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Texting and walking: Effect of environmental setting and task prioritization on dual-task interference in healthy young adults

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ABSTRACT

Recent studies have shown that young adults significantly reduce their gait speed and weave more when texting while walking. Previous research has not examined the simultaneous dual-task effects on texting performance, therefore, the attention prioritization strategy used by young adults while texting and walking is not currently known. Moreover, it is not known whether laboratory-based studies accurately reflect texting and walking performance in the real world. This study compared dual-task interference during texting and walking between laboratory and real-world settings, and examined the ability of young adults to flexibly prioritize their attention between the two tasks in each environment. Texting and walking were assessed in single-task and three dual-task conditions (no-priority, gait-priority, texting-priority) in the lab and a University Student Center, in 32 healthy young adults. Dual-task effects on gait speed, texting speed, and texting accuracy were significant, but did not significantly differ between the two environments. Young adults were able to flexibly prioritize their attention between texting and walking, according to specific instruction, and this ability was not influenced by environmental setting. In the absence of instructions, young adults prioritized the texting task in the low-distraction environment, but displayed more equal focus between tasks in the real world. The finding that young adults do not significantly modify their texting and walking behavior in high-distraction environments lends weight to growing concerns about cell phone use and pedestrian safety.

1. Introduction

Although laboratory-based studies have demonstrated that young adults are relatively resilient to dual-task interference during walking [1,2], emerging research suggests that the safety of young adults may be compromised during distracted walking in the real world, especially when walking while texting or talking on a cell phone [3–6]. Compared to undistracted pedestrians, individuals talking on a cell phone notice significantly fewer objects in their surrounding environment [4,7]. Reduced situational awareness, or inattention blindness [7], may be contributing to the increasing number of accidents and injuries reported during cell phone use while walking [8,9]. Furthermore, young adults using a cell phone demonstrate more risky behavior when crossing a street (e.g., more hits by virtual vehicles) than those not distracted by a cell phone conversation [4,6,10,11] or texting [5].

Texting while walking may increase safety risks and produce greater decrements in gait than talking while walking due to the visual attention and added motor demands required for reading and typing, in addition to the cognitive processes required for the communication interchanges [5]. Indeed, research demonstrates larger decreases in gait velocity and greater lateral deviation in young adults walking and texting compared to those walking and talking [3] or reading text [12]. Nonetheless, young adults talking on a cell phone while walking on a university campus slow down, change direction, and weave more, than those not using cell phones or other electronic devices [7].

Existing research provides insight into gait characteristics while texting, but none of the studies has reported the simultaneous dual-task effects on texting performance. Therefore, it is presently not known how young adults prioritize their attention during texting and walking. To accurately interpret dual-task interference it is imperative to measure single and dual-task performance in both tasks [13]. Thus, the purpose of this study was to comprehensively examine dual-task interference on texting and

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walking in healthy young adults. The specific aims were to (1) compare dual-task interference during texting and walking between the laboratory and a real-world setting, and (2) examine the ability of young adults to flexibly prioritize attention while texting and walking in each environment. To address our aims, we adopted the paradigm of Kelly et al. [14] with three critical differences: instead of "usual" and "challenging" lab-based gait tasks we compared walking in the lab with walking in the "real world;" we used texting as the non-gait secondary task, arguably the most relevant dual-task for young adults; finally, we used a "no-priority" dual-task condition instead of "equal focus" to investigate how young adults spontaneously prioritize attention in each environment. We expected dual-task interference to be greater in the real world than in the laboratory due to increased attentional demands required to safely navigate an open environment, and that the ability to flexibly shift attention between the two tasks would be reduced in the real world.

2. Methods

2.1. Participants

Thirty-two healthy young adults were recruited from the University community. Participants had to be 18–30 years old, fluent in English, regular users of a touch-screen Smart Phone, report familiarity with text-messaging, and have normal or corrected-to-normal vision. Individuals were ineligible if they reported a history of medical illness or hospitalization in the last 6 months, diagnosis of neurological disease, vestibular dysfunction, pain or other condition limiting walking or the ability to text on a mobile phone. Two brief questionnaires evaluated typical cell phone usage and texting habits. The study was approved by the local Institutional Review Board University and all participants provided written informed consent.

2.2. Procedures

Participants were assessed in single and dual-task conditions in the research laboratory and a real-world setting (University Student Center). In each environment, all participants performed each task: (1) texting while standing (single-task texting), (2) walking at preferred speed (single-task walking), (3) walking while texting, without specific instruction to prioritize either task (dual-task no-priority), (4) walking while texting with instruction to focus on walking (dual-task gait-priority), and (5) walking while texting with instruction to focus on texting (dual-task texting-priority). Order of the environment was counterbalanced. The dual-task no-priority condition was performed before the gait-priority and texting-priority conditions to minimize the effect of instructions on no-priority performance [14]. Order of gait-priority and texting-priority conditions was quasi-randomized. Single-tasks were performed before dual-tasks. Each task was repeated twice in each setting and the average of the two trials was used for analysis.

A freely available iPhone application, "My Speed," was used for the texting task. Participants were instructed to type the phrase that appeared on the screen as quickly and as accurately as possible into the textbox below the phrase. The texting keyboard was the typical iPhone (QWERTY) keyboard. The software did not permit any errors, nor did it perform autocorrect or autofill operations. Thus, participants were required to type every character and correct any errors. Participants were alerted to an error by a change in text color from black to red, and vibration of the phone. At the completion of the task, the software displayed the texting speed (characters per minute), error rate (%), and duration (s), which were recorded by the experimenters. Participants first underwent a familiarization period with the texting program sitting in the lab (minimum of 5 texting trials, until stability in speed and accuracy were observed). All participants used the same iPhone for the experiment.

The gait task involved continuous straight-line walking along a 30-m walkway in each environment. Spatiotemporal gait data were acquired using a 5-node a body-worn sensor system (BioSensics, Cambridge, MA), comprising 5 inertial measurement units attached via Velcro straps to the anterior surface of each shin and thigh, and posteriorly on the low back. The system uses a two-link inversed pendulum model based on the participant's height to determine spatiotemporal gait parameters [15]. Reliability and validity have been established in several publications [16–18].

The laboratory environment was a quiet corridor immediately outside the research lab. It had firm, tiled flooring and was neighbored by faculty office suites with infrequent foot-traffic. The real-world environment was an indoor walkway in the University Student Center, with firm, low-pile carpeted flooring. In contrast to the lab setting, the area was a busy pedestrian thoroughfare, with ATMs and a cafeteria on one side and a bookstore and restrooms on the other side; participants traversed through sliding doors at each end of the defined walkway.

For the dual-task conditions, participants were instructed to text and walk, and to stop walking as soon as they completed the phrase (ensuring that gait data represented dual-tasking). In the no-priority dual-task condition, participants were not given any instruction regarding which task to prioritize. In the gait-priority condition, participants were instructed to focus mainly on their walking so that they were walking as they did when they were not texting. Conversely, in the texting-priority condition, participants were instructed to focus mainly on texting so that they were texting as fast and as accurately as they did when they were not walking. Performances were videotaped and later coded for density of pedestrian traffic (number of people that walked passed or directly across the path of the participant), collisions or near collisions (number of contacts/near contacts with another person), path adjustment (number of times the participant deviated to avoid a collision, not including spontaneous weaving), and situational awareness (number of times the person looked up from the phone while walking).

2.3. Statistical analysis and sample size

The effect of environmental setting on dual-task interference (Aim 1) was first analyzed by applying a repeated measures ANOVA with Environment (lab, real world) and Task (single-task, dual-task no-priority) to gait speed (m/s), texting speed (characters per minute) and texting accuracy (%). We also compared the relative dual-task effects (DTE, percent change in performance in the dual-task condition relative to the single-task condition) between the lab and the real world on gait speed (DTE_g) and texting performance (DTE_t) using paired *t*-tests. We summed texting speed and accuracy DTE to compute an overall texting DTE, thereby accounting for speed-accuracy tradeoffs within the texting task [19]. Negative DTE values indicate performance deterioration, or a dual-task cost, while positive values indicate an improvement, or dual-task benefit. Instructed prioritization effects (Aim 2) were examined using an Environment (lab, real world) × Instructions (no-priority, gait-priority, texting-priority) repeated measures ANOVA for gait speed, texting speed, texting accuracy, DTE_g, and DTE_t. Analyses were performed using SPSS 16.0 (SPSS Inc., Chicago, IL).

The study was powered to detect a large standardized effect size for the interaction effect on gait speed between Environment and Task (Aim 1), since small or moderate effect sizes would generally be of limited practical importance for healthy young adults. Based on Type I error rate of 5% and Type II error rate of 20%