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THE EFFECTS OF MOBILITY RELATED ANXIETY AND A COMMON DUAL TASK ON TURNING KINEMATICS: A VIRTUAL REALITY STUDY

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Introduction

Walking while talking is a common every day dual-task (DT). However, mobility-related anxiety impairs cognitive-motor behaviors [1]. Healthy adults must flexibly trade-off cognitive and motor performance when speaking conversationally during complex walking tasks, and slow gait speed to continue speaking [2]. Therefore, performing a DT may be more challenging in anxiety-inducing settings, leading to impaired turning and speech performance. The purpose of this study was to investigate the effects of mobility-related anxiety on conversational speech performance when turning. We required healthy adults to perform a DT (walking and talking) at simulated low and high virtual heights using Virtual Reality (VR). We measured peak velocity and duration of turning, as well as silent pause number and duration during speech. We hypothesized that performing a DT while turning would lead to greater performance deficits at high compared to low height, reflected as slower and longer turns, and more frequent and longer silent pauses in speech.

Methods

Seven young adults with corrected to normal vision and hearing and no neurological diagnoses that affect gait participated (Age = 22.11 yrs, SD = 2.57 yrs). They wore a head-mounted VR system (HTC Vive v. 2.0) displaying a 0.4 x 5.2m virtual walkway matched to a physical walkway. Participants wore tri-axial inertial sensors (version 1.0, APDM Inc, Portland, OR, USA) on the sternum, lumbar, and both feet and wrists, to measure accelerations at 128 Hz, recording peak turn velocity and turn duration. Foot trackers (HTC Vive) worn around the ankle provided visual representations of their feet in VR. Participants performed six tasks with or without speech, where they walked back and forth on a walkway for one minute at a normal comfortable pace, beginning with a baseline walk (No VR). Participants were then randomly assigned to perform the VR or DT Block protocol. The DT Block began by choosing several topics (e.g., family, favorite sport) from a list of 21 provided. Participants performed a baseline speech task while seated (ST), before performing the gait and speech tasks (DT) in VR. Each task consisted of a different randomly assigned speech topic from their selections. Participants' responses were recorded using a wireless microphone (Movo, WMX-1). The recordings of the speech tasks were transcribed and the waveform and spectrogram were analyzed in Praat (v 6.1.3) to identify pauses (>150ms) in speech. Each block of VR trials began at low height, before participants were transported to high height (15 m) while seated in a chair moving at 1 m/s. After each trial, they completed the Rating Scale of Mental Effort (RSME) [3], and the Mental Readiness Form (MRF) [4]. To better understand the interaction between mobility-related anxiety and DT on peak turning velocity, turn duration, and silent speech pause f and duration,

we calculated Hedge's *g* to reveal effect sizes when comparing low walk to low DT walk, high walk to high DT walk, ST speech to DT low speech and ST speech to DT high speech.

Results and Discussion

The analysis revealed a medium to large effect of DT at low height on turning duration (Low = 2.24s, Low DT = 2.40s; g = -0.67), but not for peak turning velocity (Low = 157.91°/s, Low DT = 150.67°/s; g = 0.34). A minimal effect of DT was detected on the duration of speech pauses (ST = 2.73s, Low DT = 2.39s; g = 0.047), and number of speech pauses (ST = 17.6, Low DT = 18.8; g = 0.24). The results suggest that the DT was challenging enough to increase the duration of turns and speech pauses, even at low height. At high height, there was no effect of mobility-related anxiety on turning duration (High = 2.61s, High DT = 2.63s; g = 0.10), but a medium to large effect was detected on peak turning velocity (High = 139.73°/s, High DT = 121.94°/s; g = 0.50). Mobility-related anxiety had a large effect on the duration of speech pauses (ST = 2.73s, High DT = 2.22s; g = 0.93), and a medium to large effect on the number of speech pauses (ST = 17.6, High DT = 20.0; g = 0.54). The results support that mobility-related anxiety influences DT performance so that participants adjust the motor task (slow peak turning velocity), and interrupt conversational speech (longer and more frequent pauses).

Our findings suggest that speaking conversationally in anxiety-inducing settings hindered turning and speech performance in healthy participants. In non-threatening settings (low height) the DT was challenging enough to slow turning duration and moderately degrade conversational speech performance. In the high height condition, participants were unable to achieve the same peak turning velocity as at low height. Although the motor and cognitive demands remained the same, motor kinematics changed and speech performance declined at high height, supporting the negative effect of mobility-related anxiety on cognitive-motor processes during turning [2]. Participants were not willing to increase the duration of their turns at high elevation during the DT, but they slowed their turn velocity and exhibited greater interference in speech performance than during the DT at low height. Due to our limited sample size, further investigation is needed to examine the interaction between mobility-related anxiety and DT, and how it effects turning and conversational speech performance. In the future, we will target older adults at fall-risk who struggle to walk and talk simultaneously [5]. We plan to explore the influence of mobility-related anxiety and conversational speech on older adult mobility, furthering our understanding of the effects of mobility-related anxiety on everyday DT in high-risk populations.

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