Are working memory resources required for linguistic prediction during reading?

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People regularly predict upcoming linguistic information during comprehension, but it is unclear to what extent different mechanisms are involved in prediction [1,2]. According to theories of prediction [1,3], linguistic prediction involves both automatic and non-automatic mechanisms, and both have been found to underlie prediction [4,5]. To better understand the relative contribution of these mechanisms, the current study tested whether working memory (WM) resources are required for prediction by testing effects of a secondary WM task on reading measures that are sensitive to predictability (gaze duration and skipping rate in Experiment 1, and self-paced reading time in Experiment 2).

Native English speakers ($N = 80$ in Experiment 1, $N = 125$ in Experiment 2) read 44 high-cloze and 44 low-cloze English sentences (Table 1) and answered comprehension questions. In the load condition, they additionally performed a spatial WM task based on the Corsi block tapping task [6]. They memorised five blocks that changed colour before reading the sentence and recalled them after the comprehension question (Figure 1). In the no-load condition, there was no additional task. If WM resources required for this WM task are also required for linguistic prediction, the predictability effect should be reduced in the load condition compared to the no-load condition [7]. (Generalised) linear mixed-effects models were used for the analysis.

Experiment 1 found shorter gaze durations in the high-cloze vs. low-cloze condition, $t = -8.0$, and in the load vs. no-load condition, $t = -3.0$, but these factors did not interact, $t = 0.6$ (Table 2). Skipping rates were higher in the high-cloze vs. low-cloze condition, $p = .008$, and in the load vs. no-load condition, $p < .001$, but these factors did not interact, $p = .8$. Experiment 2 replicated both main effects, ts < -3.0, but additionally found an interaction of predictability and load, $t = 3.4$, indicating shorter self-paced reading times in the high-cloze vs. low-cloze condition in the no-load condition, $p < .001$, but no effect of predictability in the load condition, $p = .8$.

The predictability effects replicate previous findings and suggest that predictability facilitated reading [8]. Considering the larger main effect of WM load in the self-paced reading time vs. the gaze duration, the interaction in the self-paced reading but not eye-tracking measures may be because self-paced reading is more cognitively demanding than natural reading, making its measure more subject to the WM load. Taken together, WM resources may be required for prediction, but their role may be minor during natural reading (in line with [9]). The availability of WM resources may affect prediction only when the reading task is cognitively demanding.

Table 1. An example item. The context was manipulated to make the mid-sentence target word (*ink*) predictable (high-cloze, *M* cloze = .95) or unpredictable (low-cloze, *M* cloze = 0).

Predictability	**Sentence**
High-cloze	His green pen had just run out of ink in the office.
Low-cloze	The supply cabinet had just run out of ink in the office.

Figure 1. An illustration of load and no-load task. Sentences were presented as one line in Experiment 1 (eye-tracking) and word by word in Experiment 2 (self-paced reading).

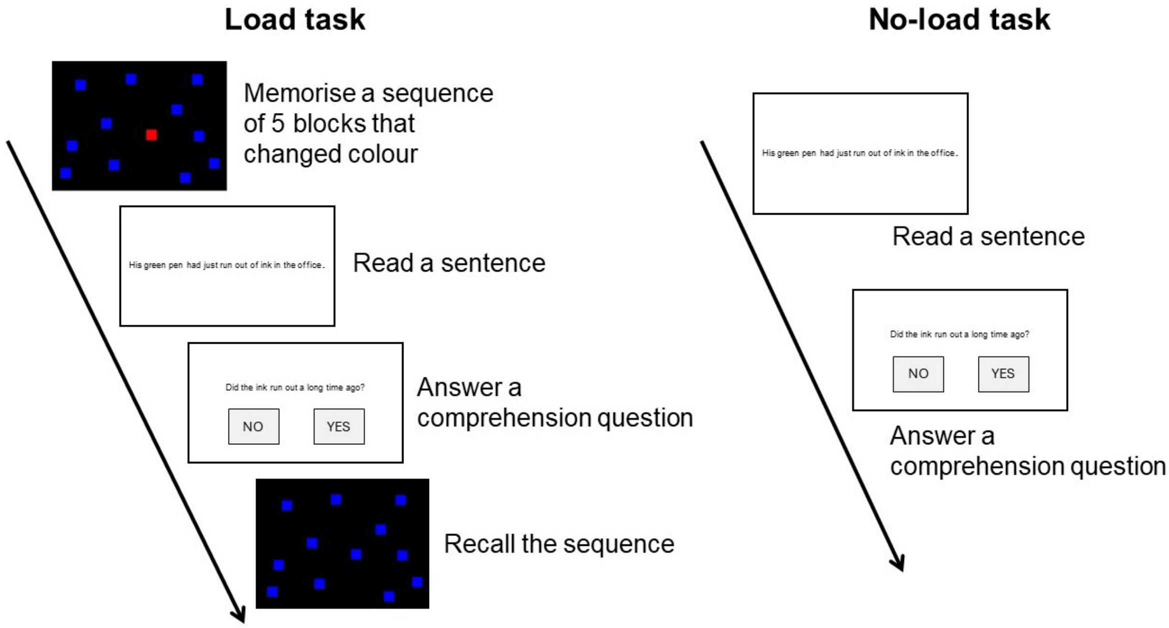

Table 2. Mean gaze duration and skipping rate for the target word (Experiment 1) and mean reading time for the target word (Experiment 2) with 95% CIs.

	Load		**No-load**	
Dependent measure	**High-cloze**	**Low-cloze**	**High-cloze**	**Low-cloze**
gaze duration (ms)	223 [218-229]	240 [235-247]	230 [224-236]	252 [247-259]
skipping rate (%)	45 [42-47]	42 [39-44]	35 [32-37]	32 [30-34]
self-paced reading time (ms)	230 [227-233]	231 [227-234]	326 [322-331]	339 [333-344]

References

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