Sixty-four or four-and-sixty?
The influence of language and working memory on children's number transcoding

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Introduction

English, French: non-inversed number languages

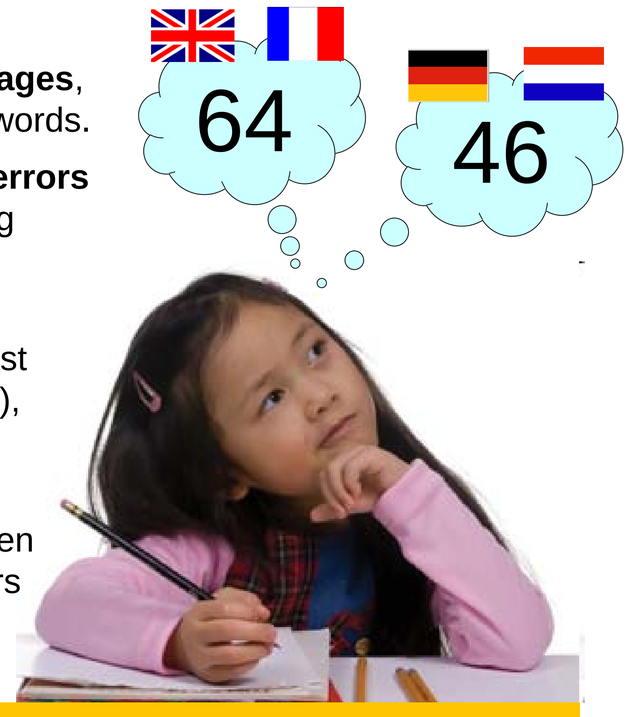
Dutch, German: inversed number languages

Transcoding is a great challenge for children – and especially so in **inversed number languages**, where the ten-unit order is inversed in number words.

Error rates are very high (47%) and **inversion errors** are very frequent (50%) when German-speaking children have to write down Arabic numbers (Zuber et al., 2009).

The children's transcoding performance was best predicted by **executive working memory** (WM), and – in a lesser degree – by visuospatial WM.

We extended this study by:
- comparing Dutch- and French-speaking children
- selecting the least and most skilled transcoders
- increasing the number of WM tasks



Experiment 1

Participants

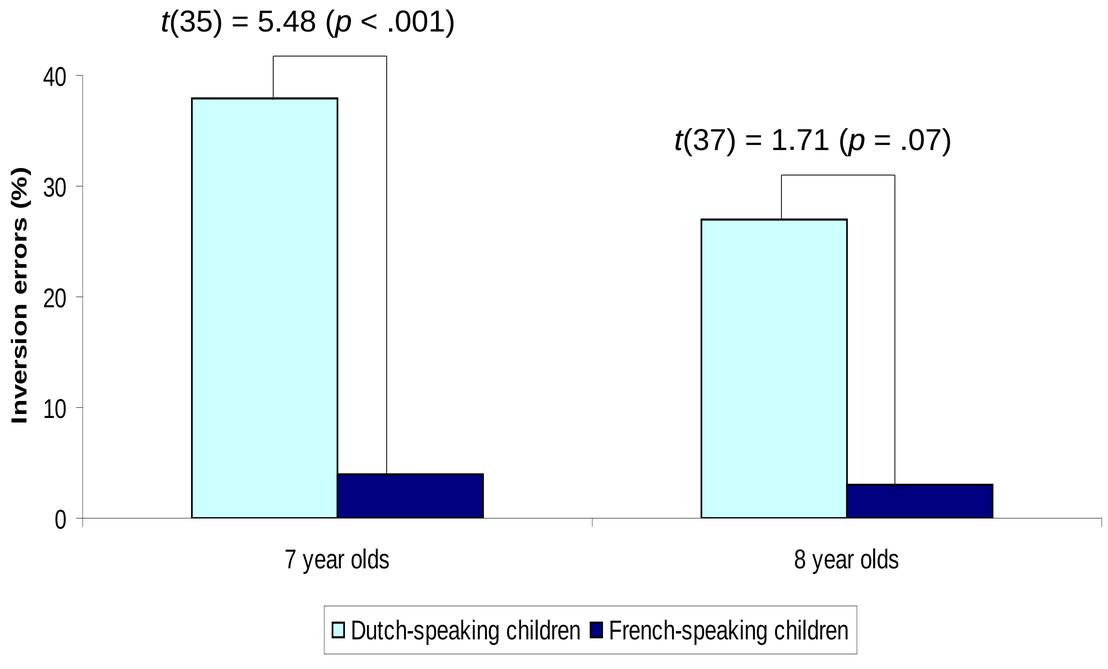
- 57 Dutch-speaking children between 7 and 9 years old, 26 ♂ and 31 ♀
- 60 French-speaking children between 7 and 9 years old, 28 ♂ and 32 ♀

Procedure

All children completed a group-administered dictation of one-, two-, and three-digit Arabic numbers.

Results

- The error rate was equally large in Dutch- and French-speaking children (29% & 25% in 7 year olds and 12% & 9% in 8 year olds)
- The percentage of **inversion errors** differed significantly:



Experiment 2

Participants

- 49 Dutch-speaking children of 8 years old, 27 ♂ and 22 ♀
- 38 French-speaking children of 8 years old, 18 ♂ and 20 ♀

Procedure

- Step 1: Dictation of Arabic numbers (all children).
- Step 2: Selection of the 10 least and 10 most skilled transcoders in each language group, based on the number of transcoding errors.
- Step 3: Testing the WM of these children:
  - Phonological: Digit span forward & Letter span forward
  - Visuospatial: Corsi Blocks forward & Mazes Memory
  - Executive: Digit span backward, Letter span backward, Corsi Blocks backward, & Sun Moon Stroop

Results

- Logistic regression analysis on transcoding performance
- Linear regression analysis on the % inversion errors
- Linear regression analysis on the less skilled transcoders' % errors

Predictors		Dependent variables
• Executive WM	$p = .05$ →	• Type of transcoder (more or less skilled)
• Visuospatial WM		
• Phonological WM	$p = .10$ →	• Error % (in less skilled transcoders)
• Intelligence		
• Language	$p = .04$ →	• Inversion error % (in all children)
• Age		

Conclusions

- Transcoding is **more difficult** for children speaking an **inversed number language**; they make more **inversion errors**
  - → This may affect the development of (automatic) links between the number word system ("sixty-four") and the Arabic number system (64)
  - → Further evidence for a possible link between transcoding ability and learning disorders such as **dyscalculia** (Van Loosbroek et al., 2009)
  - → Is this also true for children in a **non-inversed number language** system?
- Children having **fewer executive WM resources** are more susceptible to be **less skilled transcoders**.
- Less-skilled transcoders having fewer **phonological WM resources** make more **transcoding errors**.
- **Visuo-spatial WM** did not play a significant role in our study ↔ Zuber et al.'s (2009) study, where visuospatial WM predicted non-inversion errors.