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# Effects of Focus of Attention on Weight Throw Performance and Learning

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EFFECTS OF FOCUS OF ATTENTION ON WEIGHT THROW  
PERFORMANCE AND LEARNING

by

Greg Raimondi

B.A., Carthage College, 2012

A Research Paper  
Submitted in Partial Fulfillment of the Requirements for the  
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RESEARCH PAPER APPROVAL

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in the field of Kinesiology

Approved by:

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TITLE: EFFECTS OF FOCUS OF ATTENTION ON WEIGHT THROW PERFORMANCE AND LEARNING

MAJOR PROFESSOR: Dr. Jared Porter

Previous research has demonstrated that adopting an external focus of attention rather than an internal focus of attention results in superior motor performance in a variety of skills and sport settings. This study is the first to investigate if an external or internal focus of attention resulted in better practice performance and enhanced learning, as measured during an actual track and field meet, in the weight throw. It was hypothesized that an external focus of attention would result in superior performance marks and more effective learning than an internal focus of attention. Using a mixed-method design, highly skilled Division I athletes ( $N = 11$ ) completed two days of ten practice trials, separated by 24 hours. A transfer test was completed 48 hours after the last practice session during a scheduled Division I track and field meet. Data were analyzed using a univariate analysis of variance (ANOVA). Results showed that no significant differences were found between both experimental conditions during practice and between all three experimental conditions during the transfer test. Even though no significant differences were found the internal group, in competition and practice, had notably better performances compared to the external and control condition groups.

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## **CHAPTER 1**

### **INTRODUCTION**

There has been a plethora of research that has shown how motor skill learning and performance are influenced by focus of attention (Freudenheim, Wulf, Madureira, Pasetto, & Correa, 2010; Marchant, Greig, Bullough, & Hitchen, 2011; Totsika & Wulf, 2003). Specifically, the learner can be influenced by instruction or feedback that prompts the use of either an external or internal focus of attention. Coaches and instructors could benefit the most from these strategies in order to help athletes improve their ability while learning or mastering motor skills. Improvements in technology have increased the amount of methods coaches have to assess motor learning and performance in sport compared to years ago. As a result, much of the popular literature related to training and teaching of skill acquisition leads to a majority of coaches focusing on biomechanical factors when giving instruction or feedback to an athlete (Porter, Wu, & Partridge, 2010). This type of feedback tends to focus on the mechanics of the movement which could lead to athletes being told to focus their attention internally. However, research shows that a majority of studies found that inducing an external focus of attention is more valuable toward learning and performance than instructions that elicit an internal focus (Wulf & Dufek, 2009; Wulf, Lauterbach, & Toole, 1999).

When instruction or feedback is directed externally, the attentional focus of the individual is shifted toward the result of the movement or the effect the movement has on the environment. When directed internally, the attentional focus of the individual is shifted toward limb or body movements. A majority of research has shown that performance during sport is benefitted the most from using an external focus of attention (Porter, Ostrowski, Nolan & Wu, 2010; Shea &

Wulf, 1999; Wulf et al., 1999; Wulf & Su, 2007). The benefits of an external focus of attention have been commonly explained by the constrained-action hypothesis (Wulf, McNevin, & Shea, 2001). According to this hypothesis, when individuals are directed to focus internally (i.e., on their movements) the conscious thought of the movement interferes with automatic control processes. This increases the amount of motor signals the brain is trying to process at once, causing the muscles to initiate several different motor patterns leading to a decrease in performance. However, when the learner is directed to focus externally (i.e., on the movement effect) they allow the motor system to more naturally self-organize and unconsciously make the proper adjustments, resulting in an optimal performance.

Research in this area has shown that the use of an external focus of attention improves skills required for certain sports such as golf (Wulf & Su, 2007), discus throwing (Zarghami, Saemi, & Fathi, 2012), shot-putting (Makaruk, Porter, & Makaruk, 2013) and dart throwing (Marchant, Clough, & Crawshaw, 2007). Additionally, motor tasks used to assess specific abilities of individuals in the sport realm, such as the vertical jump (Wulf, Zachry, Granados, & Dufek, 2007), standing long jump (Porter et al., 2010), agility performance (Porter, Nolan, Ostrowski, & Wulf, 2010), and plyometric related tasks (Makaruki, Porter, Czaplicki, Sadowski, & Sacewicz, 2012) have benefited from using an external focus of attention. Using an external focus of attention has shown benefits for beginners and experts alike (Wulf & Su, 2007). Several studies in this area have compared a neutral (i.e. control condition) focus of attention to performances of the same tasks while the learner is directing attention internally or externally. To promote a neutral focus of attention the mover is provided instruction or feedback that does not explicitly focus attention internally or externally. For example, a neutral focus of attention might direct the athlete to perform the task to the best of their ability or in the fastest time



possible, dependent on the task. The results of those studies have generally shown that a neutral or control condition tends to perform similarly to an internal condition (e.g., Freudenheim et al., 2010; Porter, Nolan, et al., 2010; Wulf & Su, 2007).

Based on the data provided by Porter, Wu et al., (2010), coaches and sport scientists and scientific literature provide little meaningful information. Additionally, the information in educational books used to educate track and field coaches tend to focus on movement mechanics. It is possible to conclude that most athletes when being taught a sport related skill are given internally focused feedback or instruction. Even elite athletes that have competed at the USA Outdoor Track and Field National Championship reported that their coach provided instruction that encouraged them to focus internally (Porter, Wu, et al., 2010). Athletes in that study reported that 69% of the time during competition they focus their attention internally.

Marchant, Greig, and Scott (2009) examined the predictions of the constrain-action hypothesis and its influence on force production and muscular activity using electromyography (EMG). Participants ( $N=25$ ) completed repetitions of a single-arm elbow flexion on an isokinetic dynamometer using an external and internal attentional focus. The external focus group produced significantly greater force production and lower muscular activity compared to the internal group. The authors concluded that focusing externally allowed the motor program to efficiently activate and coordinate the muscles involved in the movement. However, using an internal focus of attention interfered with the planned motor program by inefficiently activating the muscles involved in the movement reducing the ability to produce maximal force production. Marchant, Greig, Bullough, and Hitchen (2010) looked at how focus of attention affected muscular endurance using three progressively more complex exercises (i.e., assisted bench press, free weight bench press, squat). The authors found that an external focus of attention resulted in

significantly greater repetitions until failure compare to the control and internal conditions.

Similar results have been observed in sport settings, such as swimming when athletes need to sustain sub-maximal force levels over periods of time (Freudenheim et al., 2010).

Although much research has investigated the effects of attentional focus on sport-related skills, no studies have looked into the effects with respect to track and field's weight throw performance and learning. The weight throw is a skill that requires maximal force production, agility, and postural stability throughout the movement. Prior studies regarding track and field throwing events such as elite athletes performing the shot-put (Makaruk, et al., 2013) and novices throwing the discus (Zarghami et al., 2012) have benefitted from an external focus of attention. The present study uniquely adds to the existing body of research by looking at the weight throw using skilled Division I athletes. Therefore, the first purpose of this study was to investigate if an external or internal focus of attention promoted better practice performance in the weight throw. The second purpose of this study was to examine if an external or internal focus of attention promoted better learning in the weight throw as measured during an actual track and field meet. A control condition was used to determine if external or internal conditions enhanced or decreased performance during a track and field meet. It was hypothesized that the participants in the external focus of attention condition would produce better performance marks and more effective learning compared to participants in the internal and control focus of attention conditions.

## CHAPTER 2

### METHOD

#### Participants

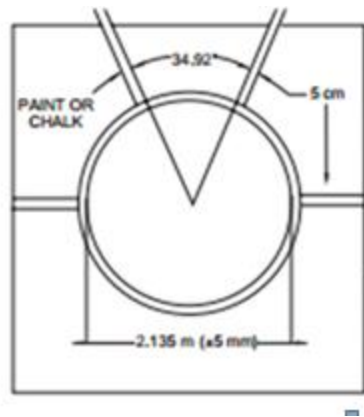
Approval from the Southern Illinois University-Carbondale (SIUC) Human Subjects Committee was gained before contact was made with potential participants for this study. Participants ( $N = 11$ ;  $n = 7$  men,  $n = 4$  women) in the study were members of a National Collegiate Athletic Association (NCAA) Division I Track and Field team in the United States of America. Specifically, the participating athletes competed in the throwing events (e.g., shot-put, discus, and hammer). All participants were skilled athletes, defined as athletes competing in athletics at the Division I level, and all participants had multiple years of formal training and experience with the task prior to the start of the study. Prior to data collection in the experiment, all participants signed an informed consent.

#### Apparatus and task

Practice trials took place in a university student recreation center, within the indoor track and field area of the building. An indoor weight throw ring 2.14 meters in diameter (see Figure 1 below), that met all other dimensions and standards set by the NCAA and International Association of Athletics Federations (IAAF) track and field guidelines, was used. The ring was composed of wood and aluminum and the landing sector was comprised of a Mondo surface. The landing sector was formed at a 34.92 degree angle extended from the center of the circle indicated by painted white lines 5 centimeters in width.

All participants used a regulation implement (see Figure 2 below) throughout the study (Dominador Athletics, IN, US.). Specifically, male participants threw a 15.88kg plastic ball

145mm in diameter, placed in a fabricated harness connected to a steel handle. Female participants threw a 9.09 kg plastic ball 120mm in diameter, placed in a fabricated harness connected to a steel handle. Implements meet all standards set by the NCAA and IAAF track and field guidelines. Practice throws were measured using a 30m, fiberglass, open-reel tape measure (Gill Athletics, Champaign, IL). Performance was assessed using the dependent variable of distance, which was measured in meters and centimeters.



*Figure 1. Over-head view of throwing ring with dimensions and sector angle. Copyright 2014 by The National Collegiate Athletic Association.*



*Figure 2. Side view of weight implement with dimension.* Copyright 2014 by The National Collegiate Athletic Association.

## **Procedure**

Participants were tested during the in-season period of the indoor track and field season (i.e. January and February). This particular time period in the competitive season was chosen because the weight throw is only thrown during the indoor season. The study used a mixed-method design. The same experimenter conducted all practice sessions and was present during testing sessions. The experimenter, an assistant coach, and participants were the only individuals present during the study. The experimenter was the only person that gave instructions to the participants. After the completion of the necessary paperwork, participants were randomly placed into one of two focus of attention conditions: internal focus (INF) or external focus (EXF). All participants signed up for specific training session times through the duration of the study.

Each participant completed 10 throws on two different days, separated by 24 hours, for a total of 20 throws. During the participant's respective sessions, a 5-minute warm-up of dynamic

exercise (e.g., high knees and butt kicks) were given. After the warm-up period, all participants were given a set of general instructions to follow during the practice sessions. The general instructions indicated that participants were to throw as far as possible on each attempt. The instructions also indicated that participants were to read the prescribed instructions prior to each throw and they were to follow the prescribed instructions while performing the task. Following the reading of the instructions, participants took a throw with their respective implement. The distance the weight was thrown was measured immediately upon landing and recorded into a computer and saved for later analysis. The distance the implement was thrown was determined by measuring from the nearest edge of the first mark made by the weight to the inside edge of the circle, measured to the nearest hundredth of a centimeter. Any throw that landed on or outside the landing sector lines was not recorded due to being an illegal throw per NCAA regulations.

The instruction used for the external (EXF) condition was, “When you are attempting to throw as far as possible, I want you to focus on pushing the weight down the left sector line on each turn of your throw.” The instruction used for the internal (INF) condition was, “When you are attempting to throw as far as possible, I want you to step your right foot to the left sector line on each turn of your throw.” After every two attempts participants were asked, “During your throws, what were you asked to focus on?” If participants did not correctly restate the cue, prior to the next throw they had to re-read the instructions and verbally tell the experimenter what they were supposed to focus on during the throw.

Participants completed a transfer test 48 hours after the practice sessions. The transfer test was conducted during one of the scheduled track and field competitions and was comprised of several Division I schools from around the country. During the test, participants were given a 15-minute warm-up period as specified by the competition rules under the NCAA Track and

Field Guidelines. Within that time frame, participants completed drills done on previous practice session days and also completed three practice throws, which were not assessed. Participants completed three throws during the transfer-test, which were measured immediately upon landing by the meet management staff. Similar to practice trials, if the throw did not land in the regulated sector, the throw was considered a foul and was not measured. At no time during the testing session did participants receive feedback or instruction from the researcher or coach. The external and internal conditions during a meet were compared to a control condition which was completed prior to the start of the study. The data used for the control condition were collected from the Track and Field Results Reporting System website (TFRRS.org), which is a publicly-available website designed to collect and keep track and field meet data for all NCAA affiliated schools.

### **Statistical Analysis**

Statistical analyses were completed using the Statistical Package for the Social Sciences (SPSS). The practice throws for the Internal and External conditions were averaged, resulting in two data sets that were used in the statistical analysis. Potential group differences between the two groups during practice throws were evaluated by using a univariate analysis of variance (ANOVA). Similarly, a univariate ANOVA was used to evaluate potential differences in throwing distance between the three experimental groups (i.e., Internal, External, and Control) during competition. The level of significance was set at  $p < 0.05$  for all analyses.

## CHAPTER 3

### RESULTS

#### Practice

The results of the ANOVA indicated that the Internal and External groups were marginally different during practice,  $F(1, 20) = 3.52, p = 0.077$ . Although the results of the ANOVA did not reach a level of significance with an alpha of 0.05, the findings revealed that the throws completed by participants in the internal condition ( $M = 14.3$  m) were moderately better than the throws completed by participants in the External condition ( $M = 13.13$  m).

#### Competition Throws

An examination of the throws completed by the three experimental conditions during competition revealed that the three groups were not significantly different,  $F(2, 19) = 0.598, p = 0.562$ . Even though the results of the ANOVA did not reach significance, it is noteworthy to point out that the throws completed by the Internal group ( $M = 15.94$  m) were nearly one-meter farther than the average throws completed by the External ( $M = 14.85$  m) and Control ( $M = 14.97$  m) conditions during the track and field meet.



## CHAPTER 4

### DISCUSSION

The first purpose of the current study was to investigate if an external or internal focus of attention promoted better practice performance of the weight throw in skilled Division I athletes. The second purpose of the study was to investigate if an external or internal focus of attention compared to a control condition promoted better performance in the weight throw as measured during a track and field competition. It was hypothesized that participants in the external focus of attention condition would produce better performance marks and more effective learning than those in the internal and control focus of attention conditions.

The results of the study do not support the hypotheses and are not consistent with the findings of previous research which has consistently demonstrated that utilizing an external focus of attention is more beneficial compared to an internal and control focus of attention condition (eg., Makaruk et al., 2013; Wulf & Su, 2007; Zarghami et al., 2012). Although the trend was towards significance, the results of the ANOVA indicated there were no significant differences between the two experimental conditions during the practice trials. Additionally, no significant differences were found between the throws completed by the external, internal, and control conditions during a track and field competition.

The findings of the present study are not consistent with the predictions of the constrained action hypothesis (Wulf et al., 2001). However, they do partially support some research that proposes benefits of focus of attention differently affect those of varying skill levels (Porter & Sims, 2013; Wulf, 2008). Specifically, Wulf (2008) investigated focus of attention in world class balance acrobats and even though no significant differences were found in the data, Wulf did

observe that there was less movement frequency when participants were in the control condition compared to when they were in the internal and external conditions. This is important to note because it suggests that participant's body movements to correct postural stability were more rapid while in the control condition compared to trials completed in the external or internal conditions. Porter and Sims (2013) found similar results when looking at elite athletes sprinting performance. Athletes in the study recorded faster times during the last half of their sprint while in the control condition compared with trials when they were instructed to direct their attention internally or externally. The participants in the Porter and Sims (2013) study were highly skilled Division I athletes which can partially explain why an external or internal focus of attention wasn't superior to the control condition. That is, considering the athletes had a plethora of training prior to the start of the study, implementing a new cue could have disrupted their automatic movement processes that were previously established. Porter and Sims (2013) concluded that if the attention directing instructions were not consistent with how the highly skilled participants normally focused their attention while sprinting, then it is not surprising performance was superior when participants were in the control condition. Similar to the results reported by Porter and Sims (2013) and Wulf (2008) in which focus of attention effects were evaluated in a highly skilled population, the results of the practice trial analysis in the present study revealed that the internal and external conditions were not significantly different from each other.

The research that supports how individuals of varying skill level are affected by the benefits of focus of attention is only partially supported in the present study because the control group did not perform better than the internal or external focus of attention conditions. One explanation for this finding is that the control condition data was taken from an early season meet

(ie., December). The participants in the control condition had only begun training the weight throw several weeks prior to the competition. The majority of fall season training for the participating athletes was completed outdoors, during that time the weight throw is replaced by the hammer throw which is thrown out of a cement ring. The combination of a short training period, different ring surface and implement may have had an effect on performances that were measured in the present study. The participants in the internal and external conditions had an additional five weeks of training prior to the competition performances (i.e., January and February) that were measured in the present study. This additional practice time for the internal and external conditions may have negated any benefits that would have been observed for throws completed in the control condition. A second explanation for the control group not performing better is that the cues and instructions given to the participants closely resembled those given to the external condition. The instruction and cues provided by the coach to the control group during the competition and weeks leading up to it were similar to those used with the external group in the present study. This would explain the nearly identical performances seen by the control and external conditions during competition.

Future research would benefit from having the participants fill out a survey telling researchers the typical cues or instructions given by the coach. Doing so would decrease the possibility of the instructions being too similar. The weight training cycle the participants were on differed from the control condition to the internal and external conditions. Specifically, the control condition participants were in a low volume, high intensity training period of the season when tested, while the external condition were in a high volume, high intensity training period during the testing period. This might explain the slightly higher averages seen in the control condition compared to the external condition. In future research, having a control condition

group perform during the same track and field meet as the other experimental conditions would maintain consistency within the assessment of post-test data. However, the logistics of the present study did not allow for such a methodology.

Being the first experiment to look at focus of attention in the weight throw, this study is able to add novel findings to the existing body of research. However, this study does have limitations that should be addressed. The first being the small sample size ( $N=11$ ) and the relatively high skill level of the volunteers used in the study. Not knowing if participants were following the instructions for all practice trials could be another limitation to the study. Participants were asked to repeat the instructions given following every two practice trials and if they did not reiterate their cue they had to read it again and repeat it. It is possible that the athletes may not have been adhering to the instructions provided prior to each throw when they were not asked to repeat the cue. Future research could benefit from having the participants reiterate the cue on every practice trial instead of every other trial. Using novice athletes or untrained individuals would be beneficial in a replication of this study to determine if a certain focus of attention is beneficial to those who are less skilled than the participants utilized in the present study. Wulf (2008) found that optimal performance in highly-skilled athletes happens when they are able to adopt their normal focus of attention. Wulf further concluded that an external or internal focus of attention could disrupt the automatic movement processes established resulting in a worse performance, which could have been the case in the present study. Being able to replicate a future study with a larger sample size to increase the amount of data analyzed would also be beneficial.

The nature of the weight throw involves the athlete attempting to move the implement rotationally for several turns while trying to maximize velocity at the release of the throw. Doing

so correctly requires whole body coordination and muscle recruitment from several different areas of the body. This leads to another limitation of this study, kinematic and EMG measures were not taken during the course of the experiment. Research by Marchant et al. (2009) found that an external focus of attention produced greater force production and lower muscular activity compared to an internal group. Additionally, Freudenheim et al. (2010) found that submaximal force levels were sustained over a longer period of time using an external focus of attention. Future research could benefit from using kinematic and EMG variables to further explain the enhanced or depressed effects provided during the weight throw using certain focus of attention cues. Specifically, the velocity of the implement at release, joint angles, and EMG activity of certain muscle groups could be studied, compared, and referenced between experimental conditions. Looking at those variables in relation to throwing distance could help show how specific focus of attention cues influence the movement pattern and muscular recruitment.

Even though there were no significant differences observed between any of the experimental conditions in the present study, it is still noteworthy to point out that the internal focus of attention condition on average had over a one-meter improvement from practice trial throws to competitive meet throws. Although not significant from a statistical point of view, such an improvement in throwing distance in such a short period of time has an enormous practical value from a coaching perspective. In the sport of track and field events can be won or lost by fractions of a second or centimeters. This can mean the difference between winning prize money verses taking home nothing at the end of the day. Being able to boost an athletes performance by over a meter would be crucial in being able to secure a greater level of success during competition. The data in the study is not consistent with previous research but it does suggest that when working with a highly skilled population coaches should be conscious of the

instructions provided. Finding the most beneficial cue or set of instructions for your athlete can help establish their most efficient movement pattern and muscle coordination. Doing so can lead to increased quality repetitions and maximal force production ability, due to less effort being exerted to accomplish the same task. This is beneficial to all coaches and athletes because ultimately over time the increased amount of quality, high intensity repetitions should lead to increased performances in competition.

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