Nuances of knowing: ERPs reveal dual influences of domain knowledge on semantic processing and knowledge confirmation during reading

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Despite an extensive literature showing that degree of knowledge about something may have consequences for how individuals perceive, categorize, and/or remember things related to it[1], the impact of knowledge variation on real-time language processing has received limited study. More knowledgeable people seem to access richer knowledge structures during reading, even when processing words completing facts that they judge to be unknown.[2] Here, we used an objective knowledge measure (from a sentence-completion task) combined with ERPs to monitor the influence of domain knowledge on word processing during reading as individuals read facts that we could objectively label as known/unknown to them, including partial/incomplete knowledge. We aimed to elucidate the extent to which individuals engage different processing mechanisms and/or pursue various goals[3] during sentence processing, differing, for example, in their reliance on top-down and/or predictive strategies, as a function of their knowledge.[4]

Experiment. We used ERPs to examine the impact of knowledge of the fictional world of Harry Potter (HP) on reading sentences about it. Each participant (N=18; planned sample=48) completed 172 sentences about HP (examples below) with what they considered the best completions. We then recorded ERPs to sentence-final words as the participants re-read the same 172 sentences (word-by-word), now ending with the actual best completion. After each sentence, participants indicated whether the final word matched their own (previous) completion. If it did not, they indicated whether the actual best completion was nonetheless familiar/known to them. Overall HP knowledge was estimated via a trivia quiz. We could thus examine how individuals with different degrees of HP knowledge processed "fictional facts" they knew, didn't know, or hadn't known but considered familiar once encountered.

Preliminary results. (1) As expected, N400 amplitude (measured between ~250-500 ms post-word onset and reflecting ease of retrieval from semantic memory) was graded according to knowledge, being smallest for known trials, intermediate for unknown-but-familiar trials, and largest for unknown-and-unfamiliar trials, each type comprising ~1/3 of all trials (Fig.1). (2) In line with previous results[2], domain knowledge was correlated with N400 amplitudes for unknown but not known completions; within unknown trials, this correspondence was stronger for unfamiliar than for familiar trials (Fig. 2), suggesting knowledge may benefit processing via access to partial information for even the most difficult-to-retrieve items. (3) We expected task-related variation in a late positive complex (LPC; brain potentials presumed to index mental model updating during reading[5] and to reflect processes similar to those of the domain-general P3b, including stimulus evaluation and context updating[6]) as a function of participants' judgments of their own knowledge. LPC amplitude was largest for unknown-but-familiar trials (Fig. 1). (4) Perhaps surprisingly, we found that *less* knowledgeable individuals showed *larger* LPCs for their known (compared to unknown) trials (Fig. 2). We speculate that, during processing of sentence-final critical words, these individuals may have been more actively seeking (and integrating) confirmation of their own knowledge.

Conclusions. Our preliminary results extend findings[2] suggesting that domain "experts" (vs. novices) have rapid access to richer semantics during word reading (inferred from N400 amplitudes). For the first time, we found that domain knowledge seemed to influence evaluative processing (inferred from LPCs) for knowledge-confirming completions. We speculate that *known* endings may have come to mind at just this point for less-knowledgeable individuals (rendering them timely and informative), but may have received focus/processing earlier in the sentence for experts due to their extensive knowledge structures. These findings point to different processing time-courses—including the recruitment of domain-general cognitive processes—as a function of domain knowledge (of sentential content) during reading.
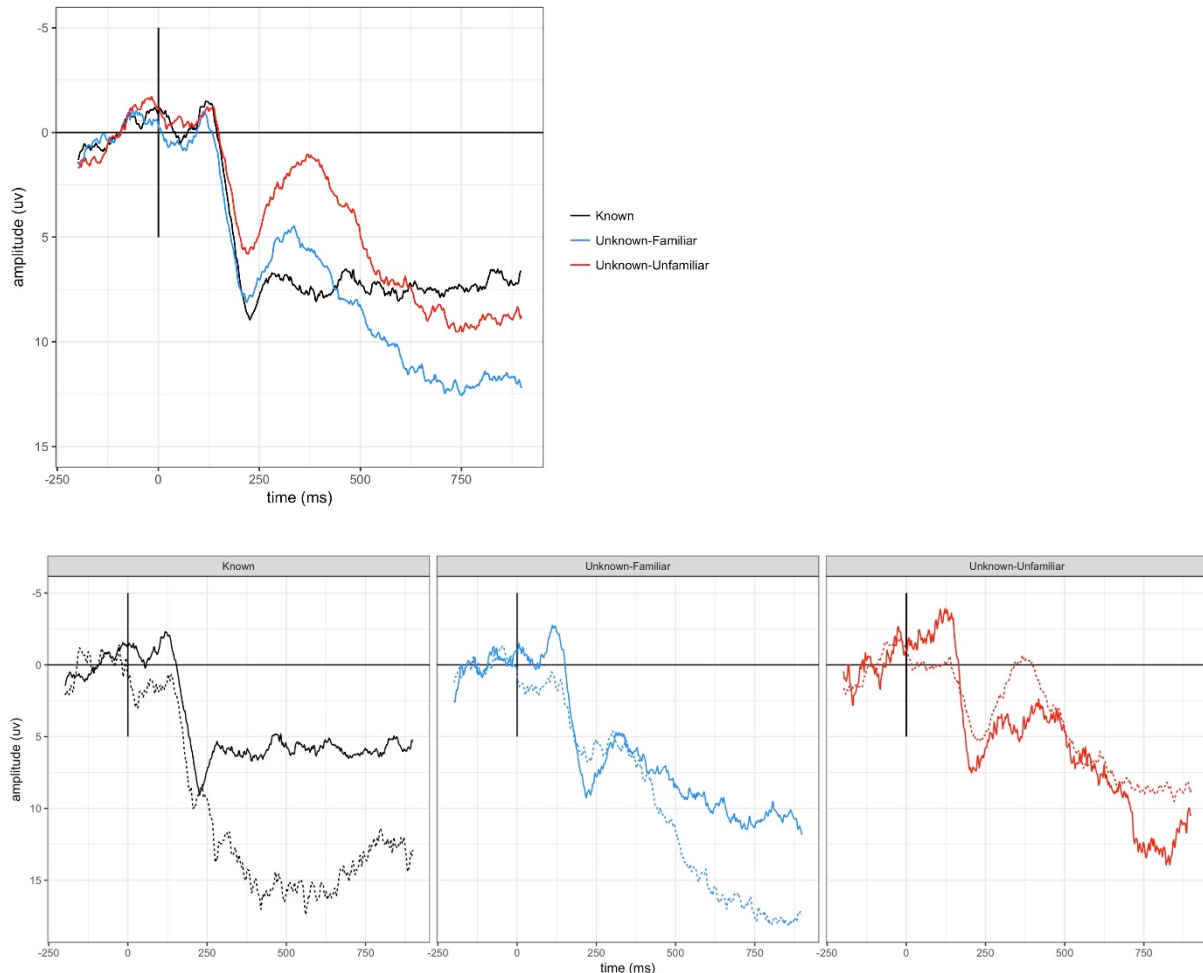
Example Materials (critical words are in parentheses)
There is one main sport in the wizarding community. It is known as (Quidditch).
Hermione owns a large, orange feline. Her pet is called (Crookshanks).
Hogwarts students shop at Madam Malkin's. This is where they buy their (robes).

Figures

References

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