



Eyes on the Prize: Eye Gaze and Cognitive Effort Exertion Near a Goal

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INTRODUCTION

- According to the goal-gradient hypothesis, animals and humans increase physical effort exertion near a goal.¹
- Recent work suggests that cognitive effort exertion follows the same principle: people exert cognitive effort more readily when they are closer to a goal^{2, 3, 4}.
- However, it remains unclear **when** people sample progress information over the course of a mentally demanding task and in turn **how** this information affects their subsequent performance.
- Accordingly, this study investigated 1) participants' behaviour and 2) their gaze (using eye tracking) over the course of a demanding cognitive task.

METHODS

- We tracked 21 participants' (mean age = 20.10, SD = 1.2, 71% female) eye movements while they engaged in an attentionally demanding odd-ball task.
- 16 blocks (8 Progress, 8 No Progress) with 25-35 trials each.
- Within-subject design.

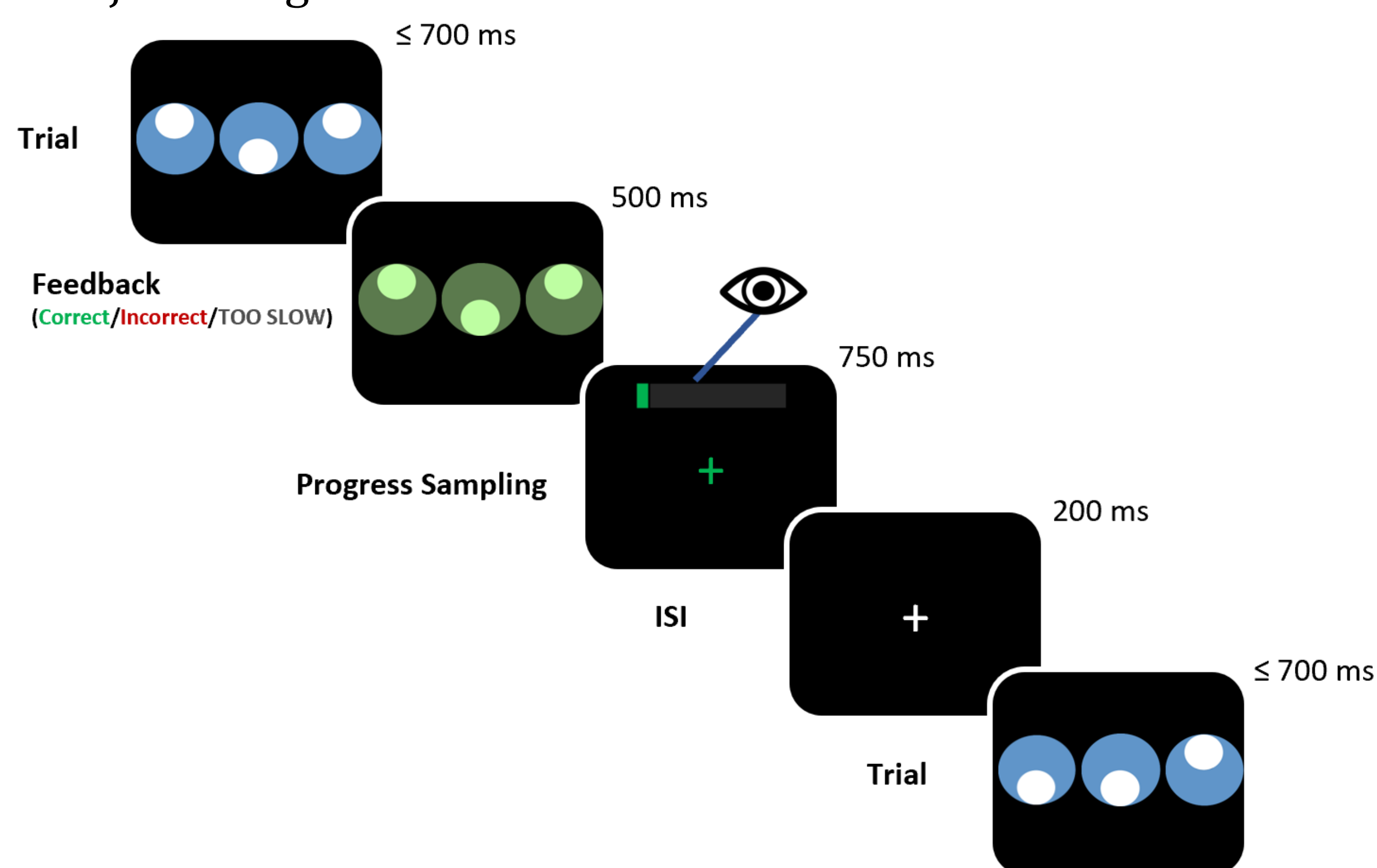


Figure 1 Task design for the oddball task. Participants were asked to identify which shape was the "odd-one-out" within 700 ms and received feedback about their performance. They were subsequently presented with the opportunity to obtain progress information (on Progress blocks) by directing their gaze to the top of the screen. This Sampling Phase lasts 750 ms, after which participants move on to the next trial, separated by a short inter-stimulus interval of 200 ms.

CONCLUSION

- Taken together, in line with our initial hypothesis based on the goal gradient hypothesis¹, these results suggest that
 - 1) participants exerted increased effort near a goal (as indexed by response times and accuracy rates) and
 - 2) participants sampled progress information more often when this information was informative (i.e., in the Progress condition).
- Preliminary analysis suggests that **cognitive effort seems to follow the tendency of physical effort exertion; people put in more effort as they get closer to their goal.**
- While in line with the hypothesis, due to the lack of power, this behaviour was not statistically significant across conditions according to the multiple linear regression model.

RESULTS

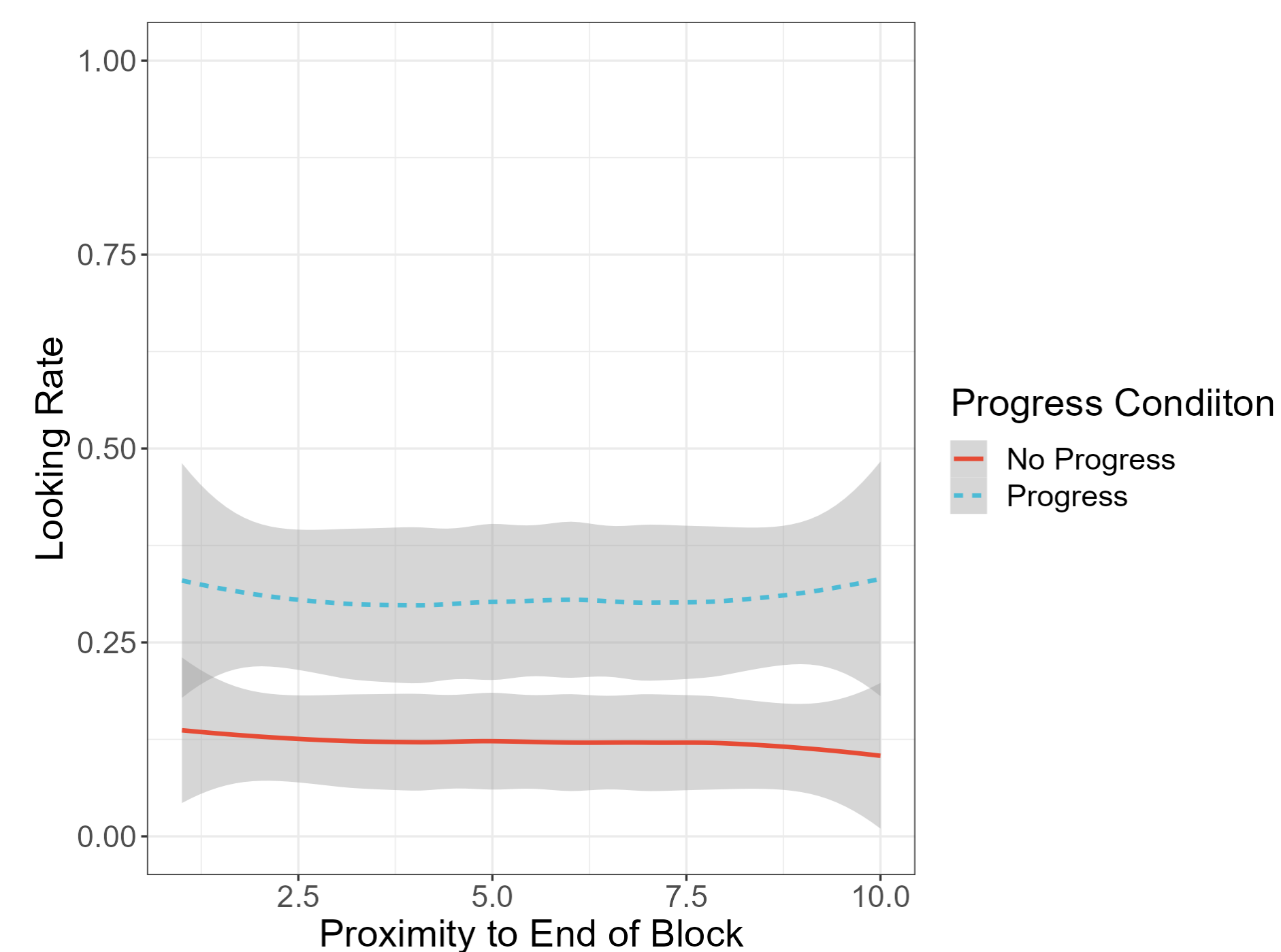


Figure 2 Looking rate (i.e., proportion of trials where the progress bar was looked at during the sampling phase) and proximity to the end of the block, dashed line showing the Progress condition, continuous line depicting the No Progress condition, grey bands indicating standard error.

There was a significant relationship between the proportion of looks at the progress bar and Progress condition such that when participants had access to progress information, they consulted the progress bar more often than when they did not.

Specifically, participants were 17.2% more likely to sample progress information in the Progress condition compared to the No Progress condition.

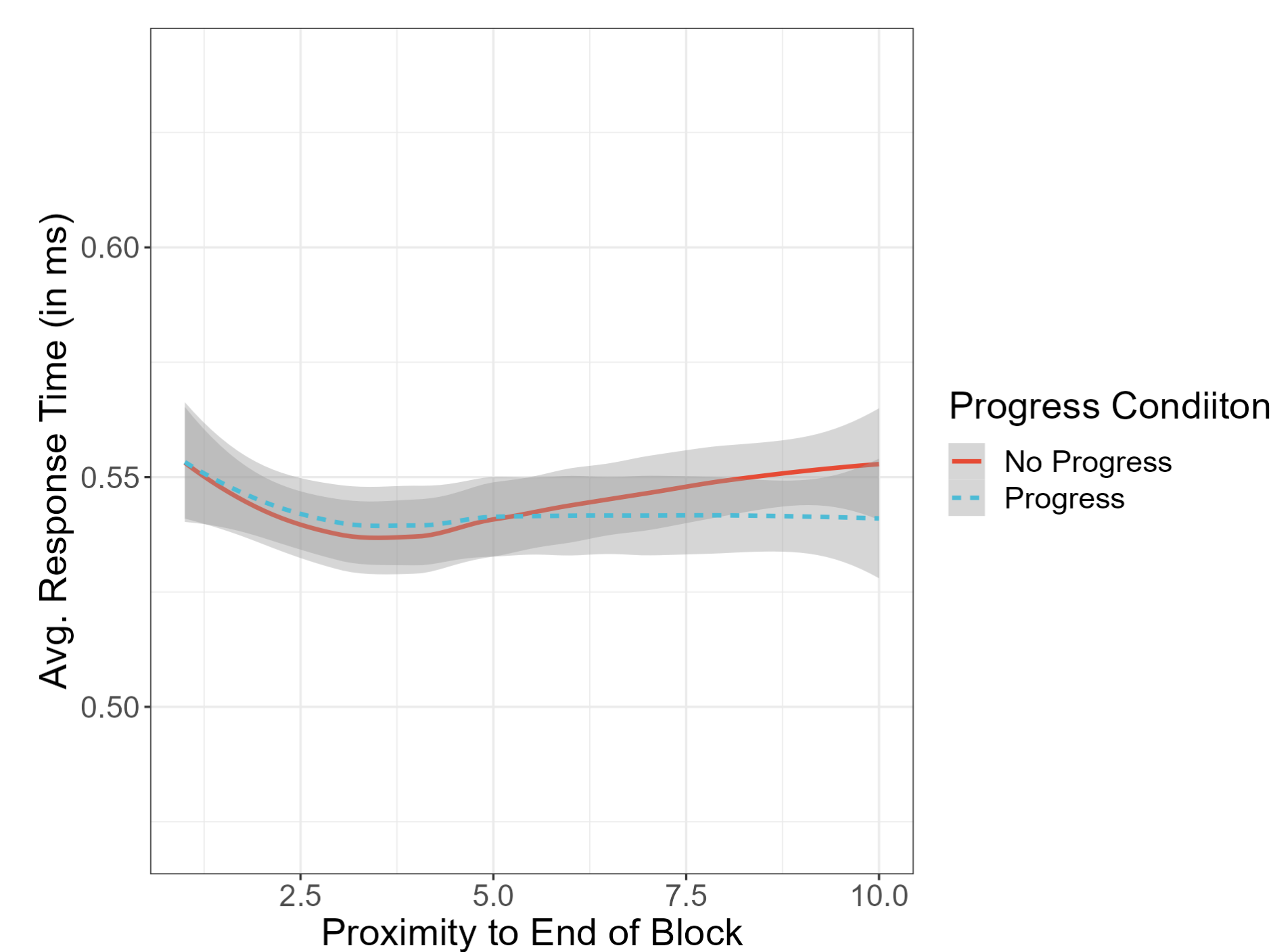


Figure 3 Average response time and proximity to the end of the block, dashed line showing the Progress condition and continuous line depicting the No Progress condition, grey bands portraying standard error.

Participants responded more quickly near the end of the block when progress information was provided.

When no progress information was provided, response speed slowed progressively over the course of a block.

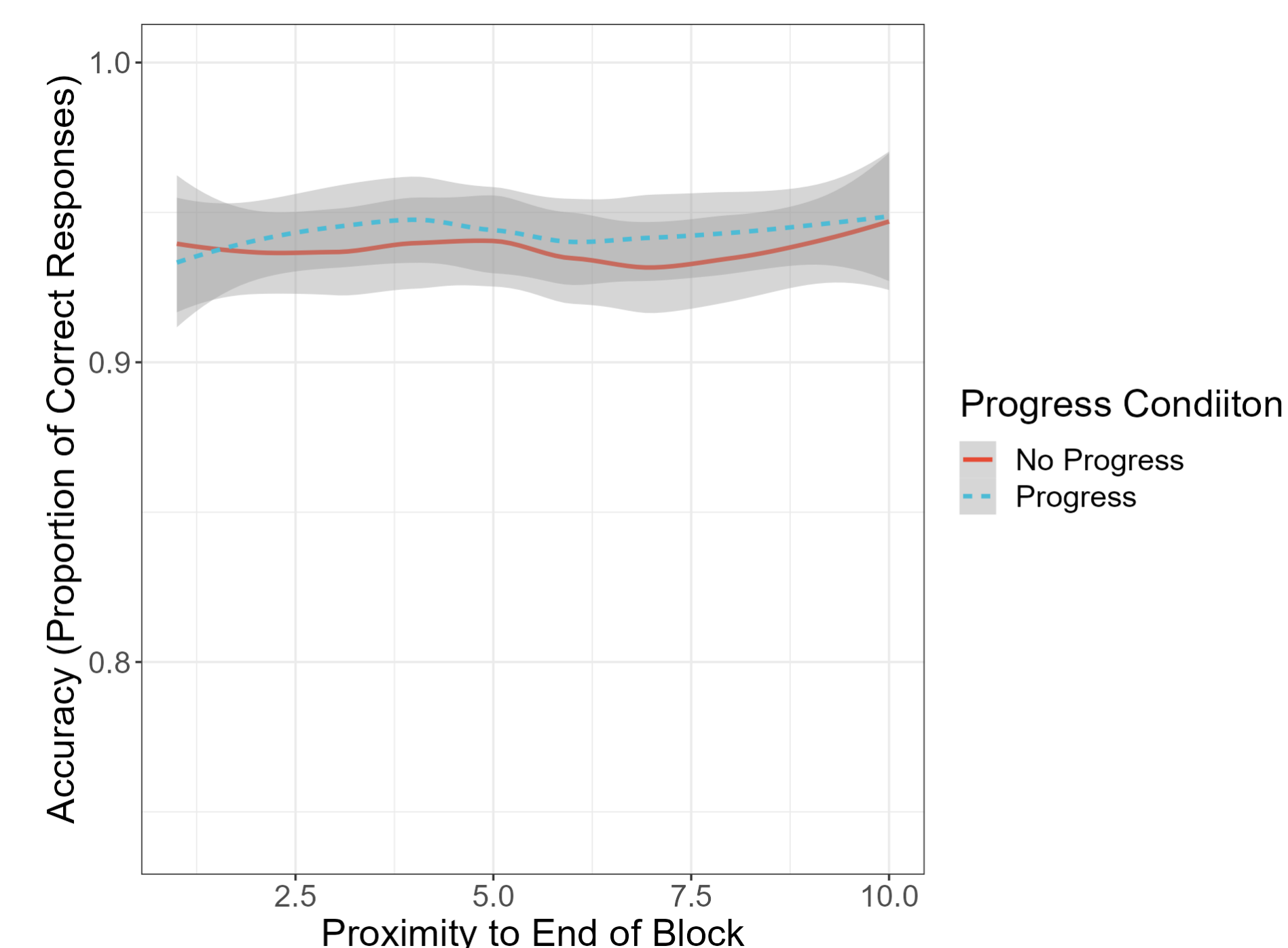


Figure 4 Accuracy (i.e., proportion of correct responses) and proximity to the end of the block, dashed line showing the Progress condition, continuous line depicting the No Progress condition, grey bands showing standard error.

Participants' response accuracy in the oddball task did not vary significantly when they were in the Progress condition compared to the No Progress condition, and their responses' accuracy did not differ significantly throughout the block.

RELEVANT LITERATURE

- ¹Hull, C. L. (1932). The goal-gradient hypothesis and maze learning. *Psychological Review*, 39, 25–43. <https://doi.org/10.1037/h0072640>
- ²Devine, S., & Otto, A. R. (2022). Information about task progress modulates cognitive demand avoidance. *Cognition*, 225, 105107. <https://doi.org/10.1016/j.cognition.2022.105107>
- ³Emanuel, A., Katzir, M., & Liberman, N. (2022). Why do people increase effort near a deadline? An opportunity-cost model of goal gradients. *Journal of Experimental Psychology: General*, 151(11), 2910–2926. <https://doi.org/10.1037/xge0001218>
- ⁴Katzir, M., Emanuel, A., & Liberman, N. (2020). Cognitive performance is enhanced if one knows when the task will end. *Cognition*, 197, 104189. <https://doi.org/10.1016/j.cognition.2020.104189>