

On gesture and speech production in the child aged 3 to 11 years

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Focus on gesture + speech production in children

Studies on language development deeply investigated the acquisition of phonemics, lexicon, syntax and pragmatics...

However : how does the child processes bimodal (speech & gesture) Language Production ?

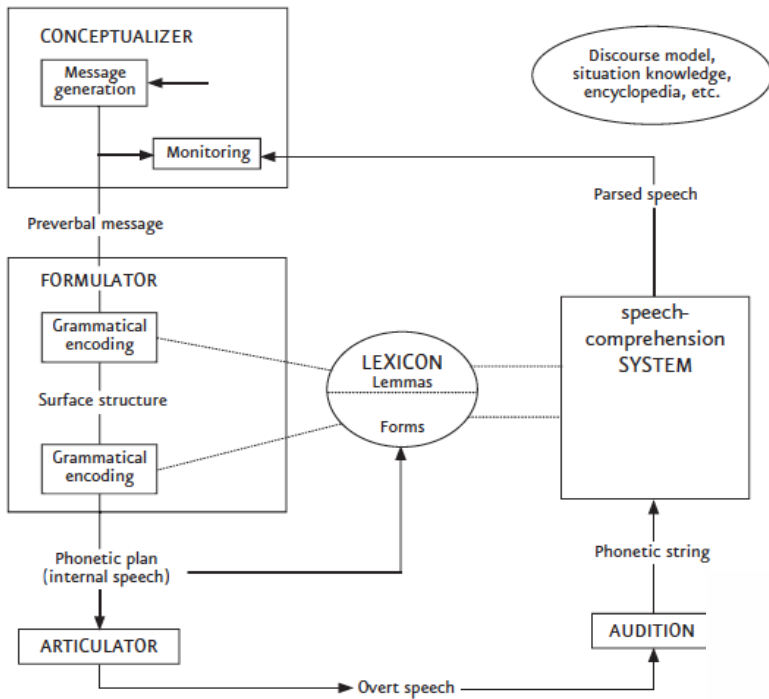
Why studying LP processes ?

Because it helps tracking changes in the conceptualization & planification of speech & gesture.

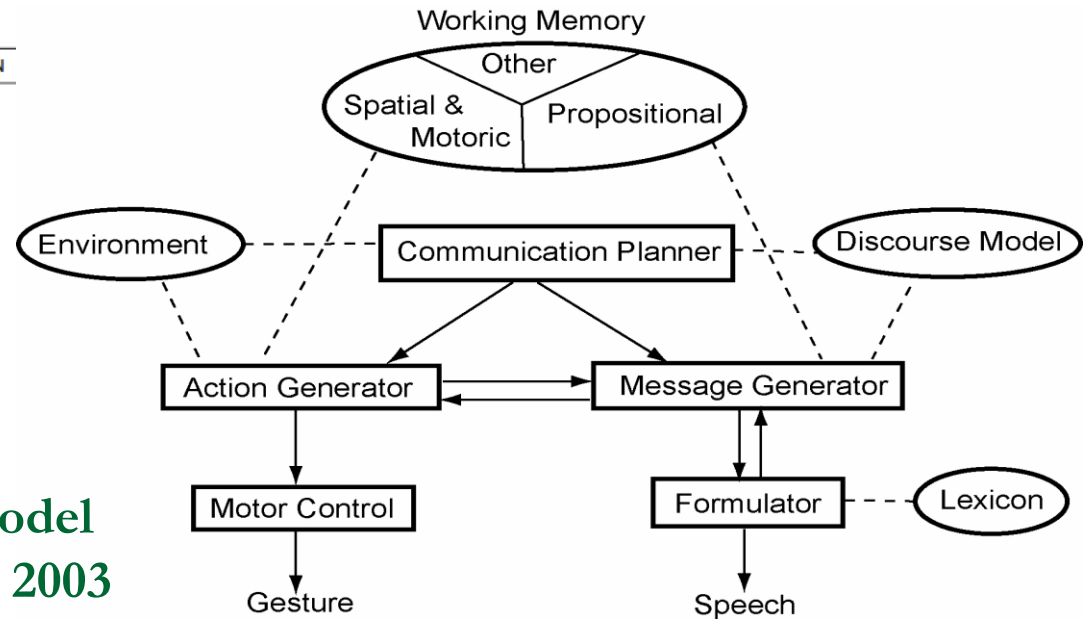
>>> 2 contrasted language performance >>>







Model for speech production Levelt, 1999



The Interface Model Kita & Özyürek, 2003

... These representations do not model language development in production !

4 entries into the study of speech processing in children :

Measure the increase in speech rate during childhood

(Adams & Gathercole, 1995 ; Koopmans-van-Beinum, 1993 ; Kowal et al., 1975 ; Legendre et al., 2012 ; Pavao Martins et al. 2007 ; Ryan, 2000 ; Walker & Archibald, 2006...)

Study silent pauses and voiced hesitations

Mainly adult data ; children's voiced hesitations appear during 4th year of age (Campione & Véronis, 2004 ; Candea, 2000 ; Duez, 1982; Kowal & al., 1975)

Study Phonic Groups

An explanatory study showed an effect of age on the length and content of PGs (Colletta, Pellenq & Rousset, 2008)

Study co-speech gestures

Effect of age on various aspects of gesture production (rate, type of gesture, relation to speech, morphology... (Colletta & Guidetti, 2010, 2012 ; Iverson & Volterra, 2008; Mayberry & Nicoladis, 2000;...)

Our study aims at tracking age-related changes in spontaneous talk shaped as a narrative.

Why a narrative task ?

- Narration is a monolog language performance (Fayol, 1985; 2000 ; Hickmann, 2003 ; Karlmiloff-Smith, 1979 ; Tolchinsky, 2004)
 - The narrator has to plan speech at 2 levels:
 - clause content (information packaging) ;
 - text content (macrostructure, dynamics between new & given information, text cohesion).
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Hypotheses

Young child does not lack conceptualization abilities, but lacks lexicon, access to lemmas & varied grammatical formats, and has a limited memory span to encode phonemic strings.

Hyp 1 : older child talks faster & processes more linguistic information than younger child

Assuming linguistic knowledge is being intimately tied to mental imagery through mimism (Jousse, 1974; Barsalou, 1999; Paivio, 2006...)

Hyp 2 : older child gestures more than younger child

Data and population :

77 oral narratives produced by children aged 3½ yrs to 11½ yrs attending preschool and primary school (data collected on a French ANR funding)

Full population : 122 children.

Exclusion criteria: children with atypical language abilities ; children who did not verbalize the story on their own; children who did not gesture during narration; children with atypical gesture production.

6 age classes were built out of the data in order to get a better representation of age differences than the 8 classroom levels

	G1	G2	G3	G4	G5	G6
Mean age (days)	1607 (182.39)	2199 (111.79)	2586 (108.73)	3054 (179.02)	3583 (96.41)	3981 (89.82)
Mean age (mnths)	4.4	6	7	8.3	9.8	10.9
Age range (mnths)	43-60	66-78	80-92	94-109	113-123	125-136
Inter-class gap (mnths)	—	20	12	15	18	11
N	15	15	12	13	16	16
F/M	5/10	8/7	5/7	4/9	9/7	10/6

Age groups



Extract from the video clip (W&G « A close shave »)

Method :

Task : at school, in a separate room, the child was asked to narrate from an extract of an animated film (Nick Park « Wallace & Gromit – A close shave », the first 3 mn)

Each child was filmed using a camscope and an external microphone.
Child sitting on a chair next to the interviewer

Each narrative was later transcribed and annotated on ELAN.
Orthographic speech transcription aligned on Phonic Groups (PG).
Gesture annotation aligned on the video

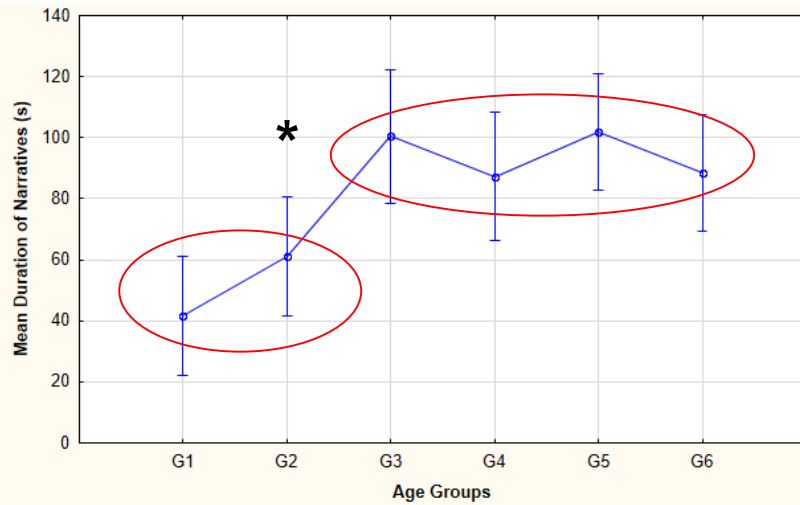
Measures :

- **Phonic Group (PG)** (# & sec.) = a continuous speech string between 2 inspiration breaths or silent pauses (silent pause => 200ms) ;
- **Length of narrative** (sec.) = total duration of PGs (excluding pauses) = total time of verbalizing ;
- **Narrative performance** : #syllables ; #words ; #clauses ; #PGs; #gest. strokes
- **Speech rate** (#syll per sec.) + **gesture rate** (#strokes per clause)
- **PG length & information content** : #syll per PG, #words per PG, #clauses per PG, #strokes per PG.

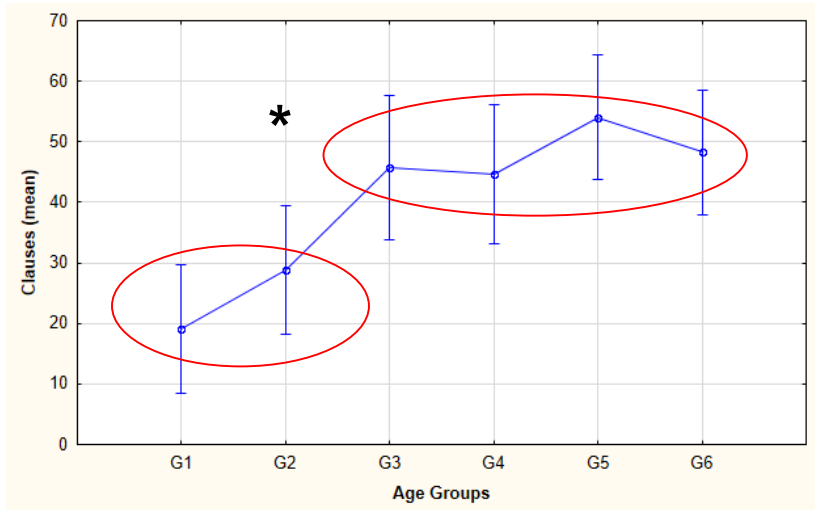
>>> **Statistica anlysis : One-way anovas (age group x dep variables) & correlations (Pearson's R)**

	G1	G2	G3	G4	G5	G6
Length of Narrative (sec.)	41.66 (19.29)	61.04 (33.60)	100.39 (50.51)	87.33 (36.91)	101.76 (45.19)	88.43 (30.07)
# Syllab.	156,53	234,20	346,17	354,62	416,94	376,38
# Words	112,27	173,67	257,75	260,23	303,31	284,19
# Clauses	19.13 (7.17)	28.86 (15.88)	45.66 (22.94)	44.61 (21.85)	54.00 (28.31)	48.25 (17.34)
# Gest. strokes	6,00 (3.93)	7,20 (6.75)	10,00 (9.06)	14,15 (15.83)	18,87 (16.83)	16,62 (8.79)

Narrative performance



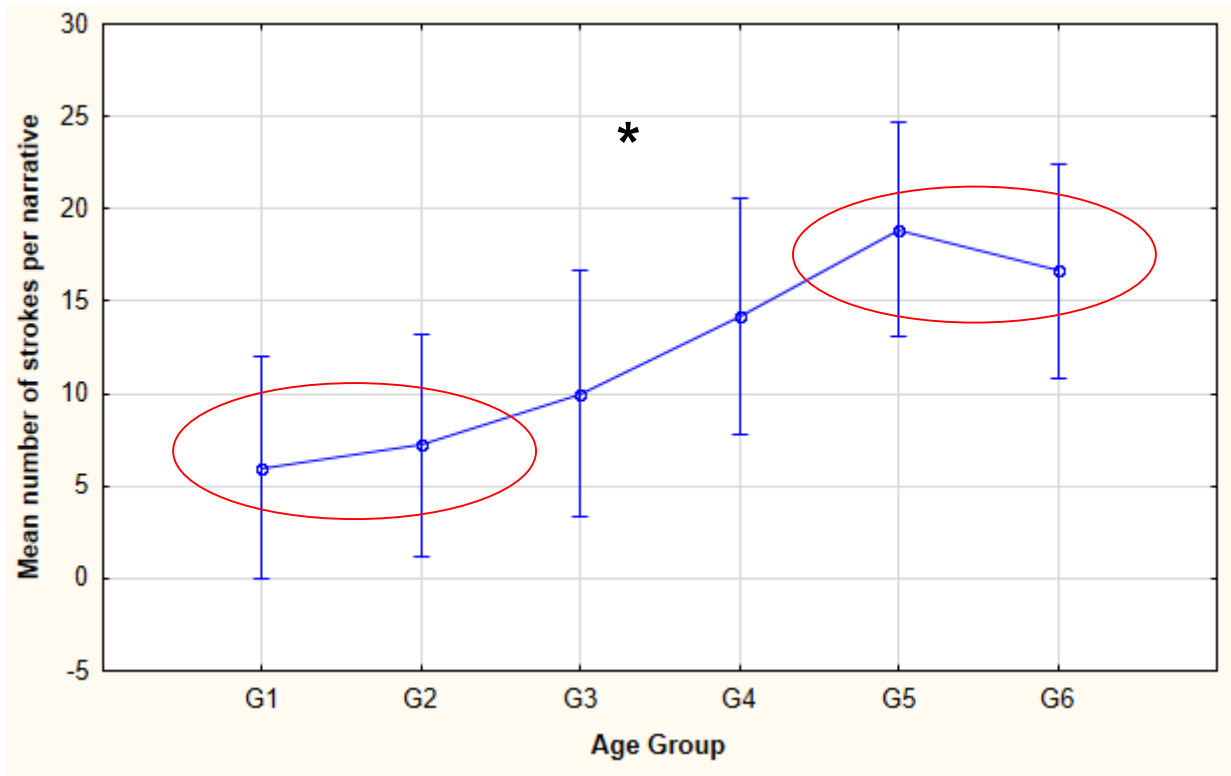
Age & length of narrative



Age & # clauses

The narrative significantly gains in length once the child enters primary school (G3). $F(5, 81)=5,7428, p=.00014$

**All linguistic measures show a significant change between G2 and G3.
Anova on clauses : $F(5, 81)=6,1944, p=.00007$**



Age & # strokes

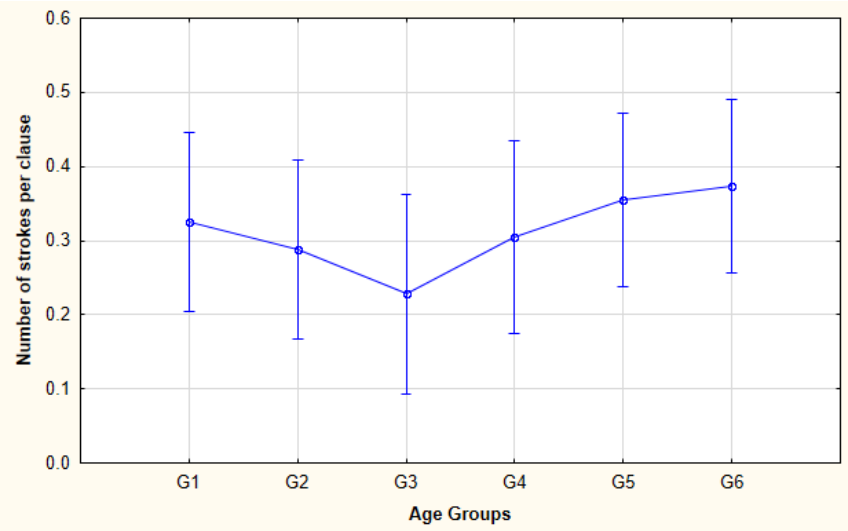
Use of gesture resources also grow with age
 $F(5, 81)=3,0882, p=.01332 ; (G1 + G2 * G5 + G6)$

	G1	G2	G3	G4	G5	G6
#syllabe /sec	3.83 (0.41)	3.87 (0.38)	3.53 (0.48)	4.02 (0.40)	4.08 (0.46)	4.28 (0.46)
#stroke /clause	0.32 (0.17)	0.28 (0.23)	0.22 (0.18)	0.30 (0.33)	0.35 (0.21)	0.37 (0.19)

Speech rate + Gesture rate

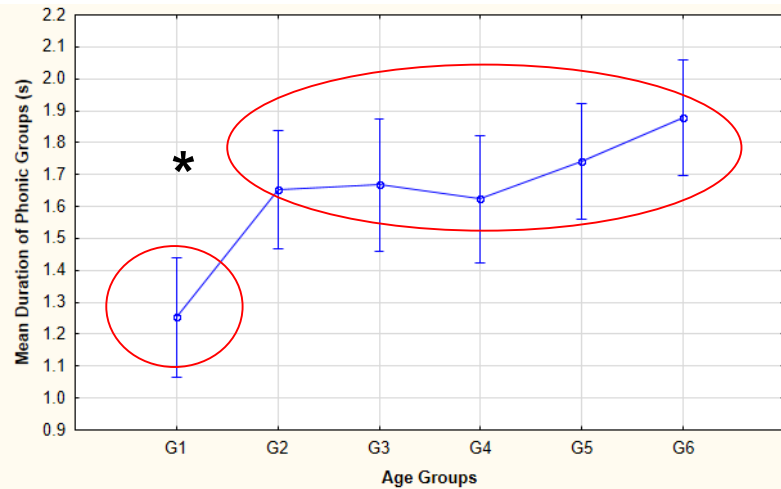
Increase in Speech rate
($F(5,81)=4.3422$, $p=.0015$)

**But no significant increase in
Gesture rate !!!**
($F(5,81)=66.313$, $p=.65244$)

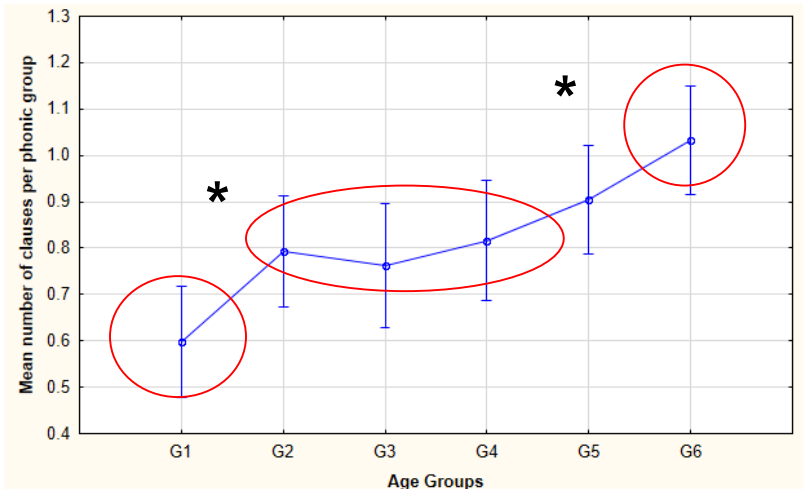


	G1	G2	G3	G4	G5	G6
# PG	33,13	37,47	63,00	55,62	59,31	48,38
PG length (sec)	1.25 (0.26)	1.65 (0.25)	1.66 (0.45)	1.62 (0.27)	1.74 (0.42)	1.87 (0.37)
# Syllab.	4,73	6,44	5,81	6,51	7,12	7,97
# Words	3,44	4,79	4,37	4,86	5,24	6,07
# Clauses	0.59 (0.12)	0.79 (0.22)	0.76 (0.24)	0.81 (0.18)	0.90 (0.25)	1.03 (0.27)
# Gest. strokes	0.18 (0.09)	0.21 (0.17)	0.14 (0.10)	0.22 (0.20)	0.31 (0.19)	0.37 (0.20)

PG length & information content



Age & length of PG



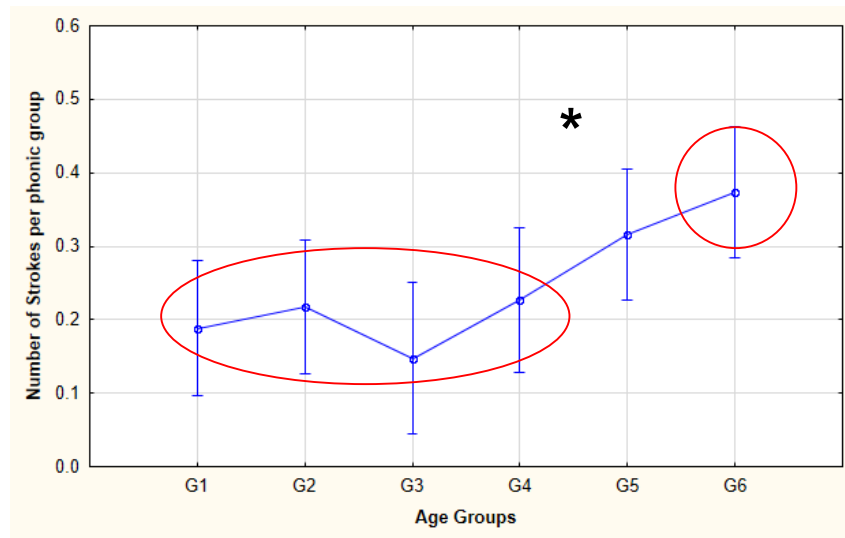
Age & # clauses per PG

Increase in the length of PGs

($F(5,81) = 5.0753, p < .00043$) with signific. diff. between [G1] and other groups.

All linguistic measures show a significant change between G1 & G2, and another one between G4 and G6.

Anova on clauses : $F(5,81)=5,9022, p00011$.



Age & # strokes per PG

Increase in the number of strokes per PG !

($F(5,81) = 3.2650, p=.00078$)

with signific. diff. between [G6] and other age groups.

(except G5)

Correlations

Pearson's R was calculated for all relevant variables. All correlations between age & PG content and PG length were high and significant :

- Age & # syllables per PG : $R = 0,556$
 - Age & # words per PG : $R = 0,503$
 - Age & # clauses per PG : $R = 0,483$
 - Age & # PG length : $R = 0,435$
 - Age & # strokes per PG : $R = 0,343$
-

Results

With age:

Child's narrative production gains in length and in linguistic & gestural content (as expected)

Child talks faster (as expected)

Child talks in longer speech strings and puts more linguistic and gestural information in GPs !!!

Discussion

2 contrasted series of results suggest 2 developmental patterns according to their respective timing :

DPN : a significant increase in length & information content of the narrative

Occurs **between 6 and 7 yrs of age** (in grade one children)

DPPG : a significant increase in length & information content of the bimodal PG

Occurs **first between 4½ and 6 yrs** (before the child enters primary school) and **later between 9 and 11 yrs** (grade 5 and grade 6 children).

DPPG1 at 4-6 yrs
New planification abilities at the local GP level

>>> hyp of a « rendez-vous » between syntax, prosody & gesture
(Diessel, 2004; Meyer & Wheeldon, 2006)

DPN at 6-7 yrs : emergent abilities in text knowledge, text cohesion & acquisition of related linguistic devices

Effect of schooling ?

DPPG2 at 9-11 yrs
New planification abilities at the global text level show in GP production !!!

Related to the emergence of new abilities :

- summarizing after a set of informations,
- selecting relevant information for interlocutor,
- linking and coupling several representations of events into a global representation

(Colletta, 2004; Fayol, 1985).



Beyond the « learning how to cycle » metaphor :

- **DPPG1** : Need to go for a detailed analysis of the syntactic and gestural content of PG's
- **DPPG2** : Need to collect additional data on naratives produced by teenagers and adults.
- Add an investigation of **silent pauses, voiced pauses and the bodily marking of mental states** for a better understanding of the underlying processes (planning speech vs searching for words)

MERCI !!!
