

## The effect of socio-cultural contexts on embodied cognition: Evidence from pupil dilation response

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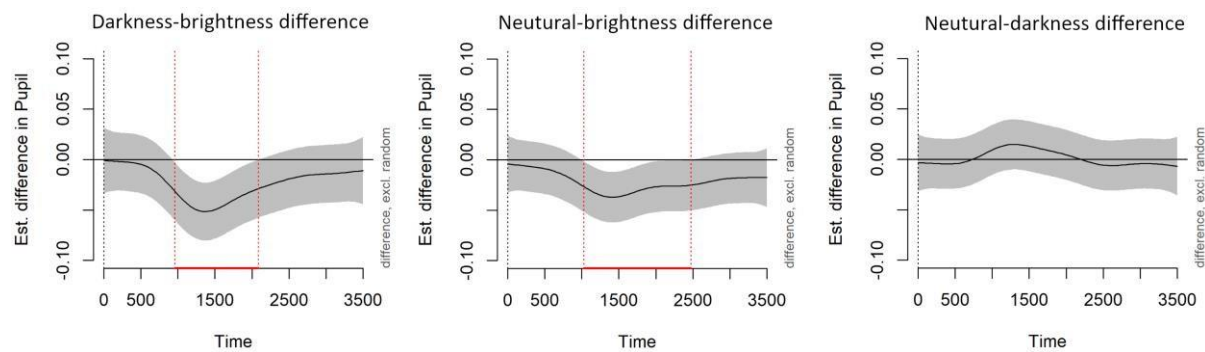
The phenomenon of embodied cognition, according to which bodily sensations and cognition are linked in the mind, argues that semantic-related features in language may be related to bodily sensations, as illustrated in an experiment in which the participants perceived the room they were in as "cold" when they were treated coldly (Zhong & Leonardelli, 2008). Theories that postulate strong embodiment in language state that correlating bodily sensations with cognition is necessary for comprehension. To illustrate; in order to comprehend the word *sun*, one will need a sensory representation of how it looks (Glenberg & Gallese, 2012; Pulvermüller, 2013). According to theories that assume weak embodiment, activations can facilitate language comprehension, but it is not mandatory (Meteyard, Cuadrado, Bahrami, & Vigliocco, 2012; Zwaan, 2014).

In this study, both to test these two theories and to reveal the effect of emotional arousal on the process in question, we investigate whether words with 'bright' (e.g. *day*) and 'dark' (e.g. *cave*) semantic contents in Turkish trigger pupil dilation. Therefore, the effect of two types of semantic effects on sensory presentation is examined in terms of their 'brightness' features. The literature review has been revealed that after reading or listening to words in French and Dutch, conveying brightness (e.g. *sun*), people from France and the Netherlands have smaller pupils compared to words conveying darkness (e.g. *night*) (Mathôt, Grainger, & Strijkers, 2017; Mathôt, Sundermann, & van Rijn, 2019). An ERP study, on the other hand, has found that pupillary deflections in response to bright or dark words are associated with long-lasting frontal activity from 300-1200 ms after stimulus onset (Ivanov, 2019). However, it is not clear yet about the effect of culture on eliciting differing embodiment effects in different cultural and linguistic groups (see Ghandhari, Fini, Da Rold, & Borghi, 2020 and Leung, Qiu, Ong, & Tam, 2011 for the effect of socio-cultural context in embodied cognition). In this study, we examine whether available findings on this subject (Mathôt et al., 2017, 2019) are valid for Turkish. We hypothesize that the development of the associations between bodily experiences and abstract concepts depends upon a socio-cultural context, which, in turn, is determined by cultural values and habits.

For the experiment, 150 words - 30 'bright' words, 30 'dark' words, 60 filler words and 30 city names to be used in the task of the experiment - were chosen from the Turkish frequency dictionary (Aksan, Aksan, Mersinli, & Demirhan, 2017) and were recorded while being read aloud. In the selection of words, a balance was achieved by taking into account the frequency value, the number of morphemes, and the word length criteria. In addition, the mood measurements of the words were also considered. Pupil measurements were performed with the SMI RED 500 eye-tracking system in a noise-free, dim room. Before the auditory stimuli were presented, the participants were asked to look at the fixation (+) for 500 ms for baseline-correction. Pupil recording was taken for 3000 ms including the auditory stimuli. The results of Generalized Additive Mixed Models revealed that, contrary to the findings of Mathôt et al. (2017, 2019), words with 'bright' semantic content caused more pupil dilation than words with 'dark' and 'neutral' semantic content, which might be a result of the sensation effect (see Figure 1). These findings seem to indicate that body-mind linkages (at least in our experimental condition) were derived from the meanings established by the socio-cultural contexts and suggest the possibility of *embodied cultural cognition* (Leung, Qiu, Ong, & Tam, 2011).

**Keywords:** Word processing, semantics, psycholinguistics, pupil measurement, embodied cognition

Figure 1. The smooth of the difference between the conditions over time. Random effects are removed from these plots. The vertical red dotted lines in the plots indicate that the difference between the two forms is significant between the two red lines.



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