Leibniz Universität Hannover

# The influence of working memory load on motor decision making: A pilot study

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## Background

In many domains, whether in everyday life or, e.g., in sports, individuals frequently encounter situations that require making decisions between multiple potential actions. Embodied accounts on decision making stress the close interrelatedness of cognitive and motor processes during action planning and execution (Cisek & Pastor-Bernier, 2014; Raab, 2021). However, how cognitive load during motor decision making affects movement execution, has not been widely investigated in single-task settings, yet. The present pilot study investigated the influence of varying working memory load during motor decision making on kinematics of goal-directed reaching movements.

## Methods

***Participants:*** 12 healthy adults (8 female), mean age ± SD: 26.9 ± 4.25 years

***Experimental procedure:***

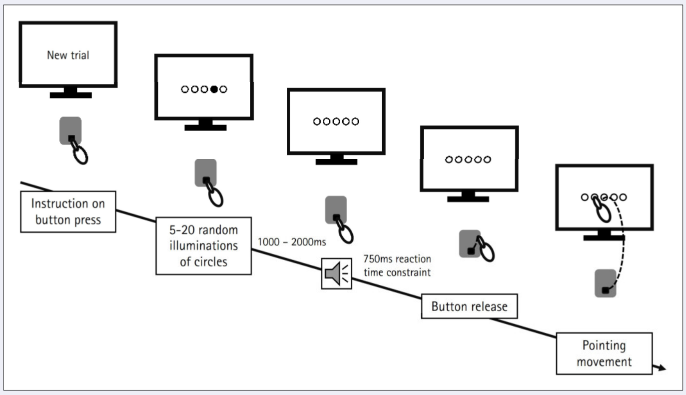


*Fig. 1: Experimental Procedure.*

- Goal-directed pointing movements towards one of five circular targets on a computer screen upon an auditory start signal
- Free target choice based on a "n-back"-instruction and following a preceding random illumination of circles
- 3 within-subject experimental conditions: 1-Back, 2-Back, 3-Back
- 4 blocks × 15 trials per experimental condition

***Measures:***

- Reaction Time: calculated as the time between start signal and button release
- Movement Duration: the time between button release and movement end
- Performance: percentage of correctly indicated targets per condition

***Statistical Analyses:***

- Repeated measures ANOVA with Condition as repeated factor (three levels)

## Results

Significant differences were found for:

- Reaction Time: $F(2,22) = 4.41$, $p = .03$, $\eta^2_p = 0.29$
- Movement Duration: $F(2,22) = 5.43$, $p = .01$, $\eta^2_p = 0.33$
- Group Response: $F(2,22) = 40.27$, $p < .001$, $\eta^2_p = 0.79$

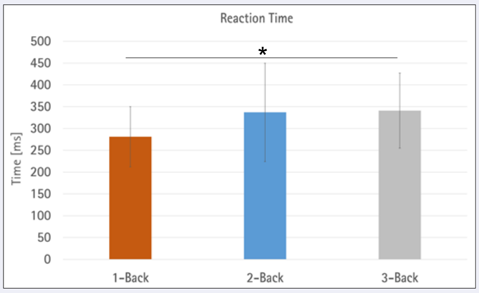


*Fig. 2: Mean reaction times per experimental condition ± SD. The asterisk indicates significant difference following Post-hoc pairwise comparison.*

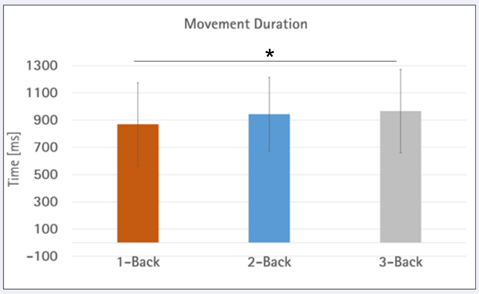


*Fig. 3: Mean movement durations per experimental condition ± SD. For asterisk interpretation see above.*

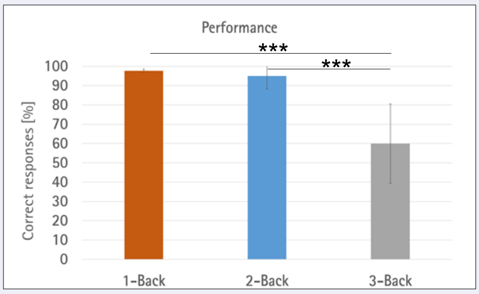


*Fig. 4: Performance. Depicted are mean percentages of correct responses ± SD. For asterisk interpretation see above.*

## Discussion

The results suggest that cognitive load during motor decision making affects action choice as well as temporal movement aspects of goal-directed reaching movements, lending support for an embodied account of motor decision making.

The outcomes of this study have potential importance when taking up a lifespan perspective, i.e. when considering the impact of age-related changes in working memory capacity on motor decision making and subsequent action execution, as well as in the context of competitive sports performance, i.e. when considering the impact of cognitive load induced by race or playing strategies.

## Outlook

Further analyses will focus on behavioral variability, i.e. with respect to variability of fingertip position along the movement trajectory and at movement end (cf. Krüger & Hermsdörfer, 2019).

### References

Cisek, P., & Pastor-Bernier, A. (2014). On the challenges and mechanisms of embodied decisions. Philosophical Transactions of the Royal Society B: Biological Sciences, 369(1655), 20130479.

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