

Reach Velocities Index Word Learning in Virtual Reality

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Overview

We developed a gamified word learning experiment in virtual reality:



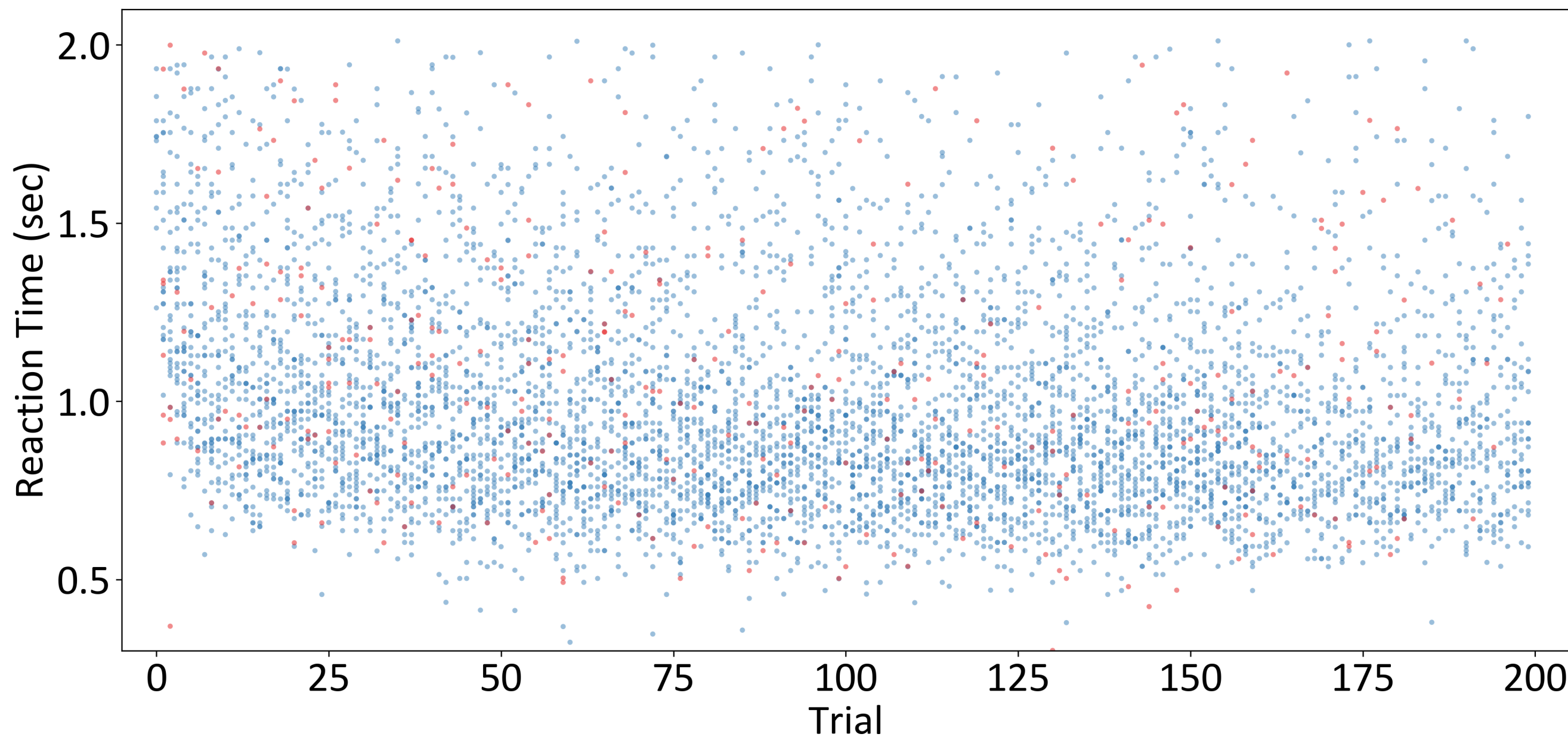
Participants learn the names of six novel objects through interaction then completed a word-color match task on the same six words.

- Exp 1:** Participants were faster to respond when the response was performed with the hand that had previously interacted with the named object (**Affordance Compatibility Effect**).
- Exp 2:** Observing virtual hands interact (no direct manipulation) with objects was sufficient to produce a compatibility effect.
- Exp 3:** The effect was driven primarily by responses with a compatible hand and not by responses in a compatible spatial location.

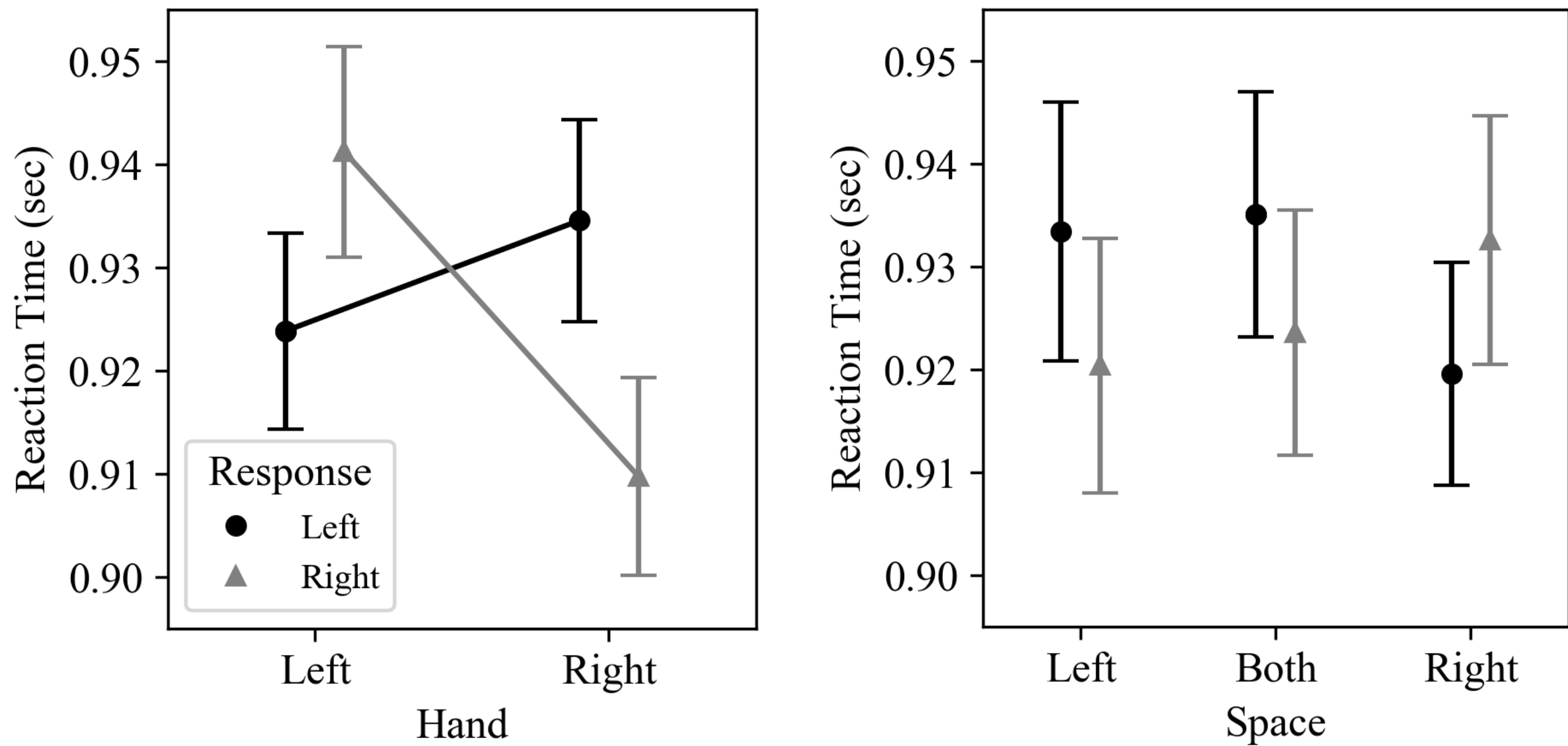
Analysis of reach trajectories during training showed evidence that motor learning is correlated with word learning in this task.

Correlated motor learning and language learning may suggest connections between underlying neural processes.

Action Compatibility Effects

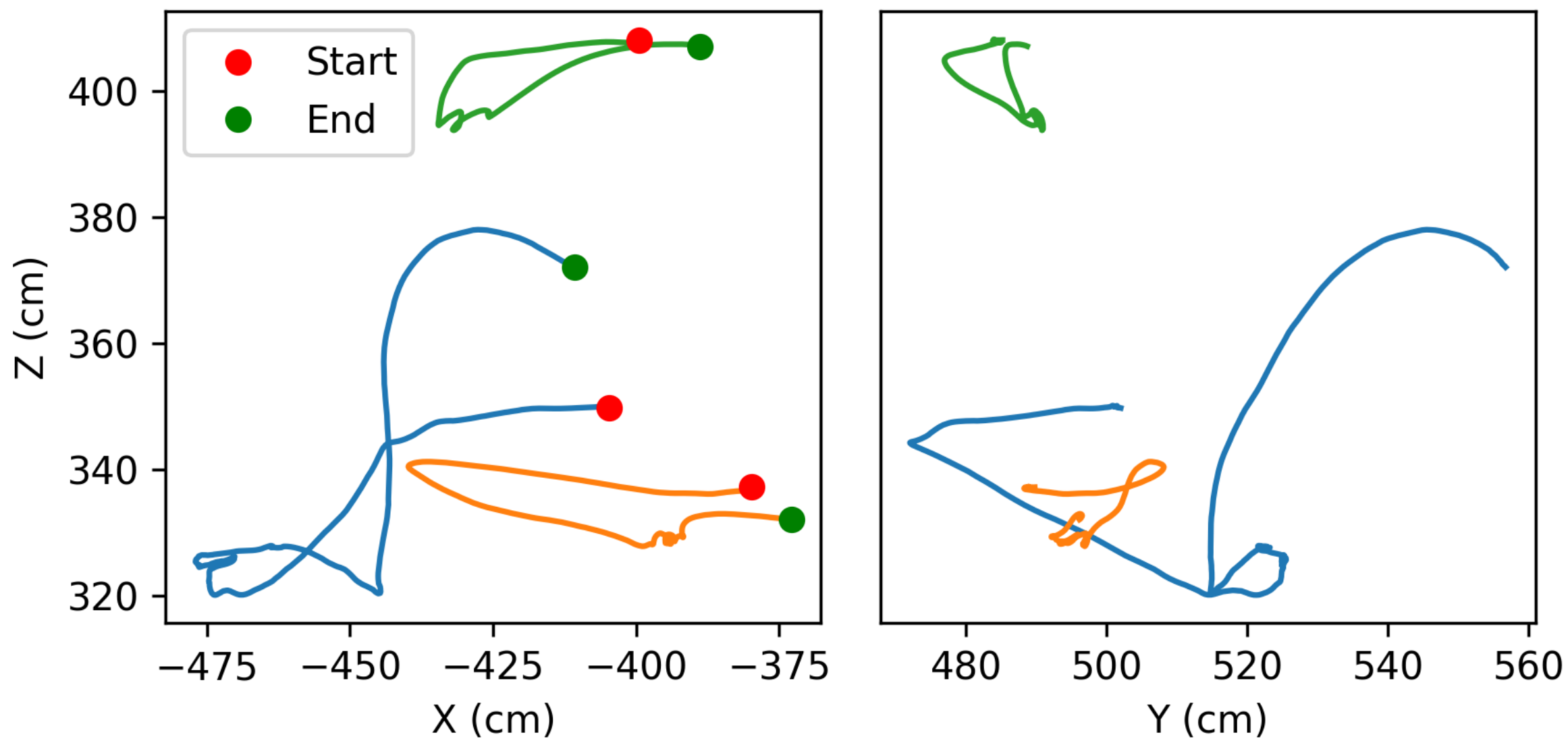


8,160 reaction times (88.9% correct). Reaction times exhibit a heavy-tailed inverse gaussian distribution ($M = 921\text{ ms}$, $SD = 291\text{ ms}$).

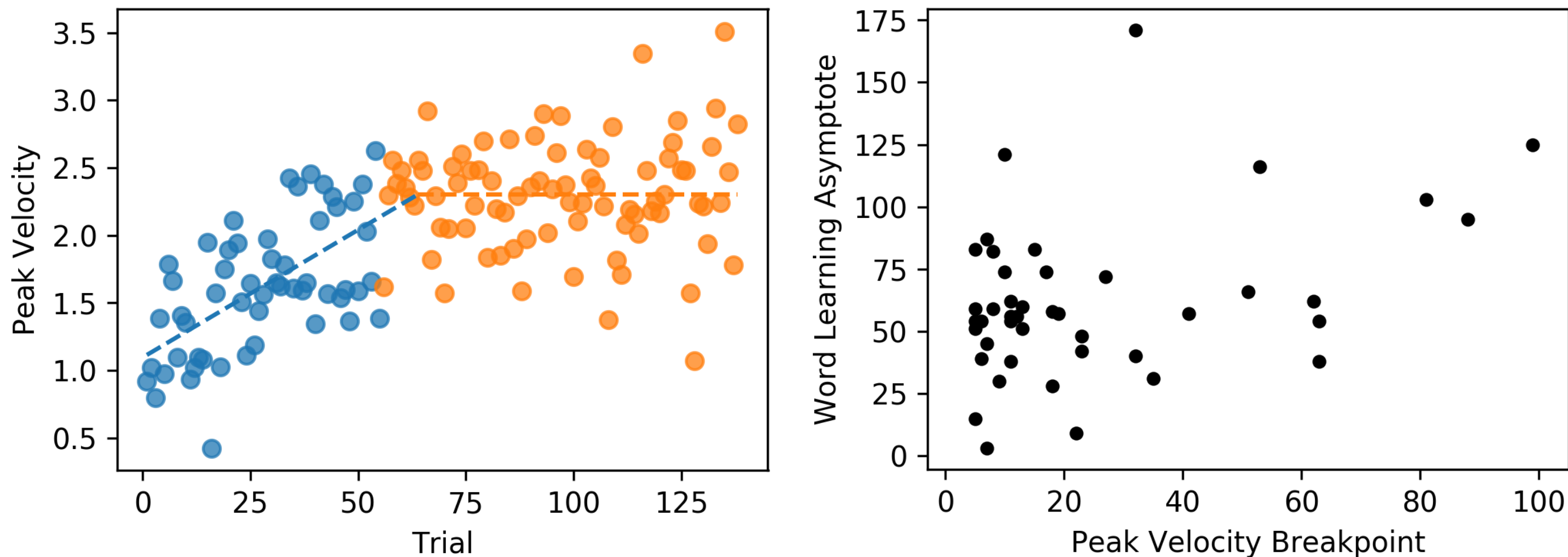


We observed a significant interaction between the hand used to interact with an object during training and the response hand. We refer to this as an **Affordance Compatibility Effect**. No compatibility effect was observed for the side of space in which the interaction occurred.

Reach Velocity and Word Learning



Above is a sample movement trajectory recorded for the head (green), left hand (blue), and right hand (green). For all trials, we identified segments containing the reach towards the cauldron, then extracted peak velocities of those reaches to evaluate differences in peak velocities before and after word learning asymptote.



On the left, we split each subjects peak velocity using piecewise linear regression. Marker colors indicate before and after word learning asymptote. On the right, the regression-based breakpoints are moderately correlated. Pearson's $r = 0.374$, $CI = [0.113, 0.581]$ estimated via bootstrapping.

References

[1] Gordon, C. L., Shea, T. M., Noelle, D. C., & Balasubramaniam, R. (*Submitted*).

[2]