Beating the Bunker: The Effect of PETTLEP Imagery on Golf Bunker Shot Performance

Dave Smith, Caroline J. Wright, and Cara Cantwell

The aim of this study was to compare the effects of physical practice with PETTLEP-based (Physical, Environment, Task, Timing, Learning, Emotion and Perspective; Holmes & Collins, 2001) imagery and PETTLEP + physical practice interventions on golf bunker shot performance. Thirty-two male county or international-level golfers were assigned to one of four groups: PETTLEP imagery, physical practice, PETTLEP + physical practice, or control. The PETTLEP imagery group imaged 15 bunker shots, their interventions incorporating PETTLEP components, such as physical, environment, and emotion, twice a week. The physical practice group physically performed their 15 bunker shots twice a week; the PETTLEP + physical practice group performed PETTLEP imagery once a week and physical practice once a week. Each group performed their respective tasks for 6 weeks. Pre- and posttests consisted of 15 bunker shots, with points awarded according to the ball proximity to the pin. All groups improved significantly (p < .01) from pre- to posttest, and the PETTLEP + physical practice group improved more (p < .05) than the PETTLEP and physical practice groups. However, there was no significant difference between the physical practice and PETTLEP groups (p > .05). Findings, therefore, support the effectiveness of PETTLEP in enhancing golf performance, especially when combined with physical practice.

Key words: functional equivalence, intervention, sports performance

Despite more than a century of imagery research in sport, the issue of how to conduct imagery for the best results remains controversial, as many studies have used conflicting methods (Weinberg, Seabourne, & Jackson, 1981; Murphy, 1994). However, neuroscience research examining the relationship between brain activity and imagery may provide useful information. Studies using techniques such as electroencephalography and positron emission tomography have found similar cortical neuronal activity prior to and during imagery and physical performance, a phenomenon termed functional equivalence (Decety, 1996; Jeannerod, 1997). These researchers have hypothesized that this may explain imagery’s performance-enhancing effects. This line of research follows work such as Lang’s (1979, 1985) bioinformational theory and Ahsen’s (1984) triple code theory that have emphasized the similarity of psychophysiological responses to imagery and actual performance as well as the importance of meaning in imagery.

In response to these theories and research findings, Holmes and Collins (2001) devised the PETTLEP (Physical, Environment, Task, Timing, Learning, Emotion, and Perspective) imagery model to aid practitioners in maximizing functional equivalence. Each element of PETTLEP is an important issue to consider when carrying out an imagery intervention.

The Physical component relates to the athlete’s physical responses. Some authors (Cabrál & Crisfield, 1996; Williams & Harris, 2001) claimed that athletes can image vividly if they are in a completely relaxed and undisturbed state. However, most studies of imagery combined with relaxation have not found significant benefits from
relaxation (e.g., Conroy, 1997; Gray, Haring, & Banks, 1984). If imagery is most effective when functional equivalence is high (e.g., Smith & Collins, 2004; Smith & Holmes, 2004), it is unlikely this approach will be beneficial. Holmes and Collins (2002) argued that this technique did not account for the somatic effects of relaxation, which are the opposite of the athlete’s somatic state. They argued that imagery is more effective when it includes all the senses and kinesthetic sensations that would be involved during actual performance. Previous clinical psychology research (Lang, Kozak, Miller, Levin, & McLean, 1980) supported this notion. For example, images that include the burning sensation of lactic acid build-up in the muscles, the feeling of the heart pounding, and smells, such as the changing room and grass pitch, can evoke actual performance. Also, wearing the same clothing one wears during performance, adopting the same posture and holding any implements one uses during performance (e.g., basketball, golf club) could enhance the physical nature of the imagery. For example, a racing driver could perform imagery while sitting in his or her racing car, dressed in racing clothes and holding the steering wheel.

The Environment component refers to the milieu in which the imagery takes place. To access the same motor representation, Holmes and Collins argued that imagery should be done in an environment similar to the one in which competition occurs. For example, a golfer could perform imagery while standing on grass to simulate being on a golf course. Studies with field hockey players and gymnasts supported this hypothesis and found better results when imagery was performed in the same environment as the competition (Smith, Wright, Allsopp & Westhead, 2007). If it is not possible to perform imagery regularly in the actual performing arena, cues such as video (e.g., Hale, 1982) and audiotape (e.g., Ainscoe & Hardy, 1987) can be used, which have been found to be more effective than a written script (cf., Smith & Holmes, 2004).

Task refers to closely matching the imagined task to the actual one. The imagery content should be highly task-specific, with the performer focusing on the same thoughts, feelings, and actions as during physical performance. To enable functionally equivalent imagery, a process known as “response training” (Lang et al., 1980) should be done as advocated in bioinformational theory (Lang, 1985). This involves focusing the participant on actual responses by eliciting and reinforcing verbal reports of physiological and behavioral involvement in the scene, thus emphasizing a kinesthetic orientation toward the imagery. Smith and Collins (2004) measured movement-related brain potentials during computer game performance and found that a response-trained group produced more functionally equivalent imagery than the group receiving stimulus training (i.e., focusing on the stimuli in the imagined scene). Also, and perhaps more importantly, the response-trained group’s performance increased significantly more than the stimulus group.

The Timing component is important, as precise timing is often essential to correct skill execution. Some authors suggested that imagery should be performed in slow motion (e.g., Whetstone, 1995). However, others advocated imaging at the correct speed of the action (Weinberg & Gould, 2003). This real-time imaging provides more functional equivalence. Andre and Means (1986) completed a study using a Frisbee disc golf putting task. They hypothesized that imagery would be more effective for the slow motion group, as it could allow participants to add detail to their feelings. However, their study showed a greater improvement in the real-time imagery group. Although they were correct in assuming it is more effective if participants add detail to their imagery, slow-motion imagery did not help. Holmes and Collins (2001) hypothesized that using sport-specific implements during imagery could aid timing, and Smith and Holmes (2004) found that video and audiotape acted as a template to help golfers image in real time.

Learning refers to adapting imagery content in relation to the rate of learning. The motor representation and associated responses will change over time as learning takes place, so it is imperative that the imagery content must change to reflect this. For example, as a movement becomes easier and more fluid, the kinesthetic sensations the performer feels will change, and so the kinesthetic content of the imagery should be altered too. Holmes and Collins (2001) suggested that where motor imagery is combined with technical training or intense learning, regularly reviewing the imagery content is essential to retain functional equivalence. This applies to all levels of athletes, as even advanced performers may master a difficult aspect of their sport (e.g., slightly changing their technique), thus exerting different forces on their limbs and experiencing different kinesthetic sensations.

The Emotion component has been referred to as the missing link (Botterill, 1997) in sports performance. The model emphasizes that the performer’s emotional response and the meaning he or she attaches to a scenario must be considered for memory strengthening to occur (cf., Lang, 1985). Both Lang’s bioinformational theory (1985) and Afschin’s triple code theory (1984) highlighted the importance of meaning in imagery. Therefore, for example, the excitement felt during performance should be an important part of the performer’s imagery experience. Of course, care should be taken to ensure the emotions felt during imagery are positive or viewed in a facilitative manner, as negative emotions may have a detrimental effect on performance. Although the main function of the PETTEP model is skill enhancement, the focus on positive emotions should also prove beneficial in enhancing self-confidence and motivation.
The Perspective component of the PETTLEP model refers to the way imagery is viewed. The model suggests that internal (first person) imagery would generally be the most beneficial, as it produces a greater functional equivalence than external imagery. However, studies have shown external (third person) perspective to be beneficial for certain form-based skills (Hardy & Callow, 1999; White & Hardy, 1995). Holmes and Collins (2001), therefore, suggested that a combination of perspectives may be most beneficial.

Previous studies (Smith & Collins, 2004; Smith & Holmes, 2004) indirectly tested elements of the PETTLEP model using various methods to deliver imagery interventions, including written scripts, video-and-audiotape, and comparison effects of stimulus and response-driven interventions. However, as Holmes and Collins (2001) noted, the model would benefit from explicit, comprehensive testing in a variety of settings. Responding to this suggestion, Smith et al. (2007) assessed the effect of PETTLEP imagery in hockey and gymnastics and found that the more PETTLEP components incorporated into the imagery, the greater the improvement in performance. However, the effects of combining PETTLEP imagery and physical practice has not yet been examined. This is important, because athletes (unless suffering from illness or injury) rarely use imagery without physical practice. Rather, they normally use imagery as an adjunct to physical training. Therefore, a comparison of physical practice with PETTLEP imagery + physical practice could help determine whether this imagery framework could actually enhance performance beyond physical practice. This was the aim of the present study.

The study focused on golf bunker shots, comparing four interventions: PETTLEP imagery group, physical practice group, PETTLEP - physical practice group, and a control group. We hypothesized that the physical practice group would improve more than the PETTLEP and the combination groups and that the combination group would improve more than the PETTLEP group. Most studies have found imagery to be less effective than physical practice (Driskell, Copper, & Moran, 1994; Felz & Landers, 1983).

**Method**

**Participants**

Thirty-four male golfers, all of whom had played for at least 10 years, were recruited to participate. All had competed at the county or international level, and all had handicaps of less than 5. All participants provided informed consent and completed the study. None had previously received imagery training.

**Instruments**

Movement Imagery Questionnaire—Revised (MIQ-R). The MIQ-R is an eight-item inventory that assesses one's ability to perform visual and kinesthetic imagery. It has acceptable concurrent validity when correlated with its earlier version, with r values of -.77, -.77, and -.87 for the visual subscale, kinesthetic subscale, and overall score, respectively (Hall & Martin, 1997). The negative correlation is due to a scale reversal, because the higher the rating in the original MIQ, the harder it was for the respondent to imagine a movement. As per previous research (Smith & Collins, 2004), participants scoring lower than 16 (moderate imagery ability) on either MIQ-R subscale were excluded from due to an apparent lack of imaging ability. A score of 16 would represent only an average of 4 on each item (“Neutral [not easy or hard]”), indicating that participants could not image easily. Two golfers scored less than 16 and were excluded from our study, leaving a total of 32 participants.

**The Bunker and Green.** The green had a gentle slope from back to front (i.e., uphill from the bunker) and was 20 m at its maximum length and 12 m at its maximum width. The bunker was located at the front right side of the green and was kidney shaped. The back of the bunker was gently sloping; the front face was riveted at a 10° angle and was 45 cm at its deepest. The distance from bunker to green was 1 m.

**Procedure**

Prior to the study, all participants completed the MIQ-R and were randomly assigned to one of the four intervention groups, with 8 participants in each group. The task involved hitting the golf ball out of the bunker and onto the green, aiming to finish as close as possible to the pin. A zone-based scoring system was used, with shots that finished closer to the pin receiving a higher score (see Figure 1). Pre- and posttests each consisted of 15 bunker shots. The points from each attempt were summed to produce an overall score. After the golfers had completed the pretest, each was interviewed to gain information about his experience of the task. For the imagery group, this information was used to produce their individualized imagery scripts; for the physical practice and control participants, the same procedure was followed to ensure all groups received equal attention.

Participants in the imagery group received response training (Lang et al., 1980), as advocated by the PETTLEP model. This involved focusing the golfers on their task responses by reinforcing verbal reports of physiological and behavioral involvement in the scene. Information from the interviews was used to create individualized imagery scripts. In this case, scripts were preferred to video and audio interventions, because the imagery took place in a simulation of the actual golfing environment.
Thus, video- and audiotape were not considered necessary or useful. The intervention for this group was based on the seven PETTLEP components. Participants were instructed to perform their imagery standing in a tray of sand or a sand pit in their back garden (Environment), dressed in their golf clothing, and holding a sand wedge. They were instructed not to actually perform the full movement but also not to inhibit any small movements they might want to make if that helped the imagery seem more realistic (e.g., adjusting to the correct foot position; Physical). This made the environment as realistic as possible. The physiological responses and emotions associated with performance were incorporated into the imagery (Task and Emotion), as the physiological responses and emotions participants felt during performance were elicited and reinforced during the response training and incorporated into the imagery scripts. The participants were also instructed to perform the imagery in real time from an internal perspective (Timing and Perspective). The golfers were consulted once each week regarding the imagery effectiveness and asked if they wanted to make any changes or additions to their imagery scripts. These changes were then incorporated for use in subsequent imagery sessions (Learning). The golfers imaged 15 bunker shots twice per week for 6 weeks.

The physical practice group completed 15 bunker shots twice per week, recording the days and times they completed the task. The PETTLEP + physical practice group completed PETTLEP imagery once a week, using the same procedure as the PETTLEP group. They also physically practiced 15 bunker shots once per week on a different day from when they performed the imagery, using the same procedure as the physical practice group. The control group read from a biography of golf champion Jack Nicklaus (Shedloski & Shedloski, 2001) twice per week, which took the same amount of time as performing the bunker shots. Control participants were told the study aim was to examine the extent they could improve their game by reading about a great golfing icon. This was identical to the placebo control used by Smith and Holmes (2004). Although the book was related to golf, it did not provide advice on technique to aid the bunker shot performance. Each participant met weekly with the tester to discuss any problems or queries, and control participants discussed how they liked the book. In diaries, participants recorded any golf they played and the number of bunker shots they hit during the study. From discussions with potential participants prior to the study, we knew that most of the golfers followed similar practice regimens (two rounds of golf per week plus some practice on the driving range and putting green). However, it was important to closely monitor the amount of golf each participant played during the study in case systematic differences emerged between groups. After completing the posttest, the golfers were interviewed in a poststudy manipulation check to ensure compliance with the instructions set out at the beginning of the study. They were asked whether they had (a) performed their imagery and physical practice as instructed, (b) perceived the interventions as useful in aiding performance, and (c) had experienced any difficulties in performing their imagery (and the nature of such).

Results

Self-Report Data

One-way analyses of variance (ANOVA) revealed no significant difference in MIQ-R scores among the four groups for both kinaesthetic, \( F(3, 28) = .146, p > .05 \), and visual, \( F(3, 28) = .150, p > .05 \). Participants reported following their imagery instructions and performing their intervention as instructed for the study period. In addition, several participants in the control group reported performing spontaneous imagery while reading the Nicklaus biography. Interestingly, the same phenomenon occurred during the Smith and Holmes (2004) study, and the forms of spontaneous imagery appeared to be identical. The controls imaged performing in a major competition or lifting a major trophy in an uncontrolled manner several times during the course of the study.

From the participants’ diaries, it was apparent no systematic differences occurred between groups in the amount of golf played during the study. Most participants performed essentially their same practice regimen during the study, although several participants across all groups played either one or three rounds per week.

All imagery participants reported finding the imagery to be personally meaningful and effective in enhancing performance, and all expressed a desire to continue...

Figure 1. Scoring system.
using PETTLEP imagery after completing the study. While it wasn’t a main aim of the study, it is interesting that several participants noted the imagery had aided their confidence in tackling bunker shots. Their diaries revealed no systematic between-group differences in the amount of golf played and bunker shots hit.

**Primary Results**

The mean scores for all groups, apart from the control group, were greater in the posttest than in the pretest (see Figure 2), with percentage changes as follows: PETTLEP + physical practice, -22.38%; physical practice, +13.27%; PETTLEP, +7.79%; control group, -1.94%. A Group x Test ANOVA revealed a significant interaction, $F(3, 28) = 7.03, p < .01$. There were no significant differences between the groups in pretest scores, $(p > .05$ in all cases). However, significant posttest differences were apparent. Tukey HSD tests revealed that the PETTLEP + physical practice, physical practice, and PETTLEP imagery groups improved significantly from pre- to posttest $(p < .05)$. There was no difference in the magnitude of improvement shown by the physical practice and PETTLEP imagery groups, but the PETTLEP + physical practice group improved to a significantly greater degree than the PETTLEP imagery and physical practice groups $(p < .05)$. The control group did not improve significantly from pre- to posttest $(p > .05)$. Effect size calculations revealed that treatment effects were large for the PETTLEP + physical practice, physical practice, and PETTLEP groups ($d = 2.10, 1.37$, and $.80$, respectively).

**Discussion**

The results of the study strongly support the effectiveness of the PETTLEP approach to motor imagery in enhancing golf performance, especially when used in combination with physical practice. The physical practice and PETTLEP imagery groups improved significantly from pre- to posttest and improved more than the control group. We hypothesized that the physical practice group would improve more than the PETTLEP imagery group. However, this hypothesis was not supported, as PETTLEP imagery and physical practice proved equally effective. This contrasts with most previous imagery studies, which found physical practice to be more effective than imagery (see meta-analyses by Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983; Hinshaw, 1991). However, these studies did not use the PETTLEP approach, and, therefore, this finding may reflect the superior effectiveness of PETTLEP interventions compared to the more traditional interventions used in previous studies. This is supported by Smith et al. (2007), who found PETTLEP imagery to be more effective than more traditional imagery interventions.

Holmes and Collins (2001) argued that personalizing imagery interventions would achieve more effective results, because individuals are unlikely to relate fully to an intervention that is not specifically based on their own experiences (Cuthbert, Vrana, & Bradley, 1991; Lang, 1985). During this study, the golfers from the PETTLEP and the PETTLEP + physical practice groups engaged in personal instructions, resulting in a significant improvement from pre- to posttest in the groups involving PETTLEP imagery. In the interviews following the pretest, participants indicated the need to personalize imagery instructions, as they reported differing physiological responses when taking the bunker shots. This suggests that psychologists or coaches who use nonpersonalized imagery instructions may not be providing the most effective intervention, and it supports previous research on the use of individualized response propositions (Smith, Holmes, Whitemore, Collins, & Devonport, 2001).

![Figure 2. Mean pre- and posttest scores.](image-url)
The significant improvement in the PETTLEP group appears to support Lang's bioinformational theory (1979), Ahsen's triple code theory (1984), and the findings of Smith and Collins (2004) and Smith et al. (2001), in emphasizing the importance of kinesthetic imagery for optimal performance improvement. In their diaries, the PETTLEP and PETTLEP + physical practice participants reported vividly imagining the physiological sensations associated with performing the bunker shot. Previous studies showing physical practice to be significantly better than imagery paid little attention to kinesthesia, with their main emphasis being the visual aspects of imagery (e.g., Lee & Hewitt, 1987; Tenenbaum et al., 1995). This could indicate why the PETTLEP intervention in this study was as effective as physical practice, a suggestion supported by the Smith et al. (2007) PETTLEP findings. Interestingly, Callow and Waters (2005) found that kinesthetic imagery significantly enhanced the confidence of flat-race jockeys. Perhaps PETTLEP may also be useful in enhancing confidence, which could have a positive impact on performance. Research is needed to specifically examine the effects of PETTLEP on sport self-confidence.

Another possible reason for the success of the PETTLEP is its emphasis on the imagery environment. Golfers in the PETTLEP and PETTLEP + physical practice groups performed imagery in an environment similar to being in a bunker without actually being on the course. Thus, they could perform relevant postural adjustments prior to imaging the shots and receive functionally equivalent kinesthetic sensations. Correct foot positioning is crucial to successful bunker shots (Cochran & Stobbs, 1968); not actually standing in the sand could remove an important feedback source. This may also have aided the Emotion component, as being in a bunker is a high-pressure situation that often leads to emotional responses in golfers (Cochran & Stobbs, 1968). As several PETTLEP participants mentioned, the "sand under the shoes feeling" made them feel as if they were really in a bunker.

In the posttest interviews, the PETTLEP imagery performers reported they felt more confident with the skill. Previous research also found that imagery enhanced confidence in motor performance (Callow, Hardy, & Hall, 2001). This is particularly interesting, in that the imagery was not specifically aimed at enhancing confidence but rather at enhancing performance. However, participants' comments suggest the effect of PETTLEP imagery on self-confidence is another area worth investigating.

A most interesting finding was the impressive improvement of such experienced players. This could be due to the functional equivalence of imagery compared to more traditional interventions. The finding that the PETTLEP + physical practice group was more effective than using either physical practice or PETTLEP imagery alone is surprising. The novelty of the PETTLEP imagery may have provided a welcome variation from physical practice in the participants' training program. Further research is needed to assess this as a potential reason for the effectiveness of PETTLEP imagery.

In conclusion, the results of this study provide clear evidence that PETTLEP-based imagery is an effective way to enhance golf performance. The results indicate the PETTLEP approach has much to offer sport psychologists using imagery interventions. However, further rigorous examination and evaluation of the model is necessary. An important limitation of the present study is that we did not test the extent the improvements in one golf shot transfer to other shots. If imagery only achieves enhanced performance of a single bunker shot, then it is of limited use. While we presume such imagery helps performance generally, we cannot know this for certain. Therefore, a study examining the effect of PETTLEP imagery on various bunker shots of differing lengths and lies would be of great interest. Future research could examine the PETTLEP model across different sports or compare the effects across sexes, age groups, and abilities. Given the importance of imagery as a potential mediating variable in the effectiveness of imagery interventions, the effects of PETTLEP interventions in groups varying in imagery ability would also be very useful to determine if it can benefit those with relatively poor imagery ability. In a similar vein, researchers could examine whether PETTLEP interventions can enhance imagery ability. Finally, research into the effects of different volumes and frequencies of PETTLEP imagery training to establish the amount necessary for optimal results would also be of great use to sport psychology researchers and practitioners.

References


Authors’ Notes

All authors contributed equally to the production of this paper. At the time of this study, the first author was with the University of Chester. Please address all correspondence concerning this paper to Dave Smith, D., Smith, Department for Exercise and Sport, Manchester Metropolitan University, Hassall Road, Alsager, UK ST7 2HL.

E-mail: d.d.smith@mmu.ac.uk