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Eye Scanpaths Influence Memory for Spoken Verbs

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Introduction

The human body is designed to interact with its environment. Information from all sensory modalities is integrated to allow for navigation and decision making. Developing theories of embodied cognition suggest that thought may be grounded in low-level motor activity and sensory modalities.

The present study tests whether eye motion affects memory for spoken verbs. Vision is a dynamic process in which saccades are used to gather information from multiple points in space. However, these eye fixations are not random. Eye scanpaths are often consistent with thought during the absence of any visual stimulus (Spivey & Geng, 2001, & Laeng and Teodorescu, 2002). The present question is whether feedback from low-level motor activity also plays a role in high-level cognitive processes. If natural eye movements are congruent with thought, perhaps it is possible to influence thought by controlling eye motion.

Richardson, Spivey, Barsalou, & McRae (2003) found that certain verbs carry either a vertical or horizontal spatial orientation, and that spatial orientation is activated upon stimulus presentation. Thus, it is hypothesized that horizontal or vertical eye scanpaths will either enhance memory for words whose spatial orientation is congruent with that of the motion and/or inhibit memory for those words that are incongruent with the motion.

Method

Participants were 45 sighted undergraduates at Indiana University. Apparent motion software was used to create a black circle flipping back and forth vertically or horizontally. As participants tracked the stimulus, a pre-recorded list of verbs played. The list contained 20 of the verbs that Richardson et al. (2003) found to carry spatial meaning. Ten verbs were played while the participant observed apparent motion in one direction, and the next ten words were played while the participant observed apparent motion in the other direction. After a two minute pause, participants were given a list of 40 verbs and asked to circle those which appeared in the previously heard list.

Congruent instances consisted of “vertical” verbs that were presented while participants’ eyes moved vertically or “horizontal” verbs while participants’ eyes moved horizontally. Incongruent instances consisted of “vertical” verbs presented during horizontal motion or “horizontal” verbs during vertical motion. According to the hypothesis,

performance on the recognition task should be better for congruent verbs than for incongruent verbs.

Results and Discussion

The results suggest that eye movements do prime memory for verbs, with vertical eye movements enhancing recognition of verbs with vertical spatial orientations over those with horizontal orientations. The effect was weaker in the horizontal condition. A 2(eye motion direction) x 2(order) x 2(congruency) analysis of variance for a within subjects design yielded a reliable interaction between eye motion direction and order, $F(1,43)=12.470$, $p<.001$. Horizontal eye movements only primed memory for horizontal verbs when this direction of motion was performed first. The analysis also yielded a reliable congruence x direction of motion interaction. The vertical condition yielded a greater difference between congruent and incongruent instances than did the horizontal condition, and the effect was reliable under both orders of presentation.

An ongoing study replicates these findings using a between subjects design (to eliminate order effects) and longer scanpaths. What one thinks is known to determine how one moves. The present findings show that how one moves (at least how the eyes move) determines what is remembered. Apparently, verb meanings are represented in a form close to the sensorimotor surface.

Acknowledgments

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