How Older Adults Regulate Foot Placement during Walking with Visual Perturbations

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Summary

We explored how age affects mediolateral foot placement after visual perturbations during walking. Two different types of visual perturbation were applied. Compared to young adults, older adults were more affected by target tracking with head movement and less by object movements in the background. Our results suggest that scenarios involving head movements to track moving objects during walking may increase risks for older adults.

Introduction

Maintaining balance during walking requires controlling the body's center of mass (CoM) against the destabilizing effect of gravity. Older adults rely more on visual information to maintain balance, which may be one of the factors leading to their high fall risk [1]. Here we explored how older adults regulate their foot placement to maintain balance after visual perturbations. We hypothesized that older adults show larger responses to visual perturbations than younger adults.

Methods

Eleven healthy older and sixteen healthy younger participants were asked to walk on a treadmill at a speed of 3.6 km/h in different conditions: normal walking (NW), fixating on a stationary target while the background moved (MB), and tracking a target moving over a stationary background with head rotation (MT). Visual perturbations were created by projections on a screen 1.6m in front of participants and were always triggered at right heel strikes. Each perturbation included a moving phase (45 degrees right movement over 4s) and a stationary phase (8s). Pelvis (as a proxy of the CoM) and foot kinematic data were collected during measurement.

Results

Over the whole trial, CoM movement variability was significantly larger in older adults than in young adults. The foot and CoM trajectories during the visual perturbations are shown in Figure 1. During MB perturbations, the younger adults started a leftward deviation in the moving phase, while the older adults did not show a significant response in this condition. During MT perturbations, a rightward deviation of foot and CoM trajectories was observed in both younger and older groups. The older groups exhibited a larger deviation than the younger adults. Besides, older adults started to deviate in the moving phase, while younger adults responded in the stationary phase.

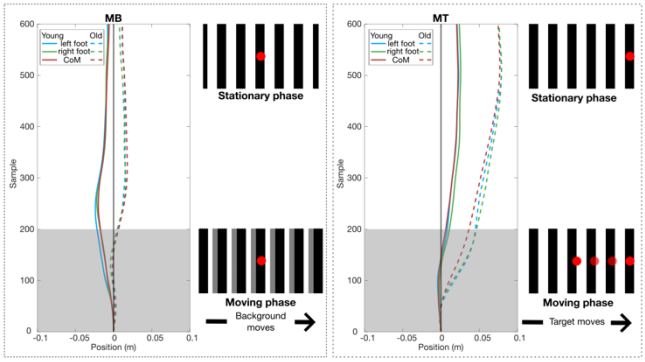

Figure 1: The trajectories of left and right feet and CoM in the MB (left panel) and MT (right panel) conditions.

Discussion

A larger CoM variability in older adults as compared to younger adults in all walking conditions indicated deteriorated balance control during walking. With aging, participants responded differently to the visual perturbations. The older adults were less sensitive to MB perturbations than the younger adults. This might indicate that their ability of detecting background motion is declined, which could be due to a decrease in peripheral vision [2]. However, the older adults were more sensitive to the MT condition than younger adults. Possibly, impaired peripheral vision decreased their ability to correct self-motion based on visual information derived from the stationary background [3].

Conclusions

Aging has a negative effect on walking performance. Older adults showed decreased sensitivity to background motions and increased sensitivity to foreground motions. Both may result from impaired peripheral vision and may increase fall risk due to difficulties in decreased visual perception of self-motion.

References

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