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## Full Length Article

## The distance effect and level of expertise: Is the optimal external focus different for low-skilled and high-skilled performers?

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## ARTICLE INFO

## Keywords:

Focus of attention  
Sports  
Coaching  
Instructions  
Volleyball

## ABSTRACT

Focusing attention on a movement effect that is farther away from the body (distal external focus) has been shown to result in more effective motor performance or learning than focusing on an effect that is in greater proximity to the body (proximal focus). The present study examined whether the distance of the external focus impacts the performance of relatively inexperienced and experienced performers differently. Low-skilled and high-skilled volleyball players passed a volleyball continuously to a target. In the proximal focus condition they were asked to concentrate on the “platform,” whereas in the distal focus condition they were instructed to concentrate on the target. The high-skilled group's accuracy scores were higher in the distal relative to proximal focus condition. However, low-skilled players' accuracy scores was greater in the proximal relative to distal focus condition. We argue that the optimal distance of the external focus depends on the level of expertise when the skill requires a specific movement technique. An external focus on that technique seems to be more advantageous for low-skilled performers. In contrast, when the movement pattern has become more automatic (high-skilled performers), a focus on the overall movement effect is more beneficial.

## 1. Introduction

As numerous studies have shown over the past two decades, the performance and learning of motor skills is enhanced when performers adopt an external focus of attention, (e.g., Wulf, Höß, & Prinz, 1998; for reviews, see Lohse et al., 2012; Wulf, 2007, Wulf & Lewthwaite, 2010, Wulf & Lewthwaite, 2016; Wulf & Lewthwaite, 2010; Wulf & Prinz, 2001). An external focus, or a concentration on the intended movement effect (e.g., implement, target), has consistently been found to result in more effective and efficient movements relative to an internal focus, or a concentration on body movements. An external focus promotes automaticity in movement control (Kal, van der Kamp, & Houdijk, 2013; Wulf, McNevin, & Shea, 2001), more efficient movement preparation (e.g., intracortical activity; Kuhn, Keller, Ruffieux, & Taube, 2017), fluent action initiation (e.g., faster reaction times; Lohse, 2012), and efficient movement execution (e.g., Vance, Wulf, Töllner, McNevin, & Mercer, 2004). Wulf and Lewthwaite (2016) have described the effect of the connections between the movement intent and neuromuscular action as fluid goal-action coupling. An internal focus on one's own body movement, in contrast, acts as a self-invoking trigger (McKay, Wulf, Lewthwaite, & Nordin, 2015; Wulf & Lewthwaite, 2010) and is associated with more conscious control attempts that constrain the motor system and disrupt efficient goal-action coupling (constrained action hypothesis; Wulf et al., 2001).

While an external focus generally leads to superior performance and learning, compared with an internal focus, there is also

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<https://doi.org/10.1016/j.humov.2020.102663>

Received 13 February 2020; Received in revised form 17 July 2020; Accepted 18 July 2020

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evidence that some external foci are more effective than others. Specifically, concentrating on movement effects that are farther away from the body (i.e., *distal* external foci) has been shown to be more effective than concentrating on movement effects that are closer to the body (i.e., *proximal* external foci). McNevin, Shea, and Wulf (2003) first demonstrated that increasing the distance of the external focus from the body led to greater learning benefits. In their study, participants who were asked to focus on markers on a balance platform that were farther away from their feet (10 in.) demonstrated more effective learning than did participants who were asked to concentrate on markers right in front of their feet, or the feet themselves. The distal markers were perhaps more easily distinguishable from the feet and therefore less likely to activate self-related thoughts. Also, the benefits of a distal external focus were independent of whether the markers were on the outside or inside (near the fulcrum) of the platform. Participants' performance on a retention test was more effective than that of participants with a proximal external (or internal) focus.

The distance effect has been replicated in several other studies, some of which were conducted with novices (e.g., Kearney, 2015; McKay & Wulf, 2012; Porter, Anton, & Wu, 2012) while others were conducted with skilled performers (e.g., Bell & Hardy, 2009; Duke, Cash, & Allen, 2011; Porter, Anton, Wikoff, & Ostrowski, 2013). McKay and Wulf (2012), for example, used a dart-throwing task and found that novices were more accurate when they adopted a distal focus on the target than when they adopted a proximal focus on the flight of the dart. Kearney (2015) asked novice golfers to perform a golf putting task. In the proximal external focus condition, they were instructed to think about the club (e.g., distance the club head moved, pendulum-like swing of the club), whereas in the distal focus condition, participants were asked to think about desired outcome (e.g., imaginary line from ball to target, final position of the ball). The results demonstrated greater putting accuracy with the distal relative to the proximal focus. In another study (Porter et al., 2012), recreational athletes performing a standing long jump jumped farther with a distal focus ("jump as close to the cone as possible") relative to a proximal focus ("jump as far past the start line as possible"). Similar benefits of a distal external focus were found for standing long jump performance in children (Marchant, Griffiths, Partridge, Belsley, & Porter, 2018).

A small number of studies examined the distance effect in skilled performers. In a follow-up study to the Porter et al. (2012) study, highly trained participants also jumped farther under the distal external focus condition (Porter et al., 2013). Bell and Hardy (2009) used skilled golfers as participants and found that a distal external focus (i.e., flight of the ball) led to more accurate chipping performance compared to a proximal external focus (i.e., clubhead). Finally, Duke et al. (2011) examined attentional focus effects on music performance. Music majors were asked to perform a keyboard passage consisting of alternating notes (A and F) that were to be played quickly and evenly. External focus conditions included the piano keys, hammers, or sound. On a transfer test, a focus on the more distal movement effects (sound or hammers) resulted in greater consistency than focusing on the more proximal effect (keys).

Thus, there seems to be consistent evidence that both novices, or low-skilled performers, and experts, or high-skilled performers, benefit more from a distal relative to a proximal focus. In the present study, we asked whether the optimal distance of the external focus might vary as a function of the level of expertise when the motor task requires the coordination of various body parts and involves multiple degrees of freedom. For instance, for a skilled tennis player performing a serve, a focus on the intended ball trajectory or the service box (distal external foci) would likely be more effective than a focus on the motion of the racquet (proximal external focus), which might disrupt the fluidity on the motion. In contrast, for a novice tennis player, focusing on the motion of the racquet might be more effective than a focus on the ball trajectory or target area. Wulf and Prinz (2001) first suggested that novices who are still in the process of acquiring the basic movement pattern might benefit more from an external focus that is technique-related (or more proximal), whereas experts might benefit more from adopting a distal focus that triggers the whole action necessary to achieve the desired movement outcome (see also Wulf, 2007).

There is some indirect evidence to support this notion. In a study with novice golfers (Wulf, McNevin, Fuchs, Ritter, & Toole, 2000, Experiment 2), one group was asked to focus on the swing of the club (proximal), whereas another group was instructed to focus on the anticipated trajectory of the ball and the target (distal). Concentrating on the club motion resulted in a greater accuracy, not only in practice, but also on a retention test. In contrast, in another study (Bell & Hardy, 2009), experienced golfers showed greater accuracy in hitting a target when they adopted a distal focus (ball trajectory, target) rather than proximal focus (club head). Furthermore, in a study by Perkins-Ceccato, Passmore, & Lee, 2003, participants hitting golf balls to a target were given instructions to "concentrate on hitting the ball as close to the target pylon as possible" versus "concentrate on the form of the golf swing and to adjust the force of their swing depending on the distance of the shot" (p. 596). While the former instruction promoted a distal external focus, the latter instruction – which might have directed participants' attention to the impact of their club on the ball (especially with participants being asked to judge the appropriateness of the force they had used after a trial) – could be considered a proximal external focus (rather than an internal focus, as intended by the authors). Thus, the performance advantage (shot variability) demonstrated by some subgroups under this condition would be in line with the findings by Wulf et al. (2000), with a focus on the club being more effective than a focus on the target in novices.

However, no previous studies seem to have directly compared the effectiveness of distal versus proximal external foci as a function of level of expertise. Therefore, the purpose of the present study was to examine the influence of the distance of external focus on the performance of a complex motor skill – continuously passing a volleyball to a target – for low-skilled versus high-skilled performers. The distal focus condition involved a focus on the target, while in the proximal focus condition participants were asked to focus on the "platform." The platform, a commonly used term in volleyball, is typically associated with the area between both wrists and elbows which can create different angles for the ball to hit off of. We considered the platform an external focus, as it provides an image the performer can use to produce a desired movement pattern, or adopt a certain posture, without focusing on body movements per se. In fact, a recent study with low-skilled volleyball players who continuously passed a volleyball to a target (same task as in the present study) showed that participants' passes were more accurate when they were instructed to concentrate on the platform as opposed to their arms (Singh & Wulf, 2020). Images have successfully been used as external foci in previous studies as well (see Lohse and Sherwood, 2011; Ong, Bowcock, & Hodges, 2010; Wulf, Lauterbach, & Toole, 1999; Wulf, McConnell, Gärtner, & Schwarz,

2002). In a recent study (Yamada, Raisbeck, & Porter, 2020), an imagined object resulted in similar performance enhancements as an actual object that served as an external focus cue. We hypothesized that high-skilled performers would show greater movement accuracy when asked to adopt a distal focus. In contrast, we expected low-skilled performers to demonstrate greater accuracy with a proximal focus. Participants were also asked what their preferred focus was. Similar to performance, we expected low-skilled players to prefer a proximal focus and high-skilled players to prefer a distal focus.

## 1.1. Method

### 1.1.1. Participants

A power analysis was conducted using G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). The computation indicated that a sample size of 28 participants would be sufficient to detect a significant interaction effect using a repeated-measures design, an  $\alpha$  value of 0.05, a power value of 0.85, and an estimated  $\eta_p^2$  value of 0.08 (Lohse, Jones, Healy, & Sherwood, 2014). Low-skilled ( $n = 17$ ) and high-skilled ( $n = 12$ ) volleyball players participated in the study. The low-skilled group consisted of 14 female and three male participants, with a mean age of 23.8 years ( $SD = 6.67$ ). The low-skilled players had less than four years of competitive volleyball playing experience (e.g., high school, club, recreation), but no collegiate playing experience. The high-skilled group consisted of eight female and four male participants who were current or former collegiate volleyball players, with an average age of 23.0 years ( $SD = 3.95$ ). Seven of them were current NCAA volleyball players and five were former NCAA or NJCAA volleyball players. They had between 2 and 4 years of competitive playing experience at the collegiate level. Participants were told prior to volunteering that the task involved passing a volleyball and that they should be comfortable with the basic fundamentals of this technique. All participants gave their informed consent before beginning the experiment. The study was approved by the university's institutional review board.

### 1.1.2. Apparatus and task

Participants' task was to continuously pass a volleyball (Molten V5M5000-3 N) towards a target located on a wall 1.5 m in front of them for 45 s. The target consisted of a bullseye, with its center located at a height of 1.4 m above the floor. The center circle of the bullseye had a diameter of 15 cm and was surrounded by four concentric circles with diameters of 45, 60, 90, and 120 cm. If a ball hit the center, four points were awarded. Four to one point(s) were given for balls hitting the progressively larger circles, respectively, and zero points were recorded for complete misses.

### 1.1.3. Procedure

Participants were asked to pass the volleyball against the target for a total of 16 trials, each 45 s in duration. Prior to the start of the experiment, the experimenter, a former professional volleyball player, demonstrated the task. Participants were informed that the goal of the task was to maximize the number of points scored throughout each trial. Participants were asked to perform a dynamic stretch on their own. They were also asked to perform a practice trial to familiarize themselves with the task. Two groups (low-skilled, high-skilled players) performed 8 trials under each of the distal and proximal external focus conditions, with the order of conditions counterbalanced. In the low-skilled group, eight of the 17 participants performed in the order proximal-distal. In the proximal focus condition, participants were instructed to "concentrate on your platform," whereas the distal focus condition they were asked to "concentrate on the bullseye." Before the start of each trial, participants were reminded of the respective attentional focus.

Each trial started off with a self-toss towards the target. If the ball hit the ground during a trial, participants were asked to self-toss again and continue the task until the 45-s time limit was reached. A 15-s break was allotted before the start of the next trial. After completing the first block of 8 trials, a 2-min break was given before the start of the second block of 8 trials. A video recorder mounted on a tripod directly facing the target was used to record the points scored for later analysis. At the end of the experiment each participant was asked which attentional focus condition they preferred.

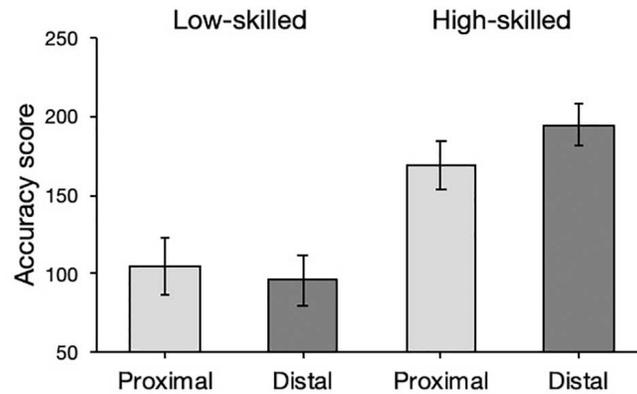
### 1.1.4. Dependent variables and data analysis

Accuracy scores were summed across 45-s trials. The scores were then averaged across all 8 trials per condition and analyzed in a 2 (level of expertise: low-skilled, high-skilled)  $\times$  2 (focus: proximal, distal) analysis of variance (ANOVA) with repeated measures on the last factor. For post-hoc tests, Bonferroni adjustments were used when appropriate. Partial eta squared ( $\eta_p^2$ ) was used to determine effect size. Magnitudes were classified as trivial (0–0.009), small (0.01–0.059), medium (0.060–0.139), or large (0.140 and greater) (Cohen, 1992). A chi-square analysis was conducted to test whether low-skilled and high-skilled participants differed in their preference of proximal or distal foci. The alpha level was set to a value of 0.05 for all analyses.

## 1.2. Results

### 1.2.1. Accuracy scores

Accuracy scores for low-skilled and high-skilled volleyball players under each focus condition can be seen in Fig. 1. High-skilled players had generally higher scores than low-skilled players. The main effect of expertise was significant,  $F(1, 27) = 12.19$ ,  $p < .01$ ,  $\eta_p^2 = 0.31$ . Importantly, the high-skilled group demonstrated more effective performance in the distal ( $M = 194.4$ ,  $SD = 47.1$ ) relative to the proximal focus condition ( $M = 168.6$ ,  $SD = 53.8$ ), whereas the low-skilled group was more effective in the proximal ( $M = 104.8$ ,  $SD = 72.3$ ) compared with the distal focus condition ( $M = 95.7$ ,  $SD = 67.0$ ). The interaction of level of expertise and



**Fig. 1.** Accuracy scores of low-skilled (two bars on the left) and high-skilled (two bars on the right) groups in the proximal and distal focus conditions. Error bars represent standard errors.

focus was significant,  $F(1, 27) = 19.75, p < .001, \eta_p^2 = 0.42$ . Post-hoc tests, with Bonferroni adjustments for multiple comparisons, indicated that the difference between focus conditions was significant for both high-skilled ( $p = .009$ ) and low-skilled players ( $p = .014$ ). The main effect of focus was significant as well,  $F(1, 27) = 4.52, p = .043, \eta_p^2 = 0.14$ , due to the high-skilled group's high scores in the distal focus condition.

### 1.2.2. Focus preference

Low-skilled participants preferred the proximal focus to a greater extent (82.4%) than the distal focus (17.6%). In contrast, high-skilled participants had a clear preference for the distal (91.7%) relative to the proximal focus (8.3%). This difference in preference between groups was significant,  $\chi^2(1, 29) = 15.44, p < .001$ .

### 1.3. Discussion

In the present study, we compared the effectiveness of proximal versus distal external foci for low-skilled versus high-skilled participants performing the same motor task. We chose a complex volleyball task with multiple degrees of freedom (continuously passing a volleyball to a target on the wall for 45 s). The task requires whole-body coordination in response to a constantly changing trajectory of the oncoming ball (direction, speed) bouncing off the wall. We hypothesized that a proximal, technique-related external focus (platform) would be more beneficial for low-skilled players than a more distal, task-goal related external focus (target), while the opposite would be the case for high-skilled players (see Wulf & Prinz, 2001). The results showed that high-skilled performers were generally more accurate than low-skilled performers. Importantly, the low-skilled group benefited more from a proximal compared with a distal focus. In contrast, the high-skilled group's performance was more effective with a distal relative to a proximal focus. Low-skilled players also indicated that they preferred the proximal focus, while high-skilled players preferred the distal focus. Thus, the present findings confirmed our hypotheses.

Previous studies examining the distance effect appeared to provide converging evidence for enhanced learning or performance with a greater physical distance of the external focus from the body for both experts and novices (e.g., Kearney, 2015; McKay & Wulf, 2012; McNevin et al., 2003; Porter et al., 2012). Yet, as Wulf and Prinz (2001) argued, for motor tasks requiring complex movement coordination with the goal of hitting a target (e.g., badminton, cricket, golf, tennis, volleyball), the actual physical distance of the focus might be less important for novices' performance than a focus on the proper technique. In contrast, for experienced performers who have already automatized the movement pattern, a distal focus on the overall task goal might be more effective. Indeed, some evidence supporting this notion comes from separate studies in which novice golfers benefited more from a proximal focus related to the movement pattern (i.e., golf club motion) (Wulf et al., 2000) and advanced golfers performed more accurately with a distal focus (i.e., ball trajectory and target) (Bell & Hardy, 2009). The present study provided the first *direct* evidence that the optimal external focus is a function of skill level by using the same task and the same instructions for low-skilled and high-skilled volleyball players. The performance of these groups was affected differently by the same focus instructions, with a proximal focus being more effective for less experienced and a distal focus being more effective for more experienced players. Interestingly, participants' preferences were in line with their performances. When asked at the end of the study which focus they preferred, most low-skilled players (82.4%) reported a preference for the proximal focus on the platform, whereas a clear majority of the high-skilled players (91.7%) indicated a preference for the distal focus on the target. These group differences are likely a reflection of their performance under the respective focus conditions.

How can the interaction of focus distance and skill level with regard to movement accuracy (and preference) be explained? Wulf and Prinz (2001) argued that the same movement outcome (e.g., trajectory of a ball) could be produced by different actions – some of which may be more efficient than others. A proximal external focus might be more effective for learning because it provides more salient information about the movement technique than does a more distal but less technique-related focus. For example, the same volleyball trajectory can result from different coordination patterns, including some that are less desirable than others because they produce less reliable outcomes. A good platform is a precondition for accurate passing. Therefore, learners initially need to focus on

creating an even platform, which in turn will enhance their passing accuracy. For expert volleyball players, producing the platform has become automatic, and a focus on the platform likely disrupts the fluidity on their motion and/or provides a distraction from the task goal. The instruction to focus on the task goal, that is, hitting the target, presumably facilitated automatic control processes in our high-skilled participants and enhanced their movement accuracy.

Thus, the optimal external focus might vary with the level of expertise, perhaps particularly when the skill involves a specific technique that subserves the achievement of the overall movement outcome, such as throwing an object as far as possible (e.g., discus or javelin throwing, shot put) or hitting a target area with a ball (e.g., tennis strokes, golf chip shots, volleyball serves). While focusing on the intended flight of a discus (distal focus) might be effective for a skilled athlete, it would likely not be very helpful in the early stage of learning how to throw a discus. Instead, adopting a more proximal focus, for example, on the acceleration of the discus, or on squeezing the discus like a bar of soap to release it, might be more appropriate foci for novices. Further investigations into how the effectiveness of different external foci might change with increasing experience will be important.

The most effective “distance” of an external focus is presumably a function of multiple factors. One such factor is clearly the physical distance from the body (e.g., Bell & Hardy, 2009; McNevin et al., 2003). As McNevin and colleagues have argued, distal effects may be easier to distinguish from the body movements that produce them than proximal effects. As a consequence, a focus on a distal effect should be more effective at reducing or preventing a detrimental internal or self-focus. The present study demonstrates that the level of expertise can also determine the effectiveness of different external foci. Aside from the level of expertise, the optimal external focus might also vary, for the same performer, as a function of his or her current performance or intention. An experienced performer who is in a “slump,” or a someone who is trying to fix a flaw in the movement pattern, might be able to improve faster by temporarily adopting a more proximal or technique-related external focus than by continuing to use a distal or outcome-related focus. The latter issue needs to be examined in future studies.

Clearly, there are a number of factors to consider for practitioners – instructors or performers themselves – when deciding how to direct attention. While research findings can provide guidelines, practitioners' experience and creativity will play an important role in finding external foci that have the potential to optimize performance or learning.

## Acknowledgment

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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