

Visually Guided Movement with Increasing Time-on-Task: Effects on Movement Preparation and Movement Execution

Árpád Csathó & András Matuz

arpad.csatho@aok.pte.hu andras.matuz@aok.pte.hu

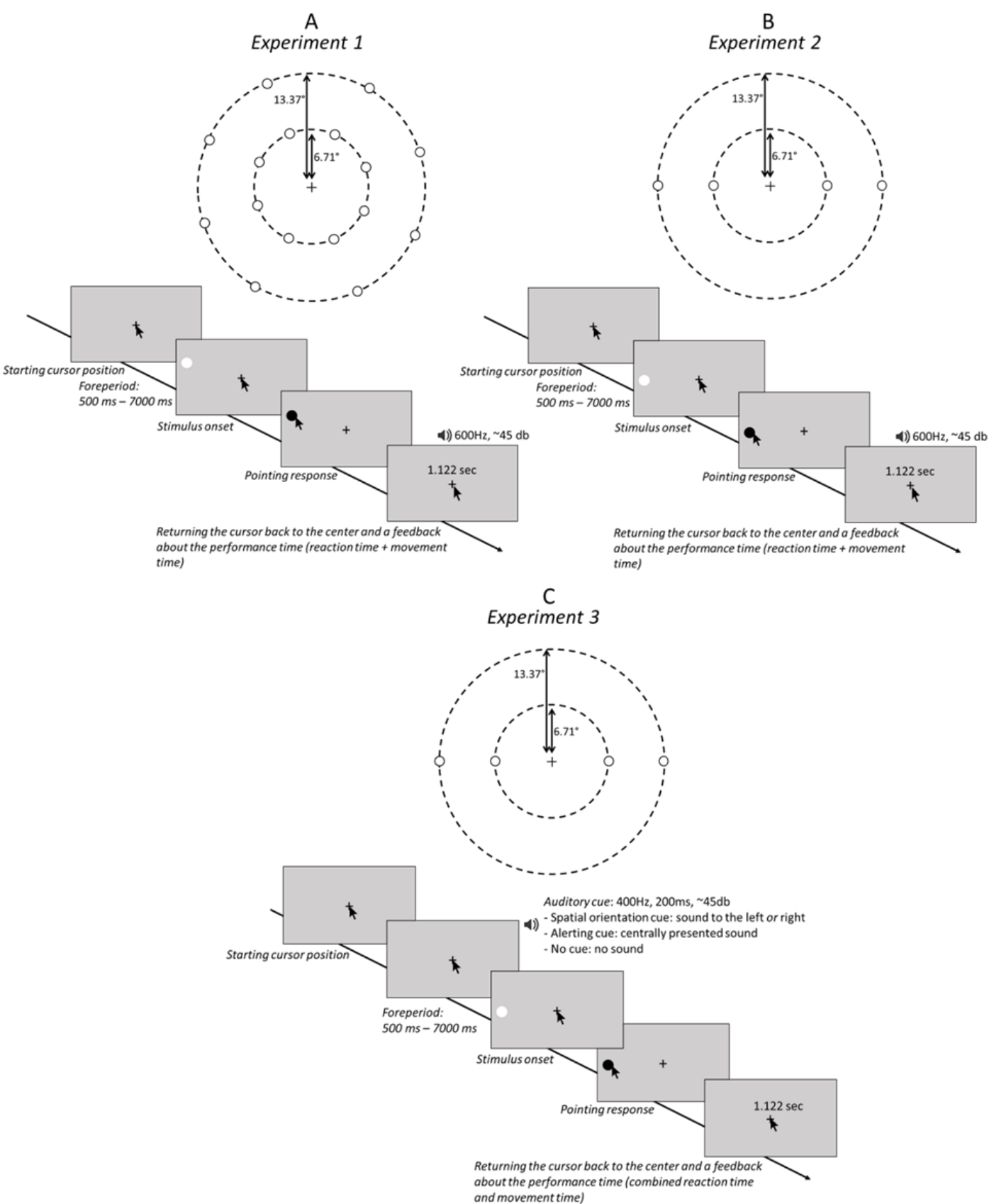
Department of Behavioral Sciences, Medical School, University of Pécs, Hungary

INTRODUCTION

Prefrontally mediated and capacity limited cognitive functions seem to be particularly sensitive to the detrimental effects of fatigue induced by increasing Time-on-Task (ToT). Previous studies have suggested that movement behaviour, especially the preparatory phase, is costly in terms of cognitive capacity (Janczyk and Kunde, 2010). Yet effects of ToT specific to the different phases of movements have received little attention. Therefore, in three experiments, we assessed the effect of ToT on a visually guided mouse-pointing task.

Our *first hypothesis* was that movement preparation assessed by reaction time lasting from the presentation of the target to movement initiation, become slower as participants spend more time with the task. In addition, participants' speed-accuracy trade-off on movement response (i.e. movement time / movement error ratio) received a special focus in our analyses because fatigue can potentially decrease the value of accurate performance and that can be resulted in faster but more erroneous responses (Le Mansec et al., 2018). We assumed that the process of impulse regulation could be vulnerable to fatigue. Specifically, our *second hypothesis* was that, as Time-on-Task increasing, participants would execute pointing task with faster but more erroneous movements.

METHODS



- Participants performed a visually guided mouse-pointing task (3 blocks of 56 trials, 15 minutes), and in each trial, they pointed to a target dot by moving the cursor from the center to the target.
- In experiment 1 (N = 26; Figure A), there were 16 possible target positions with variable movement directions.
- In experiment 2 (N = 25; Figure B), there were four target positions and horizontal movement was required only.
- In experiment 3 (N = 24; Figure C), the sequence of the trial was incorporated with three auditory cue conditions: Spatial cue, Central cue and No-cue conditions. For the Spatial cue condition, the cue was presented monaurally to either the left or the right ear and cued the side of the screen where the target was presented. For Central cue condition, the cue was presented binaurally, while for the No-cue condition, the auditory cue was omitted. With the cuing conditions we aimed to rule out whether the effects of ToT on movement preparation and execution was caused by increased orientation deficit or decreased phasic alertness.
- To induce fatigue, we used a vigilance-type paradigm and presented the targets with a wide range of inter-target intervals. Variables of preparation time, movement execution, and subjective fatigue were recorded. Gaze position recording was used to control fixation and to calculate saccadic latencies.

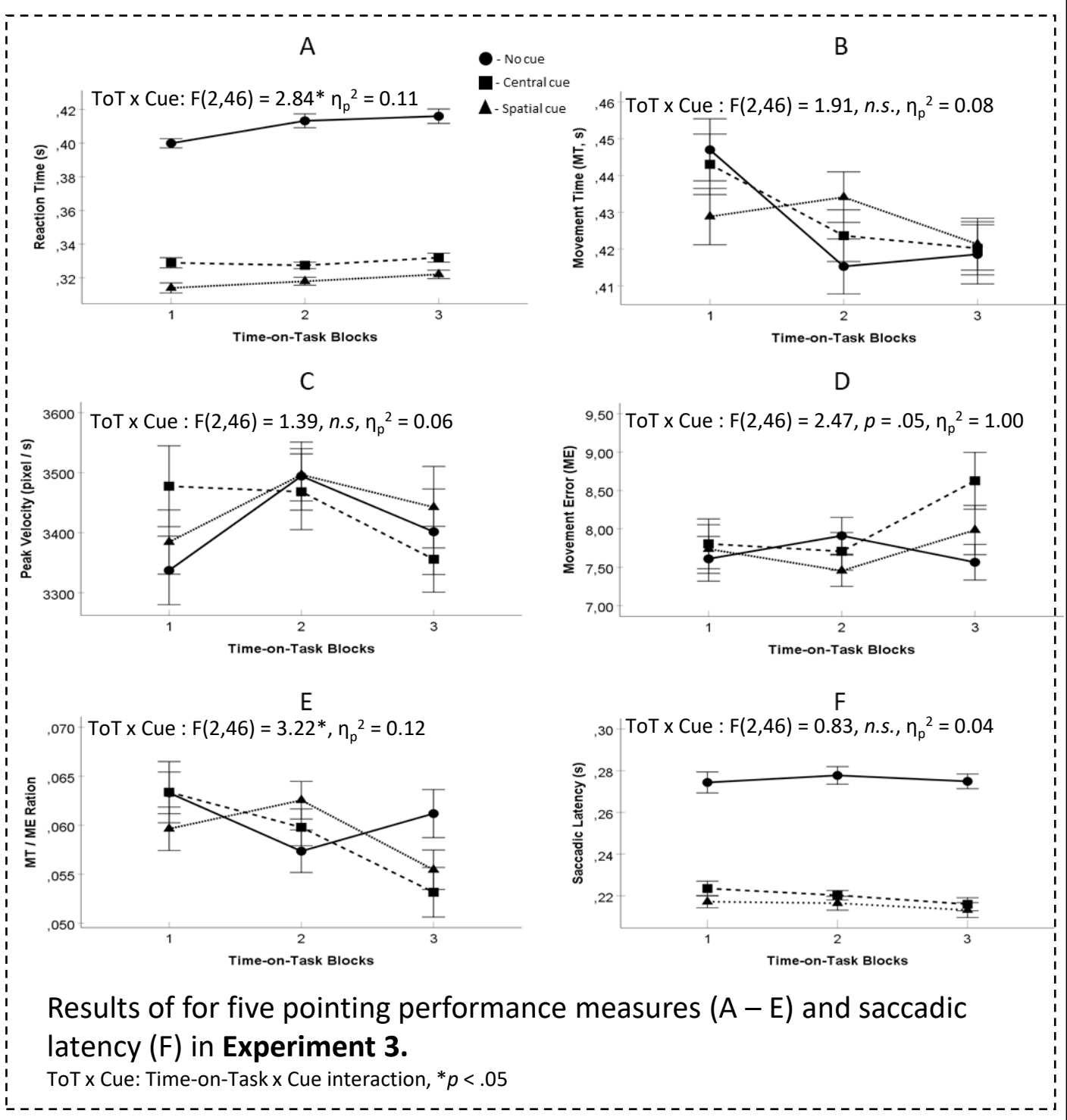
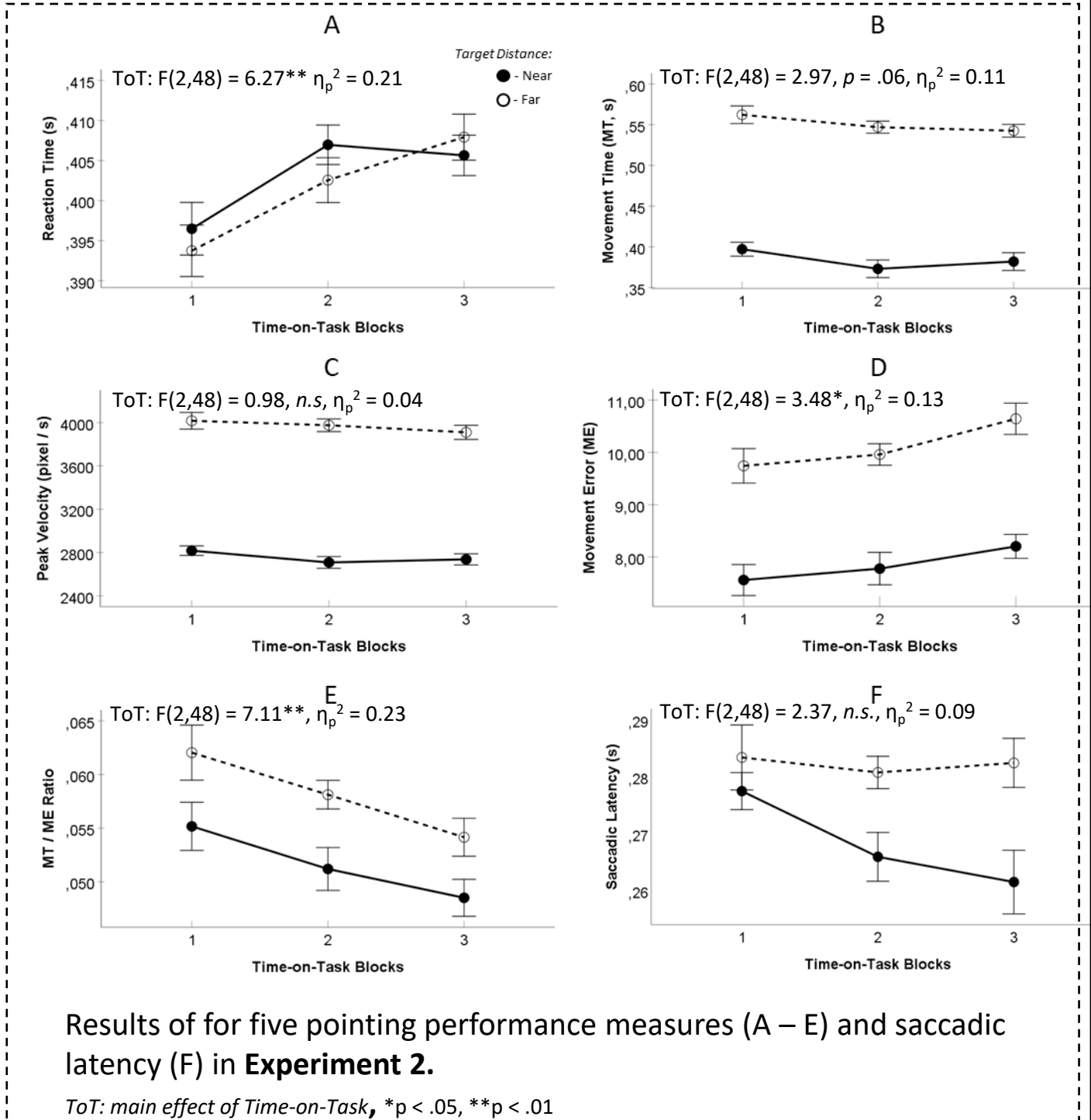
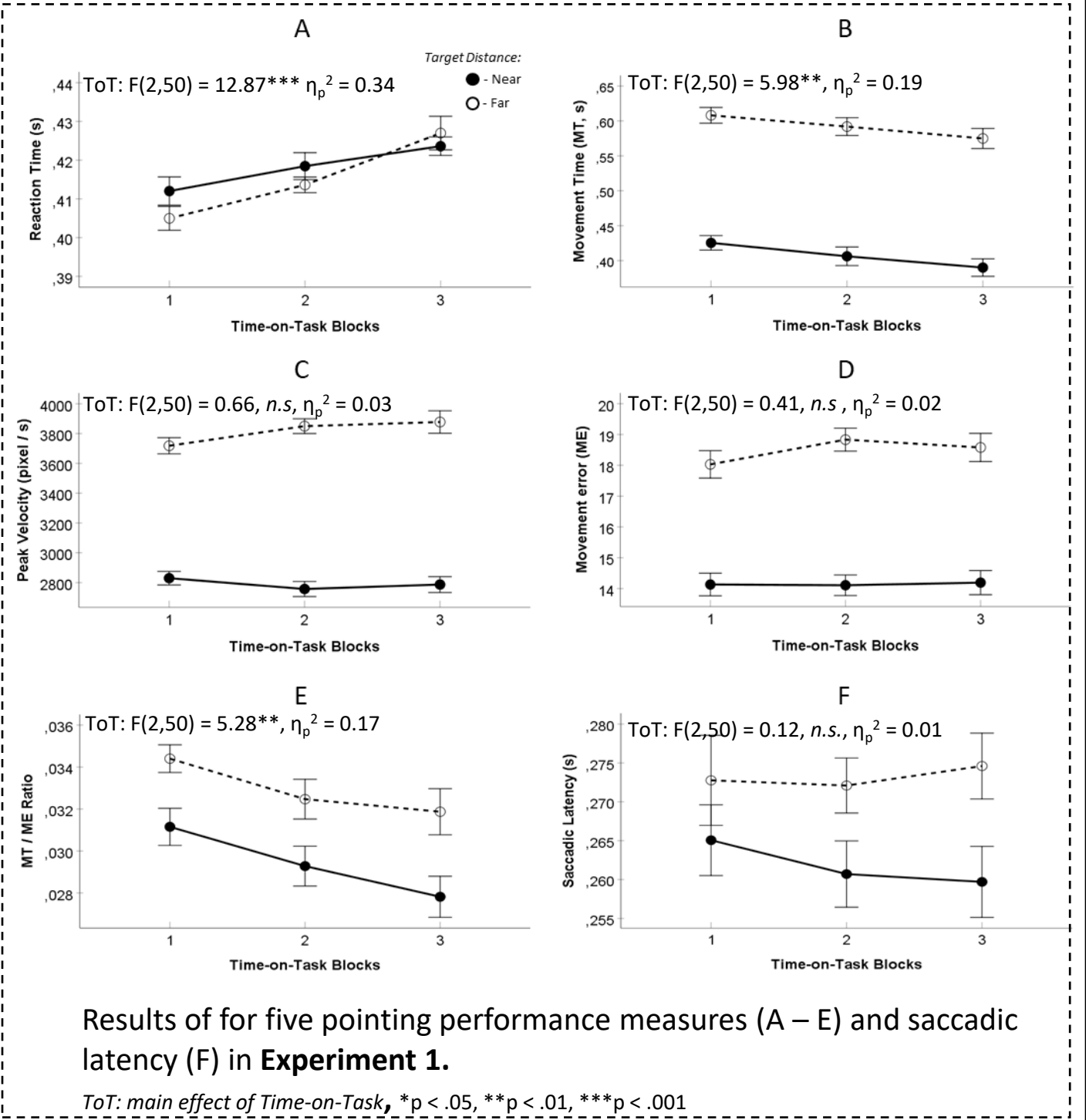
CONCLUSION

The most robust finding was that movement preparation became slower with increasing ToT. In contrast, movement execution was associated with decreasing speed-accuracy trade-off: fatigued participants made faster but more erroneous movements. The results of Experiment 3 indicated that fatigue did not induce orientation and phasic alerting deficits. Instead, decreased tonic alerting and impaired impulsivity control functions seem to be the most plausible source of the slow preparatory phase following by a faster but often more erroneous movement execution.

REFERENCES

- Janczyk, M., & Kunde, W. (2010). Does dorsal processing require central capacity? More evidence from the PRP paradigm. *Experimental Brain Research*, 203(1), 89–100.
- Le Mansec, Y., Pageaux, B., Nordez, A., Dorel, S., & Jubeau, M. (2018). Mental fatigue alters the speed and the accuracy of the ball in table tennis. *Journal of Sports Sciences*, 36(23), 2751–2759.

RESULTS



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