THE COMPARISON OF THE INFLUENCE OF ATTENTIONAL-FOCUS ON THE CENTER OF MASS DISPLACEMENT OF BODY DIFFERENT SEGMENTS IN BASKETBALL SET SHOT

INTRODUCTION

Over the past two decades there has been some evidence that an individual’s focus of attention has a significant influence on the motor performance and learning. In particular, it has been shown that directing a performer’s attention to the movement effect (i.e. an external focus), is more beneficial than attention directed to the actual movement itself (i.e., an internal focus) (Wulf et al. 1998, 2001, Wulf, 2007 a, b). A vast majority of the research has used skills that require the manipulation of an object to achieve the action goal, such as hitting a golf ball (Wulf et al. 1999, Perkins-Ceccato et al. 2003; Wulf, & Su, 2007), shooting a basketball (Al-Abood et al., 2002, Zachry et al., 2005), kicking a football (Zachry, 2005) or soccer and volleyball (Wulf et al. 2002, 2003), hitting a tennis ball (Wulf et al., 2000), baseball (Castaneda, & Gray, 2007), and even dart throwing (Marchant, 2007). The advantages of an external focus are not only seen when compared with internal focus conditions, but also when compared with control conditions (Landers et al., 2005; McNevin, 2002, 2003). This pattern of results suggests that an external focus has the capacity to enhance performance and learning. The rationale for focusing on the movement effects rather than on the movement itself is explained by the „constrained action hypothesis” (McNevin et al., 2003; Wulf et al., 2001). This hypothesis suggests that directing one’s attention to the actual movements (internal focus) might „constrain” the motor system and interfere with the automatic control processes, while focusing on the effects of the movement (external focus) actually frees the performer and enhances the automatic control processes. Overcoming this analysis paralysis, participants focus on the effects of their actions so the movement pattern becomes more „automatic”, demonstrating a smooth, coordinated response. For example, balancing on a stabilometer (Wulf et al.,
postural adjustments in balance tasks (Wulf et al., 1999, 2001, Wulf, 2007), hitting a target (Wulf et al., 1999, 2002) or balancing (Wulf et al. 1998, Landers et al., 1999 Shea & Wulf, 1999; Totsika & Wulf, 2003), but also for tasks that require the production of maximum forces and displacement of the center of mass (Wulf et al., 2007). Zachry et al. (2005) believed that an external focus of attention not only enhances movement efficiency, but also reduces „noise” in the motor system that delays fine movement control and distorts the outcome of the movement. This indicates that participants produced greater forces under that condition.

Although evidence is convincing regarding the effectiveness of an external focus in practicing motor skills, there is still much to be discovered. Conflicting findings demonstrate that age (Emanuel et al., 2008), gender (Wulf et al., 2003), skill level (Perkins et al., 2003; Ford et al., 2005; Castaned & Gray, 2007; Wulf, 2008), complexity of the skill (Poolton et al., 2006; Denny, 2010), and individual preferences (Wulf et al., 2001), sport settings (Porter et al., 2010) might all play a role regarding the efficacy of internal and external attention focus in skill performance. Recently Weiss et al. (2008) discovered that one’s preferred focus of attention could play a role in the effectiveness of attention focus, suggesting that an internal focus did not necessarily lead to a decrease in performance if it was the participant’s preferred strategy.

According to the contrary results, we decided to examine whether an external focus would have a great impact on the displacement of different body segments and mass centers in university male basketball beginners, compared to internal focus. If this were the case, it would complement and extend the findings of the previous studies which have almost exclusively shown benefits of external focus for tasks requiring movement accuracy. In two experiments, participants performed a shooting task under both conditions. Under external focus conditions, the participants were instructed to focus on the basket, whereas under internal focus conditions they were asked to focus on the wrist. Thus, the instructions were very similar in terms of the actual locus of attention.

**METHOD**

Thirty university male students (aged 18 - 30) with no knowledge of basketball shooting and not aware of the specific purpose of the study were assigned randomly to one of two experimental groups (n=15) based on their pre-test scores of 10 shots. The two matched groups were assigned one of two practice conditions. During ten consecutive practice sessions, all participants received the same initial instructions regarding the basket (external) and wrist (internal), but no feedback during the post-test. After a day of rest, participants performed a retention test consisting of 10 trials with 10 seconds rest between each trial. The task involved was the throwing ball
toward the basket from penalty line in basketball, putting markers on the subjects’ center of mass of different body segments (forearm, trunk, thigh and leg) and recording the motions from sagittal and frontal surfaces by two Panasonic cameras with 100 fps speed. Motion analysis software was used to analyze information.

Descriptive statistics were calculated to report the mean performance of the two practice groups for the retention test scores (Table 1). Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 16. The criterion for significance was set using an alpha level of $p \leq 0.05$. An independent samples t-test was used to determine significance between the experimental conditions. Statistics (Mann-Whitney U) were calculated to determine the magnitude of the observed significant performance differences.

Table 1. Center of Mass Displacement Under Internal and External Focus Conditions

<table>
<thead>
<tr>
<th>Segments</th>
<th>Groups</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>T</th>
<th>Df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forearm</td>
<td>Internal</td>
<td>3.11</td>
<td>0.162</td>
<td>-0.694</td>
<td>28</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>External</td>
<td>3.22</td>
<td>0.595</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk</td>
<td>Internal</td>
<td>2.18</td>
<td>0.409</td>
<td>-4.66</td>
<td>28</td>
<td>0.000*</td>
</tr>
<tr>
<td></td>
<td>External</td>
<td>3.22</td>
<td>0.765</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thigh</td>
<td>Internal</td>
<td>3.39</td>
<td>0.850</td>
<td>-0.299</td>
<td>28</td>
<td>0.772</td>
</tr>
<tr>
<td></td>
<td>External</td>
<td>3.48</td>
<td>0.874</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg</td>
<td>Internal</td>
<td>3.29</td>
<td>0.442</td>
<td>1.089</td>
<td>28</td>
<td>0.285</td>
</tr>
<tr>
<td></td>
<td>External</td>
<td>3.07</td>
<td>0.636</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

As shown in Figure 1, the mean displacement of trunk for internal group was 2.18 and for external group it was 3.22 with $F(9.58)= , p < .05$.

Figure 1. Mean differences of body segments Mass centers
RESULTS
Participants’ trunk center of mass displacement reached greater changes when they were instructed to adopt opposed focus to the internal focus, (3.22) for external focus group, and internal focus (2.18), (see Table 1). Mann-Whitney U tests confirmed that the external focus condition differed significantly from the internal one for the trunk center of mass displacement, $F(9.58) = , p < .05$, and independent t-test showed a statistical significance between the two practice conditions in trunk center of mass displacement ($p = .000$).

DISCUSSION
The purpose of this investigation was to determine if body segments center of mass displacement in an external focus would be better than an internal focus when performing a basketball set shot. Among numerous studies on attention focus, few have considered the effects of attention focus on body segments center of mass displacement. Traditionally, coaches and teachers have been trained in teaching sport skills using an internal focus of attention. Although a common practice, some have questioned the value of an internal focus and suggested it may actually stop performance (McNevin et al., 2003). The results of this study support the view that an external focus is more effective than an internal focus in center of mass displacement of trunk when performing shooting in basketball. This finding appears to be parallel to several studies exploring the benefits of an external focus when compared to an internal focus, including the basketball free throw (Al-Abood et al., 2002), the standing soccer shot and volleyball serve (Wulf et al., 2002), the golf pitch shot (Wulf et al., 1999), putting (Poolton et al., 2006) and center of mass displacement (Wulf et al., 2007). Throwing ball to the basket used in this study involved several variables, including the attentional focus of the performer. These factors may explain the difference in the results of this study compared to other studies done on this topic. Mechanically speaking, the only way to raise the mass displacement is by increasing the magnitude of external force exerted. From a performance perspective, one can deduce that participants either increased force production, or optimized coordination between and among the segments during a task to produce a more continuous summation of segmental velocities (Wulf et al., 2007).

The results of the present study provide converging evidence that a change in the focus of attention can affect greater COM displacement (Wulf, 2007). Focusing on a target (external focus) resulted in greater mass displacement in trunk than focusing on the wrist with which the ball was to be thrown (internal focus). Moreover, attentional focus instructions have been found to affect EMG activity not only in „related” muscle groups, but also in „unrelated” ones (Zachry, et al., 2005, Vance, et
The present results are in line with those findings in demonstrating that the attentional focus on one part of the body can impact whole-body displacement. Wulf’s experiments (Wulf et al., 2007) showed greater vertical displacement of the center of mass. This indicates that participants produced greater forces under that condition. While it might be surprising that a simple change in an individual’s focus of attention can enhance force production, previous studies have shown that an external focus results in more efficient movement patterns (Zachry et al., 2005, Vance et al., 2004, Marchant et al., 2006). In those studies, the same outcome (i.e., weight lifted in a given amount of time) was achieved with less muscular activity during an external focus, as opposed to an internal or no particular focus (Vance et al., 2004, Marchant et al., 2006). Interestingly, muscular activity was reduced not only for agonist muscle groups, but also for antagonist muscles (Marchant et al., 2006). This suggests that a focus on the movement effect might not only facilitate an effective recruitment of intra-muscular, but also inter-muscular coordination (Hollmann & Hettinger, 2000). Marchant et al. (2009 b) study also showed beneficial effects of an external focus on maximum force production. Using an isokinetic dynamometer, Marchant et al. (2009 b) had participants produce maximum voluntary contractions of the elbow flexors under internal-focus (i.e., focus on arm and muscles) or external-focus (i.e., focus on the crank hand-bar) conditions. The results showed that participants produced significantly greater peak joint torque when they focused externally compared with internally. Future studies, using motion analysis, for example, may be able to shed more light onto the exact mechanisms that are responsible for the greater movement effectiveness of an external focus for tasks that require maximum force, joint torque, center of mass displacement, agility and velocity.

REFERENCES


ABSTRACT

The purpose of this study was to determine the effect of the focus of attention (internal and external) on the center of mass displacement of the different segments of the body (forearm, trunk, thigh and leg) in university male basketball beginners, participating in learning basketball set shot. Using Udine Sky table, 360 right handed male students at average age of 18-30 with no knowledge of basketball were chosen randomly. After a 10 set shot pretest, 30 students were assigned randomly into 2 experimental groups: Internal (i.e., focus on the wrist) and External (i.e., focus on the basket). After 10 sessions of practice and a day off, a retention test was conducted for each group. Results demonstrated improvement for all groups, but these results suggest that external focus of attention has a significant effect on the trunk center of mass displacement. Data was analyzed using independent T test and Mann-Whitney U test. Analysis of the proposed hypotheses at the p≤0.05 demonstrated significant difference between Internal and External focus on the trunk center of mass displacement. The two practice conditions suggest that external feedback has a positive effect on the center of mass displacement of different segments of the body during basketball set shot. These findings indicate that the previously shown benefits of an external attentional focus can be applied to tasks requiring maximum displacement.

Key words: extrinsic attention, intrinsic attention, center of mass