Individual, strategic and environmental effects on foot positioning performance

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1. Introduction
Trips and falls in the home environment are one of the most common injury events among the older adults. A majority of the cases occurred as one was not noticing the direction of movement or the surface that he/she was about to step on. This is related to the individual differences in nature, as well as whether the foot-eye coordination is properly adopted. In addition, relative position of the target to the body could be another contributor to the performance of foot positioning. Therefore, this study aims to investigate the individual, strategic, and environmental effects on foot positioning performance. Factors of interest include gender (male or female), positioning strategy (with or without foot-eye coordination), side of target (left or right), and positioning orientation (anterior or posterior). Following the differences in positioning time and positioning error, the affecting factors can be determined and related to the perceived exertion.

2. Method
Five males and five females with the ages between 20 and 24 years old participated in this study. Each participant had the visual acuity of 0.8 or higher and was with good mobility and balancing ability validated by the timed-up-and-go (TUG) test and the Borg balancing scale (BBS) test. Besides, all of them are right-foot dominant, so that the corresponding effects can be excluded. In the beginning, the participant stood on the centre point of a 2m x 2m region as the starting position. The positioning target was in the form of a foot print attached on the ground, which was in either anterior-lateral or posterior-lateral position to the participant. As the target position was presented to the participant, he/she moved either foot onto it as quickly and accurately as possible, while the other foot remained on the starting position. In order to simulate the condition in which the foot-eye coordination is not utilized, the participant was asked to wear a specially designed goggle to obscure the lower part of his/her field of view. In this case, the participant first lowered his/her head to see the target and then kept looking forward while performing the task. As each trial ended, the participant rated the perceived exertion from 0 to 10 following the OMNI RPE. Considering the factors of the participant’s gender, positioning strategy, side of target, and positioning orientation, this study employed a 2^3 factorial design with three replications. Dependent variables include positioning time (measured by a digital timer) and positioning error (measured by the electromagnetic tracking system with trackers being placed on the participant's shoes and on the target).

3. Results
No significant gender difference was found in terms of positioning time and positioning error. Considering the strategic effect on positioning error, the participant positioned the foot more accurately on the target while the foot-eye coordination was adopted. Besides, the positioning error was significantly smaller for the left-side target and the posterior target than the right-side target and the anterior target, respectively. Further, with regard to the strategic effect on positioning time, the participant tended to finish the task more quickly as the foot-eye coordination was adopted. Significant difference in positioning time was also observed between the anterior target and posterior target, where a faster movement was produced as the foot being moved forwards. Moreover, the perceived exertion was generally at the same level in spite of the participant’s gender, positioning strategy, side of target, and positioning orientation. In summary, the adoption of foot-eye coordination seems to be useful towards the safer foot positioning. In the case of moving the foot right and forwards onto a target, special attention needs to be paid to prevent from the possible trips caused by the less accurate positioning.
4. Discussion

The study serves as a preliminary attempt to understand the affecting factors of foot positioning performance, and it will be further extended to consider the participant’s age as well. The findings may contribute to the easy-to-perform assessment of trip risks in the home environment, which provides good potential to facilitate the design of environments and corresponding assistive solutions. Eventually, the mobility safety of the older adults can be enhanced while relieving the burden of medical and social resources produced by the unintentional injury events at home.

Figure 1. Process flow of the experiment.

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References


