Dual-Task Walking Performance: Motor vs Cognitive Tasks

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Summary

Carrying a weighted box (motor) and performing a visual-verbal Stroop test (cognitive) while walking lead to altered gait patterns in healthy adults. Specifically, step length, double support time, and trailing limb angle were altered between single task and dual-task conditions. Age appeared to impact sensitivity to trial type with respect to variability in step length and double support time.

Introduction

Domains of walking adaptability include motor and cognitive dual-task elements, yet much of our research into dual-task walking performance lies in cognitive dual-tasking. Emerging evidence suggests there may be differing effects of dual-task conditions on walking performance [1], although there is insufficient evidence to generalize the outcomes. Often in activities of daily living we must perform both motor dual-tasks (such as carrying groceries while walking) and cognitive dual-tasks (such as walking and talking). Here, we explore the effects of motor dual-tasking compared to cognitive dual-tasking in healthy individuals aged 20-77 years.

Methods

Participants provided written informed consent prior to data collection. After determining preferred walking speed (PWS) using the staircase method, participants walked on a treadmill (Treadmetrix, Park City, UT) at their PWS, and while performing two dual-tasks: (1) a 15-lb weighted box carry (BOX), and (2) walking and performing a visual-verbal Stroop test (WWT). 9 motion capture cameras (Qualisys AB, Goteborg, Sweden) tracked the positions of a modified Helen Hayes marker set. Marker data were filtered using a 4th order zero-lag low-pass Butterworth filter with a 6Hz cut-off. Gait events were identified via kinematics using Visual3D, with custom MATLAB code to compute step length, step width, double support time, peak plantarflexion, trailing limb angle, and their coefficients of variation (CV).

To identify differences in variables of interest between PWS, BOX, and WWT trials, a repeated-measures ANOVA was run in SPSS (v29.0.1.0, IBM). Significance was set at α< 0.05 with Bonferroni-Dunn corrections for post-hoc comparisons.

Results and Discussion

Data was collected from 16 participants (8M; mean ± SEM age: 41 ± 5 years, range: 20-77; BMI: 27.99 ± 1.28 kg/m^2; speed: 0.99 ± 0.06 m/s). There were significant main effects of trial on step length (p=.011, η_p^2=.365), double support time (p=.035, η_p^2=.287), and trailing limb angle (p=.028, η_p^2=.240). Post-hoc testing revealed longer steps during PWS compared with BOX (p=.035, 95% CI [.002, .052]) and increased step length CV in BOX compared with WWT (p=.045, 95% CI [0, .035], **Figure 1**). Younger adults had greater variability in BOX compared with WWT for step length CV (p=.015, 95% CI [.005, .048]) and double support time CV (p=.004, 95% CI [.006, .03], **Figure 1**).

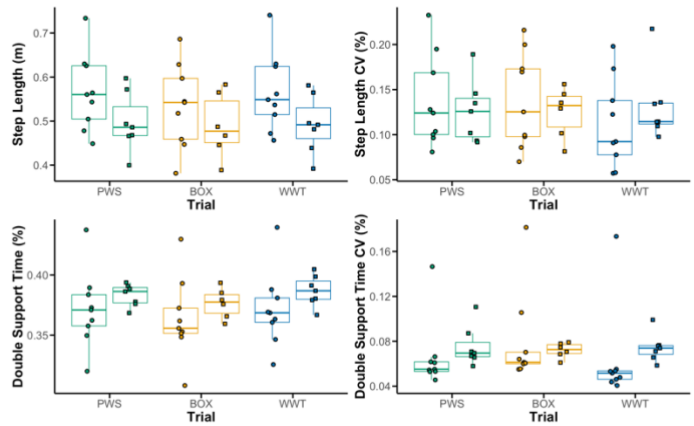

Figure 1: Box plots depicting spatiotemporal gait parameters for each trial (PWS = green; box BOX = yellow; WWT = blue). Adults: ○ ≤60 yrs ■ >60 yrs.

Our preliminary findings suggest that motor and cognitive dual tasks do have differing effects on spatiotemporal gait parameters. Prior motor dual-tasks include a tray carry, with or without a balancing task, (e.g., [2,3]), yet these tasks do not involve significant external load. Incorporating a moderate weight, like that of groceries or a load of laundry, into a motor task better translates to activities of daily living. Such external weight shifts the location of the center of mass, which may result in the observed gait changes. Future investigations will incorporate greater participant numbers, and analysis of stability metrics and gait kinetics.

Conclusions

Step length, double support time, and trailing limb angle were altered between single task and dual-task conditions. Age appeared to impact sensitivity to trial type with respect to variability in step length and double support time.

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