Eye movements and hand movements as indices of lexical processing

Anne Pier Salverda
Michael J. Spivey
James S. Magnuson
Michael K. Tanenhaus

Eye movements and computer-mouse movements to potential referents in a visual display provide a sensitive and fine-grained measure of the time course of spoken-word recognition (e.g., Allopenna et al., 1998; Spivey et al., 2005). Two advantages of mouse trajectories are that they are more easily (and cheaply) obtained than eye movements, and they provide a wider dynamic range (than saccades) of movement variables such as curvature, velocity, and acceleration. However, two disadvantages of mouse movements are that they are initiated slightly later than eye movements, and they may be more influenced by strategies. Thus, a potential concern with the mouse-tracking paradigm is that the very limited set of response alternatives available to participants may encourage a verification process that could bypass normal lexical processing.

Our study had two goals: (1) Compare the time course of mouse trajectories and eye movements as indices of lexical processing in the same task, and (2) Examine the effects of lexical variables associated with the target word (irrespective of the neutral distractor object) to test concerns that mouse-tracking may only reveal competition between explicitly provided response alternatives (and not among relevant internal lexical representations not associated with the display). We recorded participants' eye movements and mouse movements in a setup where a spoken word referred to one of two pictures. The name of the distractor picture was always phonologically and semantically unrelated to the name of the target. We compared low frequency (LF) and high frequency (HF) target words, and low cohort-density (LCD) target words and high cohort-density (HCD) target words. Cohort density was defined as the frequency-weighted sum of all words sharing the initial two sounds of the target word. Consistent with previous work, we expected faster recognition of HF vs. LF targets and faster recognition of LCD vs. HCD targets.

Fixation proportions to target pictures showed a processing advantage for HF vs. LF targets and a processing advantage for LCD targets vs. HCD targets, replicating Magnuson et al.'s (in press) findings with the standard four-picture version of the eye-tracking paradigm. In accordance with previous eye-tracking studies, we observed input-driven fixations from around 200 ms after the onset of the target word. Mouse trajectories began moving toward the target around 300 ms after the onset of the target word. Trajectories showed earlier movement toward HF targets than LF targets, replicating the eye movement data and suggesting that mouse trajectories are sensitive to frequency effects in lexical processing. However, target cohort-density affected mouse trajectories differently than expected, with faster gravitation towards HCD targets compared to LCD targets—a finding that parallels similar effects found in production experiments (Vitevitch, 2002).

Our results replicate standard frequency effects for both eye-tracking and mouse-tracking, demonstrating the sensitivity of both paradigms to the broader lexicon. Moreover, clear cohort density effects emerge in eye-tracking even when only two alternatives are displayed. The asymmetry in cohort-density effects between eye-tracking and mouse-tracking is particularly intriguing because it mirrors the asymmetry between effects of cohort density in comprehension and production.

References

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