A new view on complex span tasks.

Using eye tracking to reveal how eye movements are supported by activated long-term memory.

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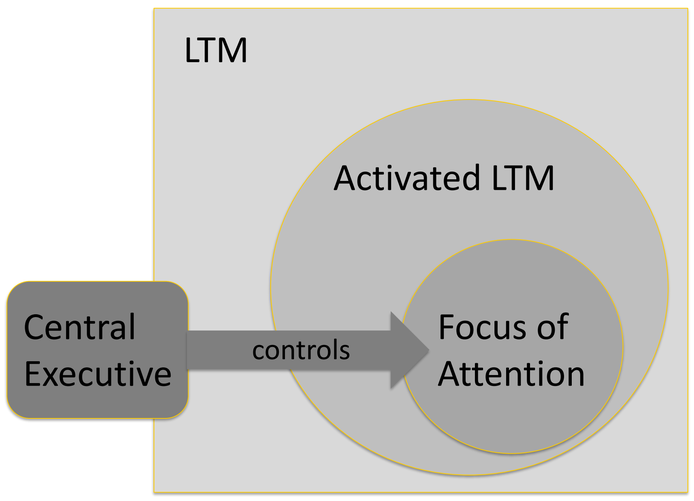
Theory

Embedded-Processes Model (Cowan, 1999)



Chunking: Experts in a domain can use information in LTM to group the input and thereby, increase their memory capacity (Cowan, 2001).

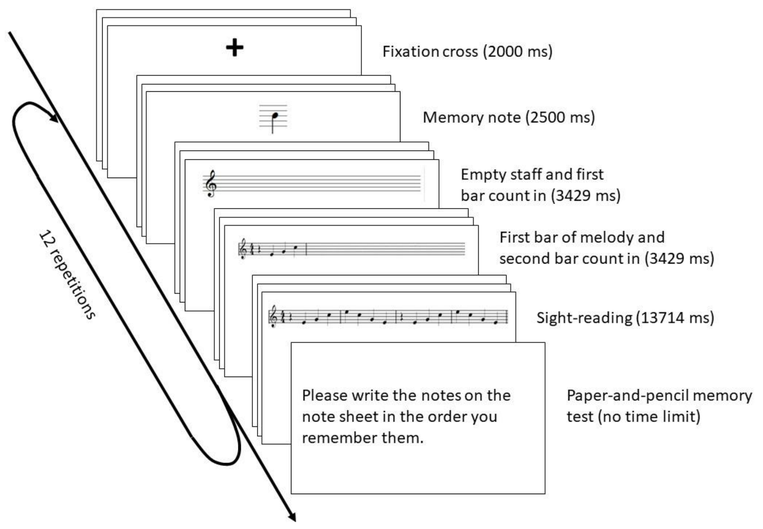
Expertise effects on eye movements: Eye movements during reading of musical notation change with expertise (Waters, Underwood & Findlay, 1997). Therefore, we can assume that the central executive controls eye movements and - while doing so - is supported by activated LTM.

→ How does an increased activation of task-irrelevant information influence eye movements?

Method

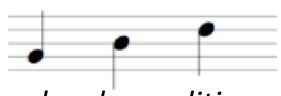
Task: complex span task for musicians:

- Memory task: remember the pitch of a single note
  → *recall accuracy*
- Processing task: perform a short, unknown melody on a piano
  → *accuracy of musical performance*
  → *number of fixations*

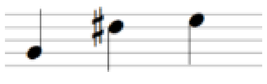


Analyses: Linear mixed effects regression with the predictors *chords*, *serial position* (position within the 12 repetitions of one trial), *trial number* (position within the 4 trials of the experiment) and by-participant random intercepts and random slopes.

Design: one-factorial within-participants design with the factor *chords.* In the *chords* condition, successive memory notes form major chords, in the *no-chords* condition they form a nonsensical sequence



chords condition



No-chords condition

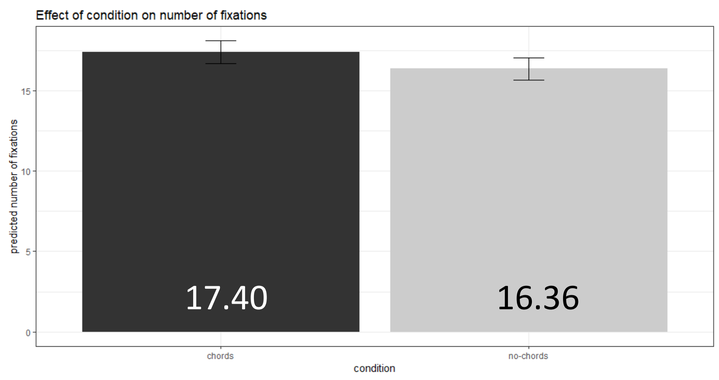
Sample: *n* = 75 music students from the *Mannheim University of Music and Performing Arts*

Results

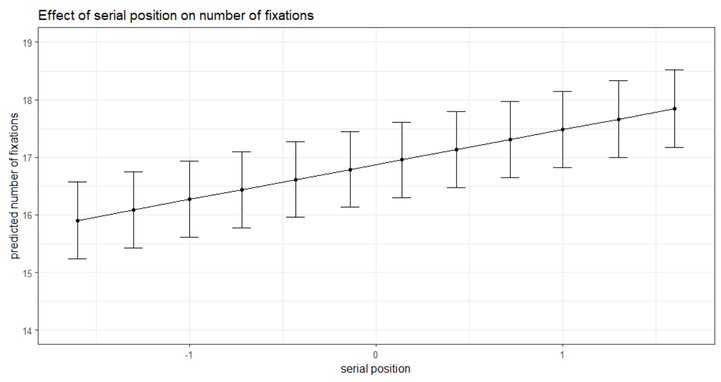
Recall accuracy:
Large difference between conditions
$M(SD)_{chords}$ = 0.86 (0.34)
$M(SD)_{noChords}$ = 0.61 (0.49)

Accuracy of musical performance:
Nearly perfect performance
$M(SD)_{pitchAcc}$ = 0.95 (0.15)
$M(SD)_{rhythmAcc}$ = 0.91 (0.16)

Number of fixations:
More fixations in the chords condition



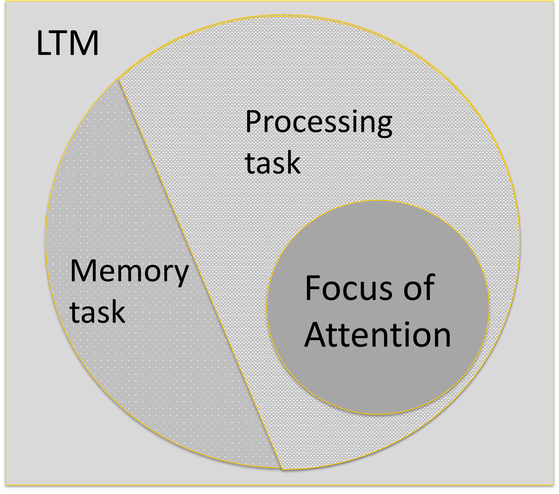
….and with increased serial position.



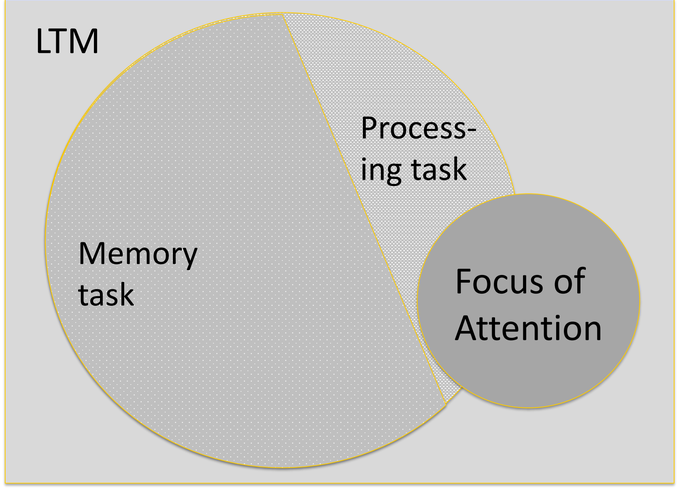
Discussion

Explanation:

No chunking/
few notes stored in memory
↓
Increased activation of information that is relevant for the musical performance
↓
Reading with fewer fixations



Chunking/
many notes stored in memory
↓
Decreased activation of information that is relevant for the musical performance
↓
Reading with more fixations



References:
Cowan, N. (1999). An Embedded-Processes Model of working memory. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62–101). New York, NY, US: Cambridge University Press.
Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences*, *24*, 87–185.
Waters, A. J., Underwood, G., & Findlay, J. M. (1997). Studying expertise in music reading: Use of a pattern-matching paradigm. *Perception & Psychophysics*, *59*(4), 477–488. https://doi.org/10.3758/BF03211857