Original Research

Increasing the Distance of an External Focus of Attention has Limited Effects on Standing Long Jump Performance

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ABSTRACT

International Journal of Exercise Science 6(4) : 300-309, 2013. Several previous studied have demonstrated that adopting an external focus of attention (i.e., directing attention towards the result of the movement) improves the performance of a variety of motor skills. The objective of this study was to investigate if increasing the distance of an external focus of attention would further improve standing long jump performance. We hypothesized that as the distance of the external focus increased so would jumping distance. We also hypothesized that when subjects completed jumps in the external focus of attention conditions they would jump significantly further than jumps completed in the baseline condition. Using a within-participant design, college aged students (N = 46) completed two standing long jumps in each of the three experimental conditions. When participants were in the Baseline condition they were instructed to "Jump to the best of your ability." When participants were in the External-3m and External-5m conditions they were instructed to "Jump as close to the cone as possible." The cone was placed at a distance of three or five meters away, respectively. Data were analyzed using a repeated measures analysis of variance (ANOVA). Results showed that trials completed in both of the external focus of attention conditions were significantly further than trails completed in the Baseline condition. Additionally, the analysis revealed that the jump distances completed in the External-3m and the External-5m conditions were not significantly different. The findings of this study suggest that there were limited benefits for extending the distance of an external focus of attention.

KEY WORDS: Motor behavior, motor control, practice

INTRODUCTION

The standing long jump has become a regularly used assessment among strength and sport coaches to evaluate motor ability and athletic potential (15). For example, the standing long jump is one of the six assessments the National Football League (NFL) uses at the NFL combine to evaluate the lower body force production of prospective players. This information is then used by NFL team executives, coaches, and team doctors to determine which athletes are the most desirable in the NFL draft. Many college sport programs also use the standing long jump as a basic assessment to evaluate high school recruits (15). Due to the importance that is placed on standing long jump performance within the sporting world, coaches should become knowledgeable about the instructional strategies they can employ to help athletes they work with achieve optimal levels of performance. If practitioners examine the

motor behavior research in regards to verbal instructions, they will find that they have the ability to help their athletes improve the performance of a variety of motor skills based on the content of the instructions they provide. In particular, when verbal instructions promote an external focus of attention the results observed in performance and learning are consistently superior to instructions that promote an internal focus of attention (22). An external focus directs conscious attention to the effect one's movements have on the environment, whereas an internal focus directs consciousness to one's own body movements (24). For example, if a coach is providing verbal instructions on power clean technique they may have the athlete focus on extension of their hips, knees, and ankles (i.e., internal focus). In contrast, the coach could have the athlete focus on the speed and path of the barbell (i.e., external focus). Another demonstration of how a coach could illicit an external focus of attention to improve performance can be illustrated using a basketball free-throw shooting example. If a coach notices that an athlete is not following thought when he or she shoots the basketball, the coach could instruct the athlete to focus on creating backspin on the ball during each shooting attempt. This form of instruction directs the athlete to focus externally on the result for the movement (i.e., creating backspin) rather than on the movement itself (i.e., flicking the wrist).

Despite the growing amount of research showing an external focus of attention is superior to an internal focus of attention in skill performance settings, it has been demonstrated that coaches commonly use instructions that direct attention internally (16). It is surprising that coaches would so heavily favor the use of internal focusing instructions, this is especially surprising considering the benefits of an external focus of attention have been demonstrated in a wide range of skills including, shooting darts (4, 7), free-throw shooting in basketball (1, 28), kick placement in soccer (25), chipping in golf (26), serve placement in volleyball (25), juggling (29), and soccer throw-ins (20). Moreover, an external focus of attention has led to better dynamic balance (10); faster times in agility based tasks (14), decreased oxygen consumption during continuous running (17), higher vertical jumps (21), longer horizontal jumps (2, 12, 13, 15, 18), and increased levels of muscular endurance in the bench press and back squat (8).

Moreover, several reports have evaluated movement related measures to explain why this form of attentional allocation facilitates optimal results. For example adopting an external focus when performing a bicep curl (9), and vertical jumping (21) has shown elevated performance through increased force production and reduced electromyography (EMG). Additionally, reduced EMG was observed when focusing attention externally in throwing darts, free throw shooting, and isometric plantarflexion suggesting that an external focus allows movers to complete motor tasks in a more energy efficient way that is beneficial to force production (9) and accuracy (4, 5, 28). These results (4, 5, 9, 21, 28) indicate that by instructing an individual to focus their attention externally they are improving their movement economy by being able to generate more forceful and more accurate movements while at the same time recruiting less muscle fiber. Findings such

as these have been used to argue that adopting an external focus reduces "noise" within the neuromotor system, which allows the movements to be performed at a higher level of efficiency and effectiveness.

The constrained action hypothesis has been commonly used to explain why an external focus of attention facilitates superior performance and learning when compared to an internal focus of attention (24). This hypothesis suggests that focusing on the effects the movements have on the environment (i.e., external focus) allows motor behaviors to happen more automatically (i.e., unconsciously). In contrast, when a mover focuses on his/her own body movements (i.e., internal focus) they consciously interfere with the automatic processes of motor behavior. This interference, due to conscious control of the motor system and disruption of automatic control processes, results in decreased accuracy, slower movements, and overall depressed motor performance. Based on predictions of the constrained action hypothesis, McNevin et al. (10) suggested when an external focus of attention is close to the body a mover would be more likely to interfere with their autonomous control processes than if the external focus was placed farther away from the body. McNevin and colleagues tested this hypothesis through a balancing task on a stabilometer. Balance was measured from participants' root-mean-square-error (RMSE) and mean power frequency (MPF) while utilizing an internal or one of three external foci of attention. The goal of all four conditions was to keep the stabilometer platform horizontal. In the internal condition participants focused on their feet. Each external condition differed with respect to the distance and direction their focus was allocated. The external near condition directed attention to markers directly in front of their feet, in the external far-outside condition the markers were 26 cm outside of the markers in front of their feet, and in the external far-inside condition participants were instructed to direct their attention to markers next to the midline of the platform. Results of the McNevin et al. (10) study revealed that the external far conditions had significantly better balance than those in the external near and internal conditions. This suggests the benefits of an external focus of attention were amplified by increasing the distance of the focus from the person's body. Similar findings have been found in evenness of timing and volume during piano performance (i.e., focusing on making the correct sound vs. pressing the correct key) (3), and accuracy of golf pitch shot performance (i.e., focusing on the trajectory of the ball vs. focusing on the swing) (11).

In the present study standing long jump performance was assessed. Previous standing long jump research has shown an external focus results in longer jumps when compared to an internal focus (2, 6, 12, 13, 15, 18). Recently Porter and colleagues (13) tested the generalizability of the results reported by McNevin et al. (i.e., focusing more distally improved balance performance) (10) in a more practical setting through the use of the standing long jump task. Conditions were counterbalanced and participants performed 2 jumps in each condition (i.e. Control, External-near, & External-far). The External-near condition instructed participants to "jump as far past the line as possible," the 'line' was located directly in front of the subject's feet. The External-far condition instructed participants to "jump

as close to the cone as possible," the 'cone' was placed directly in front of the subject at a distance of 3 meters. When subjects were in the Control condition they were instructed to "jump to the best of your ability." Results of the Porter et al. (13) study indicated that jumps completed in both external conditions were significantly further than jumps completed in the Control condition. Additionally, the results revealed the External-far condition produced significantly further jumps than the External-near condition; thus indicating that jumping performance was enhanced when the distance of an external focus was increased.

These aforementioned results demonstrate how the slightest change in verbal instructions can have a significant impact on performance, and based on the common use of the standing long jump task for the assessment of athletic ability, it would be wise for practitioners to direct their athletes' attention externally when providing instructions. However, for theoretical and practical purposes there are questions we can still answer in regard to increasing the distance of an external focus and how it affects performance. One particular question is whether or not there is a limit to how far an external focus of attention can be from a mover for it to still benefit performance. That is, if previous findings have demonstrated that focusing attention towards a target located 3 meters away improved performance, then would focusing a jumpers attention externally towards a target at a greater distance result in further enrichments in jumping performance? Thus, the purpose of this study was to investigate if increasing the distance of an external focus of attention, beyond the 3 meter distance tested by Porter and colleagues (2, 12, 13, 18), would further enhance jumping performance. We hypothesized that as the distance of the external focus increased, participants' jump distances would also increase. We also hypothesized when subjects completed jumps in either of the external conditions, they would jump significantly farther than jumps completed in a baseline condition.

METHODS

Participants

An equal number of recreationally active male and female college aged students participated in this study (N=46; average age = 21.6 ± 2.0 years; average height = 176.53 ± 8.53 cm; average mass = 82.77 ± 18.67 kg). None of the subjects were former or current collegiate athletes. Additionally, participants were not aware of the purpose of the study. Participants were properly informed of the task, and in order to participate they provided written consent. All documents and experimental methods were approved by the university's Institutional Review Board.

Protocol

The task required participants to complete a total of 6 standing long jumps. This study used a within-subject design; specifically each participant completed 2 jumps in 3 different conditions (i.e., Baseline, External-3m, External-5m). Every participant completed their two baseline condition jumps first, however the external conditions were counterbalanced to control for order effects. Prior to the beginning of the testing session each participant completed a 5-minute walking warm-up. This warm up was followed by a 2-minute seated rest. During this 2-minute seated rest all participants were instructed that they

would be completing a total of six standing long jumps that day. They were also told that the goal of each jump was to jump as far as possible. Participants were informed that they would be provided specific verbal instructions before each of the six jumps, and that they should carefully listen to those instructions. These same general directions and written examples of the verbal instructions were also provided in the consent form that each participant read and signed prior to their involvement in the study. Following the 2-minute seated rest, each participant was asked to stand at the start line located at the end of the jump mat. Before each jump participants were verbally instructed where to direct their attention. When participants were in the Baseline condition they were instructed to "Jump to the best of your ability." The baseline instructions were designed to be neutral and not promote a specific focus of attention. When participants were in the External-3m condition they were instructed to "Jump as close to the cone as possible." The referenced cone was placed at a distance of 3 meters directly in front of the participant. When participants were in the External-5m condition they were instructed to "Jump as close to the cone as possible." In this condition, the cone was placed directly in front of the participant at a distance of 5 meters. There was no cone in front of the participants when trials were completed in the Baseline condition. The distance jumped was recorded immediately after each attempt. Measurements were taken from the back of the heel that was nearest to the starting line. Each jump was separated by a 1 minute seated rest. The entire testing session took approximately 20 minutes per participant.

Testing took place in a controlled, distraction free research laboratory. Each jump took place on a large black rubber composite floor mat 4.57 meters in length and 0.61 meters in width (Power Systems, Knoxville, TN). Measurement lines were spaced in increments of 0.5 inches and printed on the rubber mat in bold white. These lines continued up to the 144 inch mark. Data were originally collected in inches and later converted into centimeters for analysis. The cone used in the present study was green in color, and stood at a height of 30 centimeters.

Statistical Analysis

The two jumps within each experimental condition were averaged for statistical analysis, these jump distances served as the dependent variables for each of the independent variables (i.e., three experimental conditions). Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 16. The criterion set for significance was $\rho \leq 0.05$. A one-way analysis of variance (ANOVA) with repeated measures was used to determine significant differences between experimental conditions. The reliability of the dependent variable was determined by calculating intraclass correlation coefficient reliabilities (ICCRs). Cohen's effect size (ES) statistics (Cohen's *d*) were calculated to determine magnitude of observed significant differences. Effect size was based on the criteria of $d<0.30$, small; $d=$ 0.31-0.70, moderate; and $d>0.71$, large.

RESULTS

The results of the ANOVA revealed a significant main effect for condition, $F(1, 45) = 1184.1$, $p = < 0.001$, $ES = 0.09$. Post hoc LSD

tests indicated the External-3m (196.86 ± 38.1 cm, *SEM* = 5.62) and External-5m (195.54 ± 38.7 cm, *SEM* = 5.71) conditions produced jumping distances that were significantly greater than the Baseline condition (186.58 ± 38.18 cm, *SEM* = 5.63). Additionally, the post hoc analysis revealed that jump distances measured for the External-3m and External-5m conditions were not significantly different. The average jump distances for each group are displayed in Figure 1. The ICCR suggests that the dependent variable was highly reliable (r = 0.98).

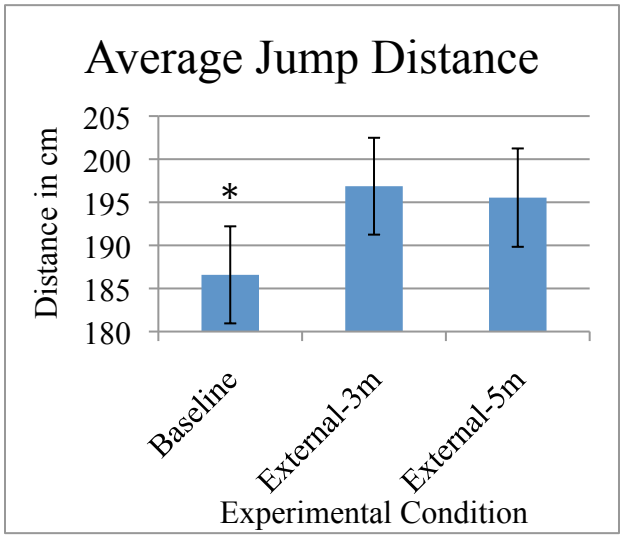

Figure 1. Average jumping distance for the Baseline, External-3m, and External-5m conditions. Error bars represent standard error. The asterisk (*) indicates that the Baseline condition was significantly different than the External-3m and External-5m conditions.

DISCUSSION

The purpose of the current experiment was to investigate the effect of increasing the distance of an external focus of attention on standing long jump performance. In particular, we examined whether or not there is a limit to the positive performance effects observed when increasing the distance of an external focus of attention while performing a standing long jump task. We predicted that performance would improve as the distance between the external focus of attention and the mover increased from 3 meters to 5 meters. We also predicted that jump distances in both external conditions would be superior to distances achieved in the baseline jumps. Based on the results of this study, our hypotheses were only partially supported. The superior jump distances of participants performing under either of the external conditions (compared to the Baseline condition) is consistent with findings in previous studies (12, 13). In this case, the verbal instructions which directed participants to focus externally presumably allowed for more autonomous movement behavior which resulted in superior jumping distances as predicted by the Constrained Action Hypothesis. In comparison, the neutral set of instructions (i.e., Baseline condition) promoted a less than optimal self-organization of the motor control system, resulting in the observed differences between the external conditions and the baseline condition. Based on the results reported in previous research (2, 18), it is likely that these superior results were not caused by differences in peak force generation between the conditions. Rather, these differences may have resulted from differences in jump projection angle (2), muscle activation patterns (21), or jump mechanics (6). Additional research is needed to confirm which, if any, of these proposed possibilities caused the difference in jump distance observed in the current study.

In contrast to previous research (10, 12, 13) and our predicted result, this study did not show any significant differences in jumping

performance as the distance of the external focus of attention increased from 3 meters to 5 meters. This finding suggests there may be a limit to the positive effects of increasing the distance of an external focus of attention. Findings presented in previous research provide possible reasons as to why no significant differences were found between the External-3m and External-5m conditions. In a recent study (2) participants performed multiple trials of the standing long jump while focusing their attention internally, externally, and neutrally. In addition to measuring jumping distance, the authors measured ground reaction force, and jump trajectory angle. Consistent with previous research, the results of that study demonstrated that participants jumped significantly further when focusing externally rather than internally or neutrally and the three groups did not differ in their generated ground reaction forces. However, the findings of that study revealed that the difference in jumping performance was the result of the external condition utilizing a more optimal jump trajectory angle compared to the internal and control conditions. It is likely that jumpers in the present study were utilizing the same (optimal) jump trajectory angle when they were focusing on the cone at distances of 3 and 5 meters. If participants were already jumping at an optimal angle in the External-3m condition, then it is not surprising that jumping performance did not improve when the focus was directed to the cone located at 5 meters. Specifically, participants were likely using the same trajectory angle when jumping towards the cone when it was located at both the 3 and 5 meter distances, which resulted in similar jump distances.

Previous research provides another explanation for the results reported above. Wulf et al. (23) suggested that based on a participant's level of experience a particular external foci may not be as effective as other attentional foci; external or otherwise. In Wulf et al. (23) novice golfers who were instructed to focus on club movement demonstrated higher accuracy during practice and retention compared to novice peers who focused on the ball's trajectory and the target. Similar results were found by Perkins-Ceccato et al., (11) where low-skill golfers received more benefit from instructions directing their attention to their golf swing, and high-skill golfers found more benefit from instructions that directed attention further away towards a target. Additionally, in Wulf (19), 12 Cirque de Soleil acrobats balanced on an inflatable rubber disk in 3 different conditions (i.e., External, Internal, & Control). In the External condition they focused on minimizing the movements of the disc. In the Internal condition they focused on minimizing the movement of their feet, and in the Control condition they focused on standing still. Performance benefits were observed in the Control condition when compared to the Internal and External conditions. Furthermore, the results of the Wulf (19) study indicated there was no significant difference in balance performance between the External and Internal conditions. Considering the low skill level of the participants tested in the current study, it is very possible that the two external conditions (i.e., External-3m & External-5m) used were not different enough to produce different jumping performances. That is, when participants were in both the external conditions they were likely using the same task-intrinsic information to generate the motor

commands needed to execute their jumps. If participants were using the same (or very similar) information to pre-plan their movements, then it is once again not surprising that the resulting jumps in the External-3m and External-5m were not significantly different.

Although the findings of this study make a unique contribution to the fields of exercise science and motor behavior; it is worth mentioning that this study does have limitations, which highlight the need for continued research on this topic. One limitation of the present experiment is that all participants were relatively low skilled jumpers. It would be valuable for both theoretical and practical reasons to test the generalizability of our findings using a population of skilled jumpers. A second limitation of the present experiment is that there were no kinematic or kinetic measures taken regarding jumping behavior. Assessing these variables in future research would provide a more thorough mechanistic explanation for why increasing the distance of an external focus of attention did not produce a greater jumping distance. Addressing these limitations through additional experimentation would make valuable contributions to this line of research and also offer answers to the many questions that remain about the focus of attention effect.

In conclusion, the findings of this study provide support for the adoption of an external focus of attention when performing a motor skill such as the long jump. Our findings also suggest when movers are allowed to choose their own focus, as was the case in the Baseline condition; they may not focus their attention optimally. It appears to be far more effective to provide explicit instructions that promote an external focus of attention. Our findings also suggest that there is a potential limit to the "distance" effect reported in previous research (10,12,13), meaning that directing attention externally at a greater distance from the body does not appear to continually enhance jumping performance. The findings of this study make a meaningful contribution to the current body of attentional focus literature by demonstrating that there may be limits to how far away focus can be directed to illicit an optimal performance, especially in low skilled populations. This finding is also valuable from a practical perspective in that it provides an easily adoptable strategy that coaches and exercise specialist can use to improve the performance of movements commonly associated with athletic and motor skill assessments.

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