



Working Memory and Language Learning: A Longitudinal Study of Trilingual Children

Pascale Engel

Department of Experimental Psychology, University of Oxford
pascale.engel@psy.ox.ac.uk

1. Background

Working memory (WM) – the ability to store and manipulate information in the course of ongoing cognitive activities - has been suggested to play a key role in supporting learning in many different domains. **This study** presents the findings of a 4-wave, latent variable longitudinal study, exploring variations and the **development** of two working memory components - **verbal short-term storage (STM)** and the **central executive** - and their contributions to **native and foreign language learning** in a population of multilingual children.

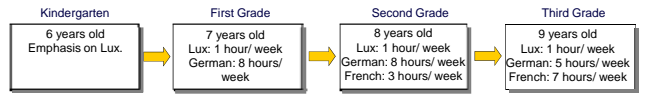
2. Method

Summary

Central executive, verbal short-term storage, and native and foreign language acquisition were investigated **longitudinally** in a population of children growing up in **Luxembourg (EU)** - a country in which **Luxembourgish** is mainly used in social interactions, and **German and French** are instructed in schools.

Participants

103 Luxembourgish speakers with both parents speaking Luxembourgish. Children were assessed in **kindergarten, 1st, 2nd, and 3rd grade** of Luxembourgish schools.



'Secondary bilinguals' - languages are learnt and socialised in the school situation

Language genealogy



Tasks

		K	1 st	2 nd	3 rd		K	1 st	2 nd	3 rd	
Central executive	Counting recall	X	X	X	--	Vocabulary	Expressive Lux	X	X	X	--
	Backw. digit recall	X	X	X	--		Expressive German	X	X	X	--
							Expressive French	X	X	X	X
Short-term storage	Digit recall	X	X	X	--	Comprehension	Receptive French	--	--	X	X
	Nonword repetition	X	X	X	--		Listening Lux	X	X	X	--
							Listening German	X	X	X	--
						Listening French	--	--	X	X	
						Reading German*	--	--	X	--	

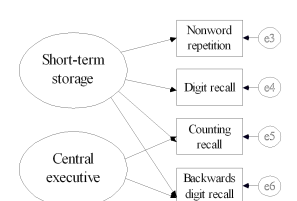
Analyses

Confirmatory Factor Analyses (CFA) to explore the underlying **task structure** - WM in kindergarten, 1st, and 2nd grade and language in 2nd grade.

Structural Regression (SR) models to explore the **contribution** of WM in kindergarten to language learning two (2nd grade) and three years (3rd grade) later.

3. Latent factor structure

WM: two-factor CFA model



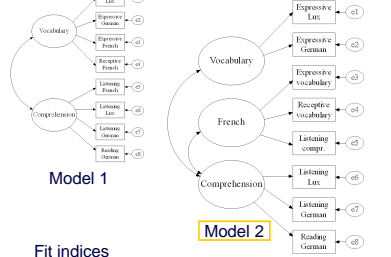
Kindergarten measures
Fit indices $\chi^2(2) = 4.1; p = .13$

Study wave	χ^2	df	p
Kindergarten	4.10	2	.13
First grade	3.67	2	.16
Second grade	.16	2	.92

Working memory
WM system with **separate but related** elements – corresponding to **verbal short-term storage** and a **central executive** – provided a good fit to the data across the years. Individual differences in young children's WM abilities were highly **stable**.

Language
In second grade **French** vocabulary and comprehension measures - in contrast to German - did not relate to the native vocabulary and comprehension measures but instead defined a **separate French language construct (Model 2)**.

2nd grade language CFA models

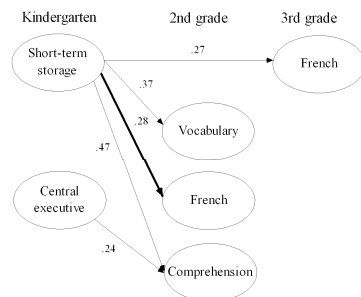


Fit indices

Model	χ^2	df	p
Model 1: 2 factors	152.32	19	.00
Model 2: 3 factors	23.34	17	.14

4. Linking WM to language - Latent factors

SR models with short-term storage and the central executive in kindergarten predicting language 2 and 3 years later. In boldface: significant path coefficients after controlling for the autoregressive effect.



Verbal STM linked to all three language domains assessed. **Central executive** specific contributions to language **comprehension**.

5. Linking WM to vocabulary - Observed

Correlations between the WM measures in kindergarten and native and foreign vocabulary in 2nd and 3rd grade using Pearson's correlation coefficient. Significant values are marked in boldface, $p < .05$

Outcome	Kindergarten predictors			
	Nonword repetition	Digit span	Counting recall	Backward digit recall
Native				
Gr2: Expressive vocabulary	.47	.29	.17	.10
German				
Gr2: Expressive vocabulary	.39	.21	.14	.15
French				
Gr2: Expressive vocabulary	.17	.07	.05	.07
Gr2: Receptive vocabulary	.23	.18	.04	.12
Gr3: Expressive vocabulary	.21	.14	.12	.08
Gr3: Receptive vocabulary	.21	.11	-.04	.17

Nonword repetition: single best predictor of French foreign language learning up to 3 years later.

6. Conclusion

The findings reinforce previous evidence indicating that **verbal STM** is one of the main contributors to **language** development by **supporting** the formation of **stable phonological representations** of new words in long-term memory. Importantly, the study showed that the **early acquisition of an unfamiliar foreign language** might draw on **different underlying mechanisms** than new word learning in a familiar second language. Whereas **German** might have been learned via a **process of bootstrapping** onto the secure knowledge base already established for the native language, **French** might not benefit in the same way from existing lexical knowledge as the **phonological structure of French** words is very **different** from words in **Luxembourgish**. French foreign language learning might therefore rely more heavily on **basic cognitive processes** such as **verbal STM**. The data supports the view that **verbal STM** is **causally** related to new word learning in **French**. Interestingly, **French vocabulary** was significantly **predicted** by only one of the verbal STM measures - **nonwords repetition** - suggesting that nonword repetition taps some specific skill that is not directly involved in conventional STM task. This finding has important **practical implications** as it highlights the potential utility of **nonword repetition** as a **screening tool** for detection children at **risk** for future **foreign language learning difficulties**.