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Influence of Attentional – Focus on Center of Mass Displacement of Body Different Segments in Basketball Set Shot

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ABSTRACT

The purpose of this study was to determine the effect of focus of attention (internal and external) on center of mass displacement of body different segments (forearm, trunk, thigh and leg) in university male basketball beginners, participating on learning of basketball set shot. 30 right handed male students by average 18-30 years with no knowledge of basketball were chosen randomly and by pretest 10 set shot, were matched randomly into 2 experimental groups: Internal (i.e., focus on the wrist) and External (i.e., focus on the basket). A retention test was conducted for each group. Data was analyzed by independent T test and Mann-Whitney U test. By analyzing the proposed hypotheses at the $P \leq 0.05$ demonstrated significant difference between Internal and External focus on trunk center of mass displacement.

Key words: Extrinsic attention, Intrinsic attention, Center of mass

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INTRODUCTION

Over these two decades, there has been some evidence that an individual's focus of attention has a significant influence on 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) [25, 32, 21, 22]. This benefit in performance has been consistent in the literature, a vast majority of the

research has used skills that require the manipulation of an object to achieve the action goal. For example, it has been demonstrated that instructing athletes to focus externally rather than internally improves learning sport skills such as hitting a golf ball [27], shooting a basketball [1, 39], kicking a football [39] or soccer and volleyball [28, 30], hitting a tennis ball[31], baseball [2], and even dart throwing [10]. Furthermore, studies using participants with Parkinson's disease [8] or cerebrovascular accident (8) have also demonstrated benefits of an external focus. The advantages of an external focus are not only seen when compared with internal focus conditions, but also when compared with control conditions [5. 29, 13, 25, 30]. 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" [14, 32]. 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 up the performer and enhances the automatic control processes. The idea that conscious attempts to control one's movements are detrimental to performance is in line with other theoretical views [12, 13]. While focusing on the movement itself may have a negative impact, focusing on the external movement effect actually frees the learner from concentrating too much on the actual movement, and as a result is more effective. 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, in the study by Wulf et al. [33], participants balancing on a stabilometer with an external focus not only showed more effective balance performance but also faster reaction times, compared to participants with an internal focus. Furthermore, postural adjustments in balance tasks generally show higher frequency characteristics when individuals adopt an external relative to internal focus, which is also viewed as an indication for the greater utilization of fast, reflexive, and automatic control processes [27, 34]. Electromyographic activity has also been shown to be reduced when participants adopt an external focus [41, 11, 20]. As free-throw accuracy was also enhanced under the external focus condition, Zachry et al. [41] 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 disturbs the outcome of the movement. Given that an external focus of attention has been demonstrated to enhance movement effectiveness and efficiency, one might expect to find external focus advantages not only for tasks that require movement accuracy, such as hitting a target [27, 28] or balancing [25, 8, 30], but also for tasks that require the production of maximal forces and displacement of the center of mass [35]. 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 [4], skill level [16, 23], gender [30], complexity of the skill [17], and individual preferences [34] might all play a role regarding the efficacy of internal and external attention focus in skill performance.

In a study by Perkins-Ceccato, Passmore at al. (2003) the performance of a pitch shot by high- and low-skilled golfers were measured and the highly skilled golfers performed better with external focus feedback while the low-skilled golfers performed better with internal focus feedback. In another study on gender differences, Wulf at al. (2003) focused on whether women could benefit more than men from using external focus. Forty students, 20 boys and the other 20 girls had to kick a ball at a target at a distance of 2 ½ meters being measured on the target by where the ball hit. The results of the tests showed that the male external group scored higher than any other group. The females in the internal group spent more time caring about the internal

movements than the actual outcome, but when given an external focus, they begin to have successful performances. Therefore, women may actually do better with an external focus during more demanding situations than men. Emanuel at al. (2008) investigated the variations between children and adults who received either internal or external focus feedback during a dart throwing activity. The results indicate that the focus of attention varies between children and adults in the acquisition, accuracy, and transfer stages but not in the retention test. This study concluded that external focus was more effective than internal focus in adults, while internal focus was more effective than external focus in children. Thus, age may play a role in the effectiveness of different types of focus feedback. In a study with soccer players, Ford at al. (2005) investigated the effects of skilled and less-skilled performers who were required to dribble a soccer ball under different task conditions which included a skill-relevant (the foot) and irrelevant component (the arm) of execution. The skilled group was negatively affected by the internal focus on the arm and the foot, while the less-skilled group showed negative results only with irrelevant attention to the arm. The complexity of the skill is another variable for investigation. Poolton at al. (2006) suggested that an internal focus of attention increased working memory load, which might be expected to detrimentally affect learning a more challenging task. Skill level is another variable to consider regarding the effectiveness of using an external focus. A study by Castaned at al. (2007) studied the hitting of less-skilled and highly-skilled collage baseball players in regards to internal and external focus and discovered that for the highly-skilled athlete an external focus was better than an internal focus. However, for the less-skilled players, batting performance was better using the internal focus of “step by step execution of the swing”. Wulf (2008) examined the effect of external and internal focus on world class acrobats and discovered that the control group did significantly better than either the external or internal focus groups. These results are contrary to previous studies and may be explained by the high skill level of the participants. Wulf’s study concluded that “the optimal attentional focus should depend on the level of expertise”. Additional studies using elite athletes will help clarify these findings. It was reported that experienced track and field coaches provided instructions and feedback during practice and competition that caused their athletes to use an internal focus of attention. This is a noteworthy observation because many experiments have investigated instructional manipulations promoting an internal vs. external focus in a variety of sport settings [18]. Denny (2010) examined the effect of external and internal focus on female volleyball players practicing the complex open skill of the jump float serve. The result demonstrated no significant difference between the two practice conditions suggesting that either an internal focus or an external focus of attention is effective for practicing the complex jump float serve. Recently Weiss at 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. In fact, “one might speculate that if you let people perform the way they prefer to perform, a heightened self- esteem and thus better performance will result”. These findings suggest that developing instructions which help direct the participants’ focus of attention to their preferred attention focus may be the best method for effective skill instruction.

According to the contrary results we decided to examine whether an external focus would have a great impact on displacement of body different segments Mass centers in university male basketball beginners, compared to internal focus. If this were the case, it would complement and extend the findings of 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 all two conditions. Under external focus conditions 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.

MATERIALS AND METHODS

Participants

Thirty university male students (age 18 -30 years), with no knowledge of basketball shooting participated in this study. They were not aware of the specific purpose of the study. All participants signed an informed consent form before the experiment.

Movement task

The task involved was the throwing ball toward basket from penalty line in basketball. The goal of the movement was to center of mass displacement of different segments of the body. The participants were assigned randomly to one of two experimental groups (n=15) based on their pre-test scores of 10 shooting. The two matched groups were assigned one of two practice conditions. All participants followed the same warm up prior to each day's practice and the shooting practice was done immediately following the five minute warm up period. On the first day of the study, all participants received the same initial instructions regarding the basket (external) and wrist (internal). This occurred during the ten consecutive sessions of practice, but no feedback during the post-test, after a day off. Following the ten practice sessions and after a day of rest, participants performed a retention test consisting of 10 trials with 10 seconds rest between each trial under two conditions: External focus (i.e., focus on the basket), internal focus (i.e., focus on the wrist).

Procedure

Testing took place in a controlled environmental conditions similar across subjects. Before the retention test some markers were put on the subjects' center of mass of body different segments (forearm, trunk, thigh and leg). Two Panasonic cameras with 100 fps speed recorded the motions from sagittal and frontal surfaces. A motion analysis software was used to analyze information.

Statistical Analysis

In order to determine center of mass displacement of different body segments, participants throw the ball from penalty line toward basket and motions of body segments displacement were recorded for each trial by cameras. The result demonstrated individuals generate more force when they focus on the desired movement effect. In this case, greater center of mass displacement of trunk should be seen under external relative to internal focus conditions. Such a finding would provide additional evidence that a focus on the desired movement effect optimizes motor control. 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 from the mean center of mass displacement to determine if there was a significant difference between the internal and external focus of attention practice conditions in retention test. Statistics (Mann-Whitney U) were calculated to determine the magnitude of observed significant performance differences.

RESULTS

Participants' trunk center of mass displacement reached a greater changes when they were instructed to adopt an opposed to an external focus, (3.22) for internal focus group (2.18). (see table).

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

Segments	Groups	Mean	Std. diviation	T	Df	Sig.
Forearm	Internal	3.11	0.162	-	28	0.005
	External	3.22	0.595	0.694		
Trunk	Internal	2.18	0.409	-4.66	28	0.000*
	External	3.22	0.765			
Thigh	Internal	3.39	0.850	-0.299	28	0.772
	External	3.48	0.874			
Leg	Internal	3.29	0.442	1.089	28	0.285
	External	3.07	0.636			

Mann- Whitney U tests confirmed that the external focus condition differed significantly from the internal one for F (9.58) =, $p < .05$ for the trunk center of mass displacement.

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. The results show there was statistical significance found between the two practice conditions in trunk center of mass displacement (p= .000).

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 suggest it may actually stop performance [14]. The results of this study supported that an external focus was 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 [1], the standing soccer shot and volleyball serve [28], the golf pitch shot [27], putting [18] and center of mass displacement [35]. Throwing ball to the basket used in this study involving 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 [35].
The results of the present study provide converging evidence that a change in the focus of attention can affect greater COM displacement [35]: 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" muscle ones [41, 20. 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 [35] 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, and previous studies have shown that an external focus results in more efficient movement patterns [11, 20, 41]. In those studies, the same outcome (i.e., weight lifted in a given amount of time) was achieved with less muscular activity when an external focus, as opposed to an internal or no particular focus [20, 11].

Interestingly, muscular activity was reduced not only for agonist muscle groups, but also for antagonist muscles [11]. This suggests that a focus on the movement effect might not only facilitate an effective recruitment of intra-muscular, but also inter-muscular coordination [7]. Marchant et al.'s (in press) study also showed beneficial effects of an external focus on maximum force production. Using an isokinetic dynamometer, Marchant et al. 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 velicity.

The results of this study indicate that an external focus was more effective than an internal focus in center of mass displacement of trunks' of male students when performing shooting in basketball. There was no major center of mass displacement differences were observed in any other segments.

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