

PEDAGOGY

Examining Different Foci of Attention on Golf Putting Performance in Novice Learners

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Abstract

Although research has leaned toward an external focus, there is no consensus on the optimal distance of the attentional focus for novice learners. The purpose of this study was to examine which type of attentional focus is beneficial for the novices performing golf putting task. Forty-five novice learners (23 males, 22 females), aged 20 to 37, participated in this study. Participants were randomized into the attentional focus of attention (FOA) conditions of internal (i.e., focus on the arm movement), external-proximal (i.e., focus on the golf club), and external-distal (i.e., focus on the target). Each participant was requested to perform four blocks of 10 putts on an artificial putting surface. The total number of putts made, total putt points achieved, and perceived confidence for each putt were recorded. A 4 (block) × 3 (condition) mixed-design analysis of variance was applied for data analysis. The external-proximal FOA condition had significantly better performance (i.e., more putt points) than the external-distal FOA condition. Under the internal FOA condition, participants significantly made more golf putt points during the third and fourth blocks than the first block. Perceived confidence was significantly elevated during the third block and fourth block compared to the first block across all conditions. Postexperimental manipulation check showed most

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participants adopted the focus as they were instructed. The external-distal FOA may be detrimental for novice learners in skill acquisition. Putting performance was related to the perceived confidence for the golf stroke. Therefore, it is recommended that practitioners consider the OPTIMAL theory by facilitating external-proximal FOA and the motivational factor together for novice learners.

Motor performance and learning is the research field that studies the principles governing motor skill acquisition. One of the most critical variables that has been widely discussed is practice. Many studies have indicated that motor performance and learning can be significantly influenced by the performer's focus of attention (FOA). To date, a series of studies conducted by Wulf and her colleagues supports the advantage of external FOA relative to internal FOA in a number of sport and motor tasks, including the balance task on the ski-simulator (Wulf et al., 1998), golf (McNevin et al., 2003) and soccer and volleyball skills (Wulf et al., 2002). Wulf et al. (1998) indicated the external FOA (i.e., the wheels of the platform) helped the participants to perform smaller balance errors and higher-frequency movement adjustment on a ski-stimulator task, compared with internal FOA (i.e., the participant's feet). Similarly, Wulf et al. (2002) indicated the external focus feedback, focusing on ball trajectory, led volleyball players to perform with greater accuracy in the volleyball serves than did internal focus feedback focusing on feet, knee, and shoulder during practice and retention sessions. In addition, the experienced soccer players who received external focus feedback produced more accurate passes than the group who received internal focus feedback. Thus, the accumulated evidence consistently demonstrates that an individual focusing on the movement effects, such as ball trajectory or target, is an advantage for motor performance and learning, compared with the movement itself, such as arm movement or leg stance (Wulf, 2013).

The common coding hypothesis (Prinz, 1990) and the constrained-action hypothesis (Wulf et al., 2001) have been used in explaining the effect of different FOA on motor learning and performance. According to common coding theory, the external FOA is beneficial for motor learning because of the similarity between afferent (i.e., perception) and efferent (i.e., action) representation. The actions are encoded with respect to the anticipation of perceivable

effects in the environment. Thus, the external FOA will facilitate the preparation and selection of the anticipated perceivable effects of an action that is the most associated with the movement goal. Further, the constrained-action hypothesis suggests the internal FOA makes movement become conscious and, as a result, interferes with a person's automatic control mechanism, which enables natural and efficient movement control. As a result, it is suggested that, through an external FOA, the performer facilitates the automatic control process, enables the movement to be naturally regulated, and corrects the movement efficiently. These proposed hypotheses have been supported by a series of studies that applied the electromyography (EMG) technique. The reduced EMG activity had been evident when participants adopted an external FOA in a basketball shooting task (Zachry et al., 2005), one-leg extension-flexion task (Kal et al., 2013), and vertical jump (Wulf et al., 2010). The reduced EMG activity might explain the advantageous motor unit recruitment and reduce "noise" in the motor system. Therefore, the external FOA seems to be less inclined to interfere with automatic programming.

In addition, the distance of attentional focus may mediate the application of an external FOA on motor learning and performance. Kearney (2015) compared the effect between external-proximal FOA and external-distal FOA and showed that external-distal FOA, thinking about the desired outcome, was better relative to the external-proximal FOA, thinking about what to do with the club to have the ball on the target, for golf putting performance among novice learners. Directing attention to a more distal effect would lead to superior putting performance relative to an internal or external-proximal FOA; however, no difference was found between internal and external-proximal FOA. Similarly, Poolton et al. (2006) found no significant differences between the internal FOA, focusing on the swing of their hands, and external-proximal FOA, focusing on the swing of the club head, in golf putting performance for novice performers. Participants in both studies were able to observe the trajectory of the ball and the final location the ball stopped. This locus of visual search might naturally adjust participants' FOA to the external focus. Furthermore, Perkins-Ceccato et al. (2003) suggested the skilled golfers performed more consistently when provided with an external FOA, whereas the less skilled golfers performed less

consistently when provided with an external FOA. However, it can be criticized that the participants in the internal FOA condition were asked to concentrate on the form of the golf swing. In addition, participants needed to estimate the appropriateness of the force they had used. Such instructions might encourage an external FOA rather than an internal FOA. Therefore, the additional visual feedback and verbal instruction might not be truly reflective that the distal FOA is the optimal distance for novice learners in motor performance and learning.

Recently, Wulf and Lewthwaite (2016) proposed the OPTIMAL (Optimizing Performance Through Intrinsic Motivation and Attention for Learning) theory of motor learning. In addition to the external FOA, the OPTIMAL theory considers the important role for motivational effect because confidence (or self-efficacy) has been revealed to predict motor performance (Moritz et al., 2000). For example, Pickens et al. (1996) examined the golfers in an 18-hole competition. Their self-confidence was rated before the first putt of each hole about whether they were confident of the putt they were making and immediately after the first putt of each hole about their confidence during the putting stroke. Putting performance was measured whether they made or missed the putt they attempted. Their results indicate that confidence during putting has a stronger relation to the performance than to confidence before putting. Thus, according to the OPTIMAL theory, the perceived level of confidence would be measured for an understanding of the effect of the motivational factor on motor performance for novice learners.

Golf putting performance was adopted in this study because research has proved a positive relationship between golf putting performance and level of attention (Babiloni et al., 2008). Moreover, to overcome the limitations and fill the gap in the literature, this study targeted novice learners. In addition, it adopted the perceived level of confidence to measure based on the OPTIMAL theory (Wulf & Lewthwaite, 2016). In summary, the purpose of this study was to investigate whether a more distal focus would promote superior putting performance in novice learners than would external-proximal and internal FOA conditions, consistent with Bell and Hardy (2009) and Kearney (2015). Further, it was hypothesized that (a) according to OPTIMAL theory, the best putting performance would be

demonstrated in an external-distal FOA condition (i.e., the most number of putts made, the most putt points achieved, and the highest perceived level of confidence) and (b) the manipulation check that all participants would be focusing as directed would be applied.

Method

Participants

Forty-five university students (23 males, 22 females), aged 20 to 37, with no golf experience in a physical education class, on a high school team, or in relevant recreational activities participated in the study. Table 1 provides detailed descriptive information of the participants. People who had physical, cognitive, and/or neurological disorders were excluded from the study. All participants signed written informed consent forms. Studies have reported age, sex, and handedness as the potential confounding variables that may impact golf performance (Loffing et al., 2014; Milanese et al., 2016; Ramsey et al., 2008). In this study, these three anthropometric variables were controlled between conditions to eliminate the group differences. This study was approved by the University Human Subject Institutional Review Board prior to data collection.

Table 1
Descriptive Statistics of Participants

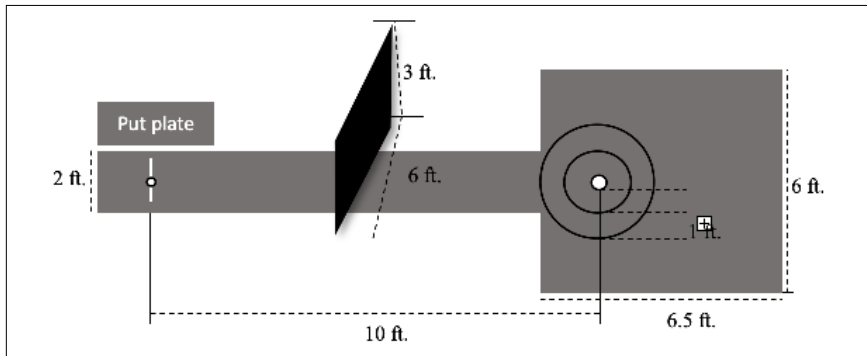
Variable	Group			<i>F</i>	<i>p</i>
	Internal (<i>n</i> = 15)	External- proximal (<i>n</i> = 15)	External- distal (<i>n</i> = 15)		
Age (years)	21.20±1.69	22.27±4.72	22.67±2.90	.76	.47
Female (<i>n</i>)	8	6	8	.71	.70
Left-handedness (<i>n</i>)	1	0	2	2.14	.34

Apparatus and Task

The putting performance was conducted in a 25-ft-long by 18-ft-wide laboratory (7.62 m × 5.49 m) with mock putting green with artificial turf. The distance from putting spot to the target hole was 10 ft (3.05 m) as shown in Figure 1. There were two circles with the hole at the center. One had a 1-ft radius, and the other had a 2-ft

radius. The two circles were used as a performance scoring criterion. Additionally, a black curtain was placed between the participant and the target to limit online knowledge of the results. Hence, the variability in the movement outcome and kinematics was associated with the FOA of the participants. With the instruments, the participants performed four blocks of 10 putting trials. Prior to beginning, each participant could practice 10 trials with full vision and familiarize themselves with the experimental procedure and surrounding environments.

Figure 1
Visual Description of Putting Green



Procedure

The participants were invited to the lab one by one for testing. Upon arrival, the participant was provided the identical instruction through a 1-min video that contained information on stance, grip, and putting stroke form. After watching the putting instruction video, the participant practiced 10 putting trials with full vision for receiving the feedback outcome of each attempt. Then the participant was randomly assigned to one of three conditions: internal FOA (i.e., arm movement), external-proximal FOA (i.e., golf club), and external-distal FOA (i.e., the target [golf hole]). It has been reported that novices have difficulty adopting certain foci, such as the anticipated trajectory of a ball. For example, Ford et al. (2009) noted it is more difficult for novice performers to adopt an external focus on the flight of the ball in kicking than for experts. Thus, in this study, the participants were instructed to arms, golf club, and golf target that were easy for them to focus on.

During the study, the participants were asked to focus on their assigned FOA. The verbal instruction was provided every one or two putting strokes. “Focus on your arm movement” was given to those in the internal FOA condition, “focus on the club” was given to those in the external-proximal FOA condition, and “focus on the target” was given to those in external-distal FOA condition. No additional verbal instruction was given. For the participants to remain focused on their FOA, the online visual information was blocked throughout the execution of the putt during the study. Only participants in the external-distal FOA condition could see the target during the movement preparation. As soon as participants hit the golf ball, the curtain was dropped down immediately. In addition, right after each putting attempt, the participants were asked about their perceived level of confidence for the putting stroke they just made. Each participant performed four blocks of 10 trials of golf putting strokes under the assigned FOA condition, for a total of 40 trials. A rest period of at least 30 s was given between each trial, 1 min between each block.

After completion of all putting trials, the participants performed the postexperimental manipulation check for confirmation of whether their focus was directed to their FOA. The statement was, “Please indicate which statement best reflects what you were thinking during the putting stroke,” and the participants selected the answer among arm, club, target/hole, and the other.

Measures

Performance Outcome

Because the purpose of putting is to make the putted ball in the hole, the number of putts made into the hole was counted. In addition, two chalk line circles were placed around the hole at 1 ft (i.e., 2.54 cm) and 2 ft (i.e., 5.08 cm), respectively, from the edge of the hole. A measure of performance based on the distance a ball rests from the hole was used (Gentner et al., 2011; Mullen et al., 2005). A 4-point system was applied for recording the distance from the final resting place of the golf ball to the hole: 3 points for making a putting stroke into the hole, 2 points for stopping the golf ball in the inner chalk circle, 1 point for stopping the ball in the outer chalk circle, and 0 points for stopping the ball outside of the outer chalk circle.

Perceived Level of Confidence

A 10-point Likert scale was applied in the measurement of the perceived level of confidence after each trial. After hitting the golf ball, the participant was immediately asked to indicate a number from 0 to 10 about their confidence on the putting stroke and performance they just made; this type of self-confidence was related to golf performance (Pickens et al., 1996). Zero indicates the lowest level of confidence and 10 indicates the highest level of confidence.

Postexperimental Manipulation Check

After completion of 40 putting trials, each participant filled out a questionnaire designed to show the extent to which they adopted the attentional focus strategies. Each participant responded to the following question: "Please, indicate which statement best reflects what you were thinking about during golf putting performance?" The statements consisted of the options (a) arm movement, (b) golf club, (c) golf hole, and (d) other. This allowed for examination of the participants' adherence to the verbal instruction of attentional focus.

Data Analysis

Statistical analysis was performed in SPSS 25.0. For all analyses, the significance level was set at $p < .05$. The differences in anthropometric variables, such as age, were examined with one-way analysis of variance (ANOVA) for continuous outcomes and chi-square for the dichotomous variables, such as sex and handedness. Further, a 4 (block) \times 3 (condition) mixed-design ANOVA comprised of four within-factors (i.e., four sets of 10 trials) and three between-factors (i.e., internal FOA, external-proximal FOA, and external-distal FOA conditions) was utilized in the comparison of mean differences of each block on putting performance (i.e., number of putts made and points) and perceived level of confidence. Adherence to the prescribed FOA instructions was examined with a chi-square test (χ^2) on the distribution of responses to the manipulation check questionnaire.

Results

Anthropometric Variables

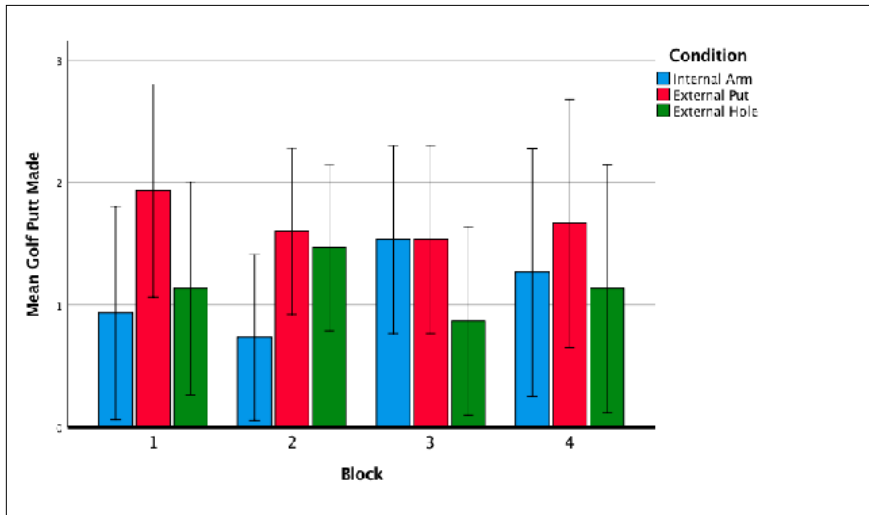
Table 1 presents the means and standard deviations for participants' background information (i.e., age, sex, handedness). Participants were equivalent across all anthropometric variables.

Putt Made

A mixed-design ANOVA compared the effect of different FOA on golf putt made under internal, external-proximal, and external-distal conditions. As Figure 2 shows, neither the block, $F(3, 126) = 0.04$, $p = 0.98$, $\eta p^2 = .001$., nor the condition, $F(2, 42) = .94$, $p = .39$, $\eta p^2 = .04$, had the significant main effect. Further, there was not a significant interaction effect between block and condition, $F(6, 126) = 1.13$, $p = .34$, $\eta p^2 = .05$.

Figure 2

Mean Golf Putt Made Across Conditions



Note. Error bars display standard errors.

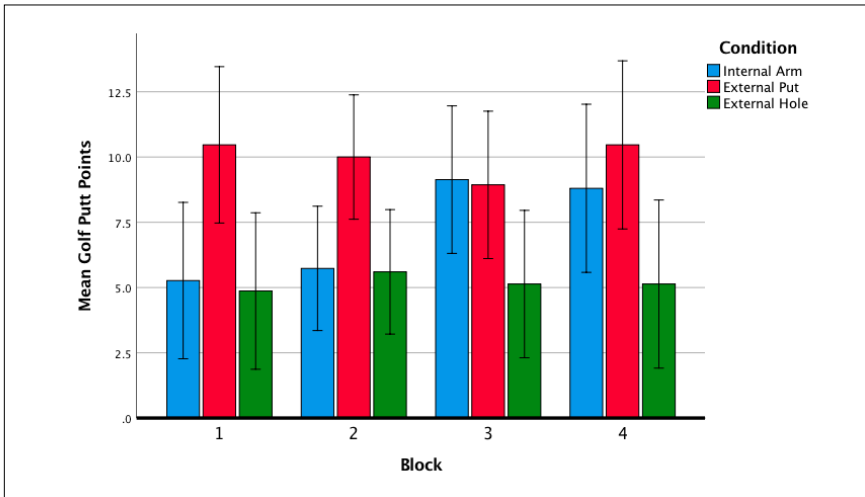
Putt Points

A mixed-design ANOVA compared the effect of different FOA on golf putt made under internal, external-proximal, and external-distal conditions. There was not a significant main effect of block, $F(3, 126) = 1.19, p = .31, \eta p^2 = .02$. In addition, there was a significant main effect of condition, $F(2, 42) = 4.02, p = .02, \eta p^2 = .16$, with participants showing significantly higher golf putt made under the external-proximal FOA ($M = 9.96 \pm 5.40$) condition compared with the external-distal FOA ($M = 5.18 \pm 4.69, p = .007$) condition.

Furthermore, there was a significant interaction effect between stage and condition, $F(6, 126) = 2.18, p = .04, \eta p^2 = .09$. As Figure 3 shows, the paired t test indicated a significant difference in the golf putt points under internal FOA between the first block ($M = 5.27, SD = 0.451$) and the third block ($M = 9.13, SD = 5.12$), $t(14) = -3.01, p = .009$; between the first block ($M = 5.27, SD = 0.451$) and the fourth block ($M = 8.80, SD = 5.34$), $t(14) = -2.28, p = .03$; and between the second block ($M = 5.73, SD = 3.77$) and the third block ($M = 9.13, SD = 5.12$), $t(14) = -3.09, p = .008$.

Figure 3

Mean Golf Putts Points Across Conditions



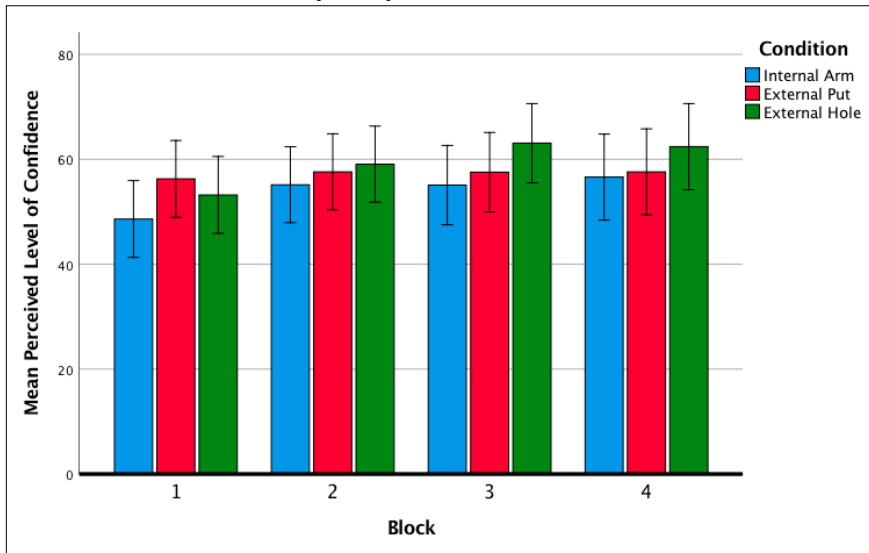
Note. Error bars display standard errors.

Perceived Level of Confidence

A mixed-design ANOVA compared the effect of different FOA on golf putt made under internal, external-proximal, and external-distal conditions. There was a significant main effect of block, $F(3, 126) = 6.97, p < .01, \eta p^2 = .14$. As Figure 4 shows, participants showed a higher perceived level of confidence during the second block ($M = 57.27, SD = 13.79$), $t(44) = -3.07, p = .004$; the third block ($M = 58.356, SD = 14.69$), $t(44) = -3.80, p < .01$; and the fourth block ($M = 58.87, SD = 15.73$), $t(44) = -3.53, p = .001$, than during the first block ($M = 52.69, SD = 14.21$), respectively.

Figure 4

Mean Perceived Level Of Confidence Across Conditions



Note. Error bars display standard errors.

In addition, there was not a significant main effect of condition, $F(2, 42) = .67, p = .51, \eta p^2 = .03$. Furthermore, there was not a significant interaction effect between block and condition, $F(6, 126) = 1.29, p = .27, \eta p^2 = .05$.

Postexperimental Manipulation Check

A nonparametric chi-squared test revealed a significant difference in reported attentional focus strategies between conditions, $\chi^2(6, N = 45) = 32.831, p < .01$. Nine participants (60%) in the internal FOA condition, 10 participants (66.7%) in the external-proximal FOA condition, and 11 participants (73.3%) in the external-distal FOA condition focused as instructed in this study.

Discussion

The primary aim of this study was to determine whether the benefit to golf putting performance was associated with the optimal FOA for novice learners. In each condition, the participant's attention was directed, through specific verbal instruction, to a different aspect of the golf putt: the motion of the arm, the golf club, or the target without online visual knowledge of the results. The attentional foci were ranged from the internal to the more external-proximal and external-distal. From a common-coding perspective (Prinz, 1990) and the constrained-action hypothesis (Wulf et al., 2001), it was hypothesized that external FOA would be more beneficial than internal FOA. However, the findings of this study did not show a significant difference between external-proximal condition and internal condition. In addition, this study did not support the recommendations of Wulf and Su (2007) and Kearney (2015) because novice learners showed worse performance with the more distal focus. There appears to be a limit beyond which performance decreases.

First, this study shows that external-proximal FOA leads to better golf putting performance (i.e., more golf putt points) compared to external-distal FOA among novice learners. The theory relating attention to motor control could explain that focusing at the external-distal target while putting might be too far for novice learners to connect their intended motor representation to the actual movement pattern. As for experienced performers, they already have more detailed procedural knowledge and motor patterns of golf than do novices (Schack & Mechsner, 2006). Thus, experienced performers, whose representation of golf putting has been organized to match functional and biomechanics demands, could connect the task dynamics to the distal variables in the environment spontaneously. However, novice performers may not have fully learned the

task dynamics. Consequently, it would be difficult for novice performers to identify the distal variables and control the movement simultaneously.

Consistent with Kearney (2015) and Poolton et al. (2006), this study found no significant difference between external-proximal and internal FOA for novices in a golf putting task. In particular, the online visual feedback was removed and specific verbal instruction was given to encourage participants to focus on the instruction they were given. It is not clear why no difference emerged between the external-proximal condition and the internal condition. One possible explanation might be that it was not easy for novice performers to distinguish between arm movements and the proximal movement effect (e.g., golf club swing). Participants in the external-proximal condition may have placed their focus on the grip and then shifted their attention to the golf club during movement execution. As such, adopting a proximal external focus may be similar to adopting an internal focus. Additionally, participants in the internal FOA condition improved performance in the third and fourth blocks. This shifting of attention in the middle of the test period perhaps helped participants become more attuned to motor performance (i.e., better at interpreting their intrinsic feedback), even in the absence of online knowledge of the result. Hence, the manipulation check may need to be made every set to understand the information processing for novice performers in the future.

In addition, few participants adopted their preferred FOA instead of following the directed instructions. Weiss et al. (2008) investigated the effects of different types of focusing strategies on basketball free throw learning and suggested participants showed significant improvement in performance either under their preferred focus (i.e., internal and external) or when forced to switch to the other, except those who had an external preference but were forced to shift over to an internal focus style. In this study, comparing the performance for participants in the internal FOA condition between those who followed and those who didn't follow the directed instruction, no differences were noted in overall perceived feeling of confidence, $t(13) = -.408, p = .690$; golf putt made, $t(13) = 1.432, p = .179$; and golf putt points, $t(13) = .021, p = .983$. Therefore, there might be no effect between preferred external FOA strategy and internal FOA

instruction in golf putting performance. Future studies should match the initial preferred FOA and add the follow-up test to measure the learning effect.

Much research in sport psychology has examined the relationship between confidence and performance by administering a questionnaire before the competition and then correlating the responses to questionnaire items with performance results. This study showed the average confidence of feeling was significantly related to the average putt made ($r = .352, p = .018$). Participants with higher confidence seemed to have a much better chance of successful performance than those somewhat or not confident. In addition, the significant relation was not evident between feeling of confidence and putt points ($r = .211, p = .165$). According to the OPTIMAL theory, these findings seem to provide further evidence that the “self-confidence” effect for a novice in golf putting performance is a general phenomenon that does not depend on the focus on instructions. Future studies may include different measures of performance (e.g., absolute error, constant error, or radial error) to determine which variables affect the relationship between motivational effect and motor performance.

In fact, this study has some limitations. Future studies will need to confirm there is an optimum limit for the external FOA for novice performers. Initial concern relates to there being no significant difference between internal FOA condition and the external-proximal FOA condition, although the external-proximal FOA condition demonstrated better performance with moderate to strong effect sizes. Vickers et al. (2000) described a phenomenon, quiet eye, in athletes’ gaze pattern. Therefore, this preliminary result is promising but needs to be replicated by other psychophysiological measures, such as eye-tracking device, for the identification of the critical location novice performers select during the performance. Further, although participants had little golf experience, this preexisting performance variability between groups might be one of the limitations. For example, the past golf putting measure (e.g., miniature golf) should be considered. In addition to physical ability, psychological characteristics (e.g., anxiety, arousal level) relate to golf performance (Schaefer et al., 2016). Different FOA instructions may induce levels of anxiety and arousal to a different extent that causes the differences

in putting performance. Moreover, there were no differences in the perceived level of confidence across FOA conditions. Participants in this study may express the similar perception of confidence due to the similar skill level of golf. Future studies can include different skill levels of golfers. The interactions between psychological characteristics and physical skills should be noted in the future.

In conclusion, this study found the beneficial effect of external-proximal FOA for novice performers to master the golf putting skills. From an applied perspective, it would be advisable to educate golf coaches that the proximal FOA is better than the distal FOA. According to the OPTIMAL theory, practitioners should encourage novice learners to be aware of self-confidence toward their stroke. This study may ascribe an important role in motivational effect. To our knowledge, this is one of the pioneering studies that explores the effect of FOA and self-confidence in motor performance for novice performers. Once this relationship is confirmed, it will be useful for the practitioner to determine which optimal instruction benefits golf learning. Accordingly, applied practitioners might benefit from future research on different skill levels of performers and with more physiological measures to enhance understanding of the benefits of external-proximal FOA for novice performers.

References

- Babiloni, C., Del Percio, C., Iacoboni, M., Infarinato, F., Lizio, R., Marzano, N., Crespi, G., Dassù, F., Pirritano, M., Gallamini, M., & Eusebi, F. (2008). Golf putt outcomes are predicted by sensorimotor cerebral EEG rhythms. *The Journal of Physiology*, *586*(1), 131–139. <https://doi.org/10.1113/jphysiol.2007.141630>
- Bell, J. J., & Hardy, J. (2009). Effects of attentional focus on skilled performance in golf. *Journal of Applied Sport Psychology*, *21*(2), 163–177. <https://doi.org/10.1080/10413200902795323>
- Ford, P., Hodges, N. J., Huys, R., & Williams, A. M. (2009). An evaluation of end-point trajectory planning during skilled kicking. *Motor Control*, *13*(1), 1–24. <https://doi.org/10.1123/mcj.13.1.1>
- Gentner, N., Wrisberg, C. A., & Lounsbury, J. (2011). The Athlete Life Quality Scale: Development and psychometric analysis. *Athletic Insight Journal*, *3*(1), 77–94.

- Kal, E. C., Van der Kamp, J., & Houdijk, H. (2013). External attentional focus enhances movement automatization: A comprehensive test of the constrained action hypothesis. *Human Movement Science, 32*(4), 527–539. <https://doi.org/10.1016/j.humov.2013.04.001>
- Kearney, P. E. (2015). A distal focus of attention leads to superior performance on a golf putting task. *International Journal of Sport and Exercise Psychology, 13*(4), 371–381. <https://doi.org/10.1080/1612197X.2014.993682>
- Loffing, F., Sölter, F., & Hagemann, N. (2014). Left preference for sport tasks does not necessarily indicate left-handedness: Sport-specific lateral preferences, relationship with handedness, and implications for laterality research in behavioural sciences. *PloS one, 9*(8), Article e105800. <https://doi.org/10.1371/journal.pone.0105800>
- McNevin, N. H., Shea, C. H., & Wulf, G. (2003). Increasing the distance of an external focus of attention enhances learning. *Psychological Research, 67*(1), 22–29. <https://doi.org/10.1007/s00426-002-0093-6>
- Milanese, C., Corte, S., Salvetti, L., Cavedon, V., & Agostini, T. (2016). Correction of a technical error in the golf swing: Error amplification versus direct instruction. *Journal of Motor Behavior, 48*(4), 365–376. <https://doi.org/10.1080/00222895.2015.1102699>
- Moritz, S. E., Feltz, D. L., Fahrback, K. R., & Mack, D. E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Research Quarterly for Exercise and Sport, 71*(3), 280–294. <https://doi.org/10.1080/02701367.2000.10608908>
- Mullen, R., Hardy, L., & Tattersall, A. (2005). The effects of anxiety on motor performance: A test of the conscious processing hypothesis. *Journal of Sport & Exercise Psychology, 27*(2), 212–225. <https://doi.org/10.1123/jsep.27.2.212>
- Pickens, M. M., Rotella, R. J., & Gansneder, B. M. (1996). The effect of putting-confidence on putting-performance. *Journal of Sport Behavior, 19*(2), 148–162.
- Perkins-Ceccato, N., Passmore, S. R., & Lee, T. D. (2003). Effects of focus of attention depend on golfers' skill. *Journal of Sports Sciences, 21*(8), 593–600. <https://doi.org/10.1080/026404103100101980>

- Poolton, J. M., Maxwell, J. P., Masters, R. S. W., & Raab, M. (2006). Benefits of an external focus of attention: Common coding or conscious processing? *Journal of Sports Sciences*, 24(1), 89–99. <https://doi.org/10.1080/02640410500130854>
- Prinz, W. (1990). A common coding approach to perception and action. In O. Neumann & W. Prinz (Eds.), *Relationships between perception and action* (pp. 167–201). Springer. https://doi.org/10.1007/978-3-642-75348-0_7
- Ramsey, R., Cumming, J., & Edwards, M. G. (2008). Exploring a modified conceptualization of imagery direction and golf putting performance. *International Journal of Sport and Exercise Psychology*, 6(2), 207–223. <https://doi.org/10.1080/1612197X.2008.9671862>
- Schack, T., & Mechsner, F. (2006). Representation of motor skills in human long-term memory. *Neuroscience Letters*, 391(3), 77–81. <https://doi.org/10.1016/j.neulet.2005.10.009>
- Schaefer, J., Vella, S. A., Allen, M. S., & Magee, C. A. (2016). Competition anxiety, motivation, and mental toughness in golf. *Journal of Applied Sport Psychology*, 28(3), 309–320. <https://doi.org/10.1080/10413200.2016.1162219>
- Vickers, J. N., Rodrigues, S. T., & Edworthy, G. (2000). Quiet eye and accuracy in the dart throw. *International Journal of Sports Vision*, 6(1), 30–36.
- Weiss, S. M., Reber, A. S., & Owen, D. R. (2008). The locus of focus: The effect of switching from a preferred to a non-preferred focus of attention. *Journal of Sports Sciences*, 26(10), 1049–1057. <https://doi.org/10.1080/02640410802098874>
- Wulf, G. (2013). Attentional focus and motor learning: A review of 15 years. *International Review of Sport and Exercise Psychology*, 6(1), 77–104. <https://doi.org/10.1080/1750984X.2012.723728>
- Wulf, G., Dufek, J. S., Lozano, L., & Pettigrew, C. (2010). Increased jump height and reduced EMG activity with an external focus. *Human Movement Science*, 29(3), 440–448. <https://doi.org/10.1016/j.humov.2009.11.008>
- Wulf, G., Höß, M., & Prinz, W. (1998). Instructions for motor learning: Differential effects of internal versus external focus of attention. *Journal of Motor Behavior*, 30(2), 169–179. <https://doi.org/10.1080/00222899809601334>

- Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychonomic Bulletin & Review*, 23, 1382–1414. <https://doi.org/10.3758/s13423-015-0999-9>
- Wulf, G., McConnel, N., Gärtner, M., & Schwarz, A. (2002). Enhancing the learning of sport skills through external-focus feedback. *Journal of Motor Behavior*, 34(2), 171–182. <https://doi.org/10.1080/00222890209601939>
- Wulf, G., McNevin, N., & Shea, C. H. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *The Quarterly Journal of Experimental Psychology: Section A*, 54(4), 1143–1154. <https://doi.org/10.1080/713756012>
- Wulf, G., & Su, J. (2007). An external focus of attention enhances golf shot accuracy in beginners and experts. *Research Quarterly for Exercise and Sport*, 78(4), 384–389. <https://doi.org/10.1080/02701367.2007.10599436>
- Zachry, T., Wulf, G., Mercer, J., & Bezodis, N. (2005). Increased movement accuracy and reduced EMG activity as the result of adopting an external focus of attention. *Brain Research Bulletin*, 67(4), 304–309. <https://doi.org/10.1016/j.brainresbull.2005.06.035>