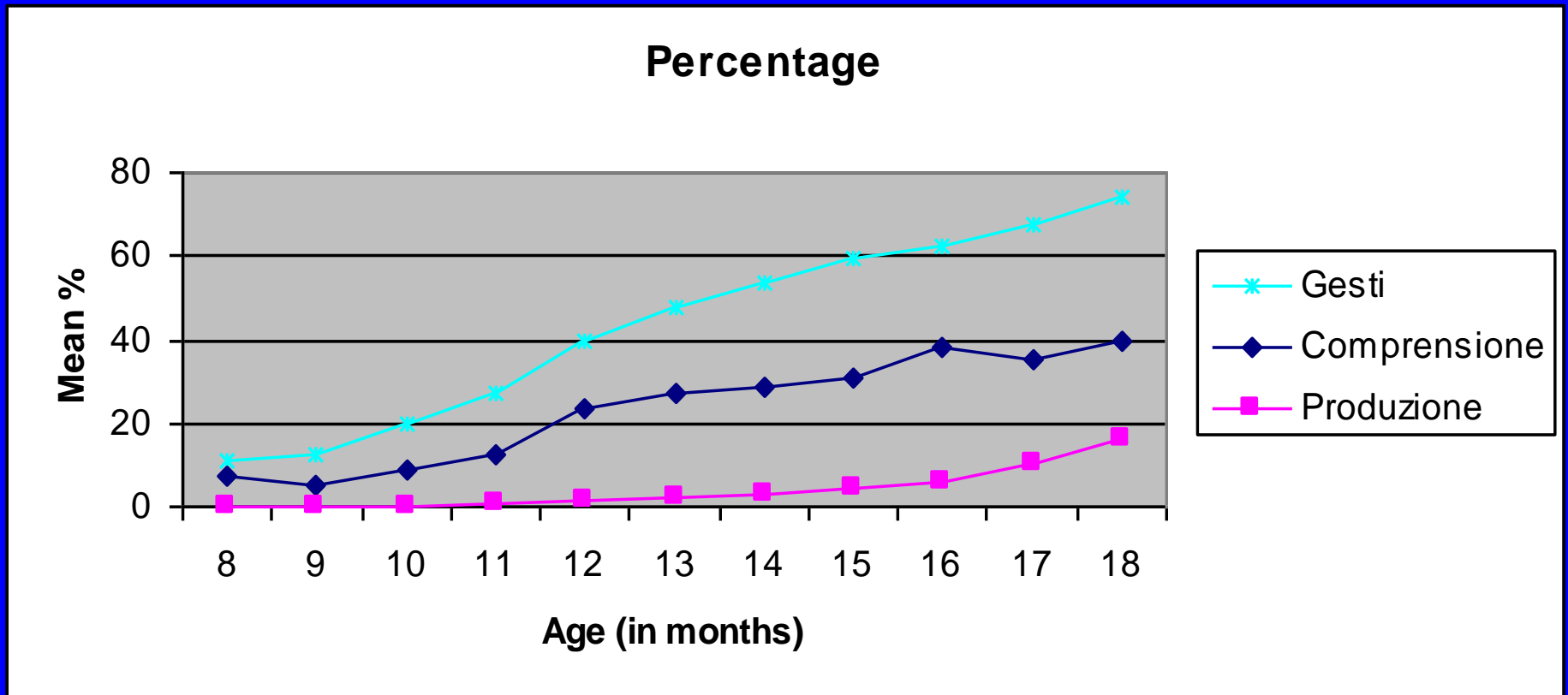
Good (referring to food)



# Comparison between Swedish and Italian children

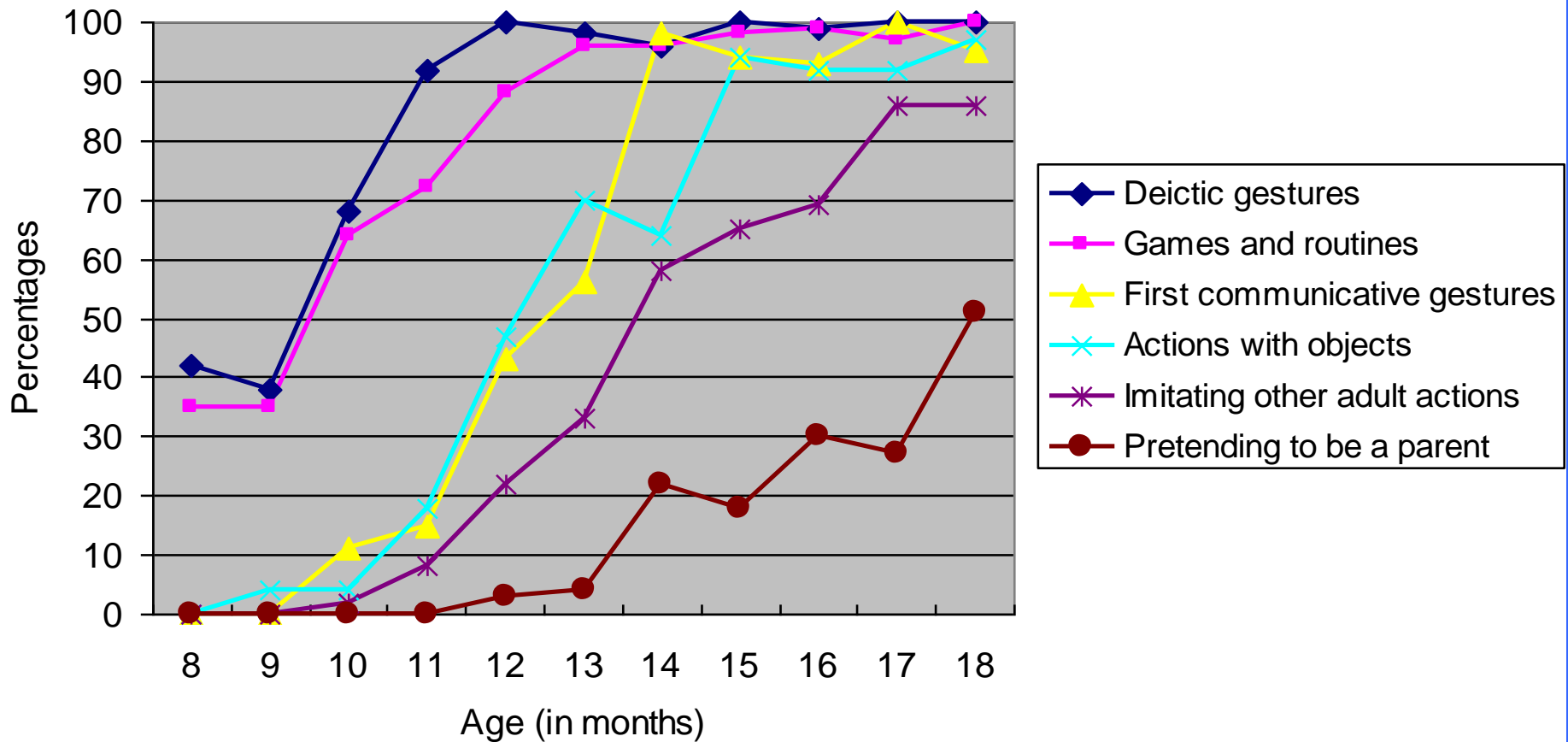


# PVB Actions/Gestures, Word Comprehension and Word Production Checklist



Action/gesture production correlates more with word comprehension ( $p=.99$ ) than word production ( $p=.82$ )

# Percentage of children producing 50% (or more) of gestures in each category



Same relationships between action/gesture production and word comprehension & production

The emergence and developmental trend of action and gesture categories is comparable across cultures.

Culture-related differences may be reported for single items

# Direct observation in a natural context: longitudinal studies

- to explore the role of gesture in the progression from action to language, considered as a gesture-speech integrated system

Capirci, Contaldo, Caselli & Volterra, 2005. From action to language through gesture: A longitudinal perspective. *Gesture*

- to explore the role of gesture during the transition to two-word utterances

Pizzuto & Capobianco, 2005;2007; Preisler et al. submitted

# Method

- Children followed longitudinally from 10 to 21 months
- Children were observed monthly in their home during a spontaneous interaction with their mother (or another caregiver)
- Each session, lasting 30-45 minutes, included three different contexts

play with new examples of familiar objects

play with familiar objects

meal or snacktime

Almost all of the meanings expressed through actions on objects are expressed later by the children through gestures and/or words

<b>ACTION</b>	<b>GESTURE</b>	<b>WORD</b>
<b>Bringing empty spoon to lips</b>	<b>Bringing empty hand to lips</b>	<b>"Pappa" (to eat; food)</b>
<b>Bringing phone-handset to the ear</b>	<b>Holding empty fist to the ear</b>	<b>"Pronto" (hello)</b>
<b>Pushing a little car</b>	<b>Pushing motion</b>	<b>"Brum - brum"</b>
<b>Blowing out a candle</b>	<b>Blowing</b>	<b>"Soffi" (you blow)</b>



# TELEPHONE /TO PHONE

*Actions and gestures produced in a communicative context are not clearly separate categories, rather they should be considered a continuum*



# COMB / TO COMB



Action: to blow out a candle



Gesture: to blow out a candle



Word : "soffi" (to blow)



# Interplay between gestural and spoken modalities

Production of gestures (deictic and representational) by children is a robust developmental phenomenon

The interdependency between gesture and speech is evident in early stages of language development

# Complementary Combination: POINT - bau (dog)





# Supplementary Combination TO POINT + “other”



A Swedish replication of the Italian study on gestures/words production at two observation points (16 and 20 months)  
(Preisler et al., submitted)

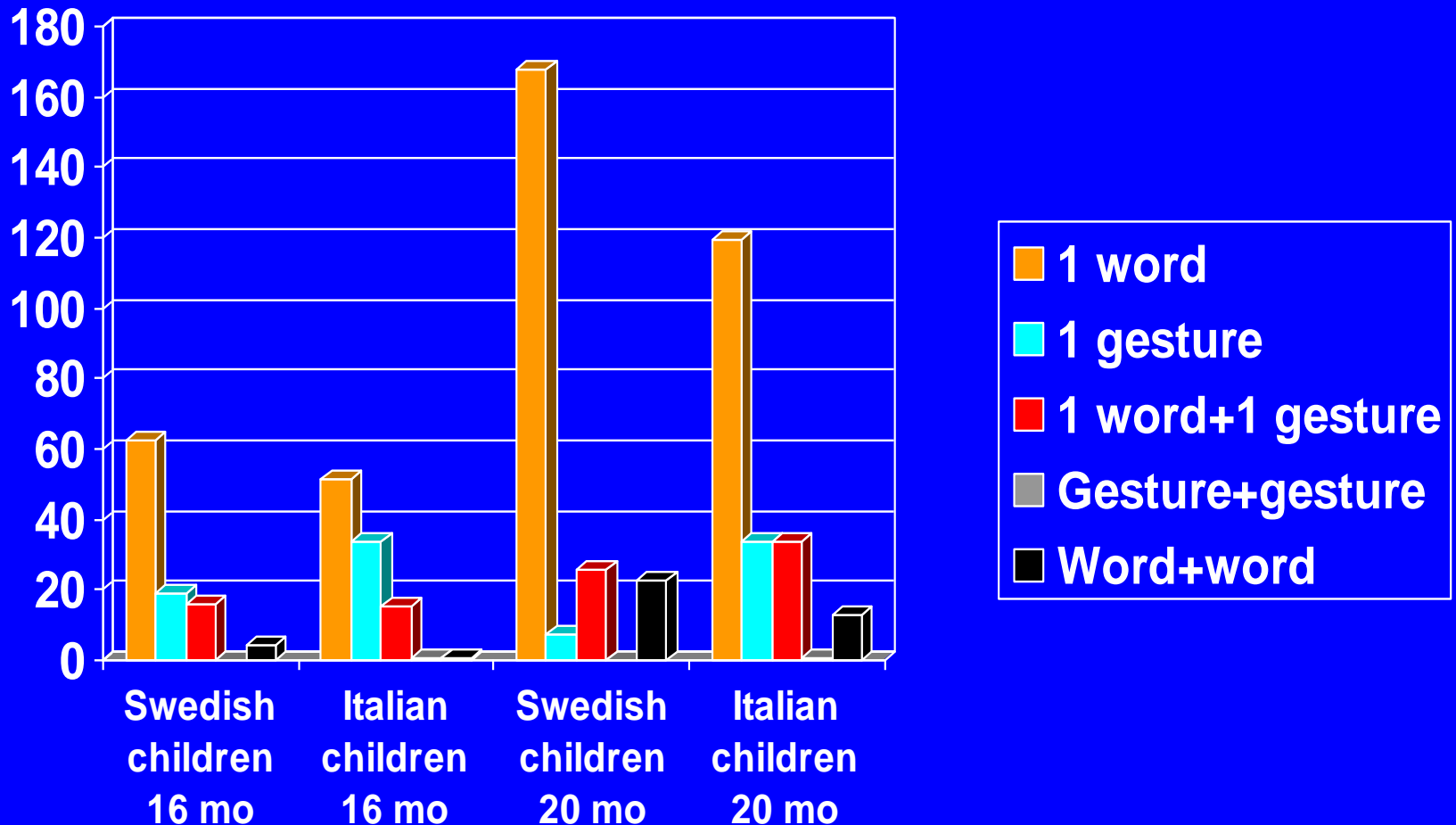
### Italian Study

- 12 children (6 boys & 6 girls)
- Two videorecorded observations (45 minutes each): 16 months and 20 months
- Three contexts: play with new objects; a meal or snacktime; play with familiar objects

### Swedish Study

- 12 children (4 boys & 8 girls)
- Two videorecorded observations (45 minutes each): 16 months and 20 months
- Two contexts: play with new objects; a meal or snacktime

# A comparison between Swedish and Italian children





# Some conclusions

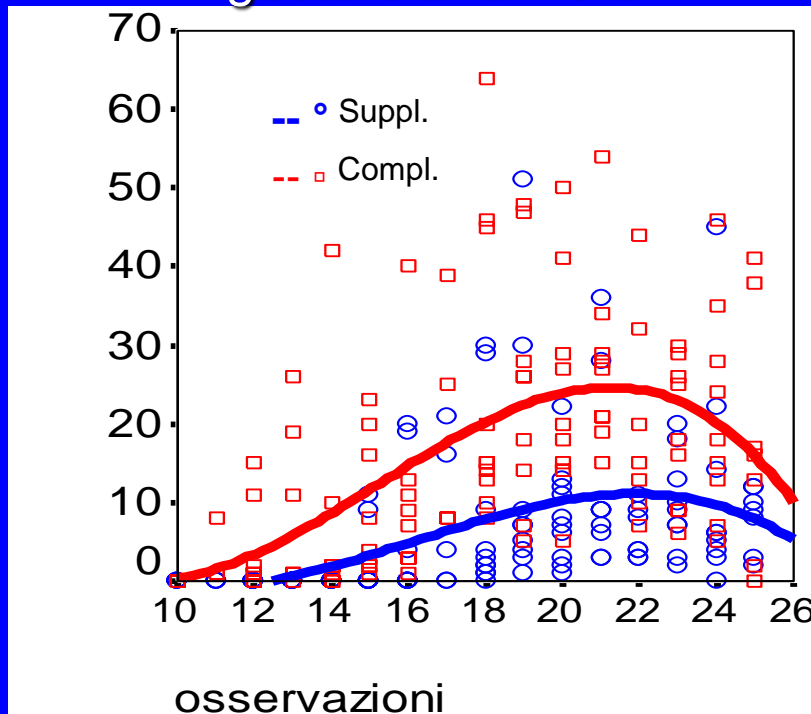
- Both Swedish and Italian group of children use gestures at 16 and 20 months
- The Italian children have a slightly larger gesture repertoire
- All children use gesture-word combinations and these cross-modal utterances precede two words combinations and continue to be used

# Developmental pattern of gesture/word combinations (complementary and supplementary)

for 10 children (10-26 months)

(Pizzuto & Capobianco, 2005; Capobianco, Pizzuto & Devescovi, 2007)

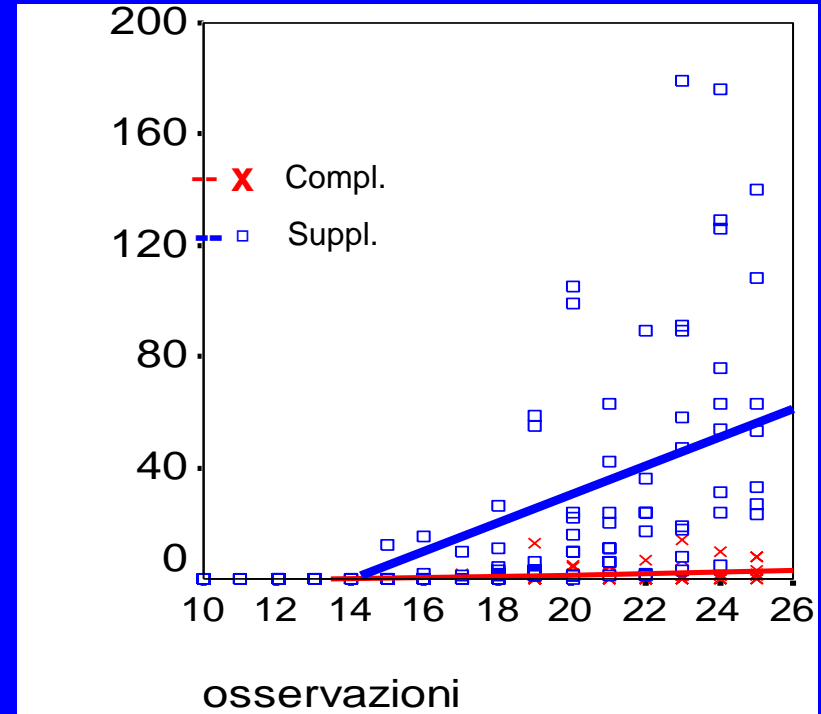
gesture and word



**Crossmodal**

More frequent combinations are  
**COMPLEMENTARY** ( peak 18-21  
months)

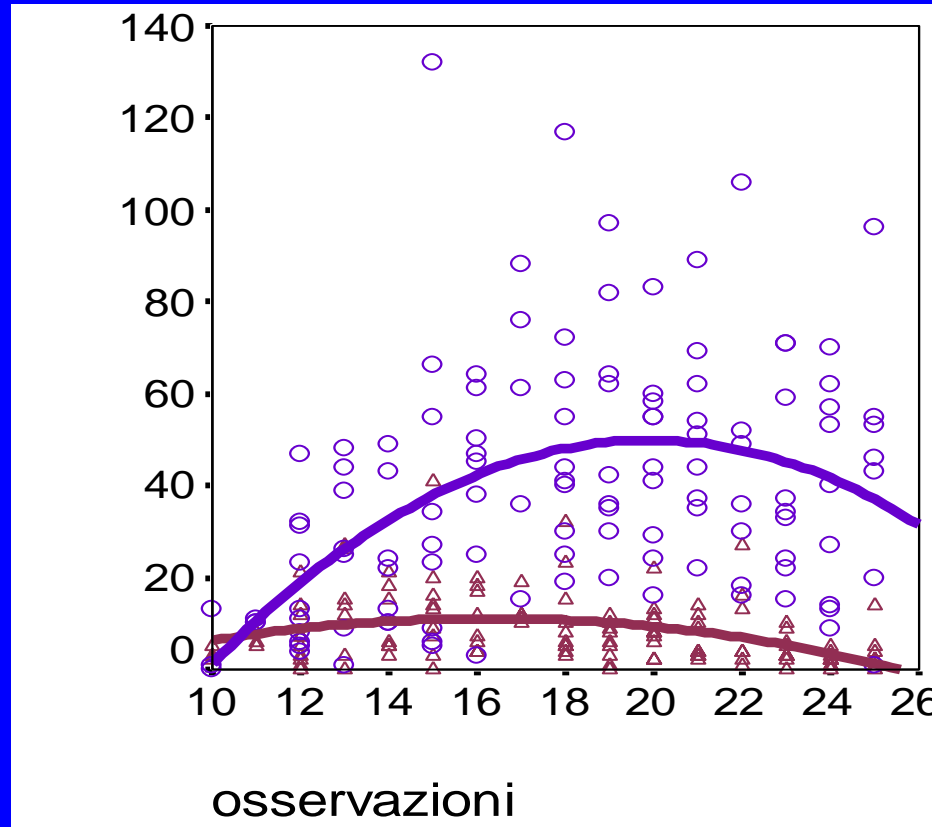
word+ word



**Vocal**

More frequent combinations are  
**SUPPLEMENTARY**

# Developmental pattern of Synchronic and A-Synchronic gesture/word combinations for 10 children (10-26 months)



--○ **synchronic**  
R Square=,20  
F=,0000

--△ **asynchronic:**  
R Square=,14  
F=,0001

# **Main results of studies on the role of gesture conducted during the transition to two-word utterances**

When children start to produce more words, these words are integrated with gestural units (cross-modal combinations)

Gesture-word combinations (complementary and supplementary) produced at 18 months predict verbal spoken complexity at 2 years

# Direct observation with a structured task: picture naming

Spoken and gestural lexicon in a naming task: developmental data  
(Stefanini, Bello, Caselli, Iverson, Volterra , in press, *Language and Cognitive Processes*)

The goal was to investigate spoken lexical development through a picture naming task in children from 2 to 7 years

# Lexical Production Task

46 Pictures which can be easily manipulated by young children:  
24 depicting objects, animals, body parts, foods and clothes  
22 depicting actions and characteristics

**Objects, animals, body parts,  
food and clothes**

“ What is this? ”



(dog)

**Actions and characteristics**

“ What is the child doing ?”



(he/she eats)

Lexical items were balanced for frequency of use according to the PVB database (Italian version of MacArthur-Bates CDI, Caselli & Casadio, 1995).

**Typical developing boy : 27 months:  
Correct spoken naming and pointing gestures**



**Typical developing girl : 24 months:  
Correct spoken naming and depictive gesture**

**Knife**





# RESULTS

All children, requested to provide a spoken label of pictures, spontaneously produce gestures in the naming task together with speech

Gestures produced were mainly deictic and representational

Gestures tended to decrease with age and spoken lexical accuracy

Representational gestures are still used as a form of gestural names when children are already able to use the verbal modality to label objects, animal and actions.

# New Study: qualitative analysis of representational gestures

The main questions are:

- What form representational gestures take?
- Are the gestures similar across children?
- Are there motoric constraints in the form of these gestures?

in order to:

Explore similarities and differences in the form of gestures produced by individual non signing children referring to the same picture

Ascertain whether the motoric constraints are similar to those found in the production of early signs by deaf and hearing children exposed to a sign language

Item:  
The comb



M.B. 25 MESI - PETTINE



N.F. 26 MESI - PETTINE



P.C. 27 MESI - PETTINE



C.D. 33 MESI - PETTINE

Item:  
To turn



M.B. 25 MESI - GIRA



Y.A. 35 MESI - GIRA



P.C.27 MESI - GIRA



M.M.F. 33 MESI - GIRA

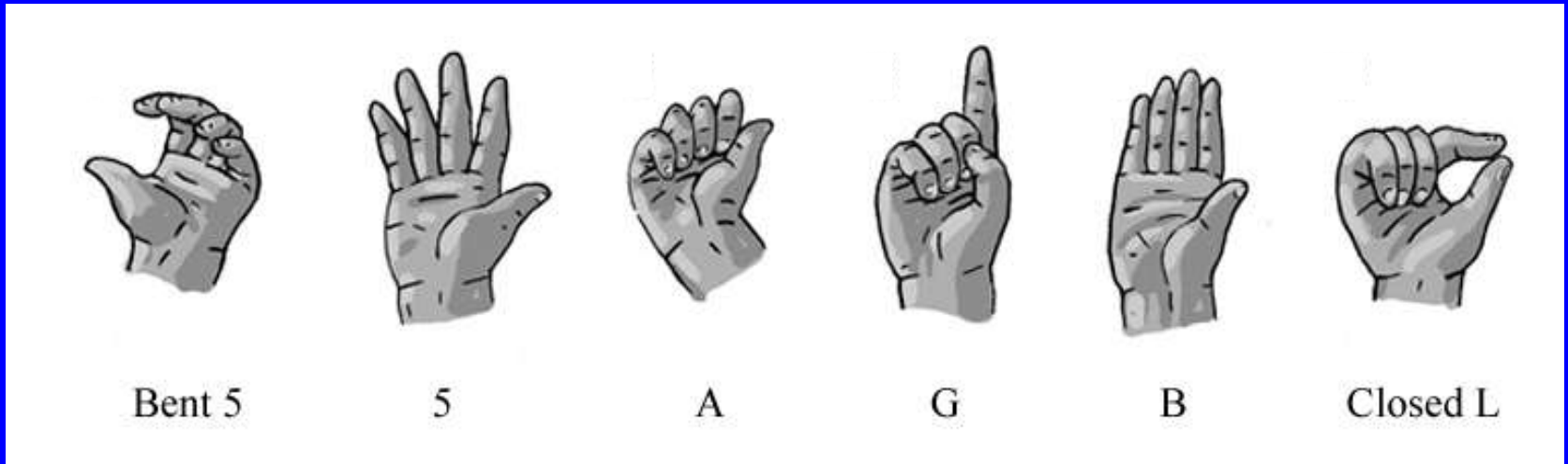
# The most frequent Handshapes identified in

## Co-speech gestures

(Pettenati, Stefanini, & Volterra, in prep)  
128 gestures tokens (87 children: 24-37 months; structured naming task)

## Early signs

(Conlin, Mirus, Mauk, & Meier, 2000):  
372 signs tokens (3 children: 7-17 months; spontaneous interaction)



(Boyes-Braem, 1994)



Results show strong similarities among gestures produced by individual hearing children referring to the same referents.

The same motoric restrictions found in the production of first signs apply also to representational co-verbal gestures

Our results could contribute to studies on:

- Deaf Children without Sign Language Input
- Deaf Children with Sign Language Input

Deaf children starting from gestures similar to those used by hearing children develop communication systems idiosyncratic to individual children but presumably shared by some of their communicative partners

Russo, T., Volterra, V. (2005) *Science*



# CONCLUSIONS

These are evidences of a continuity between co-speech gestures produced by hearing children and early signs produced by children exposed to a SL instead of a clear-cut separation

“Forms of expression in gesture have much in common with certain forms of expression in primary sign languages. That is, there is common ground between ‘gesture’ and ‘sign’.”  
(Kendon, 2004)



# General Conclusion

- Gesture and speech are linked to and co-evolve in the ontogeny of language: language itself is a gesture-speech integrated system from the beginning
- We found a progression from action to language through gesture
- Motor representations are essential for linguistic representations in speech, only later a direct link is established between the referent and the spoken word
- Gesture may compensate for a difficulty with speech conveying a meaning similar to the expected word
- Developmental data appear to support the **neurophysiological** perspective: “Language exploits the pre-existing multimodal character of the sensory-motor system” Gallese & Lakoff (2005)

**Thank you, to**

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**All the children  
and their families**





**Thank You!**