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The Effects of External Focus of Attention on Standing Triple Jump Performance

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The Effects of External Focus of Attention on Standing Triple Jump Performance

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Abstract

The purpose of the study is to determine if the use of external focus of attention has an effect on standing triple jump performance. External focus is where a subject focuses on an object or a focal point outside of themselves when performing a task. Nineteen female athletes from a university were recruited for the study. Testing consisted of 9 standing triple jumps. Each subject performed three practice jumps and three tests jumps under an external focus condition and a control condition. The variables measured were horizontal body displacement in meters, and horizontal ground reaction force (HGRF) and vertical ground reaction force (VGRF) in newtons from the initial take-off jump. A cone was used as a focal point during the external focus condition. Paired sampled t-tests were used to find a difference in jump distance and GRF between the two conditions. Non-significant results with a p value greater than the Bonferoni adjusted values of .0167 were seen in jump distance ($p = .142$) with a mean difference of -0.094 meters favoring the external focus condition, HGRF ($p = .363$) with a mean difference of 6.469 newtons favoring the control condition, and VGRF ($p = .753$) with a mean difference of 23.589 newtons favoring the control condition. It was seen that an external focus of attention does not have an effect on standing triple jump performance.

Chapter ONE: Introduction

Usually in a team or ball oriented sport there is a specific reason to jump. Whether it is blocking a basketball shot, heading a soccer ball, or catching a football, whatever the case may be, there is something visual the athlete is attempting to reach. The athletes are externally focusing on the goal or sporting implements in these examples. External focus of attention has been an ever growing topic of research because of its effects on athletic performance.

External focus of attention is when an individual is performing a task and they focus their attention on an object or something outside themselves compared to internal focus where a subject is asked to focus on a certain movement or body part (Wulf & Dufek, 2009). A study by Wulf and Su (2007) determined that external focus can enhance the accuracy of a golf shot. Aside from accuracy, external focus has been seen to improve maximal efforts also, such as discus throw distance, vertical jump height, and standing long jump distance (Zarghami, Saemi, & Fathi, 2012; Porter, Ostrowski, Nolan, & Wu, 2010; Ford, et al., 2005).

Internal focus of attention is where the athlete or subject focuses on their own physical body movements (Wulf, 2007). In track and field the high jump and pole vault are the only two events where an actual goal is seen. In the racing events the athletes can only focus externally if there are other athletes ahead and internally if there are not. For the long jump and triple jump events, because there cannot be visual markers placed in the sand, the athletes are only able to use an internal focus of attention to improve their performance (International Association of Athletics Federations, 2014).

The jumping, sprinting, and throwing events in the sport of track and field are prime examples of maximal anaerobic power and explosiveness. The triple jump which was the focus of this study is a field event that requires the athlete to jump three times continuously as far as they can into a sand pit. The triple jump is also popularly known as the hop, skip, and jump. The hop phase is first where the athlete jumps off of and lands on the same leg. The skip phase later changed to the step phase is where the athlete jumps from one foot to the other. Lastly the jump phase is where the athlete jumps into the sand pit. Being able to identify an athlete's capabilities is an important aspect of coaching. Standardized jump tests are used by general managers and coaches from all different types of sports. These tests are an excellent method of assessing an athlete's power output.

Currently jump tests such as the vertical jump, depth jump, standing long jump, and standing triple jump have become popular methods of assessing a subject's lower limb power and coordination when involving the arms (Leard, et al., 2007). Most of these jump tests incorporate a countermovement jump, some include an arm swing. In track and field the athlete has to incorporate countermovement motions and arm swing to perform at their full potential. Arguably jump tests that involve countermovement jumps and arm swing are the most realistic to actual sport performance (Ashby & Heegaard, 2002; Ford, et al., 2005; Harman, Rosenstein, Frykman, & Rosenstein, 1990)

The countermovement jump is where the subject quickly bends the knees and lowers the center of mass (COM) to a desired depth followed by immediately driving upward (Harman, et al., 1990). During a countermovement jump, a physiological phenomena known as the Stretch Shortening Cycle (SSC) occurs. The SSC is where the muscle fibers are momentarily stretched during an eccentric or lengthening phase in which it stores elastic energy, then is released immediately during a muscle contraction or shortening phase that directly follows (Harman, et al., 1990; Ford, et al., 2005). The standing triple jump consists of an initial countermovement jump followed by two additional consecutive jumps. This is important to clarify because it explains how the body reacts to a jumping task from a physiological perspective. Each individual has a certain amount of type 2 muscle fibers depending on genetic predisposition and the types of training the individual participates in. These type 2 fibers are seen to produce more force than other muscle fiber types (Wilmore, Costill, & Kenney, 2008, p. 39). This may be a contributing factor in jump height or distance (Ashby & Heegaard, 2002; Ford, et al., 2005; Harman, Rosenstein,et al., 1990). Arm motion is also a factor to sport performance. The use of arm swing during jump tests takes a certain level of coordination and when used correctly, has also been seen to be advantageous to performance (Ashby & Heegaard, 2002; Harman, et al, 1990). In the sport of triple jumping the SSC and arm swing coordination are essential to complete the task (Allen, King, & Yeadon, 2010; Ashby & Heegaard, 2002; Wison, Simpson, Van Emmerik, & Hamill, 2009)

Purpose

The purpose of this study is to determine if external focus of attention has an effect on standing triple jump performance over a control condition of no specific attention. The author is hypothesized that an external focus of attention does improve standing triple jump performance. Both Ford and his team of researchers (2005) along with Porter and his colleagues (2010) have shown that an external focus of attention can improve vertical jump and standing long jump. The vertical jump, depth jump, and standing long jump have become standardized anaerobic tests that many coaches and sports organizations use to evaluate athletes. It is speculated that the standing triple jump test is not widely used outside of the track and field circle because it could be seen as excessive or irrelevant. It could be seen this way because vertical jump and standing long jump tests are easier to perform and contain less performance variables. However, the standing triple jump should become a standard test because unlike the other jump tests the standing triple jump could be seen as an all in one test. It requires counter movements, similar stretch shortening cycle engagement as a depth jump, multi-jointed, multi-phased, coordination challenges, and maximum distance like the standing long jump (Perttunen, Kyrolainen, Komi, & Heinonen, 2000; Wison, Simpson, Van Emmerik, & Hamill, 2009)

However, studies have not been found on the effects of external focus of attention on standing triple jump performance. This topic was chosen because there are many biomechanical variables in the triple jump that can affect performance (Allen, et al., 2010). Examples of this could be if a visual goal affects the subject's GRF in each jumping phase, or do the subject's limb angles and limb placement differ when there is a visual goal. This study could also be useful for a coach's evaluation of their current athletes. They could pretest and posttest to evaluate athletes changes in performance and assess training. A coach could see how well an athlete responds to an external stimuli and how well they coordinate their body in order to improve their distance

Hypothesis

H_0: The null hypothesis for the study stated that external focus of attention does not have an effect on standing triple jump performance.

H_A: The research hypothesis stated that external focus of attention does have an effect on standing triple jump performance.

Delimitations

1. Subjects were current and former female Division II track and field athletes from the University of Central Oklahoma
2. Subjects performed the test on a wooden gym floor
3. Subjects initial jump was off of a force platform

4. Measuring tape was used to measure jump distance
5. The standing triple jump is a three phase, multi joint maximal jump test that can involve high levels of impact on a subjects ankles and knees.
6. Subjects were asked to wear loose athletic clothing to prevent clothing restriction of movement

Limitations

1. Sample size
2. The subjects received oral instructions on how to perform the test
3. Number of practice jumps, all on one day
4. Coordination/skill level differs for each person. Some may have experience in the jump but may not be able to perform it well.
5. Subjects may practice internal versus external focus during practice and compeition

Summary

The use of an external focus of attention has the potential to enhance sport performance. The following study examined the use of an external focus of attention on the standing triple jump. It was hypothesized that standing triple jump performance would increase as a result of using an external focus of attention; past research has shown that employing an external focus of attention has improved performance in multiple types of physical activities. It was also hypothesized that HGRF and VGRF would account for differences in jump distance as a result of the use of an external focus of attention. Little research has been covered on GRF and external focus of attention therefore the ability of GRF to account for increases in jump performance was relatively unknown. The findings from the study may be used by coaches and athletes who are competing or training for athletic events that require max effort and can utilize an external focus of attention.

CHAPTER TWO: Literature Review

Introduction

The literature used for the current study is mainly directed towards external focus of attention because it is the primary variables of interest. The secondary focus of the review is the factors that can affect the standing triple jump. It is important to review factors that affect the standing triple jump because there is a possibility that these may arise during testing. The reasoning for using the standing triple jump is it is an easy test to administer for both the investigator and the subjects. Also it is a maximal anaerobic power test, that results can be used by teachers, coaches, and practitioners (Leard, et al., 2007). What is interesting though is there is not much literature in the area despite it being a multijointed maximal anaerobic power test. Similar studies testing the effects of attentional focus on the standing triple jump have not been found. The triple jump literature reviewed mainly pertains to the performance of the triple jump, such as the basic movement, biomechanics for the event and kinematic parameters.

External Focus of Attention

In the past two decades, research on attentional focus has been saturated with a vast number of research studies. One of the leading researchers, Gabriele Wulf published a review covering the past 10 years of research over attentional focus and motor learning (Wulf, 2007). In the review, the author examines the benefits of adopting an internal or external focus of attention when performing a certain task. Wulf (2007) defines external focus of attention as “focus on the movement effect”. This means the subject, athlete, or whoever is performing a task focuses on something outside of them. Internal focus of attention was defined as “focus on the movements themselves”. This refers to the performer focusing on their physical body movements.

From the studies covered in the review it was seen that using an external focus of attention was more effective than internal focus of attention. The effects of external focus on specific sports and physical tests were mostly covered in the review. The sports studied were Golf, Basketball, Dart Throwing, American Football, Volleyball, and Soccer. It also provided possible explanations on why external focus of attention is more beneficial, which are to be addressed later.

To better understand why external focus could be more beneficial, it is important to know how it can affect different types of performances. Wulf and Su (2007) researched the potential affect external focus of attention might have on golf shot accuracy in beginners and experts. There were two experiments that took place. In the first experiment 30 undergraduate students with little to no experience volunteered to hit golf balls with a 9 iron into a circular target from 15 meters away. The 30 subjects were randomly assigned to three groups: control group, internal group, and external group. Instructions were provided on how to properly hit a pitch shot and practice time was given. The control group was not given attentional focus cues, the internal group was told to focus on their arms during the swinging motion, and the external was told to focus on the motion of the golf club. Testing took place over two days. The first day, subjects performed ten trials under the conditions assigned to them and with verbal cues. The next day the subjects performed another ten trials but were not given any verbal instructions. Results showed that accuracy in the external group was higher, but not significantly. In the retention test, external group accuracy was significantly higher than the other groups $F(2.27) = 5.38$, $p = .011$ (Wulf & Su, 2007).

Experiment 2 in Wulf and Su’s (2007) study was carried out much the same as Experiment 1 but with a couple differences. To start, there were only six golfers which were experts. They were allowed to use their own clubs. The radius of the target circle was smaller, and each subject was instructed to perform under each condition. Finally the order of the conditions under which they performed in was randomly selected. Results from Experiment 2 were similar to that of Experiment 1 but with greater significance when comparing external focus coaching cues to internal and no coaching cues $F(2, 10) = 9.66$, $p = .005$ (Wulf & Su, 2007). The greater significance levels could be attributed to the level of expertise of the subjects in experiment 2. The experts may have more confidence in their swing therefore allowing them to fully focus on the external cue (Wulf & Su, 2007).

The results from Wulf and Su's golf shot accuracy study were similar to the golf portion in Wulfs review article (Wulf, 2007). In the review article, Wulf also addresses free throw accuracy in basketball from the results seen in Zachry, et, al's (2005) study. Players were more accurate when they focused on the basketball rim (external) vs. focusing on the motions of their wrist during their shot (internal) (Zachry, et al. 2005). Also dart throwing accuracy increased when they focused on the bull's-eye becoming larger on the dartboard (external) compared to focusing on the physical arm throwing motion (internal) (Zachry, et al. 2005). Just like the golf studies it was seen that the external focus condition improved accuracy of those tests.

From this it can be assumed that adopting an external focus of attention can improve performance in tasks that involve some form of accuracy. Additionally, there is some evidence that performance can improve with external focus in tasks not reliant on accuracy (Ford, et al., 2005; McNevin, Shea, & Wulf, 2003; Porter, Anton, & Wu, 2012; Porter, Ostrowski, Nolan, & Wu, 2010; Salehian, Gursoy, Sen, & Mohammad Zadeh, 2012; Zarghami, Saemi, & Fathi, 2012). Examples of tasks where accuracy is not important could be throwing an object for distance or height, and or jumping for distance or height.

In a study by Zarghami and colleagues (2012), they examined whether external focus of attention enhances discus throwing performance. Twenty undergrad students were selected. The subjects were all healthy males with a mean age of 22 years. The participants were familiar with discus throwing because they all were enrolled and passed a university discus throwing course. Five warm-up trials were given for practice and then five maximal-effort trials were performed under both external and internal focus conditions. For the external focus condition the subjects were instructed to throw the discus as far as they could while focusing on the discus and the landing of the discus in particular. In the internal focus conditions the subjects were asked to throw the discus as far as they could while focusing on the hand and wrist of the throwing arm. Results from this study found significant differences between the two conditions $p < .005$. The mean difference between the two groups was 2.238m with the external focus group throwing further (Zarghami, Saemi, & Fathi, 2012).

Zarghami et al (2012) also demonstrated that external focus of attention has a positive effect on maximal effort tests. Like the other studies mentioned, this involved throwing an object. Discus throwing may or may not involve a maximal effort because of the nature of the sport. Technique is a large contributing factor in how far the discus travels. The subject may throw it as hard as they can but if the release is not right, the discus may rotate on the incorrect axis in the air. If this occurs, the distance traveled may not be as far as when the release is correctly performed and with less effort (Yu, Broker, & Silvester, 2002). This raises another discussion in terms of maximal effort tests; that do not involve manipulation of an object. These tests are usually classified as anaerobic explosive/power tests. Some of these tests include the vertical jump, depth jump, and standing long jump. Testing the effect of external focus of attention on these movements is not a new concept though. There is an ever increasing accumulation of research on attentional focus involving these tests.

In 2005, Ford and other authors examined if the use of an extrinsic motivator altered vertical jump performance and biomechanics. The purpose of this study was to test if an overhead goal improved drop vertical jump height in collegiate athletes. The subjects volunteered from two NCAA Division I soccer teams. There were 18 females and 17 males. Countermovement vertical jumps and drop vertical jumps or depth jumps were both recorded with and without an overhead goal. The MX-1 vertical jump trainer was used because an extrinsic motivator could be attached with a digital measurement of the exact height. A suspended ball was selected as the overhead goal. The subjects were instructed to complete a maximum vertical jump and grab the ball at the top of their jump. The height of the overhead goal was increased until the subject was unable to grab it after 3 trials. Reflective markers were placed on the subjects lower extremities so the researches could analyze the biomechanics of the jumps through the use of digital cameras and motion analysis software. The subjects were taken though the same protocol for the depth jumps.

The researchers found that vertical jump height was greater with the overhead goal ($p = .002$) than with no overhead goal. Biomechanically, the male subjects had an 18% greater takeoff hip extensor moment than females and for both males and females the knee moment was significantly greater when an overhead goal was present (Ford, et al., 2005). The researchers found that men and women performed maximum vertical jumps differently with the use of an external motivator and without. Similar to Ford's (2005) biomechanics findings Salehain, Gursoy, Sen, and Mohmmad Zedah (2012) found an external focus effected trunk vertical mass displacement when performing a basketball shot.

In a similar study to Ford's (2005), Wulf and Dufek (2009) tested subjects in the vertical jump but focused on the underlying reasons why subjects jump higher when an extrinsic motivator is involved or when the subjects are told to use external focus of attention. In Wulf's study the participants performed vertical jumps with the Vertec System which measures the subjects initial reach height when standing, the subject then proceeds to jump and slap a column of horizontal panes. Multiple trials are performed until the subject cannot reach the next highest pane. The horizontal panes are spread an inch apart vertically. Vertical jump height is measured by the distance between the initial reach height and the last pane that was hit. Different from Ford's study (2005), Wulf (2009) left the overhead goal but instructed the subjects to either use external or internal focus of attention. When the subjects were in the external focus test they were told to focus on the hitting the panes and they were instructed to focus on their finger touching the panes during the internal focus tests (Wulf & Dufek, 2009).

The results from Wulf & Dufek (2009) study agreed with Ford's (2005) study in terms of performance, subjects jumped higher during the external compared to the internal focus tests. The primary purpose of the study was to better understand why this happens. They learned that an internal focus on one specific body part could lead to improper muscle contraction because it has constraining effects on the whole motor system (Wulf & Dufek, 2009). Wulf and Dufek stated that "attempts to force an effective outcome by focusing on and trying to control one's body movements are generally less successful, presumably because they interfere with the body's natural organizational capabilities" (Wulf & Dufek, 2009, p. 408). From this it can be argued that when using external focus, muscle contraction and recruitment is more efficient due to the automatic motor nervous system.

Another widely used anaerobic power test is the standing long jump. This test is mostly used by athletic teams to assess athletic ability or talent identification. The National Football League uses it during their “combine” or assessment of possible prospective athletes. This test is similar to the vertical jump test but instead of vertical takeoff the subject jump horizontally for distance. Much like Ford (2005) and Wulf & Dufek’s (2009) studies Porter, Ostrowski, Nolan, and Wu (2010) tested external focus of attention on standing long jump. The purpose of Porter, et al. (2010) study was to examine if external focus of attention had an effect on standing long jump performance. One hundred and twenty undergrad students participated. The subjects were randomly placed into two groups, internal and external focus groups. There were an equal number of males and females in both groups with an average age of 22 years. For each group specific verbal cues were given before each jump. The jumps were performed on a horizontal jump mat that has a starting line and distance measurements on the mat. The external focus group was told to jump as far as possible while focusing on where they want to land and the internal group focused on their legs extending as far as possible. Unlike Ford’s (2005) study there was not a specific visual goal. There was a significant difference between the groups in which the external group jumped almost ten centimeters farther than the internal focus group (Porter, Ostrowski, Nolan, & Wu, 2010).

Results from these studies all suggest that adopting an external focus of attention can effect maximal effort anaerobic tests. Because this has been widely researched, new studies are focusing on the distance of the goal and the cause of this phenomenon. A study by McNevin, Shea, and Wulf (2003) specifically looked at if the distance of the external focus effects or enhances motor learning. There were 40 university students that participated. The subjects were instructed to balance on a stabilometer and keep the platform at a level horizontal plane for as long as they could during a 90 second trial. A stabilometer is a rectangular platform that an individual stands on and there is an axis in the middle of the platform that it can rotate on, much like a seesaw. The object of the test is to see how long a subject can balance without the platform touching the ground. Three different sets of markers were placed on the platform in which they were standing. A set of markers was directly in the middle of the board, a set was placed at the edge of the subjects toes where their feet were placed, and finally a set was placed to the far outside of the board.

The subjects were randomly selected into four groups: three external groups, one for each set of markers and an internal focus group. For the external groups the subjects were asked to only focus and think about where the markers were placed. Because focus was being tested and not visual feedback the subjects were asked to look at a wall in front of them but focus on the marker. The internal group was asked to think about and focus on what their legs were doing while they looked at the wall. The results demonstrated that the external groups that focused on the markers either in the middle of the board or on the outside of the board performed better in the retention stages than the external group the focus near the feet and the internal group. Meaning using an external focus of attention further rather than closer to the body is more advantageous to learning such a task. This is important to note because not all external focus of attention is proven to work. It is interesting to know that in this study the closer the attention is to the body the more alike it is to an internal focus of attention.

Porter, Anton, and Wu (2012) conducted more research with standing long jump but placed a visual goal and increased the distance of it according to subjects' test results. The purpose of their study was to test if increasing the distance of an external focus of attention enhances standing long jump performance. In this study the researchers had subjects test under three conditions. The first condition was the control condition. This was where the subjects were given nonbiased instructions, which did not suggest a certain focus. The other two conditions were external focus conditions both near and far from the subject. In the near external focus conditions, subjects were asked to "jump as far past the start line as possible" and for the far condition subjects were asked to "jump as close to the cone as possible" (Porter, et al., 2012). Porter found the furthest average distance jumped between the three conditions was in the external far condition. There was a significant difference in the external far condition compared to the other two conditions. The results were in agreement to the majority of the literature (Ford, et al., 2005; McNevin, Shea, & Wulf, 2003; Porter, Ostrowski, Nolan, & Wu, 2010).

Using the cone as a goal during one of the external focus conditions was much like the way Ford (2005) used the ball on a stick as motivation. Porter's study did not increase the cone distance like Ford increased the basketball height. The concept of increasing the cone distance similar to Fords overhead basketball distance was implemented in the present study. From the literature on the topic of external focus of attention, it has been consistently found that attentional focus has a significant positive effect on motor learning (McNevin, Shea, & Wulf, 2003), coordination (Wulf, McNevin, & Shea, 2001), and explosive power performance (Wulf & Dufek, 2009). It has been seen that external focus has an effect on jump height and distance (Ford, et al., 2005; Porter, Anton, & Wu, 2012; Wu, Porter, & Brown, 2012; Wulf & Dufek, 2009). However, the causes of the increased performances are to be discussed further. Measuring GRF during jump trials is the next possible explanation for the increase in performance during the use of an external focus of attention.

Application of force into the ground and take-off velocity as the subject jumps, according to the focus condition, could be a viable explanation in the difference of jump distance. Wu, Porter, and Brown (2012) studied this very concept. The purpose of their study was to determine if peak force or GRF differed between external and internal focus strategies (Wu, Porter, & Brown, 2012). In the study the subjects performed five standing long jumps. The first test was marked as a baseline in which the subjects were only told to jump as far as they could. After the baseline the subjects performed two jumps for both external and internal focus conditions. In the external conditions a cone was placed approximately four and a half meters in front of the subjects and they were asked to jump as close to the target as possible. In the internal focus condition the subjects were told to think about their legs extending as fast as possible and there was not a visual target in place like the external condition. All the subjects jumped off of a force platform, recording GRF data. Results showed that the main effect jump performance was $F_{2,38} = 15.2$, $p > 0.05$, ES = 0.444 and the external focus condition (153.6 ± 38.6 cm) jumped greater distances than both the internal condition (139.5 ± 46.7 cm) and baseline condition (133.8 ± 35.7 cm) (Wu, et al., 2012).

From previous studies on the vertical jump and standing long jump it might be assumed that in the external focus condition, GRF were greater than the internal conditions. However, that is not the case in Wu, et al. (2012) study. There were not any significant differences between the two jumping conditions in terms of GRF. In the present study GRF are still relevant because the standing triple jump has three phases. This means that there is three contact points to which the subject must push off the ground. It could be hypothesized that the subjects could produce more force on the first jump phase because the first phase is a two legged take off and the next two are single legged jumps with the opposite knee aiding the jump. An argument against that hypothesis supported by a study from Perttunen, Kyrolainen, Komi, and Heinonen (2000) is that the last two single leg jumps are like depth jumps because the subjects is landing and taking off of the same leg. As a result of that it takes more GRF to stabilize the subject upon landing (braking phase) and leaving the ground again (push-off phase) plus the subjects' weight is placed all on one leg (Perttunen, Kyrolainen, Komi, & Heinonen, 2000).

One aspect of focus strategies that has not been mentioned is the individual preference of attentional focus is attention preference. Wulf et al's (2001) study similar to that of McNevin et al (2003) tested subjects motor learning attention preference by using the stabilometer. Like McNevin's study the subjects were asked to either focus on their feet or the markers on the board depending on what condition they were told to focus on. Two experiments were used in this study and both had a day of trial and retention testing. During the first experiment the researchers asked the subjects to switch from an external focus to an internal focus on each trial and on day two (retention tests) the subjects were asked to use whatever focus they preferred. For the second experiment the subjects were allowed to switch their focus freely. From the two experiments it was seen that the majority of participants preferred the use of an external focus of attention and those who use it during the retention tests were more likely to perform better with a significant group effect of $F(1, 138) = 13.9$, $p = .0003$ (Wulf, et al., 2001).

The majority of the studies reviewed have cited Wulf's (2001) study on the automaticity of complex motor skill learning and the concept of the "constrained action hypothesis" (Wulf, McNevin, & Shea, 2001, p. 1144). As explained by Wulf the "constrained action hypothesis" suggests when subjects perform a certain task with an internal focus of attention they are trying to control their movements therefore "constrains the motor system by interfering with automatic motor control processes that would normally regulate the movement" (Wulf, et al., 2001, p. 1144). As stated by other researchers the hypothesis insinuates when a subject employs an external focus of attention it turns on the automatic nonconscious cognitive processor during which fast and accurate movements are allowed to occur through the motor control system (Porter, Anton, & Wu, 2012). For a standing triple jump this could mean that during both the no visual and visual goal conditions, the subjects may focus on themselves and try to force it by consciously controlling their movements. Apart from GRF and take-off velocity, this is a possible explanation for decreased jump distance.

In Wulf, Mcnevin, and Shea's study (2001) the purpose was to continue researching the issue of the relationship between external focus of attention and the automatic control processes. Again a stabilometer was selected for the testing and much like the previous reviewed studies, the subjects were asked to focus on their feet (internal) or markers on the board (external). There was also a secondary task the subjects had to perform which was a probe reaction time test. While the subjects were balancing on the stabilometer, they were given a hand held button and asked to press the button when they heard a specific sound. The researchers made it clear that the stabilometer was the primary task they should focus on and the reaction time test was the secondary task. Lower reaction times were found in both conditions as the days of testing progressed which was in line with their assumption of reduced attention with the constrained-action hypothesis. The learning effect was a factor in this study and because of that the researchers conducted retention tests on the third day and significant results were found with the external focus groups with a main effect of trials at $p < 0.01$, the external group (Mean = 3.26 seconds, SE = 0.091 seconds) and internal (Mean = 4.12 seconds, SE = 0.129 seconds) (Wulf, McNevin, & Shea, 2001). The concept of the "constrained action hypothesis" is important to understand because it can explain performance differences because of external focus of attention. However, biomechanically comparing angles, velocities, forces; is still the preferred method (Wulf, McNevin, & Shea, 2001).

Factors that Affect the Standing Triple Jump

According to the largest governing body in track and field or athletics, the International Associations of Athletics Federations (IAAF), the triple jump has been estimated to have originated in the ancient Greek Olympics but was officially an event in the inaugural modern Olympic Games (IAAF, 2013). For an 11 year period starting at the inaugural modern Olympic Games in 1896 the triple jump consisted of two hops and a jump. A “hop” refers to jumping off of and landing on the same leg. The “jump” refers to jumping off of one leg then landing into the sand. In 1908 the three phases changed from the two hop and jump to the current hop, skip/step, and jump. The format that was standardized in 1908 consisted of a “hop” (like before) then a “step” meaning after the hop phase the athlete would take-off from one foot and land on the other, followed by the “jump” phase into the sand (Schiffer, 2011; Yu, 1999).

A review on the track and field horizontal jumps from Schiffer (2011) explained triple jump as being the only field event that “does not require a big explosive effort, but is actually a continuous sequence of movements (Schiffer, 2011, p. 15). The three continuous movements are usually termed as phases. In order perform triple jump proficiently the athlete must find the optimal phase ratio that is most beneficial for themselves. Phase ratio means the ratio of the distance covered separately between the three phases. There is no universal optimal phase ratio for every person because of individual differences and techniques (Yu & Hay, 1996). Some individual’s prefer a strong first phase or hop phase and some prefer a stronger third phase or jump phase. However, it is important for the distance traveled in each individual phase to be similar. In novice jumpers and possibly in the present study, the second phase or the step phase could be considerably shorter than the other phase lengths because lack of experience, knowledge, and strength (Schiffer, 2011).

According to Wilson et al. study (2009) on coordination variability in expert triple jumpers, the ability to coordinate the subjects' body to meet the demand of the specific maximal effort movements can be a determinant to performance also. They studied five expert triple jumpers and found that as skill increases, movement variability increases and inexperienced jumpers have lower coordination variability.

Along the lines of coordination and biomechanics, the use of the subjects' arms is another factor that can affect jump performance. Because the standing triple jump has not been studied extensively in a research setting, studies on the effects of arm motion are limited. There are studies on arm technique in the triple jump and the effects of arm swing in both the vertical jump and more importantly the standing long jump, which is the most similar to standing triple jump. To begin to understand the use of the arms, it is important to know how arm swing affects tests such as vertical jump and standing long jump. Harmen, Rosenstein, Frykman, and Rosenstein (1990) tested the effects of arms in the vertical jump test. The study consisted of 18 subjects who performed vertical jump under the conditions of the use of arms with countermovement, arms with no counter movement, no arms and countermovement, and no arms no countermovement. The meaning of countermovement is when the subject lowers their hips by squatting down and immediately follows with an explosive jump upwards. Vertical jump height and VGRF were measured by a force platform. The authors concluded that the use of arm swing resulted in a 10% increase in takeoff velocity therefore an increase in vertical jump height and increasing peak VGRF.

Similar to Harmen et al. study (1990), Ashby and Heegaard (2002) tested the role of arm motion in the standing long jump. This study is more applicable to the present study because the standing long jump takeoff is almost exactly like the standing triple jump take off. A unique feature that there were only three subjects and they performed six jumps under two conditions involving the use of arms and without arms. The subjects were unskilled and classified as non-athletes. They found the subjects jumped 21.2% further in the use of arms condition compared to the condition without arms. VGRF were also recorded but there was no significant change between the conditions. The causes of the further distances were attributed to increased center of gravity displacement in the flight phase due to increased take-off velocity, like what was found in Harman et al. (1990). Also an increase in horizontal displacement of the center of gravity before take-off closely related to the angle at which the body takes-off (Ashby & Heegaard, 2002). A pure biomechanical analysis of the standing long jump by Wu et, al. (2003) also found take-off angles, take-off velocities, GRF, and arm swing benefits that are in agreement with Harmen et al. (1990) and Ashby et al. (2002) studies. By looking at these studies on the use of arms in these tests it is now important to know how the use of arms differs in the triple jump.

In both the standing long jump and the vertical jump, subjects use both their arms in a simultaneous back and upward swing. The take-off in the standing triple jump is the same as the standing long jump but after the initial take-off there are two more jump phases before the subject lands. In the actual triple jump event there are typically two techniques associated with the arms. There is a “single arm” technique in which the arms move in an asymmetrical fashion as they do in running; and the “double-arm” technique, which involves a symmetrical flexion of the upper arms during takeoff (Allen, King, Yeadon., 2010). It is hypothesized that novice triple jumpers tend to use the single-arm technique because it does not take as much coordination and is used mostly for balance, whereas elite triple jumps employ the double-arm technique therefore assuming the single-arm is not absolutely necessary for counterbalance (Allen, et al., 2010). In Allen et, al.’s (2010) study the researchers found the double-arm technique resulted in almost a meter further in total distance compared the single-arm technique. It also resulted in a greater contact time and center of mass height for each phase. This means the individual has more time to apply the optimal amount of force to the ground.

To the author’s knowledge, the standing triple jump has not been studied under attentional focus conditions. This test was chosen for that reason but also because external focus of attention has been seen to have a positive effect on maximal effort anaerobic tests. Additionally, a study on the reliability of the standing triple jump test by Jaksic and Cvetkovic (2009) found that the standing triple jump was one of the best tests for lower extremity explosive strength because it consists of three maximal jumps within one test. According to Jaksic & Cvetkovi (2009) and Markovic et al. (2004) the standing triple jump is a reliable and an internally valid anaerobic power test, meaning that it closely correlates with anaerobic power. Both studies agreed on implementing multiple trials because the learning effect was seen to impact the results. Markovic et al. (2004) stated that the learning effect was seen during repetitive jumps and Jaksic et al. (2009) stated that maximal practice tests were needed because they found the third trials in the testing were usually the best performances. The relevancy of these two studies on the standing triple jump being a reliable anaerobic test to the present study is to prove the standing triple jump is a viable test that researchers, coaches, and teachers can depend on and use. It has many applications for coaches’ talent identification but also in the researchers’ lab.

CHAPTER THREE: Methods

A randomized experimental design with dependant t-tests and repeated-measures was used to determine the effects of an external focus of attention on jump test performance. The dependent variables for this study were maximum distance in the standing triple jump test and the amount of force generated from the first initial jump. The independent variables for this study were the conditions for the jumping tests. The two conditions were an external focus condition and a control condition of no focus cues. Each subject participated in both jumping conditions. Order of conditions were determined by a flip of a coin.

Subjects

Students from the University of Central Oklahoma were recruited to volunteer to participate in the study. An oral recruiting script was the method to reach out to the desired audience (Appendix C and D). The desired power for this study was set at .80 and the alpha was .0167. By using a chart of Statistical Power *t* test of one or two related samples as a reference, and according to the Cohen's d equation which came out to be a 1.0, the sample size was suggested to be ten or more subjects. Because the present study does not use vertical jump height, the sample size goal for this study was set at no less than 18 subjects in the case of attrition. If a subject was unable to perform the test, whether they were physically unable or were deemed medically unfit then they were excluded from the study. The age limit ranged from 18-24 years. Athletic subjects with past jumping experience were targeted to minimize coordination discrepancies that may have an effect on maximal test performance. All subjects were asked to wear athletic shorts a t-shirt, and athletic shoes to prevent discrepancies with clothing resistance on range of motion. The subjects signed an informed consent form along with a PAR-Q and You which ensures the subjects are healthy enough to participate in physical activity. All questionnaires and protocols were approved by the University's Institutional Review Board (IRB).

Procedures

Before testing, the subjects were taken through a short lecture on how to perform the test correctly. A standardized warm up was completed before any tests or practice tests were administered. The warm up consisted of three sets of a 2 minute walk, 25 jumping jacks, 15 body weight squats, and 10 walking lunges.

A randomized selection determined which test condition the subjects performed first. The subject selected which condition they performed first by flipping a coin with heads designated as the control condition and tails as the external focus condition. The participants were given a maximum of three practice tests to control the possible effect of learning on performance as suggested by Jakisic (2009). The practice tests were used to familiarize the subjects with the movements in its entirety. After the three practice tests, verbal cues from the administer pertaining to the test ceased. A visual marker in the form of a small cone was placed on the ground ahead of their best jump for the external focus condition. A visual goal was not be used during control condition tests.

For each individual subject the testing took place over the course of 15 minutes. When the subject arrived they were given the oral instructions followed by the warm up and the three maximal practice jumps. Once the practice jumps were completed the subject performed three trials under both jumping conditions in the randomized order. After each test jump performed the subject were given a maximum of 2 minutes rest to prevent fatigue. There were a total of 9 jumps performed including both jumping conditions and practice jumps. Testing took place over the course of a week with four to six subjects each day. Testing all the jumps in one day was chosen because it is supported by the majority of the literature (Ford, et al., 2005; Porter, et al., 2010; Porter, et al., 2012; Wu, et al., 2012; Wu, et al. 2003; Zarghami, et al.,2012). The visual aid distance for each subject was determined differently depending on what jumping condition they had drawn. If the subject drew the external focus condition first then the visual aid was determined by the furthest of the three practice jump distances. If the subject drew the control condition first then the visual aid for the external condition was determined from the furthest of the three practice jumps or control jump distances. The visual goal was placed 5 centimeters ahead of the individual subject's furthest jump in either the practice jumps or control condition jumps depending on which condition they performed first. The furthest jump for each of the two conditions was used for statistical analysis.

Equipment

The equipment needed for the standing triple jump test is relatively minimal. The test took place inside a gym on a wood surfaced basketball court. The wood basketball floor was chosen because it is a flat and level surface. It is also a hard surface, so force measurements can be recorded easily and yet at the same time, has some give. This can be more forgiving on a subject's joints compared to other hard surfaces such as concrete or tile. In 2012, Durson looked at how different surfaces effected sport performance, testing oxygen consumption and vertical jump height, and the author found that the more compliant the hard surface is, the more sport performance increases. The author found wood surfaces were the most compliant. The wood surface decreased fatigue, and aided vertical jump height, along with better shock absorption (Dursun, 2012).

The subjects jumped off a force platform, which measured force generation during the initial first phase of the standing triple jump. The force plate (The Kistler Group: Winterthur, Switzerland) measures in Newtons (N) of GRF the subjects applies to the ground when jumping. Ground reaction forces were measured because it is a factor that could explain what effect the goal has on subjects. It can be generalized that the goal could cause the subject to apply greater force into the ground when jumping in the visual goal conditions. This has been seen vertical jump tests with a goal (Ford, et al., 2005). To measure standing triple jump distance, a measuring tape was placed on the floor to the right side of the subject. The tape started at the toe line that the subject must jump from and extended 30 feet forward. The measuring tape was covered when the subjects performed the test to prevent the subjects from knowing how far they jump and using that as a goal or a motivational tool. Standing triple jump distance was measured in meters. The administer measured the jump from the front edge of force platform to where the subjects heels landed after the third phase. Lastly a small orange cone was used as the goal or motivational tool for the external focus tests.

Data Analysis

All statistical data was analyzed with the Statistical Package for the Social Sciences (SPSS) software version 19. Means and standard deviation from the test jumps were determined along with descriptive and inferential statistics. Three dependent t-tests with a Bonferroni adjusted alpha level because .05/3 = .0167 was selected to determine statistical significance. The dependent t-tests were calculated from the two jumping conditions in max jump distance and peak GRF in both the horizontal and vertical planes. Lastly a multiple regression test with a stepwise progression was used to measure if GRF predict jump distance.

CHAPTER FOUR: Results

The purpose of this study was to determine if employing an external focus of attention during a multiple phased maximum jump test produced further jump distances and greater GRF than a control condition of no focus of attention cues. Descriptive statistics were calculated for three variables: jump distance, horizontal ground reaction forces (HGRF), and vertical ground reaction forces (VGRF), Table 1.

Table 1
Descriptive Statistic of Control/Experimental Jump Distances, and Control and Experimental Ground Reaction Forces and Paired Sample T-Test Significance

	Control Jump Distance (m)	Experimental Jump Distance (m)	Control HGRF (n)	Experimental HGRF (n)	Control VGRF (n)	Experimental VGRF (n)
N	19	19	19	19	19	19
Mean	6.1900	6.2837	553.962	547.492	802.913	779.324
Std. Deviation	0.70959	0.68853	143.761	120.892	204.833	165.135
	Pair 1		Pair 2		Pair 3	
p	.119		.497		.148	
t	-1.639		-.693		1.513	
Mean Diff	-.0937		-6.469		23.589	

Note. n = total number of valid participants, p = level of significance, t = t-test significance, Mean Diff = paired mean differences

The paired-sampled *t*-test function was used to determine if there was a difference between the control condition and external focus condition in maximum jump distances, HGRF, and VGRF. The t score in the maximum jump distance pair was -1.639 and a mean difference of -0.094 meters. Mean differences and t scores for VGRF and HGRF were 23.589 newtons with a t score of 1.513 and 6.469 newtons with t scores of 0.693 respectively. The 2-tailed significance levels for each pair were as follows, maximum jump distance (p = .119), the HGRF (p = .497), and the VGRF ($p = .148$). Significance levels for each pair were not less than the Bonferoni adjusted alpha level of .0167 therefore the null hypothesis of external focus of attention does not have an effect on standing triple jump performance was accepted.

Following the analysis, it was determined that trial order may have an influence on jumping results. Of the 19 subjects, six performed the control condition first and 13 performed the experimental condition first. Descriptive statistics based on trial order were also analyzed, Table 2. Dependent *t* tests were used again to determine if the randomization compromised the results. The data was grouped by the condition that was performed first and second. Meaning which ever condition a subject performed first they would be grouped together and the condition that was performed second was grouped together regardless if the condition was control or experimental. The 2-tailed significance levels for each pair were as follows, maximum jump distance ($p = .142$), HGRF ($p = .363$), and the VGRF ($p = .753$). The significance levels for each pair were not less than .0167 therefore the condition randomization for each subject did not have any adverse effects on the data collected. Although there was a trend towards longer jump distances during the 2nd set of trials regardless on the type of focus.

Table 2

Descriptive Statistics of 1st /2nd Jump Distances, 1st /2nd Ground Reaction Force, and Paired Sample T-Test Significance

	1_Jump Distance (m)	2_Jump Distance (m)	1_HGRF (n)	2_HGRF (n)	1_VGRF (n)	2_VGRF (n)
N	19	19	19	19	19	19
Mean	6.1926	6.2811	546.414	555.040	788.480	793.757
Std. Deviation	0.69328	0.70530	128.722	136.732	200.509	171.177
	Pair 1		Pair 2		Pair 3	
p	.142		.363		.753	
t	-1.535		0.933		-0.320	
Mean Diff	-0.08842		8.6254		-5.2774	

Note. n = total number of valid participants, p = level of significance, t = t-test significance, Mean Diff = paired mean differences

Lastly, a positive correlation was found in the data analysis concerning the relationship of the maximum jump distance and GRF. A multiple regression test was performed to further explore the contribution of GRF to jump distance. The function was selected to calculate to determine if GRF's could significantly predict jump distance and if so, what proportions could be attributed to each direction of attributed forces, (see Tables 3 and 4). The significance levels in both regressions were less than 0.05. It was concluded that predicting jump distance from HGRF and VGRF were statistically significant in both conditions (p =0 .002). HGRF in the control condition (p = 0.003) and experimental condition (p = 0.005) proved to be the best predictor of jump distance. The adjusted r^2 value was .486 for the control condition and .469 for the experimental condition with the predictors being HGRF and VGRF. This means that 48.6% and 46.9% of the variance in jump distance was predicted by the two GRF.

Table 3
Control Condition Multiple Regression Analysis of Horizontal and Vertical ground reaction forces

	Test				
Variable	HGRF	VGRF	r^2	Adj. r^2	p
Significance	.003	.074	0.543	0.486	.002
Beta Weight	-1.315	-.728			

Table 4
Experimental Condition Multiple Regression Analysis of Horizontal and Vertical ground reaction forces

	Test				
Variable	HGRF	VGRF	r^2	Adj. r^2	p
Significance	.005	.066	0.528	.469	.002
Beta Weight	-1.429	-.856			

The results show that the subjects did not jump significantly farther or produce significantly more HGRF or VGRF in the external focus condition compared to the control condition, Figures 1 and 2. There were slight correlations with primarily HGRF. It was seen that HGRF was the better predictor of jump distance in both testing conditions.

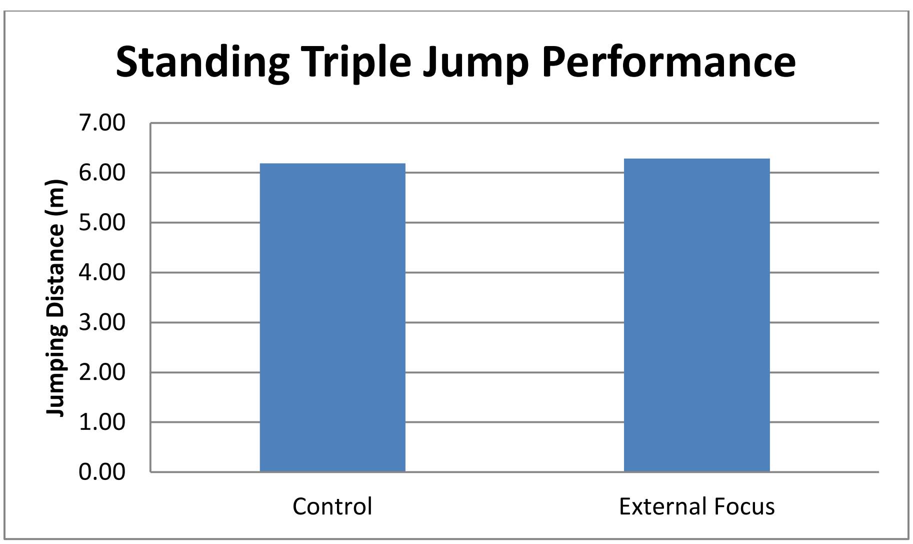

Figure 1. Mean jumping distances for the control condition and the external focus condition

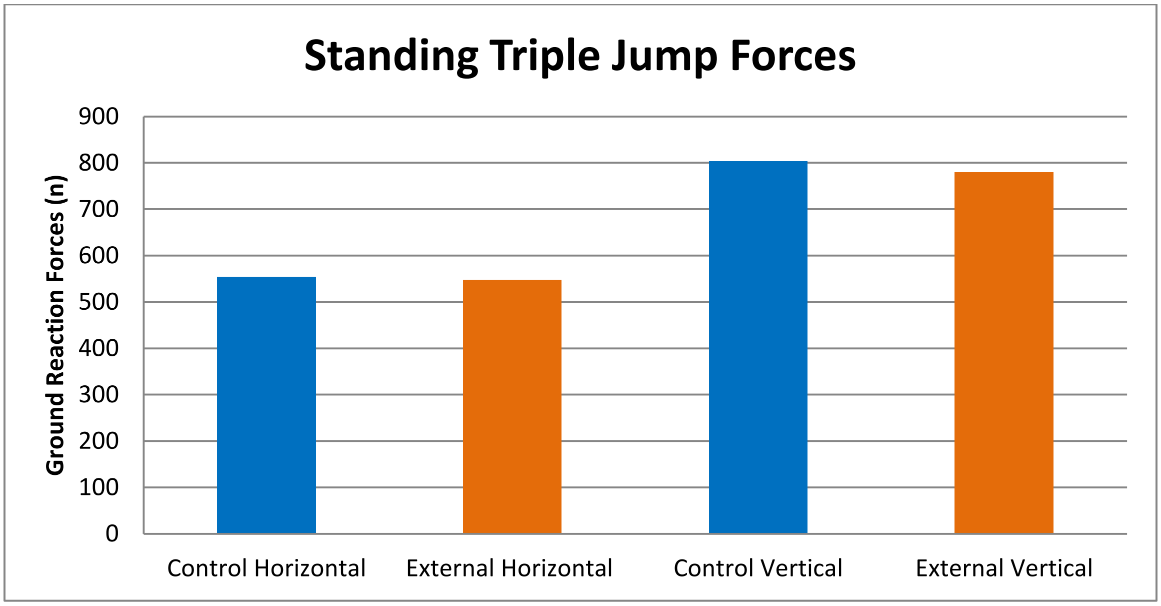

Figure 2. Mean ground reaction forces for the control condition and external focus condition

CHAPTER FIVE: Discussion

Jump Distance

The goal of the current study was to understand the effects of employing an external focus of attention during a standing triple jump test. It was hypothesized that having the subjects focus on an external goal/object would increase standing triple jump distance and GRF's compared to no instruction on focus and no goal/object. The results did not support the prediction and indicated that employing an external focus of attention did not significantly improve jump distance, HGRF, or VGRF. The means show that the subjects jumped 0.09 meters farther while using an external focus of attention. The current results were found to be non-significant but increases are supported by previous results from other studies regarding external focus and maximal jump performance.

Porter et al. (2010) studied 120 young adults in the standing long jump. Subjects were separated into one external focus group of 60 and an internal focus group of 60. Results from their study showed significantly greater jump distances in the external group (187.37 ± 42.66 cm) compared to the internal group (177.33 ± 40.97 cm). Much of the literature indicates similar result patterns to the Porter et al. study. Wulf, Dufek, Lozano, and Pettigrew (2010) researched vertical jump and found greater jump heights with external focus but conversely found conflicting data regarding muscle activity and activation. This relates to the constrained action hypothesis, which is where when one focuses on something outside the body, this triggers nonconscience automatic processing (Porter, Anton, & Wu, 2012). In the Wulf et al. (2010) study, they found EMG activity to be lower in the external focus condition compared to the control condition. Even though the current study did not find significant results there was a small difference in jump distance between the external and control conditions and this could be partly attributed to the constrained action hypothesis.

Because the standing triple jump is a three phase jump test, the maximum jump distance is dependent on the distance of each phase. Panoutsakopoulos and Kollias (2008) investigated triple jump technique for female athletes. They evaluated 10 high-level female triple jump competitors during competition. The authors found that the average jump phase distribution was 36.5% for the first phase, 29.3% in the second phase, and 34.2% in the third phase (Panoutsakopoulos & Kollias, 2008). This means that the competitors jumped further in their first phase than the other two.

In the current study, the majority of subjects placed more effort on the third phase. This observation does not support Panoutsakopoulos' & Kollias' (2008) study, maybe because the standing triple jump does not have a running approach to the first phase. However, in Panoutsakopoulos & Kollias (2008) study three variations of technique were used by the competitors. The first was a balanced technique where the athlete's phases were almost equal to each other. The second was a "hop dominated" technique which favors more distance in the first phase. Lastly the third technique was "jump dominated" where the third phase was favored by the competitors. The jump dominated technique is mostly seen in male elite level athletes and has also been found to be the most optimal technique for maximum distance in elite level athletes (Panoutsakopoulos & Kollias, 2008; Brimberg & Hurley, 2006). The longer observed distance in the third phase in the current study could be attributed to the lack of momentum from the other two phases because of standing start and possibly forcing the participants to emphasize the third phase. This idea of momentum generation from the first two phases could be explained by the force the participants applied to the ground during the first phase which are the dependent variables that were tested in the study.

Ground Reaction Forces

HGRF and VGRF were two secondary variables to support the hypothesized results in the current study. The subjects jumped off of a force platform for their first phase or first initial take off of the jump test. It was hypothesized that the subjects would produce more force during the external condition. Biomechanical loading of the triple jump has been examined multiple times. An early study by Ramey and Williams (1985) tested subjects performing the triple jump with a single force platform so the subjects had to perform three separate jumps to record a single triple jump trial capturing each phase separately. Results from the study showed the largest amount of horizontal and vertical forces in the first phase and decreasing in each subsequent phase after that. The model of the current study was setup with these results in mind though upon observation the subjects appeared to emphasize the third phase, therefore the greatest forces may not have been captured.

A more recent study by Perttunen et al. (2000) on biomechanical loading in the triple jump showed differences in GRF's in the second and third phases of the jump compared to Ramey's (1985) study. Perttunen et al. (2000) examined vertical and horizontal GRF's and the location of the foot where the most pressure is applied during each phase of the triple jump. Results from this study demonstrated the greatest amount of both horizontal and vertical forces occured in the second phase (Perttunen, et al., 2000). Forces in the third phase were also higher than the first, but not significantly. The present study's hypothesis was the subject would produce more force on the first phase in the standing triple jump because the first phase is the initial movement to generate forward momentum; from observation though it seemed that the subjects placed more effort on second and third phases.

Strengths/Limitations

The design of the current study was both a strength and a limitation. The use of the standing triple jump test is not a widely used test among researchers, making results difficult to compare. However, the test takes coordination to perform properly and three phases of the movement that can greatly affect the outcome (Wison, et al. 2009). Because of the coordination variability, the test could be more effectively used to determine strength and coordination. The current study adds a new maximal athletic test to the vast list of literature that examines the effects an external focus of attention has on human performance.

The use of subjects that were experienced in different types of jumping events helped with the actual testing protocol additionally, the movement did not have to be taught but the skill level of the subjects was not high. Because the standing triple jump is a complex movement and, if not performed on a regular basis, there can be inconsistencies in the movements.

The subjects had experience in jumping but only mild experience in the test movement. This is evident in the results of the study due to that fact that the majority of subjects increased jump distance as the testing progressed, regardless of what focus condition they were performing. Results such as this signify the “practice effect” (Donovan & Radosevich, 1999). The subjects may not have been experienced enough, and continued learning how to perform the task better through all trials. To counter this more practice tests should have been implemented or the testing should have been broken up into three days where the subjects perform multiple practice jumps on one day and the other two experimental conditions on subsequent days. This leads into the next flaw of the design which is the experimental conditions of focus.

Typically in each study that compares types of focus, the subjects must perform the activity in certain conditions. Some studies have subjects divided into groups where they only perform the activity under one condition or there is one group of subjects that perform the activity under many conditions. The present study used the latter and employed a within-subjects design similar to a study by Wu et al. (2012) and Porter et al. (2012). Results from their studies found significantly greater jump distances in the external focus condition compared to the control condition. The difference between their studies compared to the current study was that they include an internal focus condition along with an external focus and control condition.

By adding an internal focus condition where the subjects are cued to focus on themselves reduces the possibility of them using an external focus when they are not asked to. In the current study this was not regulated so the subjects could have used an external focus on an arbitrary object for example a line on the gym floor during their control condition in spite of not being given any focus cues.. If this occurred, the only difference was they did not have a visual goal.

Lastly limitations with the actual test measurements were minor but could have an effect on future outcomes. GRF results for both conditions external (779.324 ± 165.135 N) control (802.913 ± 204.833 N) in the current study were similar to that of Wu et al. (2012) external (1,429.8 ± 289.1 N) control (1,398.9 ± 293.4 N). Both study designs used the force platform on the first jump which is the most like the standing long jump. Implementing GRF sensors in the subject's insoles of the shoes or using a 13 meter long force platform like Perttunen et al. (2000) would provide more detailed GRF measures that could explain why jump distances were greater or less in certain conditions. Along with the ability to record GRF data on each phase, measuring the length of each phase could also help explain the reason for the subject's performance in each condition. If each phase was estimated then a visual goal for the subject to externally focus on could have been placed for each phase. This could have made the subject try harder each phase rather than on one or two phases. This added data could increase the ability to predict jump distance.

Conclusion

The use of an external focus to enhance human performance has been studied in a variety of athletic activities. The current study aimed to find if there was an effect of an external focus of attention of the standing triple jump test. An external focus of attention was not seen to have a significant effect on jump distance or initial GRF in the first phase. Although there was a trend of increasing jump distances as the trials progressed which promotes possible significance in future research.

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Appendix A: University of Central Oklahoma Institutional Review Board Approval Letter

February 12, 2015 IRB Application

#: 14188

Proposal Title: The Effects Of An External Focus Of Attention On Standing Triple Jump Performance

Type of Review: Initial-Expedited

Investigator(s):

Mr. Cody Sanders

Dr. Jacilyn Olson

Department of Kinesiology and Health Studies

College of Education and Professional Studies

Campus Box 189

University of Central Oklahoma

Edmond, OK 73034

Dear Mr. Sanders and Dr. Olson:

Re: Application for IRB Review of Research Involving Human Subjects

We have received your materials for your application. The UCO IRB has determined that the above named application is APPROVED BY EXPEDITED REVIEW. The Board has provided expedited review under 45 CFR 46.110, for research involving no more that minimal risk and research category 7.

Date of Approval: 2/12/2015

Date of Approval Expiration: 2/11/2016

If applicable, informed consent (and HIPAA authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. A stamped, approved copy of the informed consent form will be sent to you via campus mail. The IRB-approved consent form and process must be used. While this project is approved for the period noted above, any modification to the procedures and/or consent form must be approved prior to incorporation into the study. A written request is needed to initiate the amendment process. You will be contacted in writing prior to the approval expiration to determine if a continuing review is needed, which must be obtained before the anniversary date. Notification of the completion of the project must be sent to the IRB office in writing and all records must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of the investigators to promptly report to the IRB any serious or unexpected adverse events or unanticipated problems that may be a risk to the subjects.

On behalf of the UCO IRB, I wish you the best of luck with your research project. If our office can be of any further assistance, please do not hesitate to contact us.

Sincerely,

Robert D. Mather, Ph.D.
Chair, Institutional Review Board
NUC 341, Campus Box 132
University of Central Oklahoma
Edmond, OK 73034
405-974-5479
irb@uco.edu

Appendix B: Informed Consent

Informed consent form

Research Project Title: The Effects of External Focus of Attention on Standing Triple Jump Performance

Researcher (s): Cody Sanders

Purpose of the research: The purpose of this study is to determine if external focus of attention has an effect on standing triple jump performance over a control condition of no specific attention. The importance of the study is to determine whether using an external focus of attention is applicable to anaerobic testing and for coach/athlete training purposes.

Procedures/treatments involved: You will undergo three conditions and 9 standing triple jumps (1) practice tests (2) control condition with no visual goal (3) external focus condition with a visual goal. Each subject will perform three practice jumps and three tests jumps under an external focus condition and the control condition. A cone will be used to focus on during the external focus condition. The practice tests will be performed first and the order of the other two conditions will be selected by a coin flip. All tests will be conducted in one session.

Procedures prior to testing: Before all tests, you will be taken through a short lecture on how to perform the test correctly. A standardized warm up will be completed before any tests or practice tests are administered. The warm up will consist of three sets of a 2 minute walk, 25 jumping jacks, 15 body weight squats, and 10 walking lunges. After the warm up you will flip a coin to decide the order of the testing conditions.

Maximal testing procedures: The standing triple jump test is much like a standing long jump or broad jump but consist of three phases. For the first phase, the subject will be asked to jump off of two legs onto one single leg. In the second phase, the subject immediately jumps off the single leg onto the opposite leg. During the third phase, the subject immediately jumps off the opposite single leg and finishes the jump by landing on both legs. Testing consists of 9 standing triple jumps. Each subject will perform three practice jumps and three tests jumps under an external focus condition and a control condition. A cone will be used to focus on during the external focus condition.

Expected length of participation: Each jumping test will take seconds to perform but after each test you will receive a two minute rest to ensure all jump tests are performed without fatigue. Since you will receive a verbal instruction on how to perform the tests, a warm-up, and nine maximal standing triple jump tests the total amount of time will range from 40-50 minutes.

Potential benefits: You will receive information regarding your maximal standing triple jump performance and your attritional focus preferences. For individuals who are interested in their personal fitness, this information is interesting and may help athletic performance and or training adjustments. This study will contribute to the field of exercise science by attempting to use a variation of an anaerobic jump test to determine if an external motivator or external focus of attention can affect the performance of a multi jointed multi phased anaerobic test. Coaches, athletes, and individuals can use the results from this study to aid in their training programs and performance of anaerobic jumping activities.

Potential risks or discomforts: The anticipated risk is low, however there is some risk associated with exercise and exercise testing. The most common risk is to experienced mild discomfort during and after the tests, including fatigue, and muscle soreness. Much less likely is the risk of health complications (including death) during and following testing. The most common discomfort with anaerobic jump testing is joint impact from the quick movements of leaving the ground and landing. The risk will be minimized by using a proper warm up and jumping on gym surface that allows some relief to the joints. Health risks will be minimized by requiring a thorough health history prior to any testing (preparticipation health screening). You will be classified according to the information from the health history; only low risk individual will be included. The form required before participation will be a "PAR-Q and You" form.

Medical/mental health contact information (if required): Every effort will be made to minimize the potential health risks you may experience due to the physically taxing demands of this study, however, if you do experience any complications you should contract your personal physician. Medical assistance is located at The Mercy Health Clinic. The Clinic is located on the first floor of the University Wellness Center and is open from 8:00-5:00, Monday through Friday; the telephone number is (405) 974-2317. The University Counseling Center is located in the Night University Center, Suite 402, and open from 8:00-5:00, Monday through Friday; the telephone number is (405) 974-2215.

Contact information for researchers: For question about the study or an injury related to the study, please contact the principle investigator, and/or the faculty supervisor:

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(405) 595-8949
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100 N. University Drive #189
Edmond, OK 73034
(405) 974-5681
Jolson2@uco.edu

Contact information for UCO IRB: For questions about your rights as a research participant, please contact:

Manager: Ms. Jamie Peno
Coordinator: Ms. Pam Lumen

NUC 341, Box 132
(405) 974-5497 or (405) 974-5479
irb@uco.edu

Research Volunteer Rights: Participation in this study is voluntary. You may refuse to participate or withdraw from this study at any time. If you refuse to participate or withdraw from this study, you will not be penalized or lose any benefits.

Confidentiality: All information regarding your participation in this study will be kept completely confidential. The primary investigator will put a code number on your data prior to sharing the information with the research team. Your name will never be associated with your data as part of this research study. Information will be kept on a password-protected computer. This study may result in scientific presentation and publications; however your identity will not be disclosed. Results from the research will be reported as group data, not as individual scores.

Assurance of voluntary participation: Your participation is entirely voluntary for this study and you are free to withdraw from the study at any time without penalty. If at any time during the trails you (the subject) wish to stop the test, you have the right to do so.

AFFIRMATION BY RESEARCH SUBJECT

I hereby voluntarily agree to participate in the above listed research project and further understand the above listed explanations and description of the research project and further understand the above listed explanations and descriptions of the research project. I also understand that there is no penalty for the refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty. I acknowledge that I am at least 18 years old. I have read and fully understand this Informed Consent Form. I sign it freely and voluntarily. I acknowledge that a copy of this Informed Consent Form has been given to me to keep for personal records.

Participant's Printed Name:____

Signature:____Date:____________

Appendix C: Athletic Department Subject Approval

February 9th, 2015

TO: Institutional Review Board (IRB)

FROM: Gunnar Poff, Assistant Athletic Director

Mr. Cody Sanders has approached the UCO Athletic Department and requested permission to use a small cohort of current UCO student-athletes as test subjects in his thesis research titled "The Effects of an External Focus of Attention on Standing Triple Jump Performance." Please let this letter serve as authorization for Mr. Sanders to proceed with his assessment and that the Athletic Department is fully aware and approves.

If you have any questions please don't hesitate to contact me,

Thank you,

Gunnar Poff

Athletic Department
NCAA 100 North University Drive - Edmond, Oklahoma 73034 - Phone (405) 974-2500 - Fax (405) 974-3820 - www.bronchosports.com
I chose Division II

Appendix D: Recruiting Script

Thesis Recruiting Script

Hello, my name is Cody Sanders. I am a UCO student. As part of my graduate thesis in the Wellness Management Degree program, I am conducting a research study about The purpose of this study is to determine if external focus of attention has an effect on standing triple jump performance over a control condition of no specific attention. Your participation is entirely voluntary; you may skip any questions that you don't want to answer. No personally identifying information is being collected. I will only use aggregated data in my research study report. The data files will be turned in to my advisor who will maintain the records for 3 years to meet UCO archive requirements and then will destroy all files that contain individual data. If you would like to participate in the study please continue to the consent form where the study is explained in more detail. After that, I have a brief screening questionnaire that will take about 5 minutes of your time to complete.

Do you have any questions? Are you ready to begin?

Thank you for your participation.

If you have any questions later on you may reach me by email at csanders24@uco.edu or by phone at 405-595-8949

Appendix E: Physical Activity Readiness Questionnaire

Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	**1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	**2. Do you feel pain in your chest when you do physical activity?**
☐	☐	**3. In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	**4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	**5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	**6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	**7. Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME ____________________

SIGNATURE ____________________ DATE ____________________

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) ____________________ WITNESS ____________________

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Appendix F: Thesis Summary Document

Thesis Summary

External focus of attention is when an individual is performing a task and they focus their attention on an object or something outside themselves compared to internal focus where a subject is asked to focus on a certain movement or body part (Wulf & Dufek, 2009). External focus has been seen to improve maximal efforts tasks, such as discus throw distance, vertical jump height, and standing long jump distance (Zarghami, Saemi, & Fathi, 2012; Porter, Ostrowski, Nolan, & Wu, 2010; Ford, et al., 2005).

The vertical jump, depth jump, and standing long jump have become standardized anaerobic tests that many coaches and sports organizations use to evaluate athletes. It is speculated that the standing triple jump test is not widely used outside of the track and field circle because it could be seen as excessive or irrelevant. It could be seen this way because vertical jump and standing long jump tests are easier to perform and contain less performance variables. However, the standing triple jump should become a standard test because unlike the other jump tests the standing triple jump could be seen as an all in one test. It requires counter movements, similar stretch shortening cycle engagement as a depth jump, multi-jointed, multi-phased, coordination challenges, and maximum distance like the standing long jump (Perttunen, Kyrolainen, Komi, & Heinonen, 2000; Wison, Simpson, Van Emmerik, & Hamill, 2009)

This topic was chosen because there are many biomechanical variables in the triple jump that can affect performance (Allen, et al., 2010). Examples of this could be if a visual goal affects the subject’s GRF in each jumping phase, or do the subject’s limb angles and limb placement differ when there is a visual goal.

A randomized experimental design with dependent t-tests and repeated-measures was be used to determine the effects of an external focus of attention on jump test performance. The dependent variables for this study were maximum distance in the standing triple jump test and the amount of force generated from the first initial jump. The independent variables for this study were the conditions for the jumping tests. The two conditions were an external focus condition and a control condition of no focus cues. Each subject participated in both jumping conditions. Order of conditions were be determined by a flip of a coin.

Nineteen female athletes from the University of Central Oklahoma were recruited for the study. Testing consisted of 9 standing triple jumps. Each subject performed three practice jumps and three tests jumps under an external focus condition and a control condition. The first variable measured was horizontal body displacement in meters and the second variables were horizontal ground reaction force (HGRF) and vertical ground reaction force (VGRF) in newtons from the initial take-off jump. A cone was used to focus on during the external focus condition. Two paired sampled t-test were used to find a difference in jump distance and GRF between the two conditions

The paired-sampled *t*-test function was used to determine if there was a difference between the control condition and external focus condition in maximum jump distances, HGRF, and VGRF. The t score in the maximum jump distance pair was -1.639 and a mean difference of -.094 meters. HGRF t scores were .693 with a mean difference of 6.469 newtons and 1.513 with a mean difference of 23.589 newtons for VGRF. The 2-tailed significance levels for each pair were as follows, maximum jump distance ($p = .119$), the HGRF ($p = .497$), and the VGRF ($p = .148$). Significance levels for each pair were not less than the Bonferoni adjusted alpha level of .0167 and because of that the null hypothesis was accepted.

A positive correlation was found in the data analysis concerning the relationship of the maximum jump distance and GRF. A multiple regression test was performed to further explore the contribution of GRF to jump distance. The function was selected to calculate the significant values of p, r^2, and adj. r^2 along with beta weights. The significance levels in both regressions were less than .05. It was concluded that predicting jump distance from horizontal ground reaction force (HGRF) and vertical ground reaction force (VGRF) was statistically significant in both conditions ($p = .002$). HGRF in the control condition ($p = .003$) and experimental condition ($p = .005$) proved to be the best predictor of jump distance. The adjusted r^2 value was .486 for the control condition and .469 for the experimental condition with the predictors being HGRF and VGRF. This means that 48.6% and 46.9% of the variance in jump distance was predicted by the two GRF.

The goal of the current study was to understand the effects of employing an external focus of attention during a standing triple jump test. It was hypothesized that having the subjects focus on an external goal/object would increase standing triple jump performance (distance) and GRF's compared to no instruction on focus and no goal/object. The results did not support the prediction and indicate that employing an external focus of attention did not significantly improve jump distance, horizontal GRF, or vertical GRF. The means show that the subjects jumped 0.09 meters farther while using an external focus of attention. The current study's results were found to be non-significant but the increases are supported by previous finding from other studies regarding external focus and maximal jump performance.

The use of an external focus to enhance human performance has been studied in a variety of athletic activities. The current study aimed to find if there was an effect of an external focus of attention of the standing triple jump test. An external focus of attention was not seen to have a significant effect on jump distance or initial GRF in the first phase. Although there was a trend of increasing jump distances as the trials progressed which promotes possible significance in future research.