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

Jana Klaus

Donders Institute, Radboud University, Nijmegen, The Netherlands

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. 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

LAB VS. WEB

Table 1. BF₁₀₂₀ factors for Bayesian paired samples tests across complex span tasks.

<table>
<thead>
<tr>
<th></th>
<th>WM scores</th>
<th>Reaction times</th>
<th>Error rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>reading span task vs. mixed span task</td>
<td>4.7 × 10⁵</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>reading span task vs. operation span task</td>
<td>4.7 × 10⁴</td>
<td>3.9 × 10⁵⁹</td>
<td>868322.0</td>
</tr>
</tbody>
</table>

Table 2. BF₁₀₂₀ factors for Bayesian paired samples tests including grouping variable (situation) lab vs. web.

<table>
<thead>
<tr>
<th></th>
<th>WM scores</th>
<th>Reaction times</th>
<th>Error rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>reading span task lab vs. web</td>
<td>0.3</td>
<td>4.6 × 10⁴</td>
<td>1.2 × 10⁷</td>
</tr>
</tbody>
</table>

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