Measuring verbal working memory capacity: A reading span task for lab and web use

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INTRODUCTION

BACKGROUND

- working memory as a concept is not defined clearly enough (Cowan, 2016)
- here: ability to maintain activated information in the face of distraction
- ideal assessment: complex span tasks which contain both a processing and a storage component (e.g., Conway et al., 2005)
- BUT: no standardised open-source versions, and the tasks that are used are not easily comparable

CURRENT STUDY

- browser-based reading span task ready to use without any additional experimental software
  - reading span task vs. control tasks (within-participant)
  - tested as a laboratory vs. as a web-based version

DESIGN

PARTICIPANTS

- 200 native German speakers aged between 18 and 35 (158 female)
- 72 in the lab version
- 128 in the web version

READING SPAN TASK

Processing: judging the semantic correctness of a sentence

- 30 semantically correct and 30 semantically incorrect sentences
- presented for a maximum of 10 seconds
- left arrow key = correct; right arrow key = incorrect

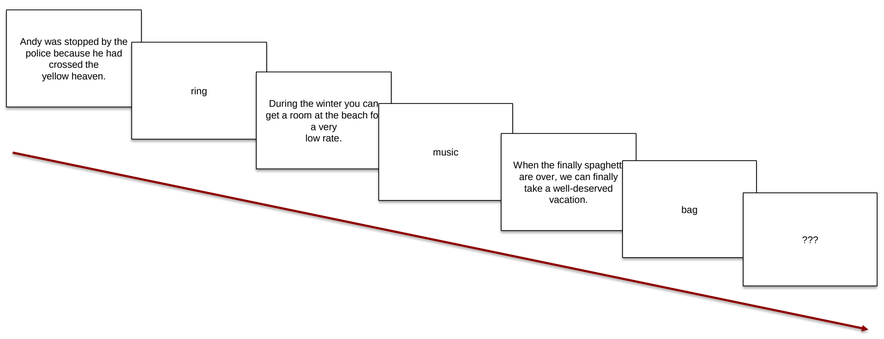
Storage: memorising words

- 30 imaginable and 30 unimaginable nouns
- presented for 1200ms

Order-independent recall

- lab: overt recall, responses coded by the experimenter
- web: written recall
- set size: 2 to 6, each measured three times (15 blocks)

Procedure



CONTROL TASKS

Operation span task

- judging correctness of mathematical equations (e.g., (8 x 4) – 2 = 32)
- memorising digits

Mixed span task

- judging semantic correctness of sentences
- memorising consonants

DETAILS

- identical timing parameters for all tasks
- control tasks were administered to the lab sample, order counterbalanced across participants
- instructions: read stimuli of the reading and mixed span task out loud, but not of the operation span task
- tasks were programmed using jsPsych (de Leeuw, 2015)
- responses were recorded using XAMPP (http://www.apachefriends.org) in the lab version and stored on the university's server in the web version

RESULTS

READING SPAN TASK VS. CONTROL TASKS

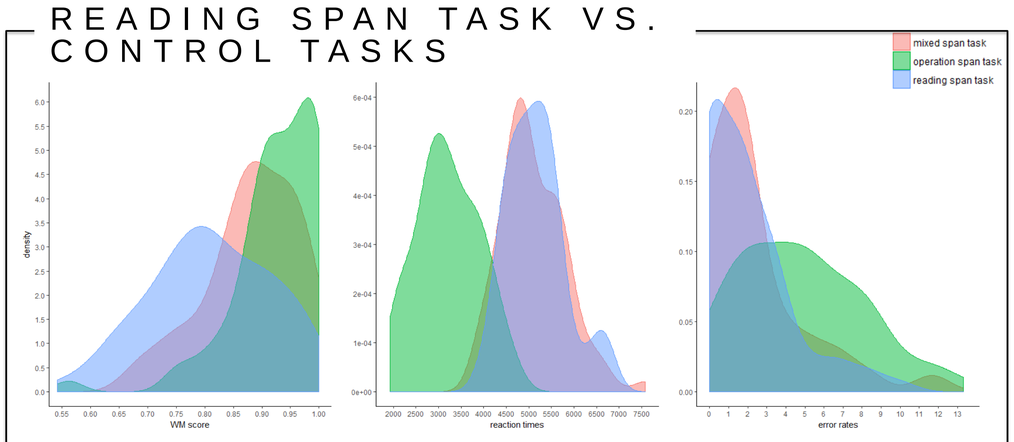
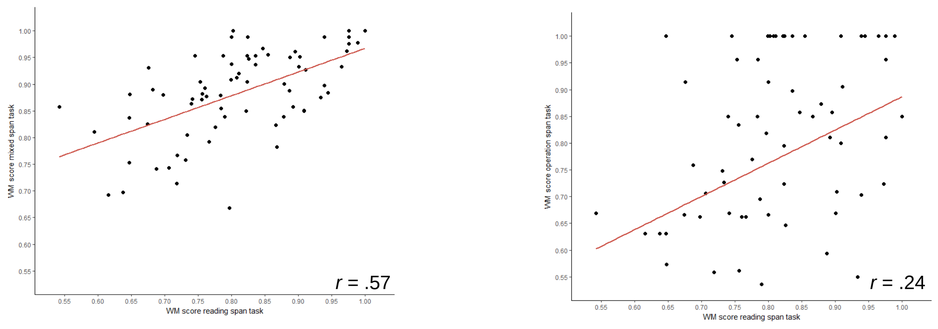


Table 1. BF_{10} factors for Bayesian paired samples t tests, across complex span tasks.

	WM scores	Reaction times	Error rates
reading span task vs. mixed span task	4.7×10^{6}	0.3	0.2
reading span task vs. operation span task	4.7×10^{9}	3.9×10^{29}	868322.0



LAB VS. WEB

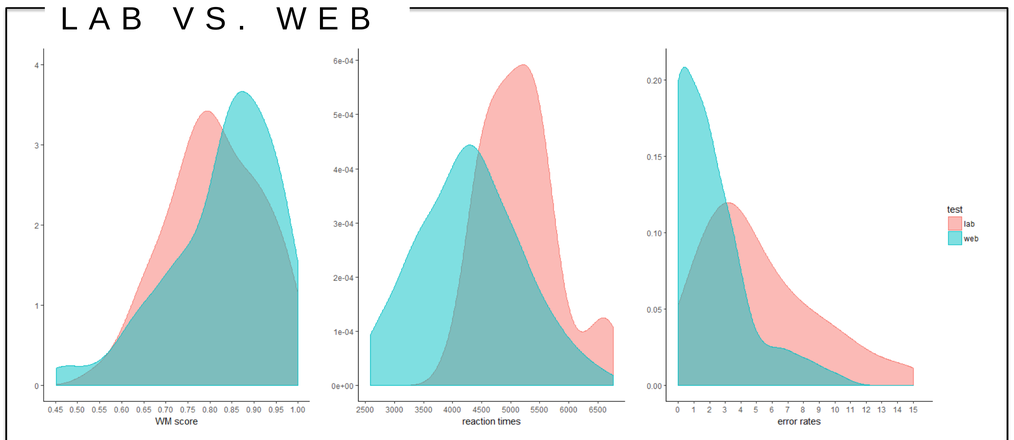


Table 2. BF_{10} factors for Bayesian paired samples t tests including grouping variable test situation (lab vs. web).

	WM scores	Reaction times	Error rates
reading span task lab vs. web	0.3	4.6×10^{8}	1.2×107

CONCLUSIONS

Reading span task as a laboratory test

- normally distributed WM scores
- reliable performance on processing task
- correlated with mixed span (same processing but different storage demands), but not with operation span task (different processing and storage demands)

Reading span task as a web test

- normally distributed WM scores: comparable to lab results
- worse performance on processing task: faster, but more mistakes compared to lab results

All materials are available for download at
https://github.com/janakl4us/workingmemory

REFERENCES

Conway, A.R.A., Kane, M.J., Bunting, M.F., Hambrick, D.Z., Wilhelm, O., & Engle, R.W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin and Review, 12*, 769-786. http://dx.doi.org/10.3758/BF03196772

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