**Harry Potter and the language-knowledge interface:**
**ERPs reveal retrieval of domain and specific knowledge during reading**

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Across cognitive systems, world knowledge allows individuals to organize raw sensation into meaningful experiences. Language processing is no exception—words cue world knowledge which can be rapidly brought to mind in real time. It stands to reason that how much and how well individuals know things will impact what each individual brings to mind during real-time comprehension; yet to date, models of real-time language processing have not taken this variability into account. We addressed this issue by studying a linguistically rich, yet constrained, popular domain—the fictional world of Harry Potter (HP), by J.K. Rowling. In a series of three studies (Experiment 1 reported in [1]), we recorded event-related brain potentials (ERPs) while young adults who varied in their knowledge of HP read sentences about HP "facts" and/or sentences describing general topics (Table 1). As a measure of real-time knowledge retrieval, we focused on N400 amplitude, a brain potential with a centro-parietal maximum occurring ~250-500 ms post stimulus onset that is sensitive to factors impacting the ease of retrieval from semantic memory, with larger reductions in N400 (i.e., more positive-going N400 potentials) associated with greater ease of retrieval [2].

Across all three studies, we found that individuals' domain knowledge of HP (assessed via an offline multiple-choice trivia quiz; details in [1]) was moderately-to-strongly correlated with average N400 brain potentials to contextually supported (i.e., accurate) words completing sentences about HP, but not to unsupported (inaccurate) endings, nor to N400 effects (i.e., difference ERPs) of more vs. less supported endings to sentences describing general topics (Experiments 1 and 3). Single-trial regression analyses pitting domain knowledge against participants' reports of knowledge about each HP "fact" (i.e., whether or not they had known each fact ahead of reading it) revealed trial-level knowledge was a strong, but not the sole, predictor of N400 amplitudes to supported words (Experiment 2). Rather, even after accounting for trial-level knowledge reports, and especially when retrieval conditions were presumably more difficult (i.e., for trials reported as unknown by an individual or those generally less likely to be known across participants), N400 amplitudes were modulated by individuals' domain knowledge of HP. We hypothesized that degree of domain knowledge might modulate real-time semantic retrieval by virtue of the differential organization of that information in semantic memory—for example, functionally organized around events and categories, as has been proposed more generally in the literature on expert knowledge [3].

In Experiment 3, we therefore manipulated the relationship between the final (critical) words of HP sentences and their sentence contexts according to these organizational structures. Critical words (each of which appeared across conditions) were supported continuations, unsupported/unrelated continuations, or unsupported continuations that were related via an HP-specific category to the supported ending or to the event/episode being described by the sentence context. Individuals with greater HP domain knowledge showed reduced N400 amplitudes not only to supported words, but also to unsupported but contextually related words (for both types of relationships), compared to the unsupported unrelated words. That is, domain knowledge systematically influenced the quick availability of functionally (categorically, event-based) related knowledge during written sentence comprehension.

Our results provide the first empirical demonstration that real-time retrieval of knowledge during reading is determined by how much information is known and which facts are readily available to an individual comprehender. Domain knowledge seems to influence implicit retrieval of (perhaps) partial information (Experiment 2) and the availability of relevant/related information (Experiment 3)—the very information that is needed to make sense of words in real time. We hypothesize that variation in domain knowledge leads to systematic variation in hallmark organizational structures of semantic memory, including organization of categories and events, which in turn influence the degree to which relevant information can be (pre-)activated in order to make sense of words in real time.

**Table 1.** Sample sentence materials for each ERP experiment. Critical words are provided in brackets and color coded by ending type. For Experiment 3, samples of items with category-related (1-2) and event-related (3-4) endings are provided.

| **HP Sentences** | |
|---|---|
| Experiment 1<br>{**Supported / Unsupported**} | *Ron Weasley joins the Gryffindor Quidditch team in his fifth year. He plays in the position of { **Keeper** / **Elder** }.*<br>*The Hogwarts staff member who heads up the Inquisitorial Squad is detested by students. Her name is Professor { **Umbridge** / **Figg** }.*<br>*Harry has a patronus. It takes the form of a { **stag** / **lizard** }.*<br>*Harry's parents left him a large inheritance. It's located at the wizarding bank called { **Gringotts** / **Wizengamot** }.* |
| Experiment 2<br>{**Supported**} | *Ron Weasley joins the Gryffindor Quidditch team in his fifth year. He plays in the position of { **Keeper** }.*<br>*The Hogwarts staff member who heads up the Inquisitorial Squad is detested by students. Her name is Professor { **Umbridge** }.*<br>*Harry has a patronus. It takes the form of a { **stag** }.*<br>*Harry's parents left him a large inheritance. It's located at the wizarding bank called { **Gringotts** }.* |
| Experiment 3<br>{**Supported /**<br>**Unsupported-Related /**<br>**Unsupported-Unrelated**} | *Ron Weasley joins the Gryffindor Quidditch team in his fifth year. He plays in the position of { **Keeper** / **Seeker** / **Animagus** }.*<br>*The Hogwarts staff member who heads up the Inquisitorial Squad is detested by students. Her name is Professor { **Umbridge** / **Quirrell** / **Flobberworms** }.*<br>*Harry has a patronus. It takes the form of a { **stag** / **dementor** / **Sectumsempra** }.*<br>*Harry's parents left him a large inheritance. It's located at the wizarding bank called { **Gringotts** / **Galleons** / **Lockhart** }.* |
| | |
| **Control Sentences** | |
| Experiments 1 & 3 only<br>{**Supported / Unsupported**} | *We had been watching the blue jay for days. The bird laid her eggs in the { **nest** / **yard** }.*<br>*The couple had to be somewhere right after dinner. They left the dirty dishes in the { **sink** / **tub** }.*<br>*The waiter was very rude. We ended up not giving him a { **tip** / **gratuity** }.*<br>*It was time for Joan to feed her baby. She was just preparing some warm { **milk** / **cream** }.* |

**References.** [1] Troyer & Kutas (2018). Harry Potter and the Chamber of *What*?: the impact of what individuals know on word processing during reading. *Language, Cognition and Neuroscience*. [2] Kutas & Federmeier, K.D. (2000). Electrophysiology reveals semantic memory use in language comprehension. *TICS*, *4*(12), 463-470. [3] Ericsson et al. (Eds). (2006). *The Cambridge Handbook of Expertise and Expert Performance*. Cambridge, UK: Cambridge University Press.