THE EFFECT OF HANDRAIL LOCATION PREDICTABILITY ON COMPENSATORY ARM REACTIONS

Tyler B. Weaver, Lauren E. Hamilton & Craig D. Tokuno
Department of Kinesiology, Brock University, St. Catharines, ON, Canada, tw06jj@brocku.ca

INTRODUCTION
Studies examining the influence of age on compensatory arm reactions in response to a loss of balance suggest that older adults are unable to initiate arm movements as rapidly or with the same magnitude as the young [1]. However, these studies have often kept the handrail location unchanged throughout the duration of the study and explicitly instructed participants to reach for and grasp the handrail [2]. A limitation of such a set-up is that it allows participants to pre-program their reaching response prior to a loss of balance. This makes it difficult to determine if age-related changes in compensatory arm reactions are due to older adults having a decreased ability to pre-program their reaching response, or to a reduced ability to react and perform the compensatory reaching movement.

Therefore, the purpose of this study was to examine how age affects compensatory arm reactions when arm responses cannot be pre-programmed prior to a loss of balance. It was hypothesized that when participants cannot pre-program their reaching response due to an unpredictable handrail location, greater differences in compensatory arm reactions would be observed between young and older adults.

METHODS
Twelve young and 12 older adults were instructed to reach for a handrail as quickly as possible in response to a forward directed support surface translation. The handrail was located always on the participant’s right side (predictable) or either on their right or left side (unpredictable). The handrail location was made unpredictable by blocking the participant’s vision with liquid crystal goggles prior to the onset of each surface translation. However, vision was always returned at the onset of each surface translation.

Surface electrodes were placed on the posterior deltoid (PD) of the reaching arm, in order to quantify the muscle’s EMG onset latency and amplitude. The amplitude of EMG signal was calculated during the 200 ms after muscle onset. To facilitate comparisons between participants, all EMG amplitudes were later normalized as a percentage of each participant’s maximum voluntary contraction.

Three dimensional kinematic data of the reaching movement was also collected using a motion analysis system. A cluster of three infrared markers was placed on the participants’ right forearm. From this cluster of markers, the distal point of the right forearm (i.e., wrist) was tracked to measure the peak wrist velocity in the medio-lateral (M-L) and vertical directions.

RESULTS
When the handrail location was unpredictable compared to predictable, posterior deltoid arm responses were 15 ms later (p<0.001) and 7 % smaller in amplitude (p=0.010). Across both handrail predictability conditions, PD arm responses were also delayed by 15% (24 ms) in older compared to young adults (age main effect: p=0.003). However, no age x handrail predictability interaction effects were observed in any of the EMG variables, indicating that arm muscle activity from young and older adults were similarly influenced by changes in handrail predictability.

Altering the handrail predictability also influenced the kinematics of the compensatory arm reaction. An unpredictable compared to a predictable handrail location resulted in 30-35% smaller wrist M-L and vertical velocities (p<0.001). Although no age x handrail predictability interaction effects were observed in any of the kinematic variables, the wrist vertical velocity was found to be greater in older adults compared to young adults (p=0.017).

DISCUSSION AND CONCLUSIONS
Regardless of handrail predictability, older adults exhibited delayed muscle responses and a greater vertical wrist velocity compared to young adults. However, since both young and older adults were equally affected between the two handrail predictability conditions, age-related changes in compensatory arm reactions are not a result of older adults being unable to pre-program their arm responses. Experimental protocols employing an unpredictable handrail location do not provide any additional benefits when comparing compensatory arm reactions between young and older adults.

REFERENCES