Co-registration of mouse cursor and eye movements reveals comparable sensitivity of mouse and eye-tracking to prediction during language comprehension

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Mouse cursor-tracking is becoming more popular in psycholinguistic research; however, how its sensitivity compares to established methods such as eye tracking remains unclear. This study has two goals: (i) methodologically, to co-register listeners' mouse cursor and eye movements to compare these techniques; (ii) theoretically, to evaluate listeners' sensitivity to nominal classifiers and tone sandhi in prediction. Our findings indicate that these techniques yield highly comparable results and corroborated prior observations that listeners use nominal classifiers [1-2], but not tone sandhi in numerals [3], for prediction.

Participants (n=47) viewed pairs of images on the top two corners of the screen while listening to simple instructions in Mandarin Chinese, which contained the sentence frame "*Please click on…*" and a critical NP consisting of a numeral, a classifier, and a noun (e.g., one CL cucumber; see Fig. 1). In **Exp 1A**, we manipulated the informativity of the classifier by pairing target objects with competitor objects associated with different classifiers in the experimental condition, and with the same classifier in the control condition. In **Exp 1B**, we manipulated the informativity of the numeral's tone using two specific numerals, "yi" (one) and "liang" (two). In the experimental condition, the classifier associated with one of the objects would trigger tone sandhi in the preceding numeral, whereas in the control condition, no tone sandhi would be triggered by either object's classifier, rendering the numeral's tone identical and therefore uninformative. The instructions were presented auditorily with a syllable onset asynchrony (SOA) of 500ms. Participants were asked to move the mouse cursor to initiate the instruction and click on the mentioned object as quickly as possible.

Divergence point analysis [4] revealed that in **Exp 1A** (Fig. 2A and 3A), participants looked significantly more quickly to the target object in the experimental condition, compared to the control condition. Similarly, they were also faster to direct their mouse cursor towards the target object in the experimental condition. In **Exp 1B** (Fig. 2B, 2C, 3B, and 3C), no significant differences in divergence points were found between conditions in either eye or mouse cursor movements. In all of our analyses, divergence points in eye movements and mouse movements were highly similar (mean mouse-eye difference = 74.2 ms, max = 107 ms). Results from a follow-up Exp 2 (n=31) with the same materials and a slower presentation rate (800 ms SOA) were also highly comparable to those in Exp 1 (mean mouse-eye difference = 107 ms, max = 156 ms).

Results showed that Mandarin Chinese listeners could use nominal classifiers, but not tone sandhi in a numeral, to predict upcoming nouns. Crucially, divergence points in mouse movements and eye movements were remarkably similar, indicating that mouse-tracking show similar temporal sensitivity and thus makes a viable alternative to eye-tracking.

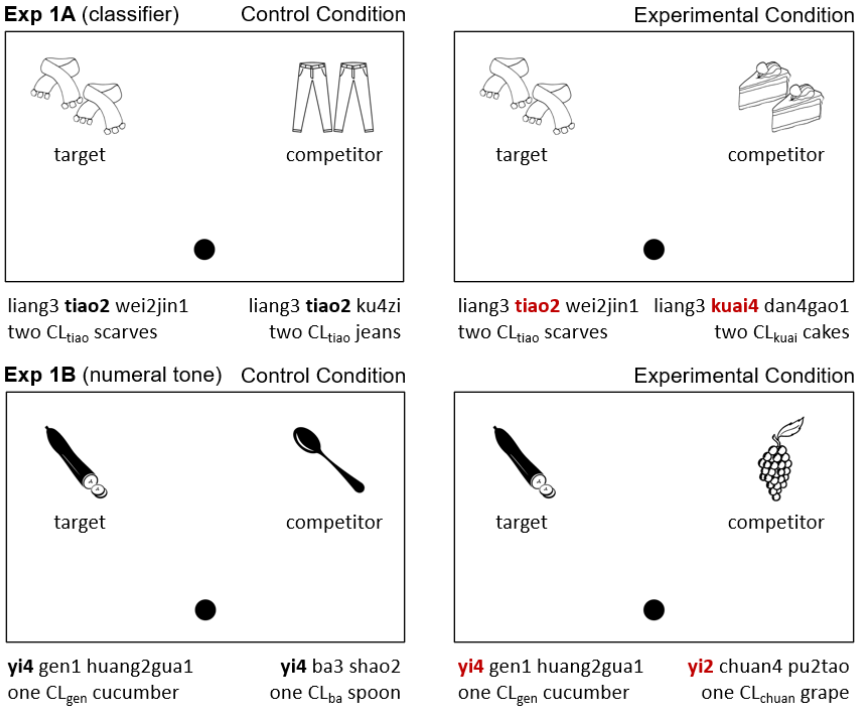

Fig. 1. A sample visual display of materials. In Exp 1A (top), the experimental and control conditions compared different vs. same nominal classifiers. In Exp 1B (bottom), these conditions compared different vs. same numeral tones.

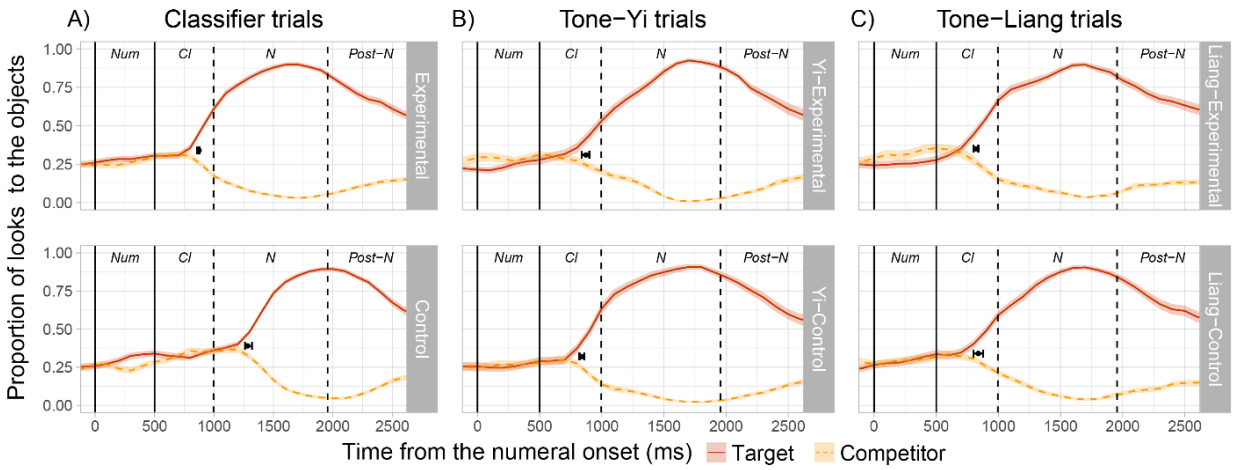

Fig. 2. Change of proportion of **eye fixations** on the target and competitor object across all conditions. Results for two numerals were visualised separately, “yi” (one) in B and “liang” (two) in C.

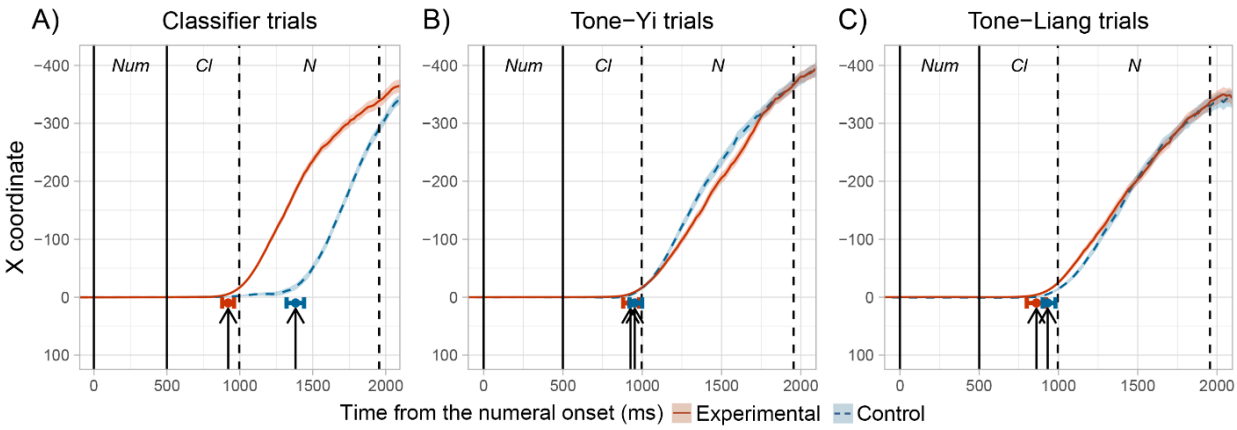

Fig. 3. Change of the x-coordinate in **mouse cursor positions** across all conditions. Results for two numerals were visualised separately, “yi” (one) in B and “liang” (two) in C.

References

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