How and when do children master the numerical content conveyed by number words and number gestures ?

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Introduction

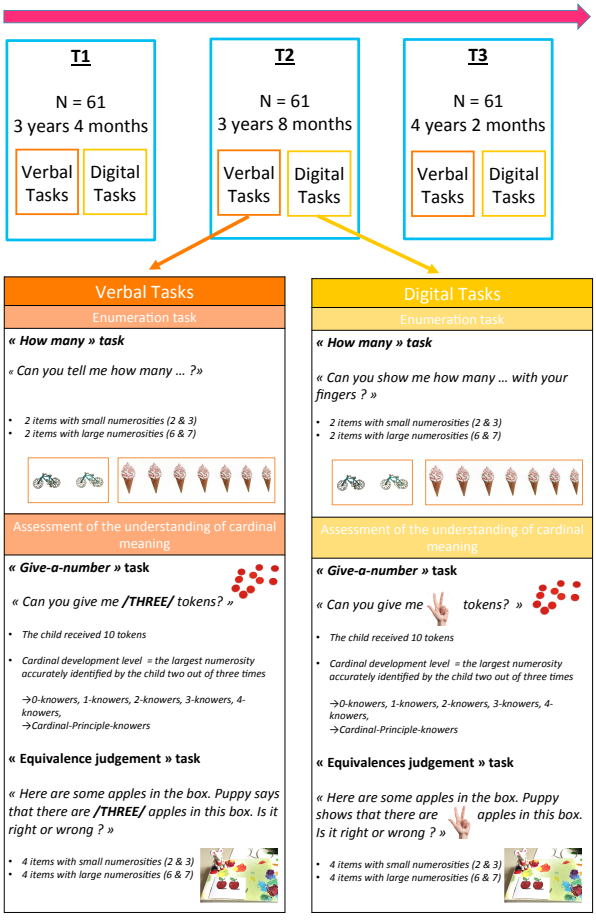
Many studies have shown that gestures support verbal number knowledge (Di Luca & Pesenti, 2011; Goldin-Meadow, Levine & Jacobs, 2014; Roesch & Moeller, 2015). Finger pointing and finger counting allow children to keep a visual track in the recitation of the verbal number sequence (Fuson, Richards & Briars, 1982; Saxe & Kaplan, 1981; Alibali & Di Russo, 1999). Fingers are usually used by young children to resolve arithmetic tasks (Fuson, 1982). Finger gnosia are a good predictor of performance in arithmetics and problem-solving in primary school (Fayol, Barrouillet & Marinthe, 1998; Noël, 2005) . However the role of fingers in the understanding of the concept of cardinality is less studied in children and is still a matter of debate. Nicoladis, Pika & Marentette (2010) found that preschoolers (2-, 3-, 4- and 5-year olds) took no advantage of number gestures compared to number words in *How many* & *Give-a-number* tasks. In contrast, Gunderson, Speapen, Gibson, Goldin-Meadow & Levine (2015) showed that children who did not master the cardinal meaning of number words (assessed with the *Give-a-number* task) were more accurate at estimating numbers with gestures than with words. Not only are these results contradictory, but these studies present an important limitation as the understanding of cardinality has never been examined using a longitudinal design which allow a precise assessment of the developmental curve of children.

Our research question

How and when do children come to master the numerical content conveyed by numbers?

At some point in a child's development is there an advantage in the understanding of number gestures or verbal numbers?

Methodology



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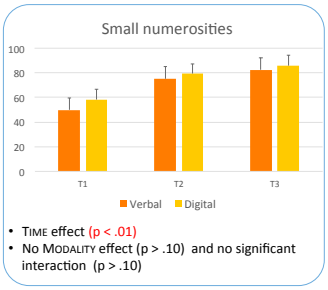
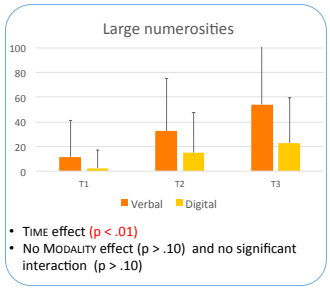
Results

« How many » task



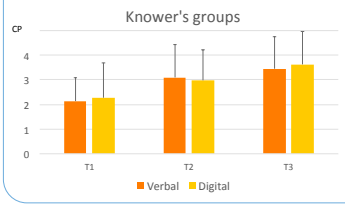
- TIME effect ($p < .01$)
- No MODALITY effect ($p > .10$) and no significant interaction ($p > .10$)



- TIME effect ($p < .01$)
- No MODALITY effect ($p > .10$) and no significant interaction ($p > .10$)

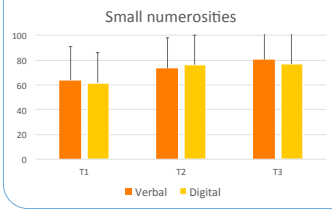
Assessment of cardinality understanding

« Give a number » task



- TIME effect ($p < .01$);
- No MODALITY effect ($p > .10$), no significant interaction ($p > .10$)

« Equivalence judgement » task



- TIME effect ($p < 0,01$)
- No MODALITY effect ($p > .10$) and no significant interaction ($p > .10$)
- No possibility of assessing large numerosities because children perform below chance level

Discussion

The period between 3 and 4 years old is a important period for the development of the concept of Cardinality.

When children have to enumerate a set of objects,

- **Small numerosities: no difference between modalities**
- **Large numerosities : a verbal advantage**

→ Even to tell How many with gestures, most children use coordinated finger pointing and the recitation of the number sequence to estimate large numerosities,

When children have to understand the cardinal meaning of a number,

- **no difference between modalities whatever the size of the set**

→ Number gestures and number words, used to communicate the cardinal value of set, develop in tandem and with mutual support.

Perspectives: The assessment of performance in a task using both modalities simultaneously would be interesting.

Références: