Working Memory and Language

A latent variable longitudinal study

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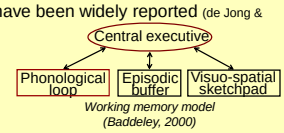
1 Introduction

ability to store & manipulate information in mind for a brief period of time in the course of ongoing cognitive activities (Baddeley & Hitch, 1974)

ability to perceive & manipulate the sounds of spoken words (Goswami & Bryant, 1990)

Links between **working memory** and **phonological awareness** with vocabulary acquisition, language comprehension and reading have been widely reported (de Jong & van der Leij, 1999; Gathercole & Alloway, 2008;).

The **central executive** and the **phonological loop** components of the **working memory model** have been found to make significant contributions to language learning.

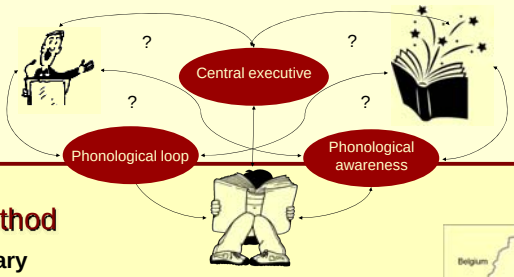


Working memory model (Baddeley, 2000)

Despite extensive research in the area, the specific associations between working memory, phonological awareness, and language are not fully understood and remain the subject of debate

AIM

Assess working memory and phonological awareness in young children exposed to multiple languages in order to explore their relationship with developing language skills in the areas of vocabulary, comprehension, and reading.



2 Method

Summary

Central executive, phonological loop, phonological awareness, native and foreign vocabulary knowledge, language comprehension, and reading 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** and in **1st grade** of 15 Luxembourgish schools.

Kindergarten

- 6 years old
- Emphasis on Luxembourgish
- Pre foreign language learners
- Pre readers and writers

1st Grade

- 7 years old
- Luxembourgish: 1 hour / week
- German: 8 hours / week
- Reading and writing in German

3 Material

		Kinderg.	1st Grade
Central executive	Counting recall	X	X
	Backwards digit recall	X	X
Phonological loop	Digit recall	X	X
	Nonword repetition	X	X
Phonological awareness	Rhyme detection easy	X	
	Rhyme detection diff.	X	
	Alliteration		X
	Spoonerism		X
Syntactic comprehension	Luxembourgish	X	X
	German		X
Expressive vocabulary	Luxembourgish	X	X
	German	X	X
Reading	Letter decision	X	
	Word detection	X	
	Single word reading		X
	Text reading		X
Fluid intelligence	Raven's matrices	X	X

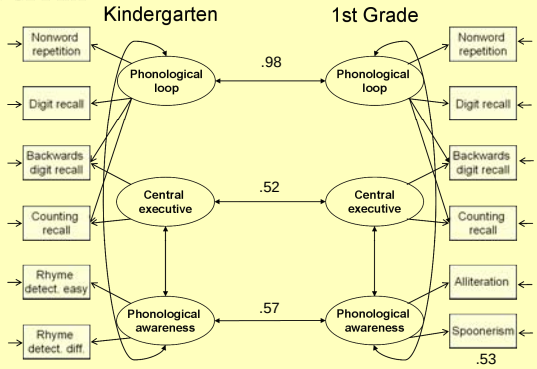
4 Analyses

Structural Equation Modeling

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

5 Results

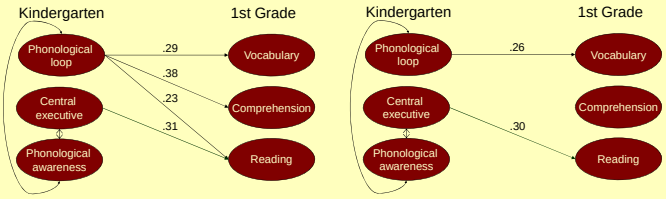


Phonological loop, **central executive**, and **phonological awareness - separate** but **correlated** latent constructs in children from 6 to 7 years

↳ Continuity/stability between the constructs over time

6 Results

Controlling for fluid intelligence & vocabulary* *(*for comprehension and reading)*



solide lines = significant effects

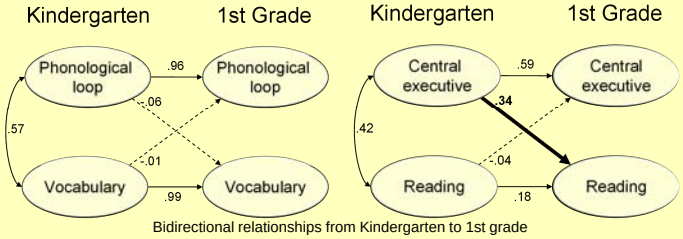
Phonological loop - strong and **specific link with vocabulary** knowledge of native and foreign languages

- links with **comprehension** and **reading**: **mediated** by **vocabulary**

Central executive - highly **specific predictor** of **reading** : independent of fluid intelligence and vocabulary

Phonological awareness: no specific links with any of the language constructs

7 Results



Bidirectional relationships from Kindergarten to 1st grade
solide lines = significant effects; broken lines = insignificant effects

When the **autoregressive effects** were included, **no causal influence** of the **phonological loop** on subsequent **vocabulary** skills and *vice versa* were found.

In contrast, the strong **forward link** between the **central executive** and **reading** was **upheld** even when **prior reading skills** were taken into account. The opposite (i.e. influence of early reading skills on the central executive) was however not the case suggesting that the impact of the central executive on subsequent reading cannot simply reflect an earlier influence of reading on central executive functioning.

8 Discussion

The findings lend strong support to the position that the **phonological loop is one of the main contributors to new word learning** in both native and non-native languages by supporting the formation of stable phonological representations of new words in long-term memory. The results point however to a reciprocal relationship between phonological loop functioning and vocabulary acquisition rather than a simple one-way causal association. The **phonological loop** seems to exert **indirect effects** on language **comprehension** and **reading** via vocabulary knowledge. The **central executive appears to makehighly specific contributions to reading development**. One explanation of these findings is that literacy classroom activities often impose heavy demands on the central executive, the capacity of which therefore has a direct effect on the frequency of task failure or success in these classroom activities which consequently influences the rate of learning. In conclusion, the presented evidence of (a) the stability of individual differences in young children's working memory capacity and, (b) causal relations of working memory with learning reinforces the value of early screening of working memory abilities to identify children who are at risk of poor academic progress over the coming years.

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