The Effects of Aging on Visuomotor Behaviors in Reaching

Authors : Mengjiao Fan, Thomson W. L. Wong

Abstract : It is unavoidable that older adults may have to deal with aging-related motor problems. Aging is highly likely to affect motor learning and control as well. For example, older adults may suffer from poor motor function and quality of life due to age-related eye changes. These adverse changes in vision results in impairment of movement automaticity. Reaching is a fundamental component of various complex movements, which is therefore beneficial to explore the changes and adaptation in visuomotor behaviors. The current study aims to explore how aging affects visuomotor behaviors by comparing motor performance and gaze behaviors between two age groups (i.e., young and older adults). Visuomotor behaviors in reaching under providing or blocking online visual feedback (simulated visual deficiency) conditions were investigated in 60 healthy young adults (Mean age=24.49 years, SD=2.12) and 37 older adults (Mean age=70.07 years, SD=2.37) with normal or corrected-to-normal vision. Participants in each group were randomly allocated into two subgroups. Subgroup 1 was provided with online visual feedback of the hand-controlled mouse cursor. However, in subgroup 2, visual feedback was blocked to simulate visual deficiency. The experimental task required participants to complete 20 times of reaching to a target by controlling the mouse cursor on the computer screen. Among all the 20 trials, start position was upright in the center of the screen and target appeared at a randomly selected position by the tailor-made computer program. Primary outcomes of motor performance and gaze behaviours data were recorded by the EyeLink II (SR Research, Canada). The results suggested that aging seems to affect the performance of reaching tasks significantly in both visual feedback conditions. In both age groups, blocking online visual feedback of the cursor in reaching resulted in longer hand movement time ($p < .001$), longer reaching distance away from the target center ($p<.001$) and poorer reaching motor accuracy ($p < .001$). Concerning gaze behaviors, blocking online visual feedback increased the first fixation duration time in young adults ($p<.001$) but decreased it in older adults ($p < .001$). Besides, under the condition of providing online visual feedback of the cursor, older adults conducted a longer fixation dwell time on target throughout reaching than the young adults ($p < .001$) although the effect was not significant under blocking online visual feedback condition ($p=.215$). Therefore, the results suggested that different levels of visual feedback during movement execution can affect gaze behaviors differently in older and young adults. Differential effects by aging on visuomotor behaviors appear on two visual feedback patterns (i.e., blocking or providing online visual feedback of hand-controlled cursor in reaching). Several specific gaze behaviors among the older adults were found, which imply that blocking of visual feedback may act as a stimulus to seduce extra perceptive load in movement execution and age-related visual degeneration might further deteriorate the situation. It indeed provides us with insight for the future development of potential rehabilitative training method (e.g., well-designed errorless training) in enhancing visuomotor adaptation for our aging population in the context of improving their movement automaticity by facilitating their compensation of visual degeneration.

Keywords : aging effect, movement automaticity, reaching, visuomotor behaviors, visual degeneration
Conference Title : ICSMSS 2017 : 19th International Conference on Sport Medicine and Sport Science
Conference Location : Paris, France
Conference Dates : June 25-26, 2017