

# 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 ?

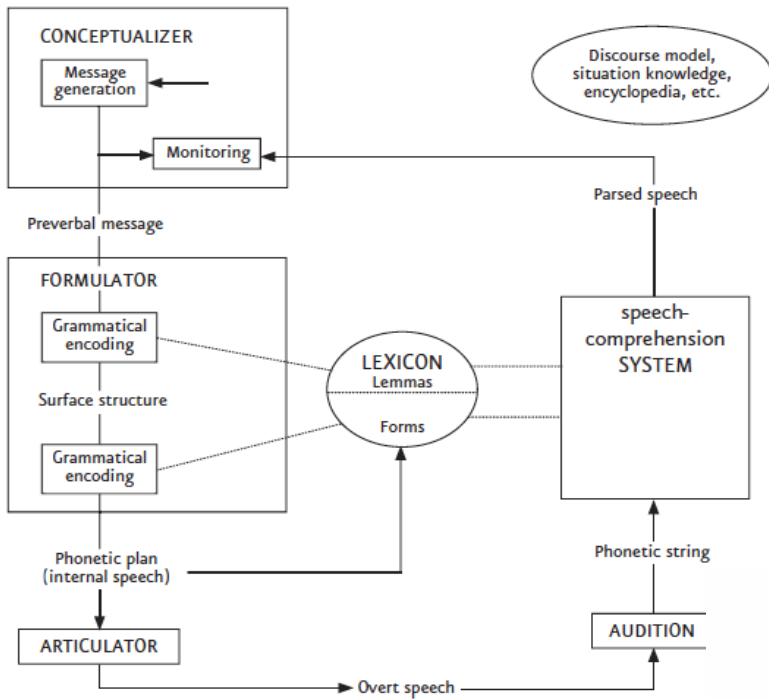
Because it helps tracking changes in the conceptualization & planification of speech & gesture.

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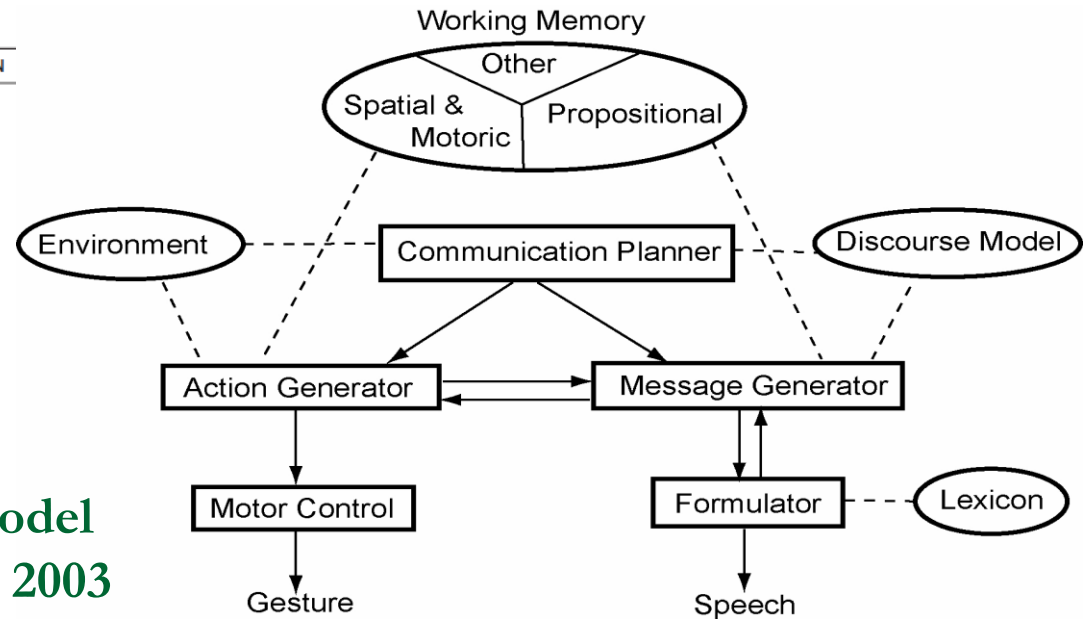
>>> 2 contrasted language performance >>>







## 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;...)

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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**



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## 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

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

## Age groups



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

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## 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

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## Measures :

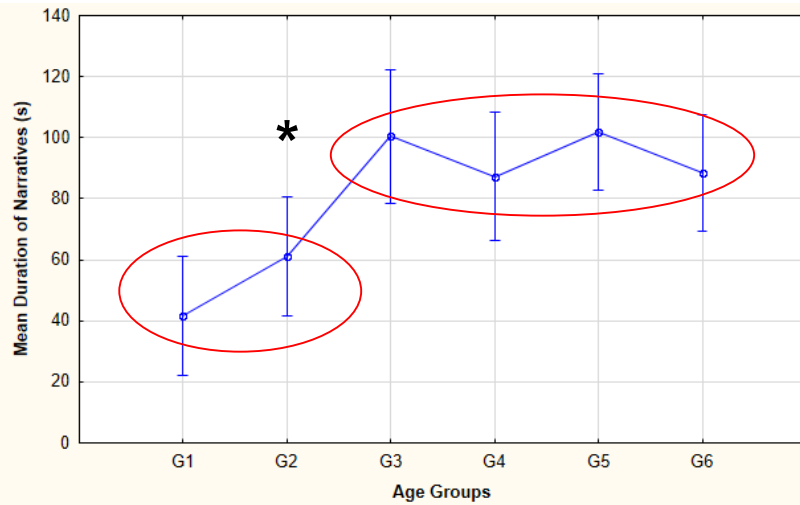
- **Phonic Group (PG)** (# & sec.) = a continuous speech string between 2 inspiration breaths or silent pauses (silent pause => 200ms) ;
- **Length of narrative** (sec.) = total duration of PGs (excluding pauses) = total time of verbalizing ;
- **Narrative performance** : #syllables ; #words ; #clauses ; #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)**

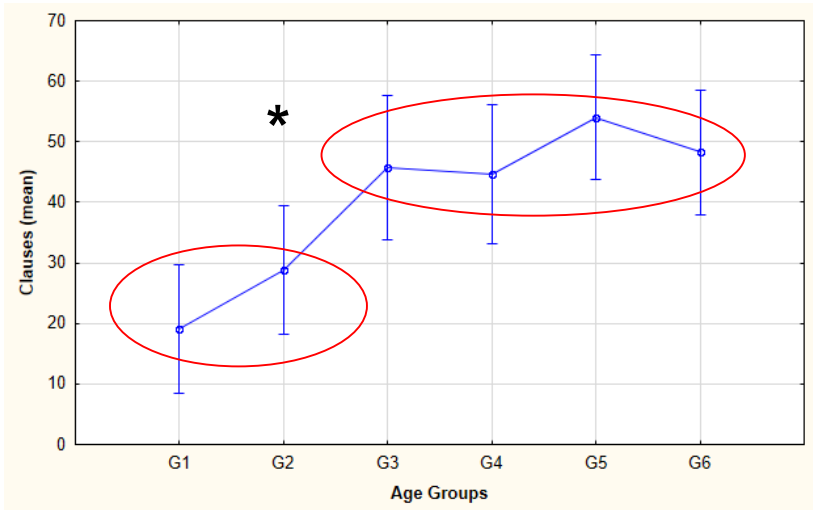
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	<b>G1</b>	<b>G2</b>	<b>G3</b>	<b>G4</b>	<b>G5</b>	<b>G6</b>
<b>Length of Narrative (sec.)</b>	41.66 (19.29)	61.04 (33.60)	100.39 (50.51)	87.33 (36.91)	101.76 (45.19)	88.43 (30.07)
<b># Syllab.</b>	156,53	234,20	346,17	354,62	416,94	376,38
<b># Words</b>	112,27	173,67	257,75	260,23	303,31	284,19
<b># Clauses</b>	19.13 (7.17)	28.86 (15.88)	45.66 (22.94)	44.61 (21.85)	54.00 (28.31)	48.25 (17.34)
<b># Gest. strokes</b>	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



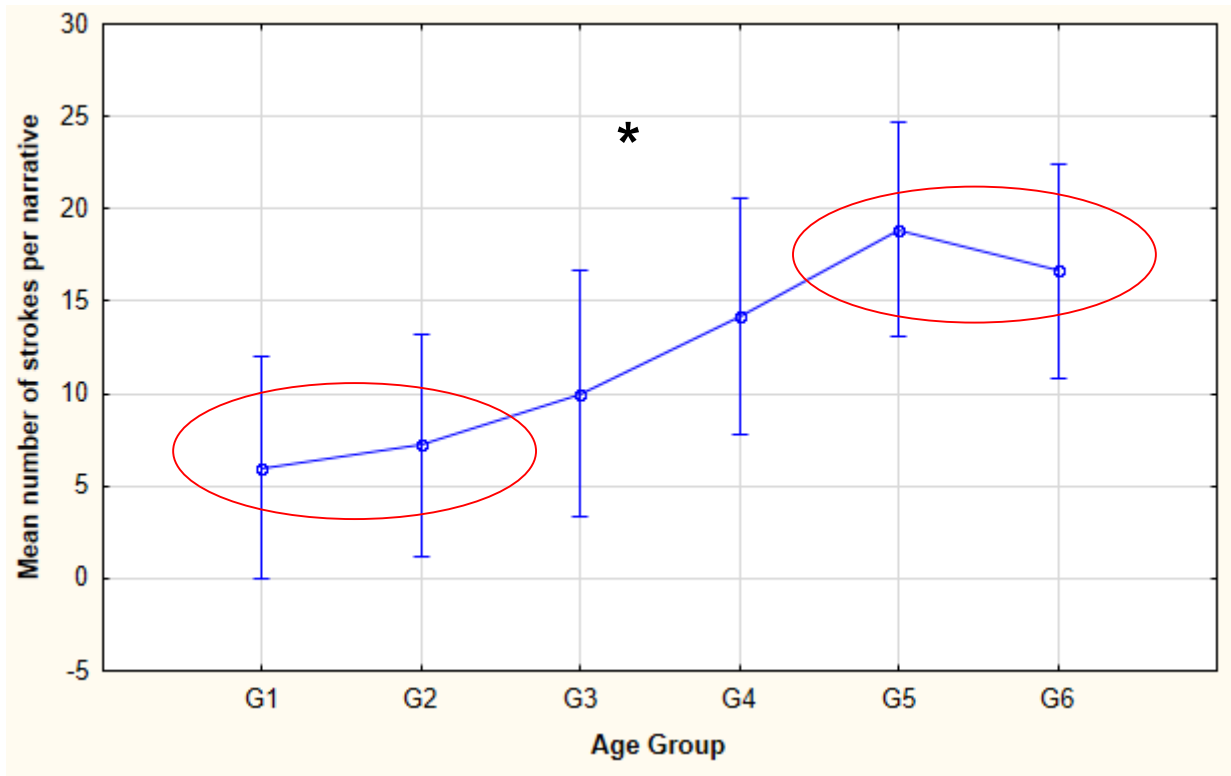
**Age & length of narrative**



**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  
 $F(5, 81)=3,0882, p=.01332 ; (G1 + G2 * G5 + G6)$

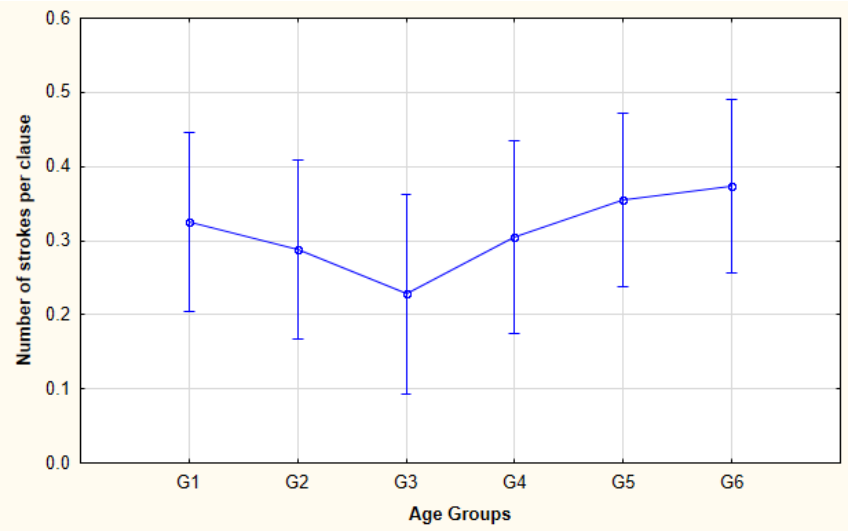


	<b>G1</b>	<b>G2</b>	<b>G3</b>	<b>G4</b>	<b>G5</b>	<b>G6</b>
<b>#syllabe /sec</b>	3.83 (0.41)	3.87 (0.38)	3.53 (0.48)	4.02 (0.40)	4.08 (0.46)	4.28 (0.46)
<b>#stroke /clause</b>	0.32 (0.17)	0.28 (0.23)	0.22 (0.18)	0.30 (0.33)	0.35 (0.21)	0.37 (0.19)

## Speech rate + Gesture rate

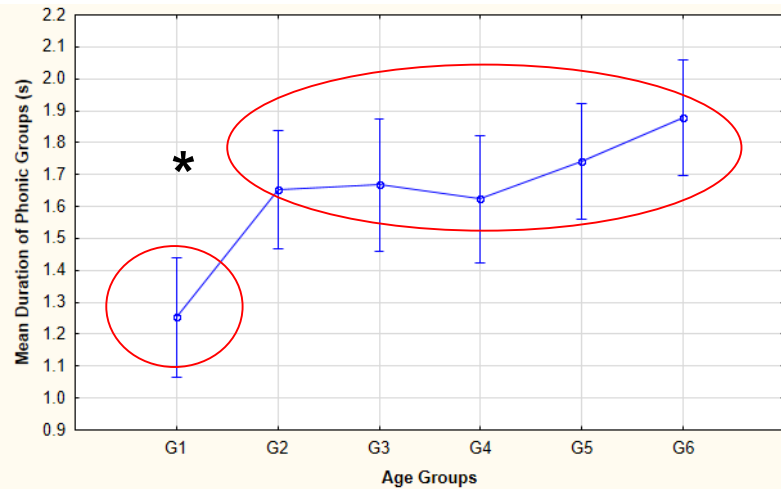
**Increase in Speech rate**  
( $F(5,81)=4.3422$ ,  $p=.0015$ )

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

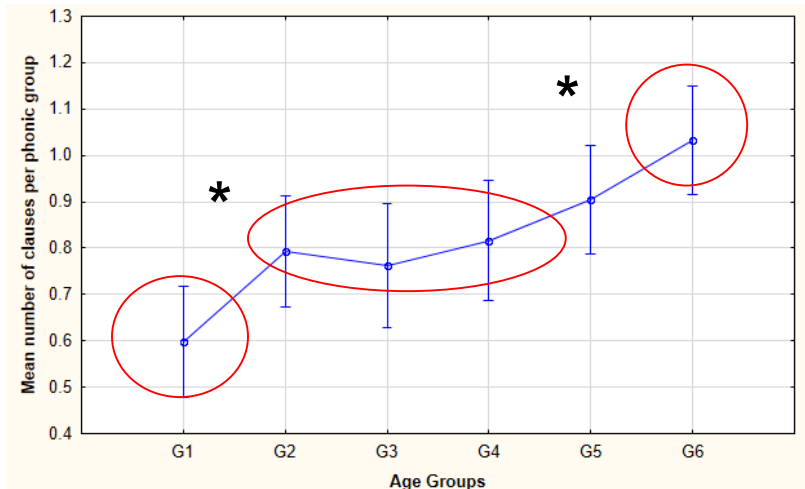


	<b>G1</b>	<b>G2</b>	<b>G3</b>	<b>G4</b>	<b>G5</b>	<b>G6</b>
<b># PG</b>	33,13	37,47	63,00	55,62	59,31	48,38
<b>PG length (sec)</b>	1.25 (0.26)	1.65 (0.25)	1.66 (0.45)	1.62 (0.27)	1.74 (0.42)	1.87 (0.37)
<b># Syllab.</b>	4,73	6,44	5,81	6,51	7,12	7,97
<b># Words</b>	3,44	4,79	4,37	4,86	5,24	6,07
<b># Clauses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



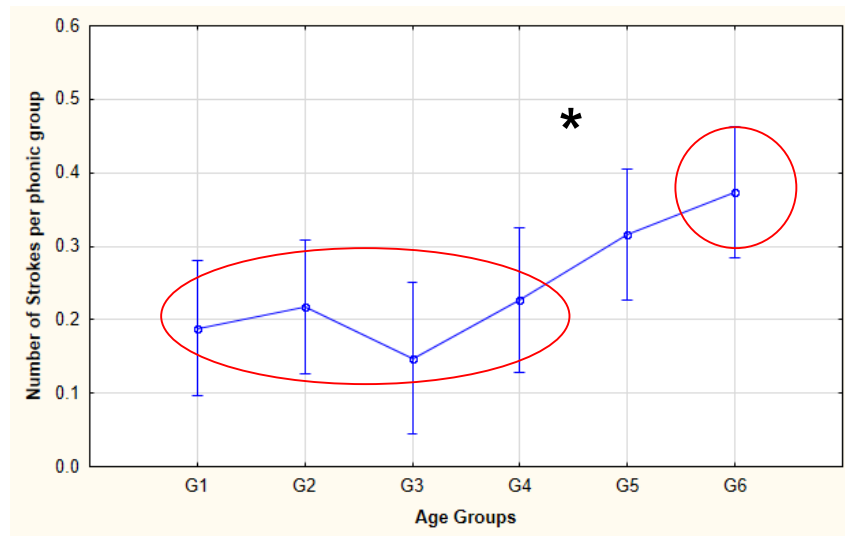
## Age & # clauses per PG

### 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)

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## 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 :  $R = 0,343$
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## 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 !!!**

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## 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).

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**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).





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## 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 !!!**

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