Spatial information and representations of word meaning: Accessing semantic size information during reading

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Symbolic distance effect; Perceptual priming; Eye-tracking during word reading; English

Our ability to build spatial mental models from linguistic input suggests that spatial properties associated with lexical items are accessed during language comprehension, either as part of word meaning during the encoding stage, or as part of discourse integration and task-goal related processes. Studies investigating the symbolic distance effect (an inverse relation between the time required to compare two symbols and the distance between their referents on the judged dimension) have found similar patterns of reaction time for comparisons of symbolic and perceptual size, suggesting task-driven activation of analog representations of referent size[1]. Studies on the representation of numbers suggest that magnitude information associated with digits and verbal numerals is stored at the lexical level and encoding stage of language comprehension, creating a numerical distance priming effect such that number processing is facilitated when targets are preceded by a numerically close prime[2]. However, findings from studies of priming for perceptual or visuo-spatial features associated with lexical items do not provide a clear picture of the importance of task goals[3,4,5]. An eye-tracking experiment, which investigated perceptual priming with lexical items, was conducted to determine the level(s) at which representations of semantic size become available during reading comprehension, and to assess the effect of task-specific goals on the mechanism of activation.

The experiment adapted a paradigm that has been used to show that numerical magnitude is automatically activated upon encoding of digits. Using a gaze-contingent display, participants read triplets of words referring to objects and animals (1), while performing either a size-order judgment or a memory task. Our results show a symbolic distance effect on the target word during the size-order task, such that gaze duration gets progressively longer for large (M=534ms, SD=196ms), medium (M=544ms, SD=206ms) and small (M=577ms, SD=243ms) size differences between the target and preceding word, $F1(1,23)=7.66$, $p<.05$, $F2(1,41)=20.43$, $p<.01$, indicating a decision-based activation of semantic size. First fixation duration showed no effect of size difference on encoding times, $F1(1,23)=1.86$, $p=.185$, $F2(1,41)=1.23$, $p=.28$, excluding the possibility of an initial encoding effect. Importantly, the symbolic distance effect did not occur during the memory task, $F1(1,23) =.33$, $p=.57$, $F2(1,41)=.21$, $p=.65$, indicating that visuo-spatial representations are activated *only* if this information is task relevant.

These results show that semantic size representations are accessed during task-specific decision processes, but are not activated automatically as part of word meaning. This conclusion challenges some theories of embodied cognition which claim that the word-meaning level encompasses visuo-spatial knowledge associated with concepts, represented in an analog fashion[6]. In addition, we identify the symbolic distance effect as a decision rather than encoding process. These results are in contrast with the numerical distance priming effect. First, this suggests a difference in the level of activation of semantic size associated with word meaning and numerical magnitude. Second, this indicates that the numerical distance priming effect and the symbolic distance decision effect cannot rely on the same processing mechanism or underlying mode of representation, and that the numerical distance priming effect cannot be fully explained by overlapping representations of number magnitude.

Stimuli

1a. Sheep – **Cow** – Monkey 1b. Eagle – **Cow** – Monkey 1c. Lobster – **Cow** - Monkey

References

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