Effects of Varying Difficulty Levels of a Secondary Cognitive Task on Motor Abilities

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Background

- Prior research shows dual tasking negatively affects motor performance and results in slower reaction times and altered movement patterns, with a greater effect shown on people with cognitive impairments[1].
- Dual-tasking causes task prioritization due to shared attentional resources and higher cognitive demands.
- Cognitive load impacts motor control, especially in fast-paced or high-stakes settings.
- Understanding the effects is critical in contexts like driving, sports, and fall prevention.

Methods

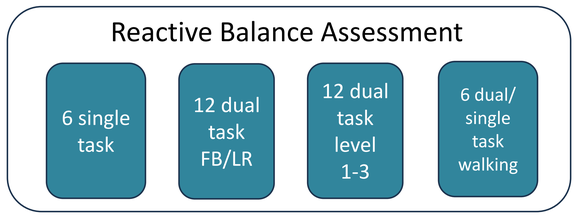
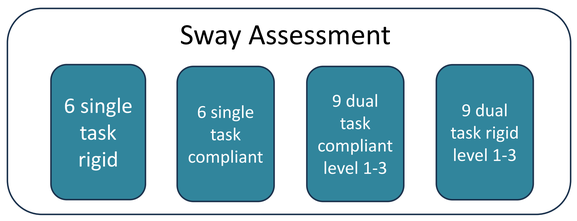


Figure 1. . Experiment layout of treadmill for reactive balance experimentation

Game Difficulty

- Level 1: Fixed sine wave (f = 0.1 Hz)
- Level 2: Fixed sine wave (f = 0.3 Hz)
- Level 3: Variable sine wave (mean f = 0.3 Hz)



- Randomization of eyes open/close trials for single-task

Figure 2. Layout of sway analysis experimentation on force plates with game screen position.

Results

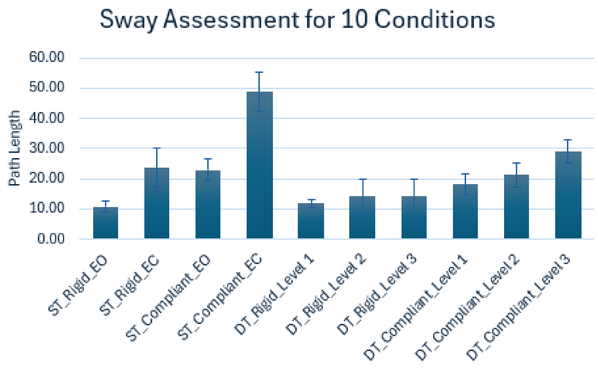


Figure 1. Difference in path length in cm under varying secondary task conditions.

- Observed an increase in path length for eyes closed versus eyes opened.
- An increase in sway during dual-task compared to single task eye opened

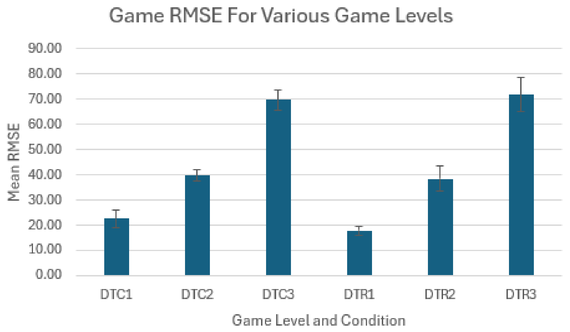


Figure 2. Mean game RMSE for dual task compliant levels 1 to 3 and dual task rigid level 1 to 3.

- Observed an increase in mean RMSE with an increase in game difficulty level.

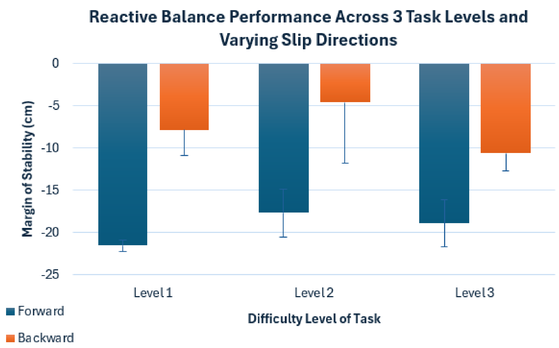


Figure 3. The margin of stability across dual-task difficulty levels 1 to 3 for backward and forward slip perturbations.

- An increase in the margin of stability for backward slips when compared to forward slips.

Motivations

Objective 1: Investigate the impact of a cognitive load on sway performance.

Objective 2: Test the effect of increasing difficulty levels of a secondary task on balance performance.

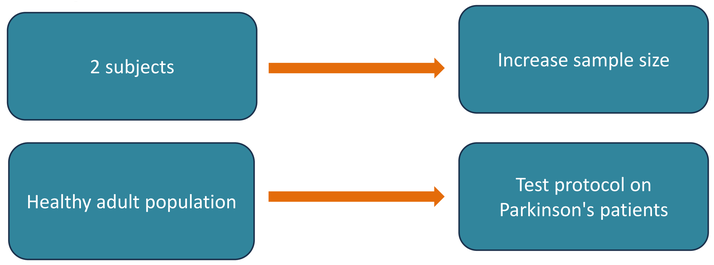
Expectations:

- The added presence of a cognitive task would cause balance performance to worsen due to added mental load.
- Increasing the cognitive task difficulty level would negatively influence balance performance because the immersion level of the participant would change

Discussion

- Postural sway increased with the addition of a secondary task, supporting the idea that multitasking impairs motor performance.
- Increasing cognitive task difficulty did not significantly impact reactive stepping. Likely due to there being a higher chance of fall during a dynamic perturbation so the participants are less engaged with the game and more concerned with preventing fall.
- However, sway assessment tasks are less threatening than slip perturbations, causing participants to engage more with the cognitive task. This is supported by the worsened postural sway as the task difficulty increased.

Future Steps:



Acknowledgments

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