Noun imageability and sensory-based decisions

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Word imageability is known to affect a number of measures related to word memory, learning and processing. Highly imageable words are acquired faster in childhood, remembered better in adults, or processed faster [1–3]. Imageability also affects the acquisition and processing of inflected forms [4]. However, some aspects of word imageability are not yet properly understood, for example, how does it relate to recourses in the cognitive system used for sensory processing? While there is some evidence that active imagination attenuates brain responses to sensory stimuli [5], it is not clear whether word imageability may modulate the strength of this effect. At the same time, there is evidence that the brain response is more left-lateralized for low-imageability words than high-imageability words, suggesting that words with high imageability recruit more bilateral resources in the brain[6]. As a first step toward a better understanding of the relation between internal imagery and the cognitive response to external sensory stimulation, we aim to investigate (1) whether word imageability is related to the word's ability to facilitate decisions about sensory properties of the word referent, and (2) whether the effect is modulated by the presence or absence of a concurrently presented visual stimulus.

To address these issues, we designed a study that uses a behavioral task. In each trial, we present participants with a written word (500 ms presentation duration) and ask them to form a mental image of the word's referent. Words (N=120) vary with respect to imageability ratings, which were obtained in separate experiments. The time participants are given to imagine the word referent was manipulated (1000, 1500, or 2000 ms). Subsequently participants are asked to respond to one of two questions that were randomly assigned to words: "Is it smaller than a car?", or "Is it heavy?" Participants cannot predict which question they would have to answer. Two versions of the task are varied between subjects, one with a blank screen during the "imagining phase", the other showing a flickering chessboard during this period (see Fig. 1 for a trial scheme). All three factors (imagining phase duration, question, presence/absence of flicker) were within item manipulations. Experimental lists ensured counterbalancing. Participants were 80 Czech and 80 German students, with the word lists for Czech and German consisting of rough translation equivalents of the same words.

We used linear mixed models to examine how response time was related to language (Czech vs. German), question (heavy vs. smaller), imageability, SOA (1, 1.5, 2 s) and the chessboard during the imagining phase (present vs. absent), including their interactions. The model also included word length and response agreement as covariates without interactions. The results revealed significant main effects of all variables except for the chessboard, and a number of significant interactions, including a four-way interaction between imageability, SOA, language and presence of chessboard, and a three-way interaction between imageability, language, and question. Overall, the effects of imageability were stronger in German, especially in the "smaller than" question (see Fig. 2); imageability effects were most pronounced for the shortest SOA and decreased more strongly in the absence of the chessboard (see Fig. 3). The results confirm that word imageability affects sensory-based semantic decisions. The stronger effects with the size question provide an intuitive proof of the manipulation's validity. The presence of the distractor stimulus (chessboard) appears to slow down the decay of the imageability effect with time. Differences between languages are likely due to a slightly unbalanced word selection, as words were originally selected based on German imageability ratings. Overall, the results validate word imageability as a phenomenon related to sensory processing, especially to the visual domain.

Figure 1: Scheme of a trial.

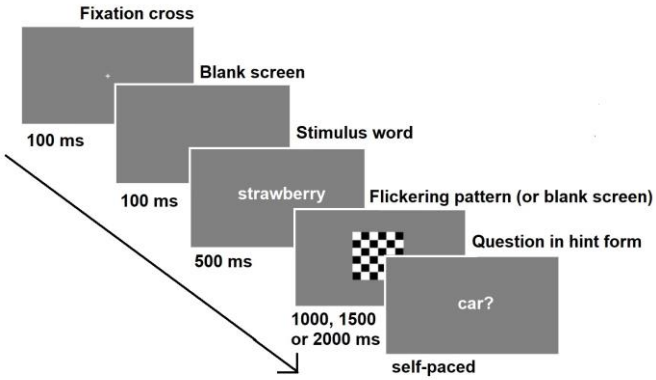


Figure 2: Interaction between imageability, language and question.

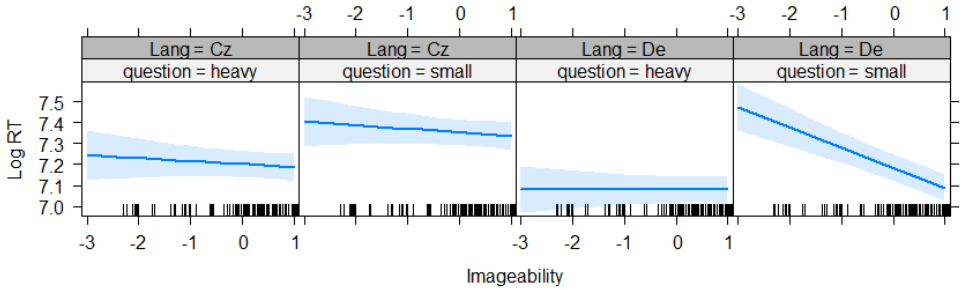
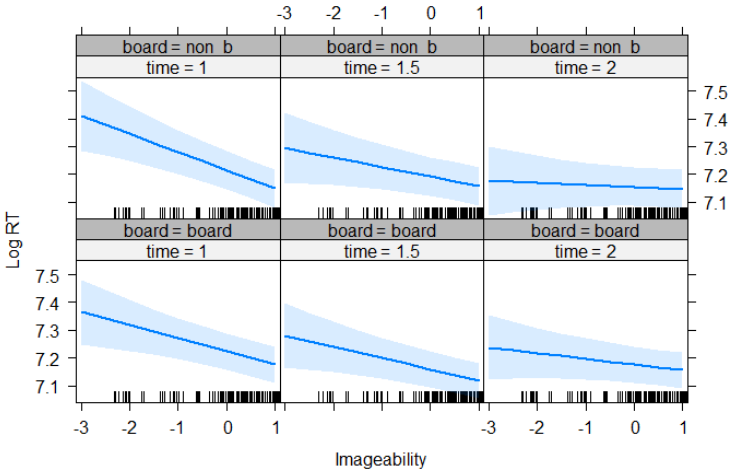


Figure 3: Interaction between imageability, SOA and distractor stimulus presence (board = present, non_b = absent).



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