

Robust effects of predictability during sentence reading under a verbal working memory load across different languages and bilingual groups

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Predictability of a word is a reliable predictor of reading times [1], but it is unclear whether predictability effects largely reflect a resource-intensive predictive mechanism requiring working memory (WM) resources or resource-free pre-activation based on lexical associations [2]. While both mechanisms may be at play, the extent to which readers rely on a resource-intensive mechanism may be contingent on their WM resources and may be reduced in a non-dominant language [3]. To shed light on the underlying mechanisms, this study examined whether predictability effects are modulated by the availability of verbal WM resources in three groups of bilinguals.

In Exp.1, 81 English-dominant bilinguals and 53 Chinese-English late bilinguals (final $N = 80$) read 88 English high-cloze and low-cloze sentences (Table 1). In Exp.2, 64 English-Chinese early bilinguals (final $N = 120$) read 56 Chinese high-cloze and low-cloze sentences (Table 2). Before reading each sentence, they memorised five (high-load task) or two (low-load task) words for later recall (Figures 1 & 3). To the extent that a resource-intensive mechanism drives predictability effects, predictability effects should be reduced in the high-load vs. low-load task because fewer WM resources should limit prediction.

(Generalised) linear mixed-effects models tested main effects and an interaction of predictability and task in each group. All groups showed shorter gaze durations and higher skipping rates for predictable than unpredictable words, as well as higher skipping rates in the high-load than the low-load task (Figure 2). Crucially, the predictability effects were not modulated by task in any of the groups. An exploratory Bayes factor analysis showed strong evidence favouring the no-interaction model (only the main effects) over the main effects plus interaction model for gaze data (BF range = 0.0005-0.0014) and skipping data (BF range = 0.0054-0.036) in all groups.

The evidence that the higher verbal WM load did not reduce predictability effects suggests that predictability effects during natural reading are largely driven by a resource-free mechanism that does not consume WM resources, regardless of whether comprehension takes place in a dominant language or an early-acquired or late-acquired non-dominant language. The higher load increased skipping rates, which may reflect participants' strategy of skipping more words under a high task demand. However, this did not affect predictability effects, suggesting that predictability-driven facilitation is robust even under a demanding dual-task set-up and in a non-dominant language.

References

[1] Staub (2015). *Lang. Linguist. Compass*. [2] Pickering & Gambi (2018). *Psychol Bull*. [3] Ito & Pickering (2021). In *Prediction in Second Language Processing and Learning*.

Table 1: An example item in Exp.1. The target word (*ink*) was predictable based on the context in the high-cloze condition and unpredictable in the low-cloze condition.

Predictability	Sentence	Mean cloze
High-cloze	His green pen had just run out of ink in the office.	.96
Low-cloze	The supply cabinet had just run out of ink in the office.	0

Figure 1: An illustration of the task in Exp.1.

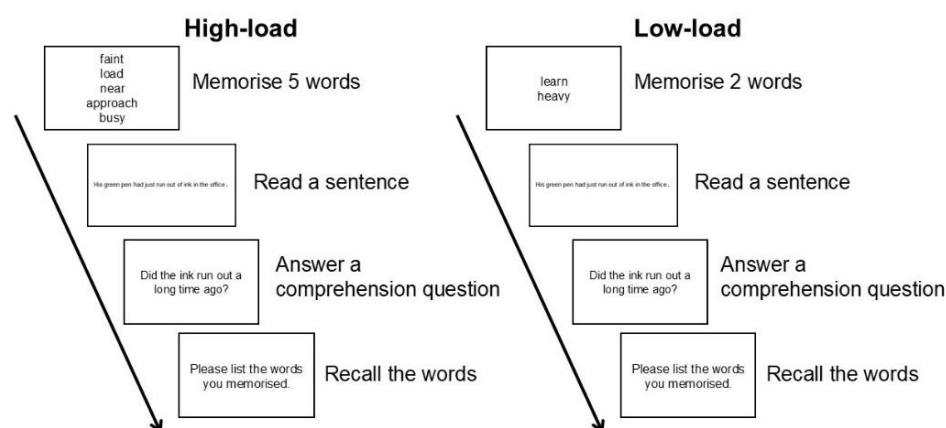
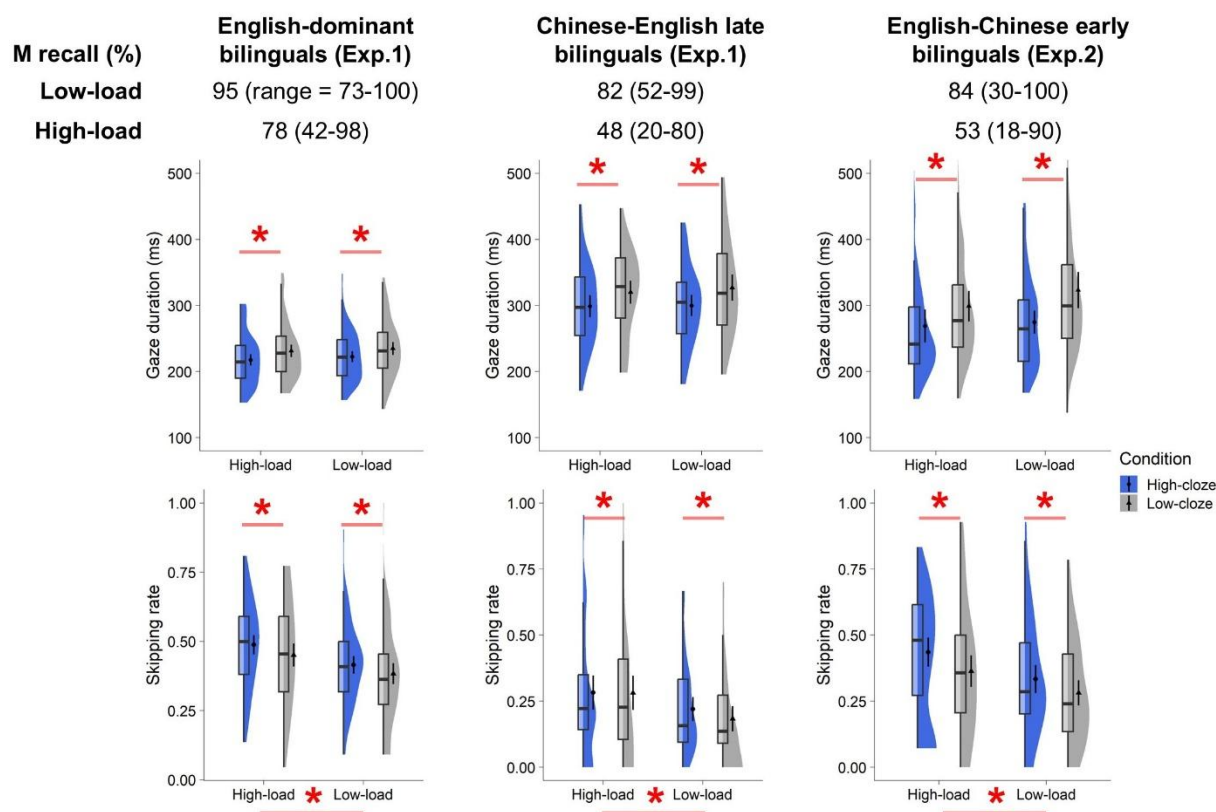


Figure 2: Mean recall accuracy in each task and group (upper panel). Gaze duration and skipping rate averaged over participants with means, 95% confidence intervals, boxplots and split violin plots (lower panel). The asterisks show significant main effects of predictability (top of each plot) and task (bottom).



Chinese materials (Exp.2)

Table 2: An example item in Exp.2. As in Exp. 1, the context was manipulated to make the mid-sentence target word (苹果 'apple'; underlined in the example) predictable or unpredictable.

Predictability	Sentence	Mean cloze
High-cloze	白雪公主吃下那个有毒的苹果后不久就睡着了。 Gloss translation: 白雪公主 Snow White /吃下 ate /那个 that /有毒的 poisonous /苹果 apple /后 after/不久 soon/就 then /睡着了 fell asleep. 'The Snow White fell asleep shortly after eating the poisonous apple.'	.91
Low-cloze	我一般每天早晨吃一个苹果来补充营养。 Gloss translation: 我 I/一般 usually/每天 every day/早晨 morning/吃 eat/一个 one/苹果 apple/来 to/补充 supplement/营养 nutrition. 'I usually eat an apple every morning to supplement nutrition.'	.02

Figure 3: An illustration of the task in Exp.2.

