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

Farahnaz Fallahtafti and Jennifer M Yentes

Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE 68182

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:

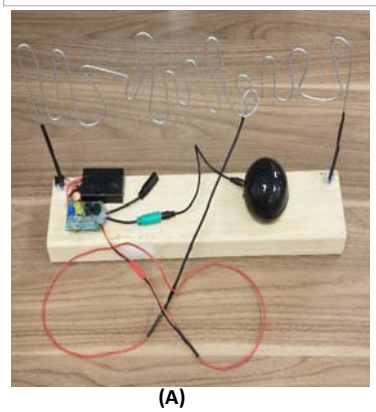
- We aimed to investigate the effect of induced stress on the performance of each task during a high cognitive load situations. The high cognitive load situations S included standing while completing a secondary motor task (wire maze).

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.

Table 1. Demographic data

Group	N	Age (years)	Body mass (kg)	Height (m)
Healthy Young	18	24.76±3.56	68.85 ±11.85	1.72±0.07



(A)

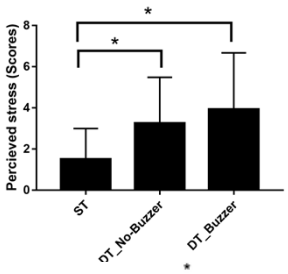
(B)

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.

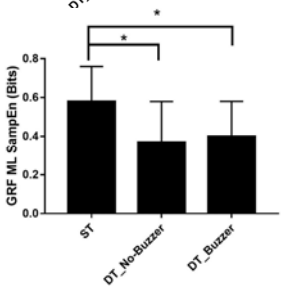
MEASUREMENTS:

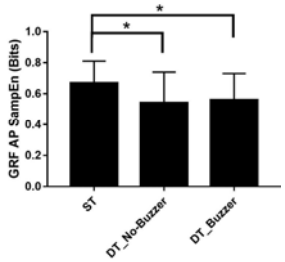
- Perceived stress was measured after each trial. Scores ranged from 1 to 10 with 10 representing the highest level of stress.
- Both task performances were assessed :
  - Primary task performance: Ground reaction force sample entropy in the anterior posterior (AP) and mediolateral (ML) directions during 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).

RESULTS

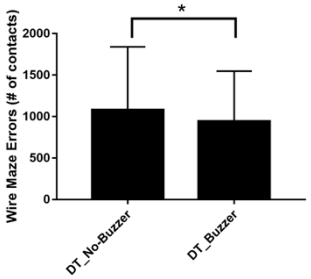


LEFT: Perceived stress was significantly lower during quiet standing (single task: ST) compared to standing while completing the wire maze (dual task: DT) with (p=0.001) and without buzzer (p=0.007) conditions.





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: Wire maze errors were significantly higher during standing while doing wire maze (DT) without the buzzer compared to the buzzer DT condition (p<0.0001).

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

ACKNOWLEDGMENTS

This research was funded by Graduate Research and Creative Activity grant from Office of Research and Creativity Activity, UNO (2018).

[1] Boisgontier et al. Neurosci Biobehav Rev, 37, 1824-1837, (2013).
[2] Fallahtafti et al. Innov Aging, 2 (Suppl 1), 991, (2018).
[3] Han et al. Atten Percept Psychophys, 75, 1395-1405, (2013).
[4] Önell, Gait & Posture, 12, 7-13, (2000).