

Goal-directed motor activation during language comprehension

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Background

Several studies show language induced effector-specific motor activations (e.g. Buccino et al., 2001; Wheaton et al., 2004) congruent with the Penfield map (Penfield & Rasmussen, 1950). However, as Fernandino & Iacoboni (2010) point out, the Penfield map alone, which is an effector specific map on the motor cortex, cannot explain the variegation of motor activations found in these studies outside the areas of interest. They suggest several other factors in addition to an effector-specific factor that contribute to the activation patterns that arise in the motor cortex during language comprehension, such as per-personal space and movement parameters of familiar coordinated actions (goal specificity).

Research Question

Do language induced simulations activate effector specific or goal specific motor areas?

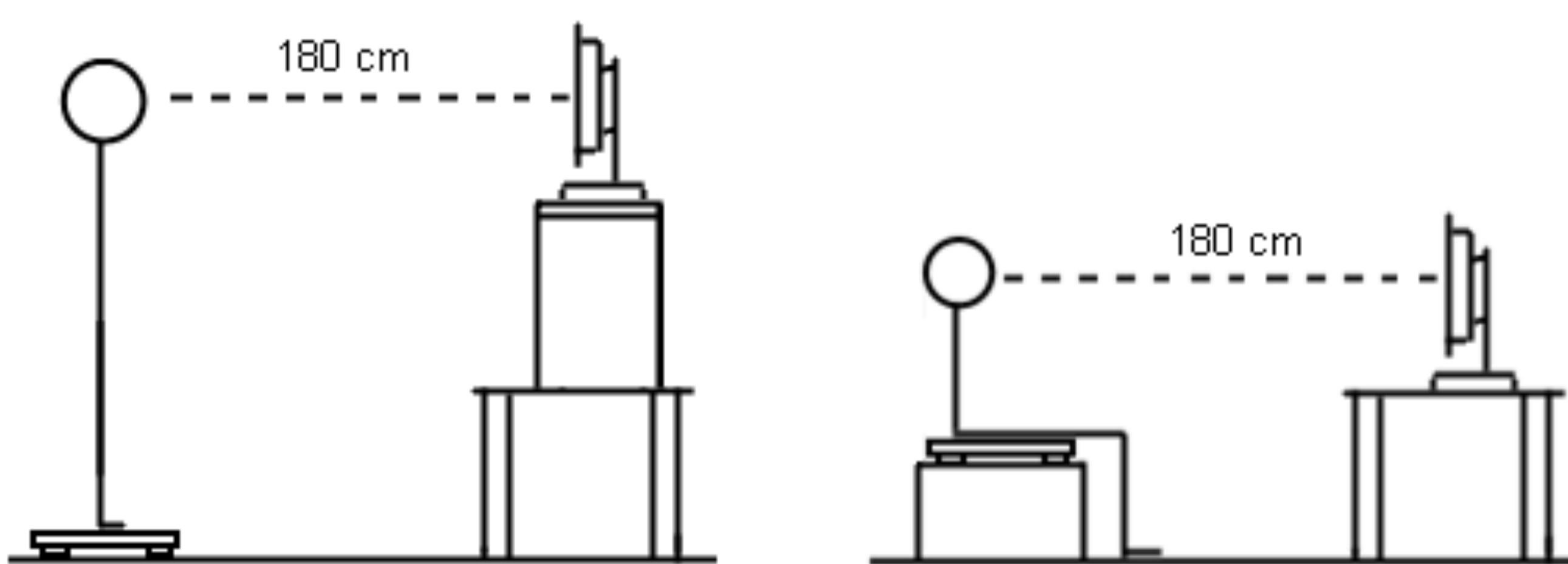
Method experiment 1a & 1b

Thirty-six Dutch sentences were presented to the participants, including 16 sensible and 20 non-sensible sentences. Target sentences implied a certain body posture (forward or backward).

“The man patted the little dog.” (Forward)

“The man looked up to the clocktower.” (Backward)

Participants had to lean left or right to indicate whether a sentence was sensible or not. Meanwhile participant's Centre of Pressure (COP) was recorded for each trial with a sample rate of 30 Hz indicating whether they leaned more forward or backward while responding.



Experiment 1a: Standing

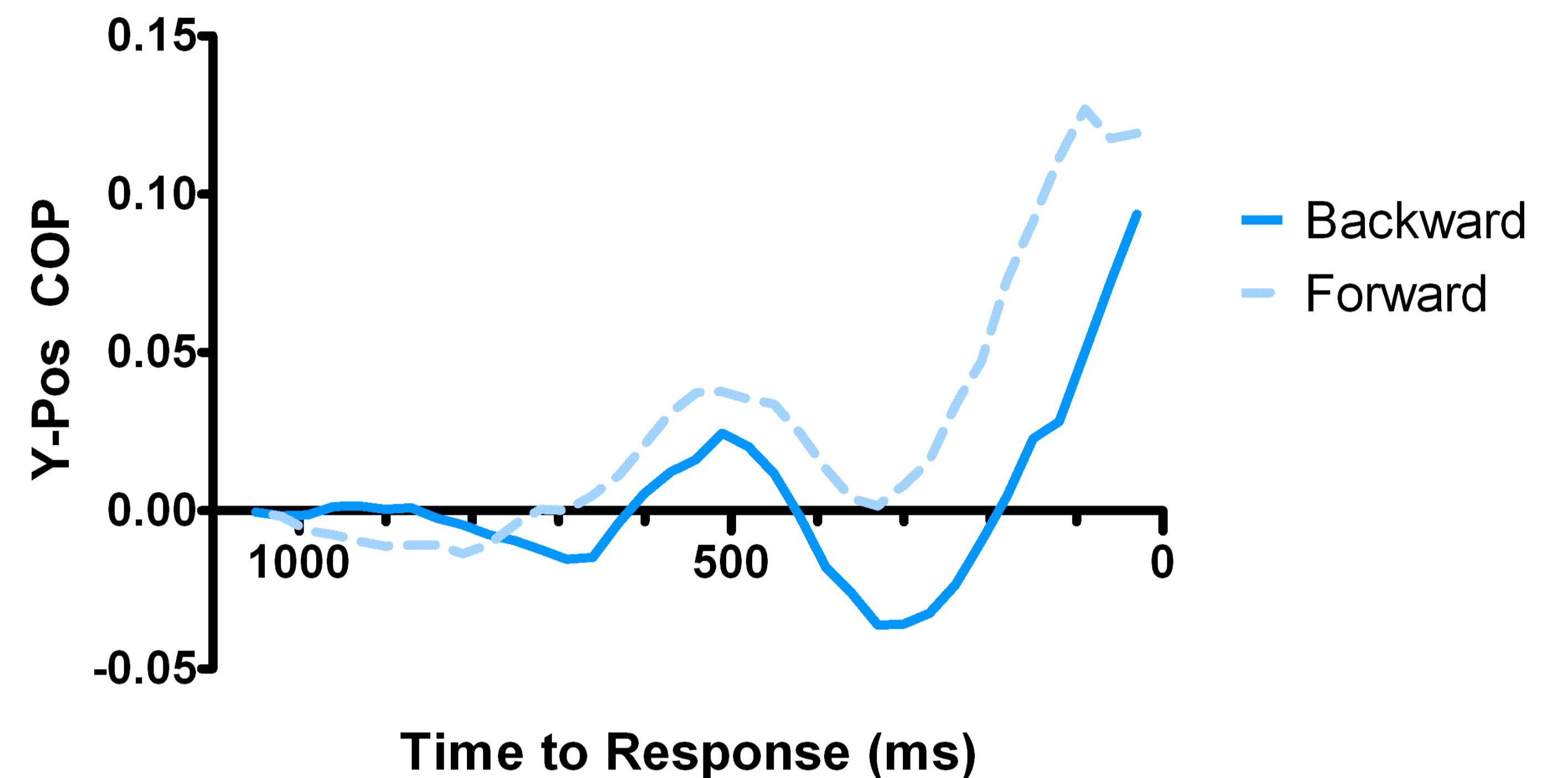
Experiment 1b: Sitting

Analysis

We used multi-level analysis (growth curve analysis, Mirman, Dixon & Magnuson, 2008) to analyze whether the averaged curves for each participant differed over time between forward and backward sentences. A model was estimated for each condition and each participant using four orthogonal polynomials: a linear, quadratic, cubic, and quartic polynomial. We assessed change in deviance (ΔD) of -2LL (minus 2 times the log-likelihood).

Results

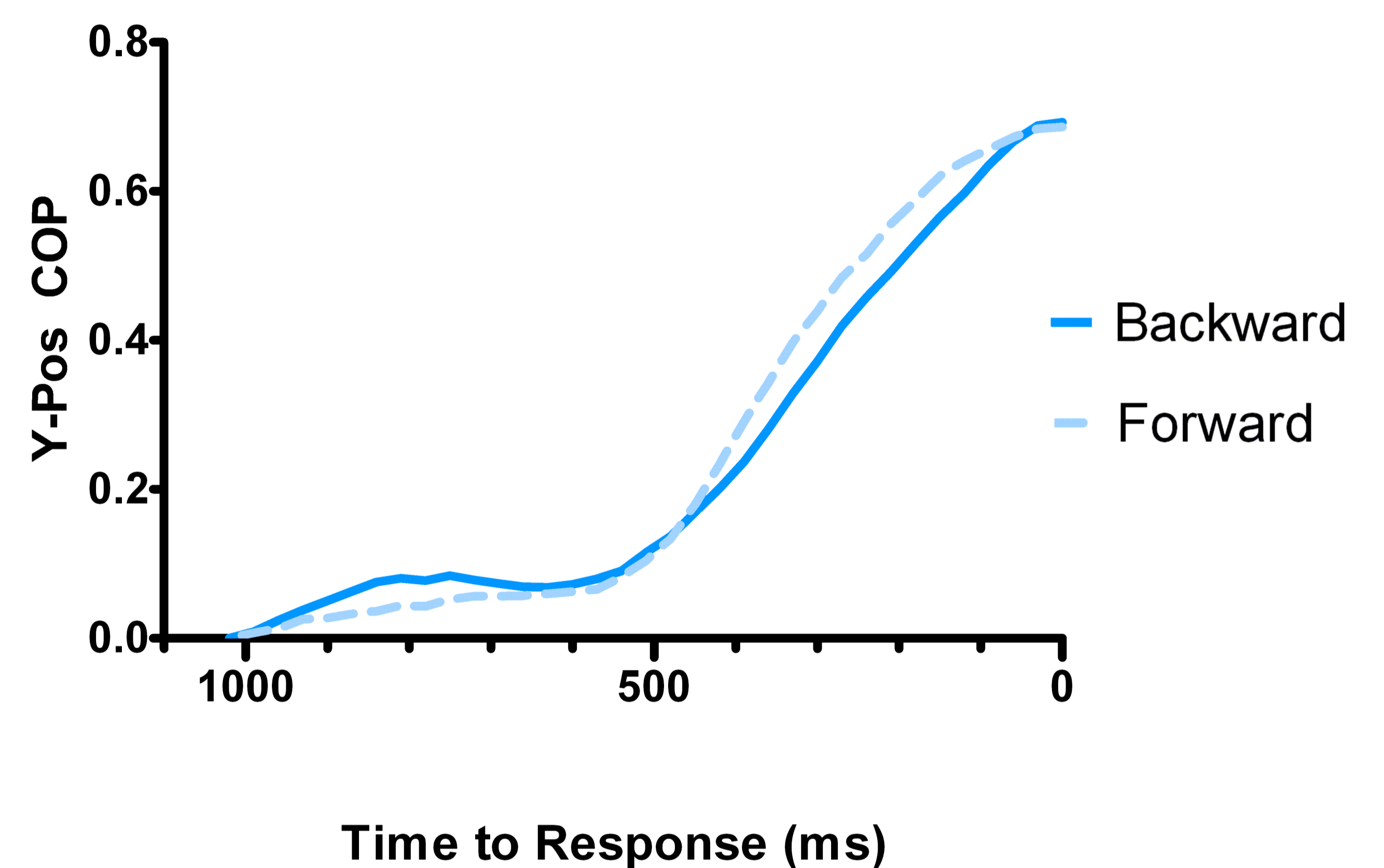
Experiment 1a: Standing



Linear: $p < .05$

Cubic: $p < .025$

Experiment 1b: Sitting



Linear: $p \approx .063$

Cubic: $p < .001$

Conclusions

- Experiment 1a: Language-induced motor activation interacts with ongoing movements, even if the intentional action is different from the action that is simulated based on sentence content.

- Experiment 1b: Although marginally significant, our results indicate that the goal of the implied movement (leaning forward) still has its influence on body posture.

- General conclusion: Our results suggest that language induced simulations activate goal-specific regions in the motor cortex at least in some degree.

References

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