Short Research Article

What Is the Role of Sustained Visual Attention in the Maintenance of Postural Control in Young Adults?

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Abstract: Dual tasks requiring sustained visual attention and upright stance are common, yet their impact on standing balance is not well understood. We investigated the role of visual attention in the maintenance of postural control, using the multiple-object tracking (MOT) task. Healthy young adults (n = 12) performed the MOT task at three object movement speeds while seated or standing. MOT performance was assessed using tracking capacity (k). Metrics calculated to assess mediolateral (ML) and anterior–posterior (AP) postural control included: maximum difference between CoM and CoP position (CoM–CoP Max), root mean square distance for center of pressure and center of mass position (CoP and CoM RMS distance), and correlation between CoM and CoP time series signals (CoM/CoP correlation). As predicted, k decreased significantly as object movement speed increased for both standing and seated conditions. Object movement speed also significantly affected AP CoM–CoP Max in seated conditions (p = .021) and AP CoM/CoP correlation for standing conditions (p = .002). The results demonstrate utility of the MOT task in understanding the role of visual attention in postural control, even though healthy young adults were able to compensate for the addition of a sustained visual attention task, with minimal deficits to postural control.

Keywords: posture, multiple-object tracking, visual attention, center of pressure, center of mass

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Dual-task situations involving a concurrent cognitive and motor task occur frequently in daily life. For example, when standing on a busy street corner, we monitor the position and velocity of moving targets in the environment (e.g., cars, pedestrians) to determine a safe time to cross. Despite the frequency of this occurrence, this area of research has only become prominent in the last 25 years (e.g., Ebersbach et al., 1995; Kerr et al., 1985; Lajoie et al., 1993; Shumway-Cook et al., 1997). This may be in part due to the prior notion that some motor tasks (e.g., walking or standing) are automatic and thus were assumed to require relatively little attention to perform (Courtine et al., 2006; Hof, 2008; Winter, 1995). However, our understanding of this relationship and its complexities has begun to shift with advancements in measurement techniques; it is now possible to use high-speed 3D motion capture cameras and force plates under the base of support to track subtle movement of body segments and estimate postural sway through measures of whole-body center of mass (CoM) and center of pressure (CoP) oscillations during postural tasks (Paillard & Noé, 2015; Winter, 1995). These metrics have revealed that postural tasks do require some attention to be performed successfully (Ebersbach et al., 1995; Kerr et al., 1985; Lajoie et al., 1993; Shumway-Cook et al., 1997) and that visual input provides critical position and velocity cues to improve human standing balance, reduce sway variability, as well as produce appropriate sway responses following an external disturbance (Assländer et al., 2015).

Although past research has examined the effects of a cognitive task on balance (Li et al., 2018; Smith et al., 2019) observed, dual-task effects vary (see review by Bayot et al., 2018). While some studies report that concurrent motor and cognitive task execution leads to performance decrements in either one or more tasks (Koch et al., 2018), others have found minimal impact (e.g., Caron et al., 2022) or even evidence of performance advantages in one or both tasks (e.g., Bonnet & Baudry, 2016). Several mechanisms behind changes in task performance under dual-task constraints have been proposed in the literature (e.g., Bottleneck theories, Broadbent, 1958; Capacity Sharing, Tombu & Jolicœur, 2003; Cross-talk model, Navon & Miller, 1987), however the existing research quantifying the specific structural interference imposed by visuocognitive tasks on standing balance has been limited. Furthermore,

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inconsistencies in study perspectives (e.g., the study of different populations) and a lack of standardized experimental protocols (e.g., the nature of the cognitive and motor tasks performed, measurement of task performance, etc.) make interpretation of results across studies challenging. To cite just a few, cognitive tasks studied in recent years have ranged from relatively simple (e.g., probe reaction time tests: H.-C. Chen et al., 1996; Lajoie et al., 1993; Wellmon et al., 2013) to attentionally demanding (Stroop tests, working memory tasks: Schaefer et al., 2008; Siu et al., 2008; Worden & Vallis, 2014) and vary greatly in the amount of visual attention required for successful task performance. Of the studies that have implemented a visuocognitive task, performance is seldom quantified in both tasks, further limiting the assessment of dual-task impacts.

The present study was designed to investigate the role of visual attention in balance and quantify the dual-task impact by measuring performance in both the cognitive and motor task. To this end, we implemented a dual-task paradigm where participants performed a sustained visual attention task during stance. The multiple-object tracking (MOT) task (Pylyshyn & Storm, 1988) was selected as the visuocognitive task as it provides an effective means of studying sustained visual attention in the laboratory setting (Meyerhoff et al., 2017). While a variety of different motor tasks have been found to interfere with MOT (see Meyerhoff et al., 2017), few studies to date have investigated the concurrent performance of the MOT task and a motor task requiring postural control; this knowledge is critical for our understanding of the role that visual attention plays in the maintenance of postural control.

Of these few, Thomas and Seiffert (2010) found evidence that self-motion impairs MOT. For example, MOT performance was better in conditions where participants walked in place as compared to when they walked to another location. They suggested that the spatial updating of one's body position required for self-motion may also be employed in object tracking. Faubert and Sidebottom (2012) had professional athletes train on a 3D MOT task while seated or standing and observed performance improvements over multiple training sessions. Specifically, starting speed thresholds and the learning progression slopes were higher for athletes who performed the MOT task while seated as compared to standing, which was interpreted as evidence of differing processes required to integrate perceptual-cognitive and motor responses based on the body posture. Overall, these studies provide some preliminary evidence that successful execution of the MOT task may involve visuocognitive processes that are also critical in maintaining standing balance such as selecting and monitoring the positions of moving objects relative to one's self over a period of time (spatial updating; Huff, Meyerhoff, et al., 2010; Meyerhoff et al., 2011; Thomas & Seiffert, 2010). Unfortunately, kinematic and/or kinetic data were not captured in many of these earlier studies; as a result, it is currently unknown if changes in postural control strategies occurred during these dual-task scenarios.

The aim of the present study was to assess the role of sustained visual attention in the maintenance of postural control and determine if the two processes employ a shared, visuocognitive process. Participants tracked three targets in MOT for 1 min while seated or standing at three different object movement speeds. Task difficulty was modulated by increasing the object movement speed of the MOT task (e.g., Alvarez & Franconeri, 2007; Faubert & Sidebottom, 2012). Performance in the MOT task was measured as tracking capacity, and the postural task performance was measured by tracking whole-body movements using 3D motion tracking and a point location of the forces generated under the participant's feet (via a force plate).

We hypothesized that if MOT and postural control employ a shared, limited-capacity cognitive resource (e.g., a spatial updating mechanism), then performing the two tasks concurrently should result in decreased performance in the cognitive and/or postural tasks. Higher root mean square (RMS) distance values, increased CoM–CoP Max difference values, and a lower correlation value between the center of pressure (CoP) and center of mass (CoM) in the dual-task conditions (postural task + tracking) as compared to single-task (postural task alone) would be indicative of reduced postural control for these experimental conditions. Additionally, we expected postural task performance to decline (higher RMS distance values) for both the center of mass and center of pressure movement as the speed of object movement in the MOT task increased (increase in task difficulty). As demonstrated in past studies, we also expected a decrease in MOT tracking capacity as the object movement speed increased, as the speed manipulation would challenge participants' ability to visually track target movement. Overall, if MOT and postural control processes rely on a shared cognitive resource, tracking capacity and/or postural task performance should decline with increased MOT task difficulty.

Methods

Participants and Inclusion Criteria

Healthy university-aged participants were recruited from the University of Guelph ($N = 12$; six males, age: 21 ± 1.48 years, height: 1.62 ± 0.11 m, and weight: 66.23 ± 19.23 kg). It was required that all participants had no known pre-existing self-reported musculoskeletal, neurological, and cardiovascular conditions. The study design was approved by the institutional research ethics board (REB#16OC006), and all participants gave written consent to participate. An *a priori* power analysis estimated that we would require 10–12 participants to detect a main effect of object movement speed on tracking capacity and postural control metrics in a one-factor repeated measures ANOVA with 3–4 levels (α = .05, Cohen's f = 0.40, correlation among repeated measures = .50, ε = 1), assuming large effect sizes for consistency with previous studies (e.g., Faubert & Sidebottom, 2012; Huff, Papenmeier, et al., 2010; Rosenbaum et al., 2017).

Multiple-Object Tracking (MOT) Task

Participants completed the *Catch the Spies* version of the MOT task (Trick et al., 2005), which included the same item movement specifications as the original study. The MOT task was displayed on a 105.4 cm high by 78.7 cm tall projector screen located 4.26 m away from the participant. The total viewing angle for the participants was 14° (horizontal axis) × 10.6° (vertical axis). Overall, the goal was to track the three targets (disguised spies) as accurately as possible as they moved among the three identical distractors. At the beginning of each trial during *initialization,* six blue happy faces appeared on the screen. Following this, *target acquisition* would occur where three of the happy faces would flash back and forth between spies and happy faces to identify their target status. Next was the *motion phase* where all the objects would appear as blue happy faces and move randomly and independently of one another for 60 s. During the *motion phase*, the objects would move at one of three base speeds: 2.77°/s (20.7 cm/s) in the slow condition, 4.62°/s (34.5 cm/s) in the medium condition, and 6.47°/s (48.3 cm/s) in the fast condition. After 60 s of movement, all the items would stop moving and the *report* phase would occur in which participants would verbally instruct a research assistant which items they believed were the targets. The research assistant would then use a mouse to click on the instructed items, and the participant confirmed the selection was correct prior to submission. The number of targets correctly reported was recorded. Participants were always required to select three targets and therefore were encouraged to make their best guess of a target location if they were unsure.

Biomechanical Experimental Setup

At the start of every trial, participants were asked to stand on a force plate in a comfortable, natural stance width for all trials; participant's feet were traced on paper fixed to the platform, to ensure consistency (1,200 Hz; ACCUGait, Advanced Mechanical Technology Inc., MA, USA). Participants were also instrumented with kinematic retroreflective markers placed over key anatomical landmarks [bilateral ear canal (head segment), bilateral acromion processes and xyphoid (trunk segment), bilateral iliac crests and anterior superior iliac spine (pelvis segment), bilateral malleoli, great toe, and calcanei]. Kinematic markers were sampled at 120 Hz using an Optitrack kinematic system (Natural Point Inc., OR, USA), and all kinematic was recorded using Motive software (Natural Point Inc., OR, USA). Participants were instructed to track the targets as accurately as possible.

Experimental Protocol

The experiment took place in three parts: (1) familiarization trials, (2) MOT task while seated, and (3) MOT task while standing (see Figure 1). First, participants completed 12 familiarization trials to orient them to the MOT task. Familiarization involved two trials at each object speed (slow, medium, fast) for each posture (seated, standing). During the remaining experimental trials, the task order was counterbalanced such that participants with odd numbered participant codes completed the block of standing trials first and those with even numbers completed the seated trials first. Both the seated and standing blocks contained 24 trials: 21 dual-task trials containing both a postural and cognitive task (7 trials at each object movement speed in a randomized order) and three control postural trials with no cognitive task (Trials 7, 14, and 21). In the standing trials, participants were instructed to stand comfortable in their natural stance and remain as still as possible throughout the trial. During the practice trials, an outline of their feet was traced on a paper fixed to the platform to ensure consistency. Participants were encouraged to take physical and visual/mental breaks between trials by stepping off the platform, extending and flexing their limbs, taking a sip of water, etc.

Data Processing

Quantifying MOT Task Performance

Control postural trials did not have a cognitive task component; thus, there are no MOT accuracy measures to calculate or report. For all other trials, tracking accuracy in the MOT task was converted into *tracking capacity* (k), a measure of the number of targets actually tracked, using a high-threshold guessing model (Hulleman, 2005). In this model, n represents the total number of items in the display (always six here), c represents the number of

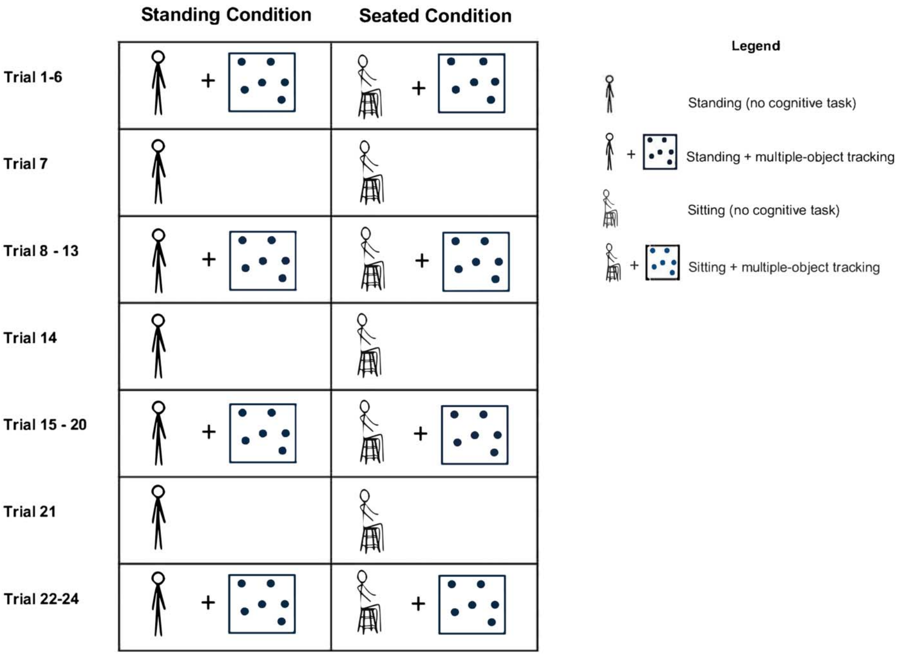

Figure 1. Overview of the experimental procedure. After completing the familiarization trials, participants completed the Standing and Seated conditions in a counterbalanced order. For both blocks of trials, 24 trials lasting 1 min each were completed (*N* = 48 total). Twenty-one trials were dual-task trials in which participants completed the multiple-object tracking (MOT) task while standing or seated. In the other three trials (Trials 7, 14, or 21), participants completed *control* postural trials which involved standing or sitting alone with no cognitive task component (no MOT task).

targets that were correctly tracked, and t represents the number of total targets (always three here).

$$k = \frac{nc - t^2}{n + c - 2t}\,. \tag{1}$$

Kinematic Data

For kinematic data, all gaps of less than 10 frames (0.0833 s) were interpolated using the cubic function within Motive. All further analyses were completed using a custom written MATLAB program (Mathworks Inc., MA, USA). Both kinetic and kinematic data were filtered using a second-order dual-pass 8 Hz low pass Butterworth filter. Kinetic data were then downsampled (to 120 Hz); the first and final 5 s of data were not analyzed as these regions contained the initiation and termination of the cognitive task, and it has been previously shown that the initial phase of force plate data collection contains more high frequency motion (van der Kooij et al., 2011). All kinetic metrics were analyzed using the 50 remaining seconds; kinematic data were then windowed for the same time period. CoP was then calculated (see Winter, 1995) as well as a three-segment weighted average of the CoM (head, trunk, and pelvis, adapted from Inkol et al., 2018).

Past research exploring postural control during standing tasks has modeled the body as a rigid inverted pendulum that rotates around the ankle joint (Winter, 1995). When the CoM moves beyond some *acceptable range*, the CoP responds by moving past the CoM to reverse the angular acceleration of the body. We included a measure of the difference between the maximum values for CoM and CoP (i.e., CoM–CoP Max) in this study as it has been observed that when the body is modeled as an inverted pendulum model, the (CoM–CoP max) metric was highly correlated to the horizontal acceleration of the whole-body CoM in the ML and AP directions and is therefore often thought of as the *error* of the postural control system, thereby providing important insight into the postural control system (Choi & Kim, 2009). Mediolateral (ML) and anterior–posterior (AP) root mean square distance (CoP RMS distance) was also calculated (for calculations please see, Lee & Sun, 2018; Prieto et al., 1996) as this measure has been reported to show strong discriminability in postural control for different balance conditions, in addition to age-related changes and pathological conditions (Bonke et al., 2023; Zaback et al., 2021). Due to the relationship outlined above between the CoP and CoM, past work in the area has demonstrated that a high RMS value is indicative of poor postural control and an increased risk of falling in certain populations (see review paper from B. Chen et al., 2021 for details). Finally, a Pearson's correlation coefficient was then calculated between the CoM and CoP time series signals for each trial in both AP and ML direction so that we could explore the strength of the relationship between these variables.

Statistical Analyses

The Greenhouse Geisser correction was applied in cases where Mauchly's test provided evidence that sphericity was violated. In cases where a significant effect of object motion speed was found, paired *t*-tests were conducted. Bonferroni corrections were applied to the *p*-values.

Significant differences between sitting and standing postural measures have been observed in the past due to biomechanical and the dynamic difference of body portions in motion during quiet sitting and standing (Vette et al., 2010). Consequently, our statistical analyses focused on the effect of object movement speed (slow, medium, fast) *within* each posture instead of across the two postures.

Results

Did Object Movement Speed Impact MOT Tracking Capacity?

MOT task data for the sitting condition were lost for a single participant due to a program malfunction. Overall, the object movement speed manipulation was successful in increasing MOT task difficulty. One-way repeated-measures ANOVAs revealed a significant main effect of object movement speed (slow, medium, fast) on *tracking capacity* in both the seated and standing conditions (seated: $F(2,20) = 5.24$, $p = .015$, $\eta^2 = .34$, standing: $F(2,22) = 7.86$, $p = .003$, $\eta^2 = .42$; Figure 2). Post hoc analyses determined that for both the standing and seated conditions, tracking accuracy was significantly higher when object movement was slow as compared to fast (seated: $p = .035$, standing: $p = .032$). In the standing condition, tracking accuracy was also significantly higher when object movement was at the medium speed as compared to fast ($p = .023$). All other comparisons were not statistically significant.

Did Object Movement Speed Impact Kinetic and Kinematic Postural Measures?

Overall, we observed a modest impact of MOT object movement speed (no MOT, slow, medium, fast) on postural measures (see Tables 1 and 2); our young adult participants did not lose their balance or fall when performing the MOT task at varying speeds. No statistically significant findings were observed for the CoM or CoP RMS distance metrics calculated ($p > .05$).

In the seated conditions, a main effect of object movement speed was observed for *AP CoM–CoP Max* ($p = .021$). Though this finding was statistically significant, it is important to note that the magnitude of the difference was quite small and likely driven by slight differences in standard error (see Table 1). The effect of object movement speed was not significant for any of the other variables (see Table 1).

In the standing conditions, a main effect of object movement speed was also observed for *AP CoM/CoP correlation* ($p = .002$). The correlation metric was significantly greater for the control quiet standing condition (none) compared to the slow ($p = .043$), medium ($p = .004$), and fast speeds ($p = .003$). The effect of speed was not significant for any of the other variables (see Table 2).

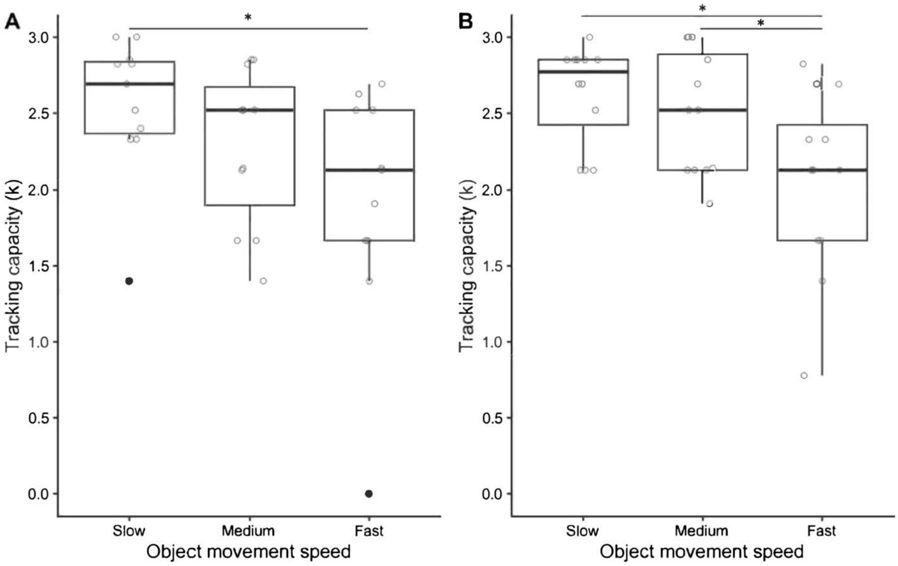

Figure 2. Boxplots of tracking capacity (*k*) in the multiple-object tracking task as a function of the object movement speed (slow, medium, fast). White circles with gray outlines depict individual data points. Black whiskers extend from the first and third quartiles to the minimum and maximum values within 1.5 times the interquartile range. Whisker length is restricted to 1.5 times the interquartile range, and black-filled circles indicate extreme values outside this range. Exclusion of these extreme data points did not meaningfully impact the results; thus, they were included in the analyses. (A) In the seated conditions, tracking capacity was significantly higher when tracking at the slow speed as compared to the fast speed ($p = .035$). (B) In the standing conditions, tracking capacity was significantly higher at the slow speed and medium speed as compared to the fast speed (slow: $p = .032$, medium: $p = .023$). Statistical significance noted by * at $p < .05$.

Table 1. Summary of the kinetic and kinematic dependent variables calculated for the seated conditions (in bold)

			Multiple-object tracking task speed				ANOVA result		
Variable	Direction		None	Slow	Medium	Fast	*F*	*p*	η^2
CoM–CoP Max (mm)	ML	*M*	.0023	.0034	.0028	.0040	1.94	.183	0.16
		SE	.0004	.0005	.0003	.0007			
	AP	***M***	**.0034**	**.0053**	**.0043**	**.0053**	**3.74**	**.021**	**0.27**
		SE	.0003	.0008	.0003	.0006			
CoP RMS distance (mm)	ML	*M*	.0101	.0101	.0092	.0096	1.42	.256	0.12
		SE	.0028	.0029	.0031	.0031			
	AP	*M*	.0478	.0450	.0463	.0457	0.23	.874	0.02
		SE	.0060	.0046	.0055	.0048			
CoM RMS distance (mm)	ML	*M*	.0245	.0243	.0242	.0243	2.32	.095	0.19
		SE	.0003	.0003	.0003	.0033			
	AP	*M*	.0195	.0198	.0196	.0199	2.29	.833	0.03
		SE	.0008	.0009	.0111	.0100			
CoM/CoP correlation	ML	*M*	.687	.699	.686	.702	0.28	.836	0.03
		SE	.022	.021	.025	.024			
	AP	*M*	.768	.819	.829	.797	2.01	.169	0.17
		SE	.024	.023	.019	.019			

Note. The mean (*M*) and standard error (*SE*) for each speed condition is presented. The *F* value, *p*-value, and effect size (η^2) are reported from each repeated-measures ANOVA; bolded values indicate statistical significance $p < .05$

Table 2. Summary of the kinetic and kinematic dependent variables calculated for the standing conditions (in bold)

			Multiple-object tracking task speed				ANOVA result		
Variable			None	Slow	Medium	Fast	*F*	*p* value	η^2
CoM–CoP Max (mm)	ML	*M*	0.0030	0.0034	0.0032	0.0033	1.21	.322	0.10
		SE	0.0003	0.0002	0.0002	0.0002			
	AP	*M*	0.0054	0.0053	0.0051	0.0050	0.69	.565	0.06
		SE	0.0004	0.0004	0.0003	0.0003			
CoP RMS distance (mm)	ML	*M*	0.0192	0.0189	0.0187	0.0179	0.56	.562	0.05
		SE	0.0027	0.0027	0.0030	0.0028			
	AP	*M*	0.0379	0.0408	0.0386	0.0390	1.79	.167	0.14
		SE	0.0047	0.0048	0.0044	0.0047			
CoM RMS distance (mm)	ML	*M*	0.0250	0.0250	0.0250	0.0250	1.32	.287	0.11
		SE	0.0003	0.0003	0.0003	0.0003			
	AP	*M*	0.0292	0.0287	0.0289	0.0290	2.33	.133	0.17
		SE	0.0010	0.0009	0.0009	0.0009			
CoM/CoP correlation	ML	*M*	0.879	0.870	0.881	0.868	0.38	.769	0.03
		SE	0.017	0.018	0.022	0.027			
	AP	***M***	**0.965**	**0.935**	**0.934**	**0.944**	**9.42**	**.002**	**0.46**
		SE	0.053	0.050	0.047	0.049			

Note. The mean and standard error for each speed condition is presented. The *F* value, *p*-value, and effect size (η^2) are reported from each repeated-measures ANOVA; bolded values indicate statistical significance $p < .05$.

Combined visuocognitive and motor task performance results suggest that when young adults are required to sustain their visual attention and maintain stable, upright posture they prioritize postural control over visuocognitive task performance.

Discussion

In both the seated and standing conditions, performance in the MOT task aligned with our predictions in that tracking capacity declined as the speed of object movement increased. Tracking capacity at the slow speed was found to be significantly higher than at the fast speed where participants performed as if they were tracking two targets and guessing the location of the third (see Figure 2). These results demonstrate that our speed manipulation sufficiently increased attentional demands of the MOT task, aligning with previous research (for a review, see Meyerhoff et al., 2017).

While object movement speed had a significant effect on MOT task performance, the kinematic and kinetic results demonstrated a modest impairment of postural control metrics contrary to what was predicted. In the seated trials, a significant effect of object movement speed was only observed in the AP difference between CoM and CoP (CoM–CoP Max). However, it is important to note that the magnitude of this difference was in fact quite small (see Table 1). In the standing trials, a significant effect of object movement speed was only observed in the AP correlation between the CoM and CoP. Overall, these findings demonstrate that our young adults were able to maintain postural control and not fall, despite increases in attentional demands of the MOT task.

While we observed a modest impairment of postural control in the dual-task standing trials, the magnitude of this impairment is small and thus provides limited evidence of task interference. Berger and Bernard-Demanze (2011) also found minimal interference between tasks, reporting improved postural stance (e.g., decreased mean velocity and area of CoP–CoM) in younger adults along the AP axis during their visuospatial task (a 3D construction of 12 cubes). The authors attributed these improvements in postural control due to saccadic eye movements that may have had a stabilizing effect on postural control. In line with this idea, several findings in the MOT literature provide evidence of a *center-looking* strategy used to successfully track the targets in MOT (e.g., Fehd & Seiffert, 2008), in which individuals tend to look toward the center of the shape formed by the targets they are tracking. It is possible that this center-looking strategy used to track the targets in MOT may have actually facilitated performance in the postural tasks, which could help to explain the minimal impact on postural control reported in the present study. Furthermore, there is some suggestion that center-looking time increases with increases in object movement speed in the MOT task, which could explain why many of the postural metrics did not change with speed increases (e.g., Huff, Papenmeier, et al., 2010). Unfortunately, we did not collect data related to eye/visual gaze during our paradigm, and thus, we are unable to comment on how eye movements might have impacted balance control; however, this would be an interesting addition for future research paradigms in the area.

The increasing attentional demands of our MOT task, as demonstrated by the significant decline in tracking capacity, may have promoted a *posture-first strategy* in our young adult population. Participants may use a *stiffening* strategy to fuse their body segments to reduce the number of degrees of freedom they are required to control, essentially directing attentional resources to the postural task as the visuocognitive task increases in difficulty. Our observations related to the impact of tracking speed on postural control could be, in part, a limitation of the smaller sample size. However this explanation seems less likely given that the reported effect sizes are for the most part moderate to large given Cohen's standards (Cohen, 1988), and the obtained sample size is comparable to previous work in the field (Schaefer et al., 2008; Siu et al., 2008; Smith et al., 2019). Another possible explanation is that MOT and postural control employ independent resources and thus do not interfere with one another when performed concurrently. While we cannot rule out this alternative without an MOT-alone experimental condition, this explanation seems unlikely given findings that previous literature has stated that visual attention is required for the maintenance of postural control (e.g., Assländer et al., 2015; Ebersbach et al., 1995; Kerr et al., 1985; Lajoie et al., 1993).

Overall, the observed minimal changes in postural control strategies used for the different MOT speeds in the present study suggest that the *error* between CoM and CoP signals is quite small, which is in turn, indicative of good postural control in our young adult population. Future work could investigate the impact of other tasks requiring increased postural control demands, for example, balancing on an altered support surface (foam) or balancing on a reduced base of support (single leg stance) while simultaneously performing the MOT visuocognitive task to assess postural control strategies under these more complex dual-task scenarios.

A possible limitation to our center of mass estimations is that we used a simple inverted pendulum model to characterize postural sway as we assumed a low frequency and small angular displacement of the CoM; multilink models based on motion tracking of additional body segments might be more sensitive to subtle changes in control strategies during our task. In addition, while RMS calculations have been used by many researchers in the field (Bonke et al., 2023; Zaback et al., 2021) and are considered to be valid measures to track changes in postural control (for review article, please see B. Chen et al., 2021), we do acknowledge that due to the nature of the mathematical calculations, RMS values must be carefully interpreted.

In summary, the results of the present study demonstrate the utility of the MOT task in understanding the role of visual attention in postural control. Here we observed modest changes in postural control for both the standing and seated conditions demonstrating that our young adult participants were able to compensate for the increased attentional demands required to complete a sustained visual attention task; minimal changes to CoP and CoM control parameters were required to maintain their upright stance. The efficacy of the MOT task to assess dual task costs for the execution of visuocognitive tasks in special populations will be explored in future paradigms in our laboratory.

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The authors declare no conflicts of interest.

Open Data
To the best of my ability and knowledge, I have provided all original materials and clear references to all other materials via a stable online repository.

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