

# CHANGES IN DISTAL POSTURAL CONTROL ACCURACY NEAR THE LIMITS OF THE BASE OF SUPPORT

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## INTRODUCTION

Balance is an integral part of daily living. The ability to maintain Center of Mass (COM) stability during tasks such as reaching or stooping reduces the risk of falling and suffering injury.

Balance control requires accurate and rapid control of the Center of Pressure (COP) upon the detection of a loss of balance. A loss of balance can be considered to occur when the center of mass falls outside of the base of support and is not actively accelerating towards a state of equilibrium (i.e., stable gait).

Fitt's law introduced a theoretical framework for the trade-off between accuracy and speed in upper extremity reaching tasks, such as reciprocal tapping (Fitts, 1954). To our knowledge, these principles have not yet been applied to distal postural control or the control of the COP by the ankle musculature. We propose a 1-DOF distal postural control (DPC) task, to evaluate speed-accuracy tradeoffs in the reciprocal movement of the COP in the anteroposterior plane.

## METHODS

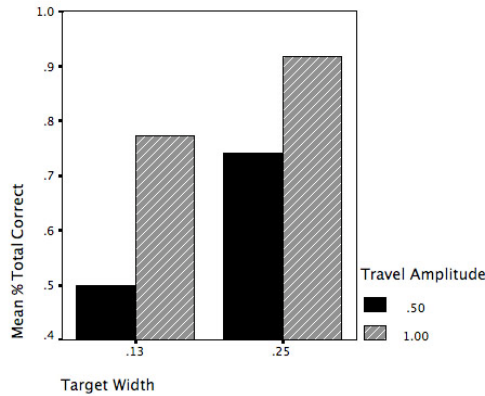
*Subjects.* Twenty healthy young adults (Age < 30 yrs., males = 10, females = 10) are to be recruited for this study, out of which 2

have been recruited thus far, and are used for this analysis (N=2, males =1, females = 1, Age = 20 and 25 yrs).

*Protocol.* In order to determine the relationship between reciprocal COP movement accuracy and the COP excursion amplitude and target width, a modification to the Functional Base of Support (FBOS) test is proposed (King et al., 1994, Fitts 1954). Participants stand upright and then lean maximally forward and backward to determine their FBOS. FBOS is defined as the limits between the maximal forward and backward excursion of the COP from a steady upright stance. Participants are instructed to shift their COP signal as fast and as accurate as possible between a pair of target COP positions using visual feedback in a 15 second trial. Specific target width and COP excursion amplitude combinations are repeated five times. Outcome measures of this task include COP excursion, COP velocity, and limits of the FBOS.

## RESULTS AND DISCUSSION

Changes in the mean percentage of correct reciprocal movements during the performance of the distal postural control task are shown in Figure 1 and summarized in Table 1. The 28 trials analyzed from the two subjects suggest a change in COP control accuracy, depending on the COP excursion and target width.



**Figure 1:** Mean Percentage of Correct Reciprocal Movements in the Distal Postural Control Task (Travel Amplitude and Target Width are reported as a percentage of the FBOS)

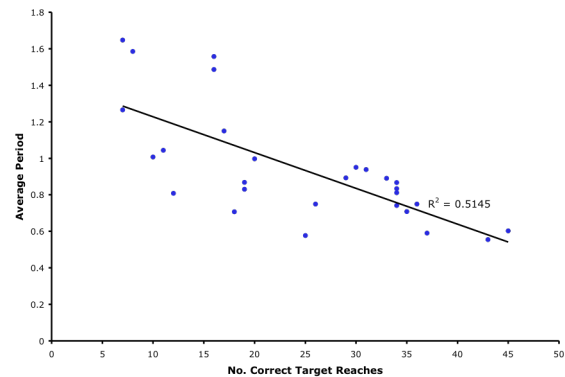
**Table 1:** Summary of total percentage of correct reciprocal movements

Target Width	Travel Amplitude	
	0.5	1
0.25	0.74 ± 0.23	0.92 ± 0.13
0.125	0.50 ± 0.21	0.77 ± 0.19

The proximity of the large amplitude reciprocal tasks to the edge of the FBOS, might explain the higher accuracy rate observed, when compared to tasks requiring smaller amplitude COP excursions. As the edge of the FBOS is approached, the consequences of a perturbation become more significant (i.e., falls) and thus the detection of a loss of balance becomes increasingly important. Subjects more attuned their position in space relative to their limits of stability may be less likely to fall.

A question remains as to the theoretical framework underlying difficulty imposed by a greater travel of the COP or narrow target width, as analysis has not yet revealed a relationship between accuracy rate and difficulty. Figure 2 illustrates the inverse

relationship between time and the number of correct reciprocal movements.



**Figure 2:** Inverse relationship between the Mean Period between reciprocal movements and the total number of correct reciprocal movements in the Distal Postural Control Task

## SUMMARY/CONCLUSIONS

Preliminary findings suggest that COP accuracy rate may depend on the COP excursion and target width. Group sizes are presently too small to draw any conclusions.

## REFERENCES

- Fitts, P.M. (1954). *J. Exp Psychol*, **47**, 381-91.
- King, M.B., Judge, J.O., Wolfson, L. (1994). *J. Gerontol*, **49**, M258-63.

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