

CAN THINKING BE HAZARDOUS TO YOUR BALANCE? THE EFFECTS OF COGNITION ON POSTURAL STABILITY IN OLDER ADULTS.

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INTRODUCTION

Older individuals are often prone to falls as they perform routine activities of daily life (i.e. reaching for an item or walking around clutter in the home). To address this issue, there has recently been an increase in research examining how older individuals control posture as they are engaged in some other activity. Since most activities of daily life require some degree of cognition, many of these studies have examined how individuals control posture as they are concurrently performing some other cognitive task.

In both older and younger adults, research has shown that the magnitude of postural sway does change when people perform a concurrent cognitive task (Woollacott & Shumway-Cook, 2002). However, exactly how posture changes appears to be a matter of debate. For example, Swan et al. (2004) found that in older adults, as the cognitive difficulty of a concurrent task increased, postural sway decreased. Consequently, Woollacott & Shumway-Cook (2002) reported that older individuals tend to increase postural sway when performing a concurrent cognitive task.

Additionally, changes in the magnitude of sway while performing a cognitive task are often believed to reflect changes in overall postural stability (Woollacott & Shumway-

Cook, 2002). However, recent research on postural control has demonstrated the importance of spatiotemporal measures in relation to the stability boundary at the base of support for assessing postural stability (Haddad et al. 2006).

The purpose of this study was to examine changes in posture using spatial and stability boundary (time-to-contact) measures of postural sway as younger and older individuals performed a cognitive task that systematically increased in difficulty.

METHODS AND PROCEDURES

A group of older adults (N=6; 65-80 yrs) and younger adults (N=12; 18-30 yrs) stood on a force plate facing a computer monitor while holding a button under each thumb. Subjects performed five blocks of trials: SIMPLE (Ss pressed the right button whenever a letter appeared in the center of the screen); CHOICE (Ss pressed the left button when an 'A' appeared and the right button when a 'B' appeared in the center of the screen); WHAT and WHERE (letters were presented laterally on the screen, and the auditory cues 'what' or 'where' sounded before the display of each letter. In the what trials, Ss pressed the left or right button when the letter 'A' or 'B' appeared respectively. In the where trials, Ss pressed the button corresponding to the location of the displayed letter); TASK-SWITCHING (the

'what' and 'where' games were mixed together and letter presentation was either congruent or incongruent). Center of pressure (the anterior-posterior range) and virtual time-to-contact (VtC) data were analyzed according to the procedures in Haddad et al. (2006).

RESULTS

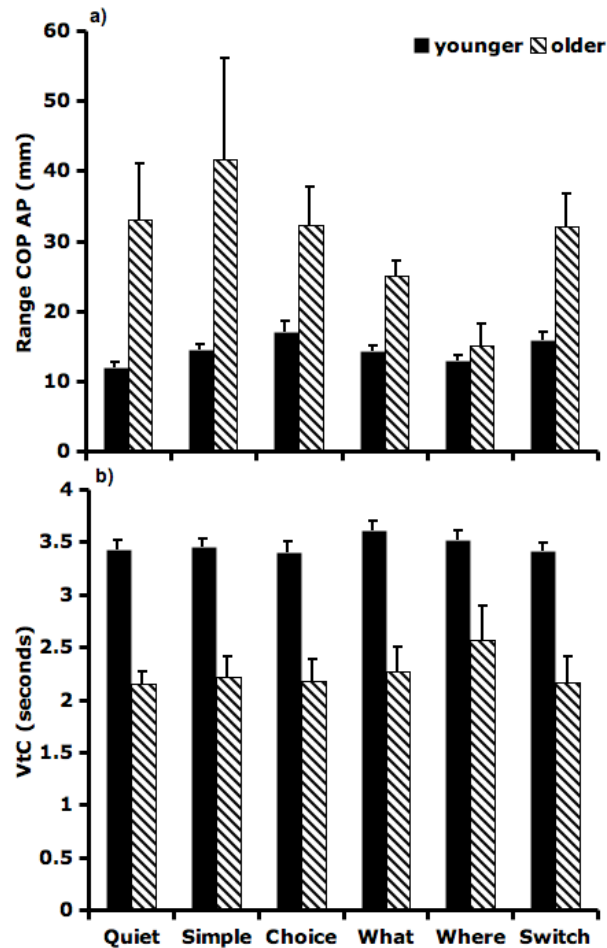


Figure 1. a) The anterior-posterior (AP) range and b) the virtual time to contact (VtC) of the center of pressure (COP).

In the young subjects, the range of the COP in the AP direction did not change across conditions. However, the older subjects tended to exhibit a U-shaped function, where, sway decreased from low (SIMPLE) to moderate cognitive loads and then increased at high cognitive loads (TASK SWITCH condition). The young subjects maintained a

longer time to the stability boundary compared to the older subjects. However, VtC remained constant in both groups between conditions.

DISCUSSION

Two main conclusions can be drawn from this research. 1) In older individuals, the U-shaped function in postural sway with increases in cognitive load can explain some of the differences in past studies. Specifically, based on these findings, studies that used easy cognitive tasks would have obtained different results compared to studies that used difficult cognitive tasks. This U-shaped function also agrees with recent data from Huxhold et al. (2006). 2) Although individuals change the magnitude (AP range) of sway during a cognitive task, a constant temporal margin to the stability boundary is maintained. This may suggest that in both older and younger subjects overall postural stability is maintained despite increases in cognitive load.

SUMMARY

Based on traditional postural measures we observed differential responses to task difficulty. The VtC results however indicate that changes in postural sway (at least in this postural task) have no consequences for postural stability. Therefore, performing a concurrent cognitive task does not appear to influence overall postural stability.

REFERENCES

- Haddad JM et al. (2006). *J App Biomech*, 22:155-161.
- Huxhold O et al. (2006). *Brain Res Bull*, 69:294-305.
- Woollacott M and Shumway-Cook A (2002). *Gait Posture*, 16:1-14.
- Swan L et al. (2004). *Brit J Psych*, 95:31-40.