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Directing Attention Externally Produces Consistent Vertical Jump Assessment Results

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ABSTRACT

International Journal of Exercise Science 16(5): 448-457, 2023. Recent research has demonstrated that consistent external attentional focus instructions produce more reliable jumping measurements compared to non-consistent focus of attention instructions. While previous research has examined the effects of different external attentional focus instructions, less is known about different external focus of attention instruction effects during a vertical jump. Given that previous work has demonstrated that consistent external focus of attention instructions produced reliable jumping estimations, we hypothesized that using multiple methods to direct attention externally would produce consistent vertical jump results. Using a within-participant design, college aged students (n = 35) completed two vertical jumps on a Vertec™ within five conditions. Each condition was provided different external directing instructions conditions (control; external-lower near, -upper near, -upper far, -unreachable far). Data were analyzed using a repeated measures analysis of variance (ANOVA). Results showed that jump heights in the control and external focus of attention conditions were not significantly different from one another, p = .119. The findings of this study suggest there are numerous external focus of attention instructions that can be provided during a vertical jump producing consistent results.

KEY WORDS: Instructions, cues, coaching, jumping evaluation

INTRODUCTION

The vertical jump is a commonly used assessment among coaches and practitioners to evaluate motor ability, lower body power, and is sometimes used as a predictor of athletic success (5, 31). For example, vertical jumps have been heavily used to predict athletic success in volleyball (28), as well as in professional football by the National Football League (NFL) (9, 26). With such importance placed on the vertical jump, coaches and practitioners should become knowledgeable about the instructional strategies they can use to help athletes achieve optimal

performance. Additionally, Porter et al. (25) identified a need for fitness instructors, personal trainers, physical educators, coaches and other test administrators to provide effective and consistent instruction during physical ability assessment sessions. Test administrators have the ability to help individuals maximize their performance during an assessment based on the content of the instructions they provide, specifically if they use verbal instructions that direct attention in a particular manner (23).

Past studies have shown that when an individual focuses their attention during the execution of a motor skill, there are influences on both the performance and learning of the practiced task (18, 36, 42). In particular, if a performer's attention is directed to the movement's effect on the environment (i.e., external focus), rather than towards the body (i.e., internal focus), the performer will likely produce a more accurate (i.e., decreased radial error) and efficient movement (i.e., decreased neuromuscular activation) (23). For example, Marchant et al. (16) found that performers who focused on the apparatus being lifted (i.e., external focus) during a bicep curl exhibited greater force production and lower levels of muscular activity compared to focusing on the movements of the arm and muscles (i.e., internal focus). Researchers also found attentional focus benefits for balance tasks (29, 35), muscular endurance (15), and performance on physical fitness tests (4). These same benefits have been observed in sport specific motor skills as well. For example, by altering focus of attention, researchers have demonstrated increased swimming speeds in intermediate swimmers (7), along with better accuracy in soccer ball placement and volleyball serving (38).

A theorized reason for the advantages of focusing on the effects of one's movements, instead of on the body's movement, is an explanation proposed by Wulf and colleagues (40) called the constrained action hypothesis. According to this hypothesis, trying to consciously control one's movements by directing attention internally constrains the motor system by interfering with automatic motor control processes that would normally regulate the behavior. Instead, focusing on the movement effect (i.e., externally) allows the motor system to more naturally self-organize, unconstrained by the interference caused by conscious control attempts, resulting in more effective movement (40).

Given the significant performance differences than can occur based on the individual's focus of attention, instruction that promotes an inconsistent attentional focus can potentially weaken the reliability, validity and objectivity of an assessment. Empirical evidence suggests that attentional focus instruction can alter the repeatability of an assessment (19, 33, 43). More specifically, if instruction is provided that does not promote a consistent focus of attention, the assessment would be expected to yield an inconsistent performance across multiple trials. Makaruk et al. (12) recently investigated this concern by examining the reliability of consistent and non-consistent attentional focus instructions during test-retest sessions. Participants performed a jumping task over the course of two testing sessions in a consistent condition or a non-consistent condition. During the consistent condition, participants were provided the same external focus instruction during both testing sessions. The non-consistent condition provided an external focus instruction during one of the testing sessions and an internal focus instruction during the

other testing session. The results of the Makaruk et al. (12) study showed instructions that promoted a consistent external attentional focus resulted in a more reliable estimation of jump performance in the counter movement jump and the standing long jump relative to a combination of internal and external attentional focus instructions.

While instructions that promote a consistent external focus during an assessment have been shown to produce more reliable jumping performance (12), instructions that promote an external focus can be provided in numerous ways. In fact, prior research has shown that instructions that direct attention externally at incremental distances led to differences in performance (22). More specifically, standing long jump studies have found that instructions that promote an external focus of attention at a greater distance improved jumping performance compared to directing attention towards a closer distance (22, 23). However, less is known about this distance effect during a vertical jump. Given that non-consistent performance weakens the reliability, validity, and objectivity of an assessment, it is important to understand if instructions that promote different types of external attentional focus yield inconsistencies in performance during a vertical jump. Thus, the purpose of this study was to investigate how different types of external attentional focus instructions affect vertical jump performance. Based on the results of Makaruk et al. (12) indicating that consistent focus of attention instructions produced a more reliable horizontal and vertical jump compared to non-consistent instructions, we hypothesized that consistently directing attention externally through verbal instructions would produce consistent vertical jump performance, regardless of the external directing cue. Testing this prediction is important to better understand how exercise and sport assessments should be instructed to better ensure accurate measurements.

METHODS

Participants

Approval was gained from the Institutional Review Board before contact was made with any potential participants for this study. Additionally, this research was carried out full in accordance to the ethical standards of the International Journal of Exercise Science (20). During the recruitment process, participants were asked if they were a former or current collegiate athlete. If they were a former or a current college athlete, the participant was not used in the present study. The participants were not aware of the purpose of the study. Prior to their involvement in the experiment, all participants signed an informed consent. A total of 35 young adult participants (n = 21 men and n = 14 women; M age = 22.39 years, SD = 4.62) participated in the study (see table 1). All participants were considered recreationally active individuals. This was qualified by verifying that no participant had received formal training regarding how to perform the vertical jump with a Vertec™. Additionally, all volunteers had regularly participated in some form of exercise at least three times a week (e.g., aerobics, weight training, swimming, biking, etc.) for the past continuous six months, and had not competed in any sport activity on a collegiate or professional level prior to their participation in the study.

Table 1. Participants Demographics by Practice Group

Participants	Males (n = 21)		Females (n = 14)	
	M	*SD*	*M*	*SD*
Age	21.55	6.46	21.76	0.93
Height (m)	1.79	0.07	1.67	0.07
Weight (kg)	80.78	10.54	66.12	11.55
Body Mass Index	25.06	2.4	23.83	3.93

Protocol

This study used a within-participant design. All research sessions were held in a climate-controlled laboratory environment. The only people present for the testing session were the participant and experimenter. The same experimenter conducted all testing sessions. During the testing session, participants performed two vertical jumps in each of the five conditions with a 1-minute active rest between each jump. All instructions were read aloud by the researcher in a counterbalanced order in an attempt to control for possible order effects.

A Vertec™ measurement device was used to record vertical jump-and-reach height. The Vertec™ consists of a series of horizontal plastic rungs incrementally spaced by 1.27 cm (i.e., 0.5 inches) at increasing vertical heights, which participants reached for during maximum vertical jumps. The participants were asked to stand with their dominant hand closest to the Vertec™. From a standing position, the participant reached with their dominant hand, along the spine of the measurement device. The height of the device was then adjusted so that the lowest rung was 30.48 cm (i.e., 12 inches) from the extended fingertips of the participant.

After the completion of the consent form, the Vertec™ was adjusted to the appropriate height using the previously described method. Consistent with previous research (12, 13), participants were then given a 5-minute warm-up by briskly walking in a climate-controlled building. After the completion of the warm-up, the participant sat to observe a demonstration of the vertical jump given by the researcher, and received general instructions about the testing protocol. Each participant was told they would be given a series of instructions of things to focus on while they were jumping. All participants were instructed that their goal was to jump as high as possible on each attempt while following the prescribed instructions. They were also told that they should be as honest as possible on a survey after each jump attempt. The survey asked the participant "On the previous trial, what did you focus on?" Participants were not asked this question following jumps completed in the control condition. They were able to practice two sub-maximal jumps to familiarize themselves with the equipment prior to testing.

After the initial general instructions were provided, the participant was asked to stand under the Vertec™. Once in the correct position, they were read aloud one of the below prescribed instructions. The instruction used for the control (CON) condition was, "Jump to the best of your ability." When participants were in the lower near (LN) condition, they were given the instruction, "When you jump, focus on your shoes leaving the ground." Instructions for the

upper near (UN) condition were "When you jump, focus on the rung you want to touch." When participants were in the upper far (UF) condition, they were instructed, "When you jump, reach for the pink tape." The pink tape was attached to the highest rung of the Vertec™, located 76.2-cm (i.e., 30 inches) from the participants' standing reach. This rung was positioned slightly out during this condition to allow for better visibility. Finally, the unreachable (UNR) instructions were "When you jump, focus on jumping up and reaching the ceiling." The ceiling of the test facility was 3.66 m tall (i.e., 12-ft) (see Figure 1).

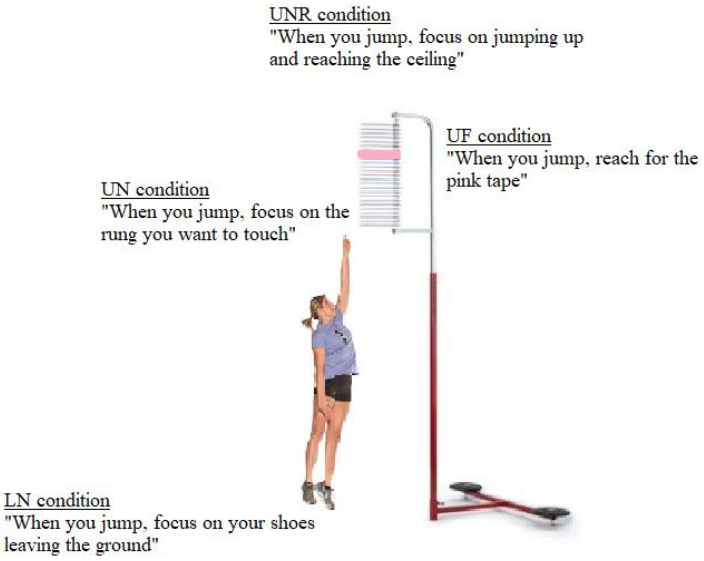

Figure 1.

Statistical Analysis

The two jumps completed in each of the five conditions were averaged and used for each participant, resulting in 10 jumps per volunteer. The Statistical Package for the Social Sciences (SPSS, version 16; IBM, Armonk, NY, USA) was used for the statistical analysis. The criterion for significance was set using an alpha level of $p \leq 0.05$. A repeated measure analysis of variance (ANOVA) was used to assess the differences between the five experiment conditions. The average jumping heights for each condition are reported below (see Table 2) with their ± standard errors. The upper and lower 95% confidence intervals (CI) associated with average jumping heights for each condition are also reported below in Table 2. Lastly, for the curious reader, an additional two-way (sex X condition) ANOVA was conducted to investigate if sex influenced the focus of attention effect.

RESULTS

Results of the ANOVA indicated a nonsignificant main effect for condition, $F(4, 136) = 1.868$, $p = 0.119$ with a small to medium effect size ($\eta^2 = .052$). No significant differences were found between conditions. The questionnaires taken after each trial revealed moderate to strong adherence rates to the instructions given across the experimental conditions. The respective adherence rates for the various conditions were as follows: LN (71%), UN (84%), UF (84%), and

UNR (63%). The ANOVA to assess sex effects on attentional focus revealed significant jump height differences between males and females $F(1, 33) = 66.642$, $p < .001$. Additionally, the ANOVA revealed there was not a significant interaction between sex and condition, $F(4, 132) = 1.040$, $p = .389$ indicating that sex was not a mitigating factor in the focus of attention effect.

Table 2. Means, standard errors, and 95% confidence intervals of all five conditions.

Condition	Mean (cm)	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control (CON)	53.848	± 1.580	50.637	57.059
Lower Near (LN)	52.850	± 1.587	49.625	56.076
Upper Near (UN)	53.576	± 1.544	50.438	56.714
Upper Far (UF)	53.921	± 1.532	50.808	57.033
Unreachable (UNR)	53.775	± 1.506	50.715	56.836

DISCUSSION

The purpose of the current study was to investigate how instructions that promote different external attentional foci affect the assessment of the vertical jump in recreationally active young adults. The results of this study showed that there were no significant differences between various external attentional focus conditions, supporting the hypothesis that providing an external focus of attention instruction is important for the generation of a reliable jumping assessment (12). These results show that regardless of the external focus of attention, vertical jump performance was not significantly different during the assessment within this population. Secondly, this analysis also revealed that the external conditions did not significantly differ from the control condition. This is a noticeable difference between the current study and existing research (13, 15, 22, 33, 34) given that none of the external conditions resulted in better performances in comparison to the control condition. It suggests that when given a choice, as was the case in the control condition, recreationally active individuals may have selected a near-optimal strategy of focusing their attention since the control condition resulted in jump heights comparable to the external focusing conditions. While previous research has suggested that individuals tend to select a suboptimal focusing strategy compared to an external focus (13, 24) when in a control condition, the Vertec™ device used in our study may have inadvertently prompted participants in the control condition to adopt an external focus of attention. Although the jumping performance advantage from an external focus has been shown to be independent of vision, Abdollahipour et al. (1) did find that individuals jumped higher when vision is available compared to when it is not. Perhaps, the ability to see the rungs of the Vertec™ prior to each jump led to a more optimal focusing strategy (i.e., external) within the control condition, leading to non-significant differences between the control and external conditions. Future studies should be conducted to fully test this possibility.

Other focus of attention research has found that focusing attention externally at greater distances can also lead to increases in standing long jumping performance (22, 23). However, this distance effect enhancement was not observed in the external conditions in the present study.

Specifically, none of the external focusing conditions were found to be significantly different from one another, even though participants were instructed to direct their attention at progressively greater distances from the start (i.e., standing) position. Westphal and Porter (31) found results similar to this when testing the distance effect in the standing long jump. The researchers found that instructing participants to jump towards a cone that was placed in front of them at a distance of 3-m resulted in further jumps compared to a baseline measurement; but placing the focus further away at 5-m did not result in better performance in comparison to the 3-m focus. In that study, they reported that there appears to be a limit to the beneficial effects of incrementally increasing the distance of an external focus when performing the standing long jump. The results of the present study suggest that the limited distance-effect benefit observed in the long jump (31) also exists in the vertical jump.

Westphal and Porter (31) attributed the lack of difference to the low-skill level of the individuals tested. Past literature suggests that, depending on a participant's level of experience, some external directing instructions may not be as effective as other external cues (39). Similar results were found by Perkins-Ceccato, et al. (21), where low-skilled golfers received more benefit from instructions directing their attention to their golf swing, and high-skill golfers found more benefit from instructions directing attention further away towards the target. This could explain the lack of difference between external focus conditions in the present study. Considering the skill level of the participants tested in the current study, it is possible that the foci of attention used in the external conditions were not different enough to have a meaningful effect on jumping performance, thus our results should not be generalized to moderate or highly skilled jumpers.

Previous research suggests that instructions that promote attentional focus can alter the repeatability of an assessment (19, 33, 43). This can have implications regarding the reliability, objectivity, and validity of a vertical jump assessment when the instructions are not generating a consistent attentional focus. Baumgartner et al. (2) suggested that in order for a test to have validity, it must first have reliability. However, a test must first have objectivity in order to have reliability. Baumgartner et al. (3) stated that validity only exists if the test score interpretation is correct. Baumgartner et al (2) later defined reliability as test score consistency, and in order for a test to have objectivity, scores must not be dependent on who is administering the test. Previous data have found significant performance differences between an internal and external attentional focus (18, 24, 32). More recently, a study by Makaruk and colleagues (12) suggested that instructions that inconsistently deliver internal and external attentional focus cues produced a less reliable jumping estimation compared to consistent instructions that provided external cues. Therefore, in order to optimize the reliability of a jumping test, consistent attentional focus cues that are external are important (12). The current study supports those findings and adds to the existing literature by suggesting that as long as the instructions promote an attentional focus that is external, the precise external cue does not lead to significant differences during a vertical jump assessment. These results provide coaches and test administrators the freedom to choose the type of external instruction during a vertical jump that is most appropriate and effective for the individual during that given assessment.

This also raises an interesting theoretical question that stems from the self-controlled motor learning literature. Allowing performers to control aspects of their practice or testing environment has come to be known as self-controlled practice (37). Previous research on self-controlled practice has shown that motor performance and learning tend to increase when the individual is provided a choice relative to no choice (37). For example, Iwatuski et al. (10) found that individuals generated more force when provided the option to choose the order of their practice trials compared to having no choice. Additionally, other research has shown that even inconsequential choices have been found to be effective at improving performance compared to not allowing the performer the option to choose (11). Given that this current study found that the precise external focus of attention instruction did not significantly alter vertical jumping performance, future research should examine whether providing the individual with numerous external attentional foci cues to choose from improves jumping performance compared to not providing the option.

In closing, the results of this study have meaningful practical applications for the conduction of a vertical jump assessment. We found when instructing individuals during a vertical jump, the type of external instruction did not significantly alter performance. Taken together with the results from Makaruk et al. (12), these findings suggest that a test administrator can use an external focus that is most effective for the individual during a vertical jump assessment. Furthermore, given that there were not significant jumping performance differences between conditions, and based on previous self-controlled practice research (37), providing an individual with the option to choose a preferred external attentional focus might elicit performance benefits. Thus, future work should investigate this to further determine how to best maximize vertical jump performance during exercise and ability testing.

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