THE INFLUENCE OF TEMPORAL EXPECTANCY DURING COGNITIVE DUAL TASKING ON BALANCE CONTROL

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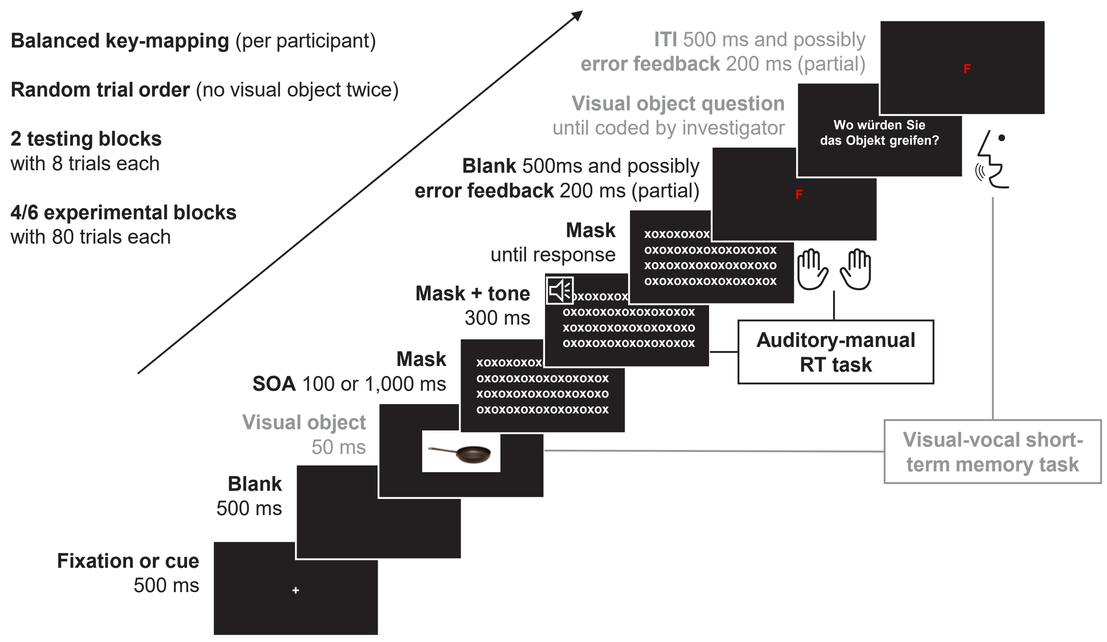
INTRODUCTION

Cognitive-processing demands can affect balance control. Traditional methods of analysing balance control aggregate sway data, making it difficult to isolate the specific influence of cognitive processes on balance control. Recently, balance-control parameters were measured continuously with a force plate during standing and analysed in an event-related approach while participants completed a Simon task (Johannsen et al., 2023). Resolving response conflict in incongruent trials reduced balance adjustments prior to the manual response.

In the present study, we combined this event-related approach with a cognitive dual task which comprised a visual-vocal short-term memory task with a delayed vocal response and an auditory-manual reaction time (RT) task. This hybrid form of a psychological refractory period (PRP; Pashler, 1994) paradigm created a functional processing bottleneck during memory-consolidation processes (Koch & Rumiati, 2006).

To explore the influence of this cognitive bottleneck on balance control, we varied the stimulus-onset asynchrony (SOA: 100 vs. 1,000 ms; Koch et al., 2018) between the targets (Experiment 1) and whether participants had to report or ignore the visual object (task load: report vs. ignore; Experiment 2).

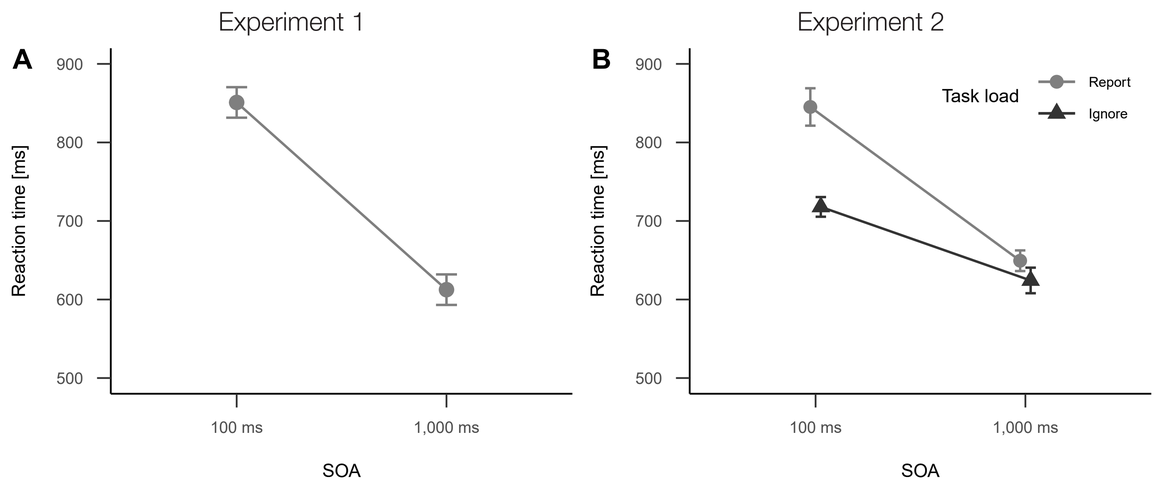
METHOD



RESULTS

N = 48 per Experiment

COGNITIVE DUAL-TASK DATA



Plots for the RTs in Experiment 1 (A) and Experiment 2 (B) of the auditory-manual RT task.

Results of Experiment 1:

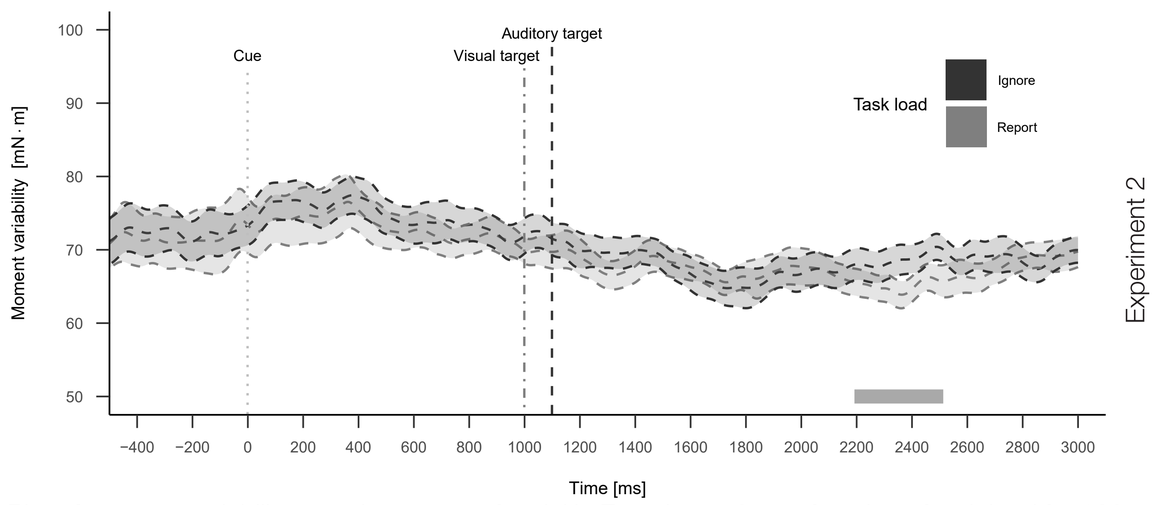
- *SOA, $F(1, 47) = 17.44$, $p < .001$, Cohen's $d = 1.32$*

Results of Experiment 2:

- *Main effects of SOA and task load reached significance with $F \geq 90.05$ and $p < .001$.*
- *SOA x task load: $F(1, 47) = 81.13$, $p < .001$, $\eta^2_p = 0.63$*
- *The SOA effect was clearly larger for report trials (196 ms) but still present for ignore trials (94 ms).*

FORCE-PLATE DATA

Plot of moment variability over the course of a trial in Experiment 1 as a function of SOA. Horizontal grey bar indicates significant cluster from 1,971 to 3,000 ms after fixation onset ($p < .001$, and a cluster mass of 18,529), indicating significantly more moment variability for short compared to long SOA.



Plot of moment variability over the course of a trial in Experiment 2 as a function of task load for 100 ms SOA only (memory consolidation bottleneck is only present in report but not in ignore tirals). Horizontal grey bar indicates significant cluster from 2,193 to 2,514 ms after fixation onset ($p = .034$, and a cluster mass of 2,170), indicating significantly less moment variability for report compared to ignore trials.

DISCUSSION

We experimentally varied cognitive load created by the interference of memory consolidation and response selection processes by manipulating the SOA and the relevance (task load) of a visual-vocal short-term memory task.

For RTs, we replicated well-known main and interaction effects of SOA and task load, demonstrating that memory consolidation processes can create a functional processing bottleneck at the level of response selection processes.

Assessing the balance correlates revealed no process-specific influence of the memory consolidation bottleneck on balance control, but a more general adaptation of balance adjustments before and during cognitive tasks.

We assume that flexibility allows the balance control system to delay or advance balance adjustments, possibly to minimise cognitive-motor interference

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