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Switching Focus of Attention Mid-trial and its Effect on Stability During a Balance Task

William P. Westphal

Southern Illinois University Carbondale, westphal.william32@gmail.com

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SWITCHING FOCUS OF ATTENTION MID-TRIAL AND ITS EFFECT ON
STABILITY DURING A BALANCE TASK

by

William Westphal

B.S., University of Wisconsin- La Crosse, 2010

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Masters of Science in Education Degree

Department of Kinesiology
in the Graduate School
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RESEARCH PAPER APPROVAL

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Approved by:

Jared M. Porter, Ph.D., Chair

Julie A. Partridge, Ph.D.

Graduate School
Southern Illinois University Carbondale
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TITLE: SWITCHING FOCUS OF ATTENTION MID-TRIAL AND ITS EFFECT ON
STABILITY DURING A BALANCE TASK

MAJOR PROFESSOR: Jared M. Porter Ph.D.

For more than a decade focus of attention studies have shown an external focus is superior for performance compared to an internal focus of attention. The constrained action hypothesis suggests this occurs because an external focus of attention allows movement to happen more autonomously compared to an internal focus of attention. The purpose of the current experiment was to investigate if the benefit of an external focus of attention would still exist when participants were asked to change their focus of attention mid-trial. Based on the constrained action hypothesis and the findings of previous research it was hypothesized that participants' ($N = 21$) balance on a stabilometer would be superior when using an external focus (i.e., keep the markers level) compared to their balance on a stabilometer when using an internal focus (i.e., keep your feet level). Results did not reveal significant differences in RMSE of the external ($M = 6.73$, $SD = 1.15$) and internal ($M = 6.09$, $SD = 1.16$) attentional foci. These findings are not with the majority of focus of attention research. Due to these findings it is suggested that practitioners avoid switching their verbal instructions mid-trial. Also future studies should consider using additional dependent variables (i.e. MPF) or conditions where participants do not switch foci mid-trial so a better understanding can be found in regard to the processes that are occurring when participants switch focus of attention mid-trial.

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INTRODUCTION

For more than a decade research has been completed looking at differences in motor skill performance and learning when comparing an internal focus of attention to an external focus of attention (for a review, see Wulf 2007). Wulf, Höb, & Prinz (1998) defined an *internal focus* of attention as a mover directing their attention to their body movements while an *external focus* of attention is when a mover directs their attention to the effect the movement has on the environment. To clarify the difference between these differing attentional foci picture yourself in a wellness center or weight room. While you are there you hear a personal trainer teaching another member a power clean. As you listen in on this teaching session the trainer instructs the mover to, “drive your elbows to the ceiling, and then bring them through.” The next day you come in and a different trainer is teaching someone the same lift. However, this trainer instructs the mover to, “move the bar fast and keep it close (i.e., to the body).” The first trainer gave instructions that directed the mover’s attention internally while the second trainer’s instructions directed the mover’s attention externally. You may assume both trainers are confident in their instruction and believe their directions will help establish a quality movement pattern. However, it is unlikely that either set of instructions were based off of information in coaching manuals or research findings. In a recent paper by Porter, Wu, and Partridge (2010) it was reported that many popular coaching manuals and textbooks did not discuss research related to the topics of verbal instruction and feedback. In addition, Williams and Ford (2009) suggests that coaches usually do not read motor learning research, and if they do they typically do not embrace the findings. This is unfortunate, because motor learning research can provide evidence based methods for improving performance and learning. Upcoming paragraphs will discuss how one particular area of motor learning literature, focus of attention, can help improve performance.

For instance, Singer, Lidor, and Carraugh (1993) demonstrated the Five-Step Approach and nonawareness strategies (i.e., completing a task without attending to yourself or task details), were better for performance when compared to awareness strategies (i.e., consciously attending to the act you are completing).

The Five-Step Approach used by Singer et al. (1993, 1988) consisted of:

- 1) Ready: Attaining an optimal emotional state
- 2) Imaging: Mentally picture performing the act
- 3) Focusing: Concentrate intensely on one relevant feature of the situation.
- 4) Executing: Do it whenever you feel you are ready
- 5) Evaluate: If time allows, use available feedback to evaluate your performance.

One particular step from Singer's Five-Step Approach, *focusing*, has received significant attention in motor learning research (Wulf, 2007). The purpose of this step is to concentrate on a cue with effort, such as the backspin of a basketball, which will in turn reduce the attentional capacity to process other information (Kahneman, 1973). In a two experiment study, Wulf et al., (1998) investigated whether instructions that direct performer's attention to different foci would lead to differing results in learning. In particular, Wulf and colleagues hypothesized an external focus of attention would result in better learning than an internal focus of attention. In experiment one they used a ski simulator task and in experiment two a stabilometer balancing task was utilized. In both experiments learning was superior during retention for those who practiced in the external focus conditions when compared to internal focus conditions.

Since the initial study by Wulf et al., (1998) the benefits of an external focus have been demonstrated with a variety of tasks and skill levels (Wulf, 2007). For instance with object manipulations tasks, accuracy has been enhanced in shooting darts (Marchant, Clough,

Crawshaw, & Levy, 2009; Lohse, Sherwood, & Healy, 2010), free-throw shooting (Al-Abood, Bennett, Hernandez, Ashford & Davids, 2002; Zachry, Wulf, Mercer & Bezodis, 2005), chipping in golf (Wulf & Su, 2007), serving in volleyball (Wulf, McConnel, Gärtner, & Schwarz, 2002, Exp. 1), and kick placement in soccer (Wulf et al., 2002, Exp. 2). An external focus has also resulted in a more proficient form for volleyball serves (Wulf et al., 2002, Exp. 1), juggling (Zentgraf & Munzert, 2009), and soccer throw-ins (Wulf, Chiciacowsky, Schiller, & Avila, 2011).

Motor skills requiring whole body movements have also demonstrated benefits when using an external focus of attention. Enhanced stability has been found when using an external focus on a ski simulator (Wulf et al., 1998, Exp. 1), stabilometer (McNevin, Shea, & Wulf, 2003; Wulf et al., 1998, Exp. 2; Wulf, McNevin, & Shea, 2001) or other unstable surfaces (Wulf, Mercer, McNevin, & Guadagnoli, 2004; Wulf, Töllner, & Shea, 2007; Wulf, Landers, Lewthwaite, & Töllner, 2009). Some stability studies have also found that another benefit to an external focus is smaller, more frequent postural adjustments (McNevin et al., 2003, Wulf, McNevin et al., 2001; Wulf et al., 2004). Outside of stability an external focus has resulted in faster agility times (Porter, Nolan, Ostrowski, & Wulf, 2010), longer horizontal jumps (Porter, Ostrowski, Nolan, & Wu, 2010), and higher vertical jumps (Wulf, Dufek, Lozano, & Pettigrew, 2010).

Another interesting aspect of the difference between external foci and internal foci is their effect when varying skill levels are tested. For instance, novice and moderately skilled volleyball players benefitted equally from an external focus in Wulf et al., (2002, Exp. 1). Also, Wulf and Su (2007) found expert golfers (with an average handicap of 1.3) were most accurate with their chip shots when they used an external focus, in comparison to an internal focus of

attention strategy. In contrast to these findings, Wulf (2008) tested the balance of 12 expert acrobats from Cirque de Soleil on a Disc 'O' Sit. After a 10 s familiarization trial, each participant completed four, 15 s trials in each condition (i.e., internal, external, and control), and for all of the trials the Disc 'O' Sit was on top of a force plate. Wulf found no difference in postural sway between conditions but the control condition had a significantly higher mean power frequency (MPF) reading than either the external or internal conditions. The higher MPF readings indicate a more autonomous movement. This indication of autonomous movement suggests more active degrees of freedom, which is often associated with highly skilled performance (Newell & Slifkin, 1996). The internal and external conditions did not have significantly different MPF readings. Wulf (2008) proposed these conflicting results may have occurred because any focus outside of what the acrobats usually focused on took them from their highest control level and inhibited their performance. Whatever the true mechanism might have been the difference in results shows more research should be conducted in regard to the effectiveness of particular types of attentional foci across skill levels.

For more than a decade, the most commonly used explanation for why an external focus of attention is superior for performance and learning, when compared to an internal focus of attention, is the constrained action hypothesis (Wulf, McNevin, et al., 2001). This hypothesis suggests that focusing on the effects movement has on the environment (i.e., external focus) allows motor behaviors to happen more autonomously or unconsciously. In contrast, when a mover focuses on their own body movements (i.e., internal focus) they interfere with the automatic processes of motor behavior. The constrained action hypothesis has been validated using a variety of tasks and measures. For example in a study conducted by Wulf, McNevin et al. (2001), during a stabilometer balancing task, probe reaction times (RT) were taken as a measure

of attentional demands required with an external and internal focus of attention. The external focus participants had faster probe RT intervals than the internal focus participants in addition to enhanced stability as indicated by a lower root mean squared error (RMSE). These results are consistent with the constrained action hypothesis because an external focus allowed participants balance to occur more autonomously. The authors concluded this automated processing (i.e., an external focus) did not require as much attentional resources which allowed participants in the external condition to have faster reaction times.

Additional support for this hypothesis is found through Fast Fourier Transform (FFT) analyses of the balance platform movements. These analyses show a higher frequency of movement adjustments with an external focus in comparison to an internal focus (McNevin et al., 2003; Wulf, McNevin et al., 2001; Wulf et al., 2004). This combination of high frequency and low amplitude adjustments in MPF is viewed as a more autonomous control mode because the neuromotor system is capable of handling minor and major perturbations to the base of support (Newell & Slifkin, 1996). Whereas, a reading with lower frequencies (i.e., slower movements) shows less coherence between sensory input and effector output which is thought to be caused by a mover's conscious intervention in these processes (McAuley & Marsden, 2000). Lower MPF readings suggest lower coherence (McAuley & Marsden 2000) and higher MPF readings suggest the capability to handle perturbations (Newell & Slifkin, 1996). These ideas match well with the constrained action hypothesis as the external condition had higher MPF readings, and internal condition had lower MPF readings (McNevin et al., 2003, Wulf, McNevin, et al., 2001; Wulf et al., 2004). This provides further support that an external focus of attention can result in more autonomous movement whereas directing attention internally interferes with performance due to attempts to consciously control movement.

Studies utilizing EMG readings found in focus of attention literature also provide support for the constrained action hypothesis. For instance, multiple studies have found reduced EMG activity when using external focus even though higher force levels are produced (Marchant, Greig, & Scott, 2009; Vance et al., 2004; Wulf et al., 2010). External focus conditions have also resulted in reduced EMG levels, for movers, while at the same time demonstrating superior accuracy compared to internal focus conditions (Lohse et al., 2010, 2011; Zachry et al., 2005). This suggests an external focus provides a more efficient and coordinated movement pattern. This observation provides additional support for the constrained action hypothesis because the enhanced efficiency and coordination found when using an external focus group parallels non-conscious (i.e. automatized) skill execution (Wulf et al, 2010). This reinforces the idea that an external focus allows a movement to be executed more autonomously.

The reviewed literature demonstrates that directing attention externally benefits accuracy (Lohse et al., 2010; Marchant, Clough, et al., 2009; Wulf et al., 1999, 2002; Wulf & Su, 2007, Zachry et al., 2005), jumping heights (Wulf et al., 2010) and distances (Porter, Ostrowski et al., 2010), balancing ability (McNevin et al., 2003; Wulf et al., 1998, Exp. 2, Wulf, McNevin et al., 2001, Wulf et al., 2004, Wulf, Töllner, & Shea, 2007, Exp. 2, & Wulf et al., 2009), agility (Porter, Nolan et al., 2010), and movement efficiency (Lohse et al., 2010; Marchant, Greig et al., 2009; Vance et al., 2004; Wulf et al., 2010; Zachry et al., 2005). The constrained action hypothesis provides a general explanation for this consistently observed phenomenon. However, there are areas in focus of attention research that need further clarification.

One area that deserves further research, and thus is the purpose of this paper, is finding the issue of whether the benefit of an external focus of attention still exists when participants are asked to change their focus of attention mid-trial. This topic is important because it may provide

information on how immediately a focus of attention may or may not affect performance when one is asked to switch focus of attention mid-trial. Therefore, potential findings could be used to provide guidance for practitioners and theorists. From a practical perspective one should gain a better perspective on whether or not it is beneficial to change verbal instructions mid-trial. For theorists, these findings may provide further support for the constrained action hypothesis (i.e., if the external focus of attention leads to superior performance) or they could provide more questions that need to be answered if differences are not found when comparing performance under the two differing attentional foci.

Prior research has investigated the concept of changing a learner's focus of attention while practicing a motor skill. Specifically, researchers have had participants switch between an internal and an external foci of attention from trial to trial (Wulf, Shea, & Park, 2001, Exp.1), and from block to block (Marchant, Clough et al., 2009). In one experiment participants were allowed to switch between external and internal foci whenever they chose (Wulf, Shea et al., 2001, Exp.2) in order to find out what foci of attention participants preferred, if their preferences would change with practice, and if their preferences affected performance. However, to this point no matter the duration of time between switching from one focus to another the results during testing are predominantly in favor of an external focus of attention (Wulf, 2007).

Two previous studies provide guidance with regard to switching attentional foci mid-task, and it is not the purpose of this paper to refute their findings, but rather to expand this area of research to help improve understanding of the processes occurring when movers are directed to switch their attentional foci mid-task. A recent study by Shücker, Hagemann, Strauss, and Völker (2009), looked at how differing attentional foci affect running economy (i.e., a breath-by-breath procedure was used to measure oxygen consumption continuously throughout the trial).

While the main purpose of the study was not how performance changed when participants were asked to change attentional foci mid-trial, it was part of the experiment's design and has relevance to this present study. Participants completed a treadmill running task at a target speed for 30 min, and for each 10 minute block they had a different focus of attention. During each 10 minute block they were asked to change their focus. In each condition instructions were provided every 15 s. One internal condition asked participants to focus on their running mechanics. They were asked to "concentrate on the running movement" and this was alternated with "pay attention to the steps and forward movement of your legs." The second internal condition directed their attention to their breathing. In this condition instructions alternated between "focus on your breathing" and "pay attention to breathing in and out." The one external condition asked participants to focus on their surroundings. In this condition the surroundings they were asked to look at came from a movie clip displayed directly in front of them. It is worth noting that in the other two conditions (i.e., internal) the movie clip was not playing. In the external conditions instructions alternated between "concentrate on the movie" and "pay attention to the route." They found the external focus resulted in the lowest oxygen consumption when compared to an internal focus on the running movement and breathing. This answers the question of whether an external focus is still the most beneficial when one switches attentional foci mid-task in part, but the external focus of attention in this study did not specifically direct participants' focus to the effects of their movement as suggested by Wulf, McNevin, Fuchs, Ritter, and Toole (2000). Instead their external focus was directed to the movie projection in front of them or on the particular route shown in the movie. Due to this difference one cannot be sure whether the improved oxygen consumption that took place in the external conditions is truly the same as

what is occurring when studies have used external attentional foci that focus on the effects movement have on the environment.

Wulf, Shea et al., (2001, Exp.2) also provided insight in this area of research when participants balanced on a stabilometer over the course of two days of practice. During those two days, participants could switch their attention from their feet to markers on the stabilometer platform whenever they desired during each trial. They were also asked to indicate every time they switched attentional foci so the experimenters could record the time each participant spent balancing with in each condition. On day three participants were asked to select their preferred focus of attention for the retention test. Sixteen of the 20 participants reported a preference for focusing on the markers. There were no performance differences between the two conditions during practice. However, during retention, those who preferred an external focus had significantly smaller RMSEs and more frequent, smaller amplitude MPFs, thereby demonstrating more proficient balance than those who preferred the internal focus. While this does show that external foci are still the most beneficial for learning, even when participants switch attentional foci between trials, it does not answer the question of whether or not an external focus will be superior for performance and learning when switching attentional focus mid-trial. The present study aimed to further the work of Wulf, Shea et al., (2001, Exp.2) by investigating whether or not an external attentional focus is superior for movement performance when compared to an internal attentional focus when participants are asked to switch between the two options mid-trial instead of participants switching between the two whenever they desire.

Due to the findings of Shücker et al., (2009), Wulf, Shea et al., (2001, Exp.2), Newell and Slifkin (1996), and predictions of the constrained action hypothesis (Wulf, McNevin et al., 2001) it was hypothesized when participants were directed to switch attentional foci (i.e., from internal

to external, and vice versa) mid-trial balance performance under an external focus would be superior when compared to an internal focus. The motor skill performed in this task was balancing on a stabilometer. In particular it was hypothesized that time spent balancing using an external attentional focus would result in lower RMSE values when compared to time spent balancing with an internal attentional focus. Lower RMSE values were expected based on the findings of previous stabilometer research which manipulated attentional foci (McNevin et al., 2003; Wulf et al., 1998, Exp. 1; Wulf, McNevin et al., 2001).

METHOD

Participants

College-aged students participated in this study ($N=21$; M age = 21.6, $SD = 2.0$ years; M height = 176.11, $SD = 6.08$ cm; M weight = 74.74, $SD = 11.24$ kg). Participants did not have prior experience with the task nor were they aware of the purpose of the study. While participants were considered untrained in this skill, it is possible the participants had performed balance tasks, similar to this task, at some point in their lives prior to the study. Due to this, participants were considered untrained, but they were not considered complete novices. Participants agreed to having had no previous experience using a stabilometer. Also, participants were properly informed of the task, and in order to participate they provided written consent. This consent was approved by the Human Subjects Committee at Southern Illinois University-Carbondale.

Apparatus and task

The task required participants to balance on a stabilometer. The stabilometer had a 65x105-centimeter (cm) wooden platform with the maximum possible deviation of the platform

to either side being 30 degrees. The task was to remain in balance (i.e., maintain the platform in a horizontal position) for as long as possible throughout the trial. A tape measure, which ran the whole width of the stabilometer, was attached 6 cm from the front of the stabilometer and orange floor tape (65x2.5 cm) was placed down the midline of the stabilometer to help clarify where participants should orient their bodies to start. Before the first trial participants oriented the middle of their bodies with the floor tape and then took a shoulder width stance. From their shoulder width stance, the instep of each of their feet was recorded by marking where each instep aligned with the numbers of the tape measure attached to the stabilometer. This foot position was used for the rest of the trials. Also two, 2x2 cm orange markers were attached to the stabilometer; each marker was placed 5 cm from the side edge and 8 cm from the front edge of the stabilometer platform.

The movements of the platform were measure by a potentiometer, linked to the platform. An analog signal from the potentiometer was recorded for the duration of each trial. These data were stored on a computer for later analysis.

Procedure

Using a within participant design, all participants performed seven, 90 s trials under each condition, (i.e., External to Internal [EtI], and Internal to External [ItE]). A familiarization trial and all the trials for one condition were performed on day one of testing, and all the trials for the other condition were performed on day two of testing. The order of the condition was counterbalanced across participants.

After providing written consent, participants' sex, age, height, and weight were recorded. Then participants completed a 5 minute walking warm-up. Following this, participants took a 2 minute seated rest where they received directions on the procedures of each trial. After this,

participants completed a 60 s familiarization trial, on the stabilometer. During the familiarization trial participants were instructed to “Balance to the best of your ability.” After their familiarization trial, participants received a 90 s rest where they received verbal directions covering the two attentional foci (i.e., internal- their feet, external- the orange markers on the platform) prescribed for their trials, clarification was provided on what particular markers participants were to direct their attention towards during their external focus, and they were informed of which focus they were to use first for their trials on day one. When participants were in the external condition they were instructed to do the following, “While trying to stay balanced as possible, focus on keeping the markers level,” and during the internal focus condition participants’ directions were, “While trying to stay balanced as possible, focus on keeping your feet level.”

Before the first trial participants were asked to state what two attentional foci they would use during the trial, and which focus came first. If the participant could not state what both foci were, and which focus would come first they were reminded before the trial started. Also, it was made clear to participants that they should look straight ahead and concentrate on the prescribed attentional focus, rather than looking down at their feet or the markers on the platform. Approximately 15 s before the start of the trial participants were asked to step onto the stabilometer and to keep the right side down until they heard the starting signal. The stabilometer produced a beeping sound which served as the starting signal.

When in the EtI condition, participants were focused on the markers for the first 45 s. Every 15 s, participants were verbally reminded of the focus they were currently under. While in the external condition they heard the following reminder, “Keep the markers level”, and while in the internal condition they heard, “Keep your feet level”. At the 45 s mark, another beeping

sound came from the stabilometer which signaled the participants to switch their attentional focus. At this time they were also verbally reminded by the experimenter what to focus on. Under this attentional focus, participants were reminded of the focus they were currently under every 15 s as well. This same process was completed for the ItE condition; only the internal focus was first, followed by the external focus. After each 90 s trial, participants received a 90 s rest under both conditions. The second day of testing took place at least 24 hours after the first day of testing.

Dependent Variable and Statistical Analyses

The potentiometer data was transformed into degrees out of balance. Participants' proficiency in performing the task was measured by RMSE in degrees, with the 0-degree position (i.e., platform in horizontal) as the criterion.

RMSE was analyzed with a 2 (Focus) * 2 (Day) analysis of variance (ANOVA) with repeated measures. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 17. The criterion set for significance was $p \leq 0.05$.

RESULTS

The results of the ANOVA did not find significant difference in the main effect for Focus, $F(1, 20) = .063$, $p = >0.05$, as the difference in RMSE between the external ($M = 6.73$, $SD = 1.15$) and the internal ($M = 6.09$, $SD = 1.16$) foci was minimal. However, there was a significant main effect for Day, $F(1, 20) = 74.827$, $p = < 0.001$, as the RMSE for trials on Day 2 ($M = 5.49$, $SD = 0.98$) were lower than the RMSE of trials on Day 1 ($M = 6.73$, $SD = 0.96$) indicating participants were better on day 2 compared to day 1 regardless of condition (see Figure 1).

Figure 1.

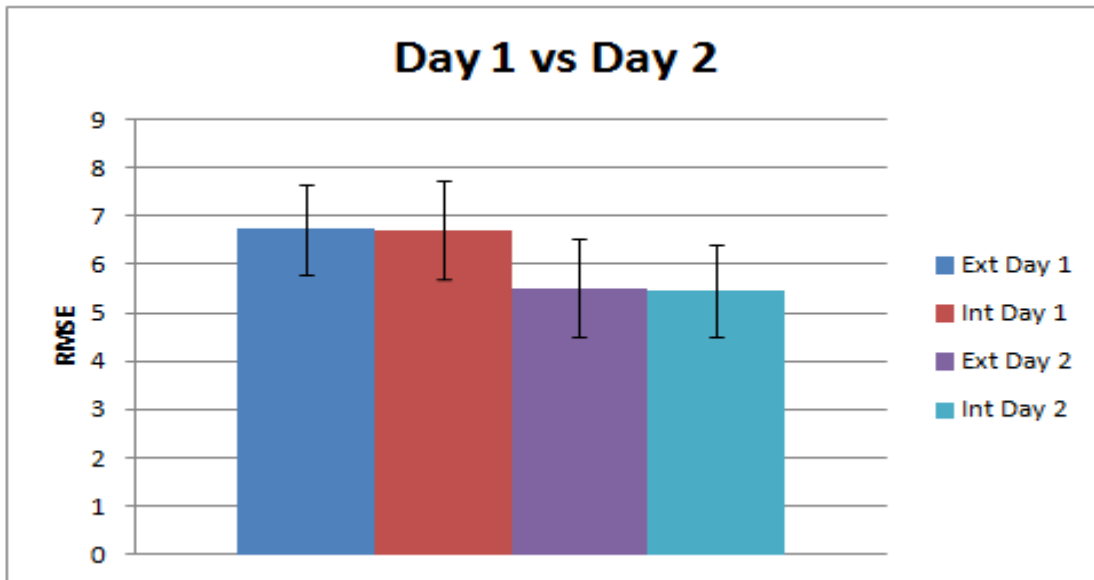


Figure 1 Caption: Average RMSE for time using an external or internal focus by day with the error bars representing standard deviation.

DISCUSSION

The purpose of this study was to investigate if differences commonly observed between internal and external foci would still be found when asked to alternate between the two during a motor task. However, the findings of this experiment are not completely consistent with previous research. Participants' performance improved with practice, regardless of condition, which is commonly found in focus of attention literature (McNevin et al., 2003; Wulf et al., 1998, 2007, & 2009; Wulf, McNevin et al., 2001) but a significant difference was not found between the two experimental conditions. Despite the lack of difference between the performances of the experimental conditions these findings still provide meaningful points of discussion. Possible limitations of the present study provide an explanation for the observed results and potential avenues for future research.

One limitation to this study was failing to use MPF as a dependent variable. Previous stability research measuring MPF has shown a higher frequency of movement adjustments at lower amplitudes when using an external focus of attention, and less frequent movement adjustments with higher amplitudes when using an internal focus of attention (McNevin et al., 2003, Wulf, McNevin et al., 2001; Wulf et al., 2004). The combination of high frequency and low amplitude adjustments in MPF is viewed as a more autonomous control mode because it suggests the system is capable of handling minor and major perturbations to the base of support (Newell & Slifkin, 1996; McAuley & Marsden, 2000).

This has further importance because MPF readings may indicate if participants switched their focus of attention when asked to. Previous research has reported differences in MPF while not finding differences in RMSE when comparing external and internal focus of attention (McNevin et al., 2003, Wulf, McNevin et al., 2001; Wulf et al., 2004). Depending on possible differences in MPF between these two conditions it could provide a clearer insight into whether or not participants are actually adopting the prescribed focus of attention during motor performance as expected. This is said because to this point studies have primarily relied on a variety of questionnaires to find out whether or not participants are following prescribed instructions (Marchant, Greig et al., 2009; Marchant, Clough et al., 2009; Porter, Nolan et al., 2010; Shucker et al., 2009). While the information provided from these questionnaires is valuable, the questionnaires used lack consistency from study to study which makes it difficult to come to a consensus on whether or not participants are actually doing what they are prescribed. Future research should attempt to become more consistent with the method used to help focus of attention research come to better conclusions about what participants are actually doing when asked to use a particular attentional focus or to switch from one focus to another.

Another possible limitation to the current study was the lack of a retention test. Previous stability studies have not found significant differences between external and internal conditions during practice only to later find differences during retention tests (Wulf et al., 1998, Exp. 2; Wulf, McNevin et al., 2001; Wulf, Shea et al., 2001). If a between-subjects design had been used in this study, a retention test could have been implemented, and in that case the findings of the study may have been similar to previously mentioned studies.

Other possible limitations to this study are the amount of practice time provided for each focus of attention and the conditions that were used. Much like several previous stability studies (McNevin et al., 2003; Wulf et al., 1998; Wulf, McNevin et al., 2001; Wulf, Shea et al., 2001) 90 s trials were used. However, since time was split evenly between each focus of attention, participants only received 45 s of practice in each trial. When compared to previous within design stabilometer studies the time spent under each focus differs with this current experiment because participants could switch between the two attentional foci at their own discretion during each trial (Wulf, Shea et al., 2001). As a result, the time spent under each in this present study also differs from previous between design stabilometer studies because participants in this experiment only received half as much practice time in their respective conditions. These possible discrepancies in practice time in addition to the lack of a retention test may be possible reasons for findings that are not consistent with previous studies.

In regard to the conditions that were used, this design may be limited because we do not know how the performance of the conditions used in this current study would compare to “only external” or “only internal” conditions. One could speculate that the results found in the study would be similar to the “only internal” condition. This is said based on the possibility that asking participants to switch their focus of attention mid-trial may have overwhelmed their information

processing system. It could also be possible that asking participants to switch between foci mid-trial led to more conscious intervention in the movement being performed. With either possibility, the findings would be consistent with the constrained action hypothesis since a cognitively overwhelmed mind or a mover who is consciously trying to control movement should lead to decreased performance much like only using an internal focus decreases performance because it interferes with autonomous processes (Wulf, McNevin et al., 2001). Until a study is completed where “only external” and “only internal” conditions are used along with the conditions used in this study one cannot say whether prescribing switches of attentional foci optimizes or inhibits performance when compared to using one particular attentional focus throughout practice of a skill. It is suggested that future research look into these possible practice time and condition design discrepancies to help answer whether or not these topics were truly limitations in the present study. At the same time looking into these discrepancies, as mentioned above may also help us better understand what is occurring from a theoretical perspective.

While the findings of this research do not support the constrained action hypothesis as the majority of focus of attention literature before it has. It does provide more questions for future focus of attention research to answer. However, until those questions are answered one cannot say how effective or ineffective prescribing switching of attentional foci mid-trial might be for practitioners or what impact switching foci mid-trial might have from a theoretical perspective. Based on this information, it is suggested that practitioners use instruction that direct a mover's attention externally since the majority of evidence suggests it is superior for performance when compared to an internal focus of attention. It is also suggested that practitioners avoid switching instructions mid-task doing so does not appear to benefit performance.

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VITA

Graduate School
Southern Illinois University

William P. Westphal

Date of Birth: February 14, 1986

333 Buchner Place #308, La Crosse, WI, 54603

westphal.william32@gmail.com

University of Wisconsin- La Crosse

Bachelor of Science, Physical Education with a minor in Adapted Physical Education, May 2010

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Major Professor: Jared M. Porter, Ph.D.