



Working Memory and Fluid Intelligence in Children

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1. BACKGROUND

Working memory (WM) – the ability to store and manipulate information in the course of ongoing cognitive activities – and **fluid intelligence (Gf)** – the ability to reason under novel conditions – have been found to be highly related constructs. The underlying nature of the association remains however an issue of controversy. Furthermore, the vast majority of studies have focused on adults: Whether findings from the adult literature can be extended to children remains to be seen. The main aim of the present study was to **explore the development of WM and Gf** in a population of young **children** in order to clarify the **relationship** between these two aspects of fluid cognition.

2. METHOD

Summary

Working memory, verbal short-term memory (STM), and fluid intelligence, were investigated **longitudinally** in a population of children growing up in **Luxembourg** – a country in which **Luxembourgish** is mainly used in social interactions, and **German** and **French** are instructed in schools.

Participants

119 Luxembourgish speakers with both parents speaking Luxembourgish. Children were assessed in **kindergarten (6 years)**, in **1st (7 years)**, and in **2nd grade (8 years)** of Luxembourgish schools.

Socioeconomic status: middle to upper middle class; 100% Caucasian

Tasks

Working memory: complex span tasks

- Counting recall
- Backwards digit recall

Simultaneously store and process information

Short-term memory: simple span tasks

- Digit span
- Nonword repetition

Store word (or visually coded items) in the right order – no explicit storage and processing link

Fluid intelligence: Raven Coloured Progressive Matrices (CPM)

- Raven A
- Raven AB
- Raven B

Require a set of rules or relations between stimuli in order to complete a visual puzzle

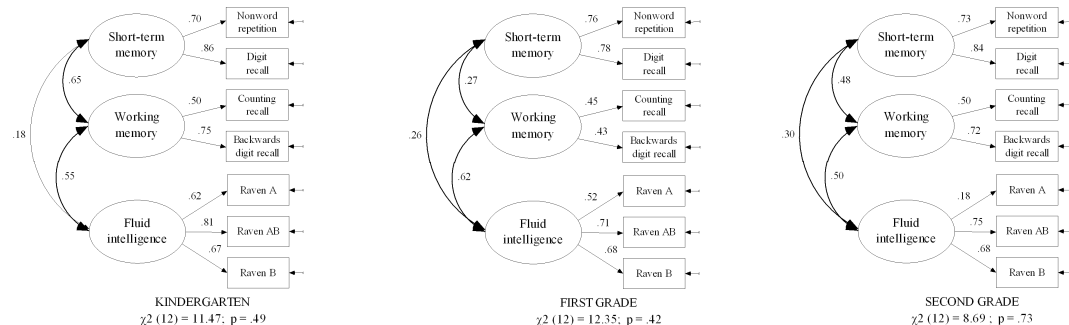
Analyses

Confirmatory Factor Analyses (CFA) to explore the **structure of WM and Gf** in young children: Evaluate **adequacy of measurement model**; Model relationships between **latent constructs** that are not directly observed but relate to observed variables; **Reduce measurement error** by having multiple indicators per latent variable.

Hierarchical regression models (HRM) to explore the **specific contribution** of different **WM components** to **Gf**: Latent predictors are entered into the regression equation in a pre-specified order.

3. RESULTS I: Structure of working memory and fluid intelligence

Three-factor CFA models for the different study waves

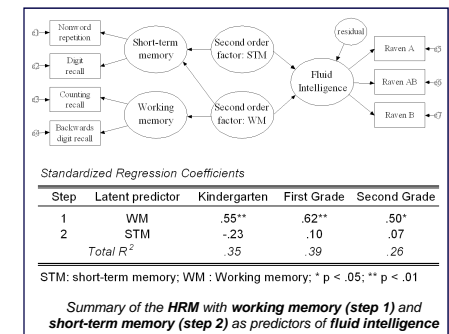
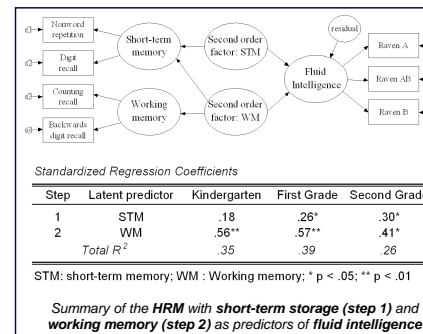


The data are consistent with the position that **short-term memory** and **working memory** performance reflect **distinguishable** but **related** processes in young children

4. RESULTS II: Links between working memory, short-term memory, and fluid intelligence

For each study wave **two sets of hierarchical regression analyses** were performed to examine the **specific effects of WM and STM** to **Gf**.

After the effects of STM were controlled, the **WM residual** described **additional variance in Gf** in all three study waves, accounting for 31% of additional variance in Gf in kindergarten, 32 % in first grade, and 17% in second grade. **STM** in contrast **did not make any specific contributions** to Gf after controlling for the variance shared with WM.



5. CONCLUSION

The present study has shown that in young **children** individual differences in verbal **STM** and **WM** were **distinct, but associated**. Whereas **WM span task** uniquely predict fluid intelligence, assessments of **STM** **did not**. These findings suggest that complex **WM span task** tap into a fundamental aspect of cognition that is **shared** with measures of **fluid intelligence** and that might represent the ability to **effectively control attention** in order to maintain task goal relevant information activated in the face of interference. The study further showed that despite its suggested strong **visual perceptual component**, the **Raven's Coloured Progressive Matrices** was, as in adults, strongly linked to WM. The CPM therefore seems to tap into some **higher order cognitive abilities** that are shared with complex WM span tasks and are likely to reflect **executive attention processes**.