INTRODUCTION
Older adults exhibit greater postural instability compared with young adults. Of the many causes attributed to this decline in postural control, a defect or slowing of central integration processes may play an important role (Woollacott et al., 1986; Teasdale et al., 1991). As a result, older adults may have more difficulty maintaining balance when confronted with a sudden change in postural demands (Teasdale et al., 1991; Hay et al., 1996).

For example, Hay et al. (1996) found that while both young and older adult subjects were greatly affected by the removal of reliable proprioceptive inputs (in the form of tendon vibration), only the elderly had difficulty maintaining balance when proprioceptive information was reinserted. While the young subjects quickly incorporated the reinserted sensory input, some older adults took over 10 s to realign.

The purpose of this study was to examine if there was a similar pattern of reduced readaptation to accurate somatosensory input in older adults standing on a posture platform that changed from moving to fixed.

METHODS
Twenty-five healthy young control (YC) subjects (14 females, mean age = 27 y), and 24 healthy older control (OC) subjects (13 females, mean age = 70 y) completed the study. Informed consent was obtained from each subject before participation.

Subjects stood on a NeuroTest posture platform within a full field of view (FOV) display enclosure (Sparto et al., 2004). The head sway of each subject was recorded using a Polhemus Fastrak™ electromagnetic tracking system.

Subjects performed 24 trials, with rests after every 2 to 4 trials. During each trial, subjects viewed 0.4 Hz sinusoidal anterior-posterior (AP) optic flow for 50 s while standing on a fixed or sway-referenced platform. During sway-referenced trials, the platform moved about an axis of rotation aligned with the each subject’s medial and lateral malleoli, in proportion to the amount of sway in the pitch plane. For this report, we are reporting on 3 of the trials in which the platform transitioned from sway-referenced to fixed at a random time between 22 and 28 s of the trial duration. These trials were the final three trials that were performed.

The AP head sway was sampled at 20 Hz. The data were lowpass filtered using a 4th order, zero-phase digital Butterworth filter with a cutoff frequency of 2 Hz. The sway velocity was computed by differentiating the signal. The instantaneous power of the head sway velocity was determined by squaring the velocity signal. For these trials, we limited our analysis to the 10 s segments of data before and after the transition from sway-referenced to fixed platform. Each 10 s segment was further subdivided into two consecutive 5 s periods. The log of the
average power (dB) during each 5 s interval was computed and statistically analyzed. A mixed factor repeated measures ANOVA was used to test for the effects of subject group (YC and OC), period (1, 2, 3 and 4), and trial (1, 2, and 3).

RESULTS AND DISCUSSION

As shown in Figure 1, the level of postural sway power decreased from periods 2 to 3 (p < 0.001). The amount of decline in sway power was greater in YC (3.88 dB, p < 0.001) than in OC (2.83 dB, p < 0.001). Sway power continued to decrease in the fourth period. The YC showed a larger reduction, with an average decrease of 3.38 dB from period 3 to 4 (p < 0.001), whereas the OC had a 2.83 dB decrease (p = 0.026).

Comparison of the sway during period 4 with sway obtained during steady-state, fixed platform conditions revealed that sway power had not returned to baseline levels. The OC subjects had a greater difference (4.99 dB) in comparison with the baseline trials compared with YC subjects (3.30 dB).

SUMMARY/CONCLUSIONS

The results indicate that healthy older adults do not adapt as quickly as healthy young adults when sensory conditions change from a sway-referenced to fixed surface environment. This finding is likely due to age-related changes in the central nervous system, although the neurophysiological correlates are not yet understood.

REFERENCES


ACKNOWLEDGEMENTS

This research was supported in part by the National Institutes of Health under Grants K25-AG01049, P30-DC05205, and by the Eye and Ear Foundation.