Induced stress during dual task improved secondary task performance at the sacrifice of primary task performance

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INTRODUCTION

• Completing a simultaneous secondary task while standing or walking, i.e. a high cognitive load situations, may disrupt one’s postural control [1,2].
• Several factors such as pathology, aging, and stress may have an effect on the performance of each task being completed [3].

PURPOSE:

• We aimed to investigate the effect of induced stress on the performance of each task during a high cognitive load situations. The high cognitive load situations S included standing while completing a secondary motor task (wire maze).

METHODS

• Participants (Tab. 1) were asked to randomly stand 1) quietly, or while completing the wire maze 2) with or 3) without a loud buzzer noise (Fig. 1). Stress was induced through a loud buzzer when the ring contacted the maze.

RESULTS

ABOVE: Posture was more irregular during quiet standing (ST) compared to standing while doing wire maze (DT) with and without the buzzer in both the AP and ML directions (p=0.02, p=0.001, respectively in AP) & (p=0.004, p<0.0001, respectively in ML). (NOTE: GRF=Ground Reaction Force, SampEn=Sample Entropy).

LEFT: Perceived stress was significantly lower during quiet standing (single task: ST) compared to standing while completing the wire maze (dual task: DT) with (p=0.001) and without buzzer (p=0.007) conditions.

DISCUSSION and CONCLUSIONS

• During the most stressful high cognitive load situations, the high level of perceived stress coincided with less wire maze errors.
• The addition of a secondary task increased the regularity of the ground reaction force in both directions, which might be due to more automatic and less flexible postural control.
• Induced stress during high cognitive load situations caused a cost for postural control, yet a benefit for wire maze performance, indicating task prioritization under stress.
• Identifying the strategies underlying task prioritization can help clinicians design appropriate interventions to challenge patients appropriately to improve performance during high cognitive load situations

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Table 1. Demographic data

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Age (years)</th>
<th>Body mass (kg)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Young</td>
<td>18</td>
<td>24.76±3.56</td>
<td>68.85 ±11.85</td>
<td>1.72±0.07</td>
</tr>
</tbody>
</table>

Figure 1. (A) The wire maze device including a wire path and a ring. The wire maze was composed of a metal wire path (maze) and a single ring, held in one hand that was moved over the maze without contacting the maze itself. (B) Study Protocol – Participants stand on a force-plate for three minutes during quiet standing compared to standing while doing wire maze.

MEASUREMENTS:

• Perceived stress was measured after each trial. Scores ranged from 1 to 10 with 10 representing the highest level of stress.
• Both task performances were assessed : 
  • Primary task performance: Ground reaction force sample entropy in the anterior posterior (AP) and mediolateral (ML) directions during quiet standing, and standing while doing wire maze [4].
  • Secondary task performance: The number of times the subject touched the metal ring to the wire maze was recorded as the number of errors.
• One-way repeated measures ANOVAs were used to compare dependent variables during the three conditions (α=0.05).