

The Effects of Divided Attention on Dynamic Balance in Young Adults

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Introduction: Dual task methodology has been used to assess the attention demands necessary for performing a primary task. With this approach, several authors have shown that maintaining a stable upright posture requires a certain amount of attention. Typically, they report that performance on a secondary task deteriorates when either young or old adults perform a demanding balance task [1-3]. Relatively few studies have examined the effect of a dual task on maintaining balance during locomotion [3, 4]. The purpose of this study was to investigate, in young adults, the effects of performing a secondary task on dynamic balance. Specifically, we wanted to compare the effects of two different cognitive tasks (an attention task and a memory task) on unrestricted fast walking and on narrow path walking.

Statement of Clinical Significance: Older adults are less able than young adults to divide their attention during activities such as driving. It is possible that an inability to divide attention may be responsible for falls during locomotion. This study presents normative data for young adults.

Methodology: Eight young adults were asked to perform concurrently, a dynamic balance primary task and a cognitive secondary task. The primary tasks were two different walking tasks: a) fast walking along a 30 foot walkway and b) narrow path walking on the same walkway with a requirement to walk between two lines on the floor. The secondary tasks were two different cognitive tasks: a) doing simple arithmetic as fast as possible (assessing the attention domain), and b) reciting as many animal names as possible (assessing the memory domain). Performance on each primary task was measured under three conditions: baseline (no secondary task), while performing the arithmetic task, and while performing the memory task. Thus, 4 dual task and 2 single task conditions were studied. Subjects performed 3 trials per condition and were instructed to do all tasks as fast as possible. Subjects practiced both of the cognitive tasks 5 times before any testing occurred. The order in which the tasks were performed was randomized. For fast walking trials subjects walked 30 feet with no restriction on their gait. For narrow path trials, subjects walked between two parallel lines on the floor. The distance between the lines was 1.5 times the width of the subjects' stance measured as they stood with both feet touching each other. For the arithmetic task subjects performed continuous subtraction by three. For the memory task subjects recited the names of as many animals as possible. The performance measure for both secondary tasks was the mean *rate* of correct response. All trials were recorded from the side with a video camera (including audio). Infrared timers were used to measure walking velocity. For narrow path trials, a camera was placed in front of the subject at the end of the walkway. The record from this camera was used to count the number of times that the subject stepped on, or outside of, the lines on the floor. To test for differences in gait speed and in the secondary task performance measures two-way ANOVA's with repeated measures (primary tasks x secondary tasks) were used. Where it was warranted, *post-hoc* one-way repeated measures ANOVA's and Tukey tests were used.

Results: Overall there was a significant difference in gait speed between the single and dual task conditions (Figure 1). Post-hoc analysis, however, showed no significant difference in gait speed for the *fast* walking trials when the cognitive tasks were added. For the narrow walking, the gait speeds for the dual task trials were slower than for the baseline condition. There was no significant difference in gait speed between fast walking and narrow path walking in either the single or dual task conditions. All subjects performed the narrow path walking with no errors. For the secondary task performance there was a significant difference between the arithmetic task and the memory task (Table 1). There was no difference in performance speed brought about by either fast walking or narrow path walking.

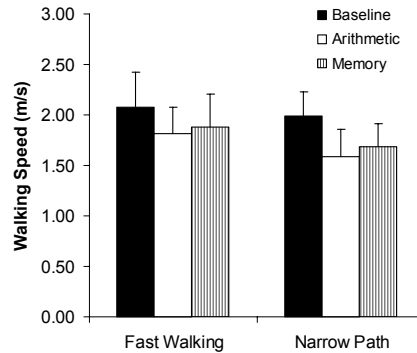


Figure 1: Gait speed for single task (baseline) and dual task conditions.

Table 1: Performance Measures*

Walking Condition	Arithmetic Task	Memory Task
Fast	1.22 ± 0.31	1.76 ± 0.29
Narrow Path	1.10 ± 0.39	1.49 ± 0.31

* correct responses per second. Values are mean ± standard deviation.

Discussion: The decrease in gait speed when a secondary task was added is consistent with other studies [3, 4]. In previous studies, however, the gait used was unrestricted walking with no request for maximum walking speed. For our subjects the difference in gait speed when a secondary task was added was only significant for the narrow path walking. This suggests that narrow path walking requires just enough attention to make it a sensitive test of gait under conditions of divided attention. The results also suggest that with competing demands, it is gait speed that is sacrificed with little change in the performance of the cognitive tasks. Although there were differences in the rate at which the arithmetic task and the memory task were performed, there was no difference in their effect on gait speed. It appears that despite differences in the cognitive resources used by these tasks, both overlap the resources used for locomotion.

References:

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