

THE RELATIONSHIP BETWEEN CENTER OF PRESSURE DISPLACEMENT AND ESTIMATED INSTABILITY OF DANCERS AND NON-DANCERS WHILE IN A MOVING ROOM

Leigh Schanfein and Shirley Rietdyk

Department of Health and Kinesiology, Purdue University, West Lafayette, IN, USA.
lschanfe@purdue.edu

INTRODUCTION

Balance is an innate aspect of dance, which leads one to believe that dancers receive "balance training" (Schmit et al., 2005) in the process of developing their technical and artistic abilities. Dancers are significantly less stable than controls when proprioceptive information is unreliable (Simmons, 2005), and they are only more stable than controls when standing with eyes closed (Perrin et al., 2002) suggesting that dancers are less dependent on vision than non-dancers. It may be that, through dance training, dancers are able to maintain postural control when reliance on the visual system is jeopardized by more effectively distributing sensory weightedness away from the visual system to the proprioceptive and/or vestibular sensory systems. If such adaptation occurs, the dancer would be less susceptible to illusions of self-motion induced by a moving visual surround (calledvection) than controls but potentially unable to utilize stationary references within an advantageous distance to further aid postural stabilization. The current project proposes to examine if balance control is altered andvection reduced by the addition of stable visual references, in central and/or peripheral vision, within a moving visual surround. Additionally, it will examine ifvection, measured as estimated instability, is correlated to center of pressure (COP) displacement.

METHODS AND PROCEDURES

Ten advanced-level university modern dancers (22 ± 1.7 yrs) and ten athletic controls (20.3 ± 2.2 yrs) stood on a

forceplate inside a moving room. Visual references were stationary black vertical poles (2 m height, 6.25 cm diameter). Eight visual conditions were examined: (1) static visual field, the room not moving and no references present; the room was moving for the remaining seven conditions: (2) without references, (3) peripheral references within the room, (4) peripheral references outside the room, (5) central references within the room, (6) central references outside the room, (7) both central and peripheral references within the room, (8) both central and peripheral references outside the room. Two trials were observed for the first condition, and five trials for the latter seven conditions, for a total of 37 trials. Each trial lasted 70 seconds. Perception of instability was assessed after each trial; subjects were instructed to provide a number between 1 and 10, 1 indicating "I felt solid as a rock" and 10 indicating "I felt I was about to fall over." COP displacement was quantified as root mean square (RMS) in the anterior-posterior direction (AP).

RESULTS AND DISCUSSION

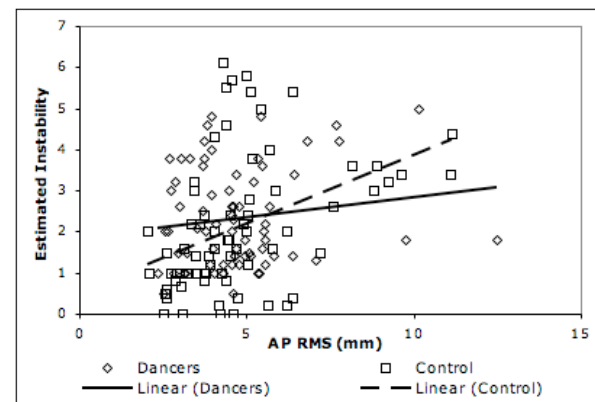


Figure 1. Estimated instability plotted against AP COP RMS.

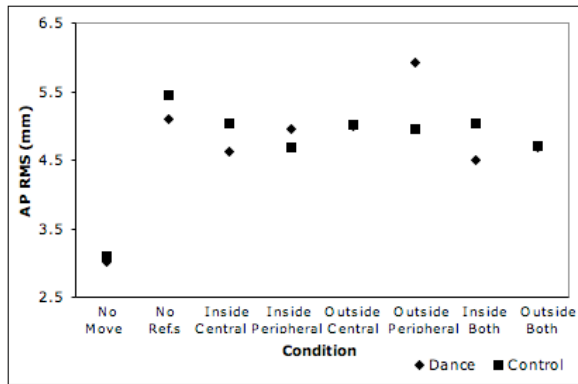


Figure 2. AP COP RMS for each group by visual condition.

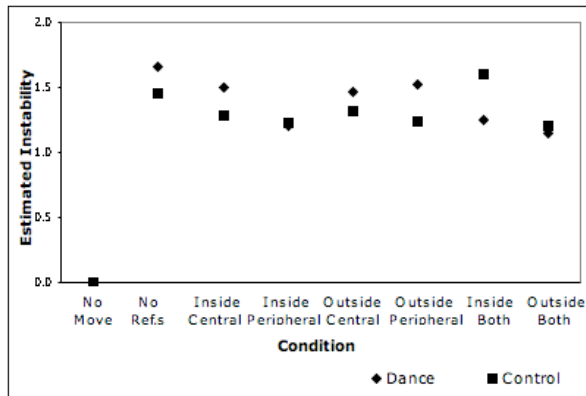


Figure 3. Estimated instability for each group by visual condition. Values are normalized to baseline measure obtained through subjective estimate of instability during the no room movement condition.

Estimated instability and AP COP RMS were linearly correlated for controls ($R^2 = 0.168$, $p < .001$), but not for dancers ($R^2 = 0.021$, $p = .258$) (Figure 1). Therefore, COP displacement appears to affect estimated instability for the control group but not for the dancers, the group with “balance training.” This is consistent with the interpretation that increased COP displacement does not necessarily reflect decreased stability, and may indicate increased behavioral flexibility (Schmit et al, 2005).

An interaction effect was observed for AP COP RMS ($p = .008$); post hoc analysis revealed that dancers demonstrated significantly greater AP COP RMS with

references in the outer periphery than with any other reference positioning, including having no references (Figure 2, third condition from right). This observation does not support the concept that dancers are less visually dependent (as suggested by Perrin et al. 2002; Simmons, 2005). Increased AP COP RMS with outside peripheral cues may reflect that the dancers are “dancing with the room,” providing further evidence of increased behavioral flexibility.

Estimated instability was affected by condition ($p < .001$); the greatest instability was perceived with no references. Estimated instability was reduced when inside peripheral references were available or outside central and peripheral references were in place (Figure 3). Estimated instability was also affected by group ($p < .001$); dancers had higher estimated instability than controls, which does not support the concept that dancers are less visually dependent, although one must take into account that this measure is subjective.

SUMMARY

This study did not support the concept that dancers are less visually dependent, either with subjective or objective measures. However, dancers do respond differently to visual cues within a dynamic visual environment than non-dancers, consistent with the idea that dance training modifies how dancers use visual cues. This may reflect increased behavioral flexibility.

REFERENCES

- Perrin P, Deviterne D, Hugel F, Perrot C. *Gait and Posture* 15 (2002): 187 – 194.
 Schmit JM, Regis DI, Riley MA. *Experimental Brain Research* 163 (2005): 370 – 378.
 Simmons RW. *International Journal of Neuroscience* 115.1 (2005): 87 – 97.