

AN EXTERNAL FOCUS OF ATTENTION ATTENUATES BALANCE IMPAIRMENT IN PARKINSON'S DISEASE

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press)**

Parkinson's disease (PD) is a progressive neurodegenerative disease that characteristically produces a variety of motor control problems and movement disorders including bradykinesia, rigidity, resting tremor, as well as deterioration in balance and postural control. The cumulative effects of these impairments often result in considerable functional limitation and disability, thereby predisposing the individual to falling. Interestingly, postural instability, which is implicated as a causative factor of falls in PD, is the only major motor sign that appears to be resistant to dopaminergic therapy. This further illustrates the need for developing physical therapy interventions, which effectively enhance balance in those with PD.

In the past few years, a number of studies have demonstrated that a performer's focus of attention has an important influence on motor performance and learning. In a series of studies, Wulf et al. manipulated performers' attentional focus via instructions or feedback (for a review, see Wulf & Prinz, 2001). Specifically, they compared the effectiveness of instructions that directed the performers' attention to their body movements that were required to produce the goal action (internal focus) with those of instructions that directed attention to the external effects of the movements on the environment (external focus). For example, using the dynamic balance task (stabilometer), Wulf, Höß, and Prinz (1998) instructed one group of learners to focus on their feet and to try to keep them horizontal (internal focus), whereas another group was instructed to focus on markers attached to the board in front of each foot (external focus). Compared to an internal focus, the adoption of an external focus resulted in enhanced learning of the balance task. External focus advantages have also been found in comparison to control conditions without attentional focus instructions (e.g., Wulf et al., 1998, Experiment 1; Wulf, Weigelt, Poulter, & McNevin, 2003; Wulf & McNevin, in press).

The primary purpose of the present study was to examine whether instructions to focus attention on the movement effects (i.e., inducing an external focus) would benefit patients with PD (and a history of falls). Specifically, we wanted to determine whether patients' balance could be enhanced by giving them external focus instructions, relative to internal focus or no attentional focus instructions (control condition).

The Sensory Organization Test (SOT) protocol was administered using the NeuroCom Smart[®] Balance Master system (Balance Master). One type of test used with CDP is the Sensory Organization Test (SOT). The SOT measures sway and is designed to quantify an individual's ability to maintain balance in a variety of complex sensory conditions. Equilibrium scores reflect the performance on the SOT for each condition. Scores are expressed as a percentage between 0 and 100 with 0 indicating sway that exceeded the limits of stability (large sway), resulting in a loss of balance, and 100 indicating perfect stability (small sway).

Participants stood in their stocking feet on rectangular pieces of contact paper (30.5 x 17 cm) (one under each foot) that were placed on the force plate. These

rectangular pieces of paper were to be focus points of the attentional focus conditions. Participants were tested under baseline (no focus instructions), internal focus (“Stand quietly and concentrate on putting an equal amount of force on your *feet*”), and external focus (“Stand quietly and concentrate on putting an equal amount of pressure on the *rectangles*”) conditions. For each attentional focus condition, participants performed 3 20-s trials under each of the following three Balance Master conditions:

- A. Eyes open, fixed support surface and surround
- B. Eyes closed, fixed support surface and surround, and
- C. Eyes open, sway-referenced support surface and fixed surround

Results

Equilibrium scores. Mean equilibrium scores under the different conditions and types of instructions are shown in Figure 1. Scores were generally highest (i.e., sway was the least) in the eyes-open condition, lower in the eyes-closed, and lowest in the sway-referenced condition. Also, while the attentional focus instructions did not appear to differentially affect the equilibrium scores under eyes-open and eyes-closed conditions, the external focus instructions resulted in less sway than both internal focus instructions and no instructions (control) under sway-referenced conditions. Thus, for the most challenging condition (sway-referenced) instructing subjects to focus on the rectangles under their feet was more effective than directing their attention to their feet or giving no attentional focus instructions.

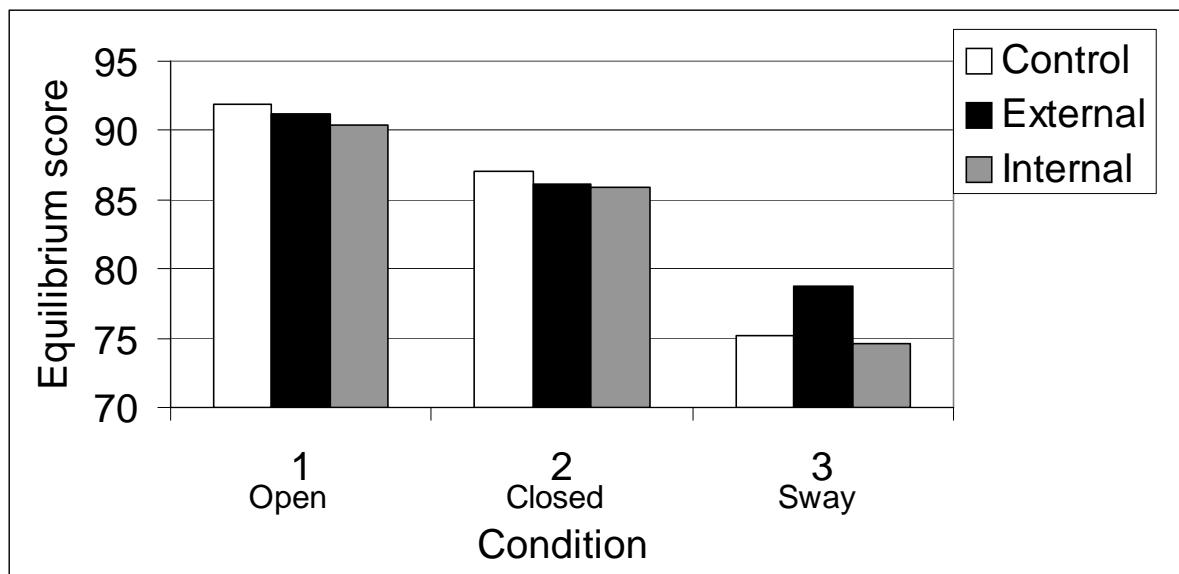


Figure 1

Number of falls. We also recorded the number of “falls” (i.e., incidences where the subject completely lost balance and had to be supported by the harness and/or experimenter) There were no falls in the eyes-open and eyes-closed conditions for those subjects that reported a history of falls. However, in the sway-referenced condition, 4 falls occurred when no attentional focus instructions were given (control), and 3 falls

occurred with internal focus instructions. However, there were no falls with external focus instructions. Thus, these results are nicely in line with the equilibrium score data in showing that balance was enhanced by instructions that directed participants' attention to the effect of their movements (external focus), compared to the movements themselves (internal focus) or no instructions (control).

Discussion

The purpose of this study was to test the generalizability of previous attentional focus instruction results to balance performance in patients with PD. While the type of attentional focus did not differentially affect postural stability under the conditions that required participants to stand still on a stable surface with eyes open or eyes closed, clear effects emerged under the sway-referenced conditions. Instructing participants to focus on keeping the rectangles under their feet horizontal (external focus) resulted in less sway than instructing them to focus on keeping their feet horizontal (internal focus) or not giving them any attentional focus instructions (control). Furthermore, the latter two conditions produced similar equilibrium scores. These findings nicely replicate those of previous studies that found external focus advantages compared to both internal focus and no-instruction conditions, and no difference between the latter two (for a review, see Wulf & Prinz, 2001).

An external focus appears reduce cognitive load by taking advantage of self-organizing capabilities of the neuromotor system. Recent results by Wulf, McNevin, and Shea (2001) support this view. In their study, participants balanced on the stabilometer, and probe reaction times (RTs) were taken as a measure of the attention demands required under external versus internal attentional focus conditions. External focus participants demonstrated shorter probe RTs than internal focus participants, indicating reduced attention demands associated with an external focus. This finding also provides evidence for the view that an external focus promotes the utilization of more automatic control processes.

The present findings have important practical implications, as instructions given by therapists in physical therapy or clinical rehabilitation settings often refer to the patient's movement coordination. In contrast, phrasing instructions in a way that they direct the patient's attention away from his or her body movements, and to the effects of those movements, might enhance the effectiveness of training.

learning is enhanced.