

Does Semantic or Phonological Working Memory Modulate Syntactic Prediction?

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We investigated the roles of phonological and semantic working memory in syntactic prediction. Given that phonological working memory stores words verbatim^[1], while semantic working memory stores meanings^[2], they may support syntactic prediction differently. As processing speed and spatial working memory may also support prediction^[3, 4], we also tested whether syntactic prediction is modulated by these individual differences.

We tested syntactic prediction using “either...or” sentences^[5], and measured capacities in **phonological, semantic, spatial working memory**, and **processing speed**. Native English speakers ($N = 86$) read 22 target sentences in predictable (“either” present) and unpredictable conditions (“either” absent) (**Table 1**). In the preregistered analysis, we computed reading times in the **critical** (e.g., “or the President”) and **spillover** regions (e.g., “issued an order”). In the exploratory analysis, we computed reading times in the **object NP** (i.e., “the bill”), as well as the critical and spillover regions^[5]. In both analyses, (generalised) linear mixed-effects models tested the predictability effect and how it is modulated by the individual-difference predictors using log-transformed first fixation duration, first pass time, go past time, and binomially-coded regression in the three regions (**Model syntax**).

Replicating previous findings^[5], we found shorter first pass, $\beta = -.03$, $SE = .01$, $t = -3$, go past times, $\beta = -.05$, $SE = .02$, $t = -2.61$, and lower percent regression, $\beta = -.019$, $SE = 0.08$, $z = -2.32$, $p = .02$ in the **critical region**, as well as shorter go past time, $\beta = -.03$, $SE = .01$, $t = -2.33$, and lower percent regression, $\beta = -.023$, $SE = .06$, $z = -3.79$, $p = .0002$ in the **spillover region** in the predictable than unpredictable conditions (**Figs. 1–3**), demonstrating syntactic prediction. We found main effects of processing speed on go past time, $\beta = -.07$, $SE = .03$, $t = -2.1$ in the **object NP region (Fig. 4A)**, on first pass, $\beta = -.08$, $SE = .03$, $t = -2.99$, and go past times, $\beta = -.08$, $SE = .03$, $t = -2.20$ in the **critical region (Figs. 4B–C)**, as well as on go past time, $\beta = -.19$, $SE = .07$, $t = -2.84$ in the **spillover region (Fig. 4D)**. There were no significant interactions between predictability and working memory. Further, we found low reliability of the predictability effects (split-half $rs = -.4$ to $.09$), so future research should adopt more reliable measures to examine the relationship between syntactic prediction and working memory. The processing speed effects suggest a positive relationship between domain-general processing speed and reading speed.

References

[1] Baddeley. (2020). *Memory*. [2] Martin et al. (2025). *Cogn. Affect. Behav. Neurosci.* [3] Hintz et al. (2024). *Sci. Rep.* [4] Allison et al. (2025). *Lang. Cogn. Neurosci.* [5] Staub & Clifton (2006). *J. Exp. Psychol. Learn. Mem. Cogn.*

Figures, tables, and model syntax

Table 1. Example stimuli

Conditions	Examples
Predictable	Either Congress passed the bill or the President issued an order.
Unpredictable	Congress passed the bill or the President issued an order.

Figure 1. First pass and go past times for the predictable and unpredictable conditions in the critical region.

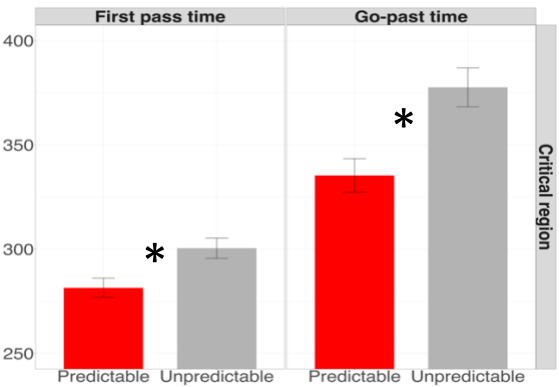
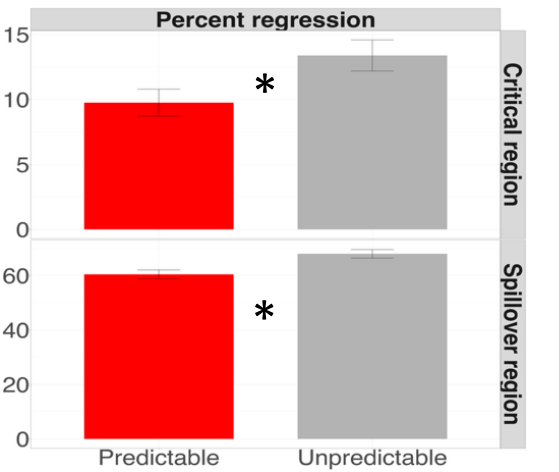


Figure 3. Percent regressions for the predictable and unpredictable conditions in the critical and spillover regions.



Model Syntax

Log-transformed reading times/percent regression ~ Predictability * (phonological working memory + semantic working memory + spatial working memory + processing speed) + (1 + Predictability | Subject) + (1 + Predictability | Item)

Figure 2. Go past time for the predictable and unpredictable conditions in the spillover region.

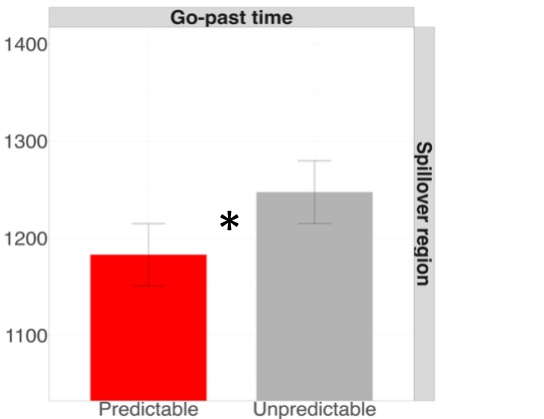


Figure 4. The effects of processing speed on go-past time in the object NP region (A), on first pass time in the critical region (B), on go-past time in the critical region (C), and on go-past time in the spillover region (D).

