Running Head: IMAGERY AND FUNCTIONAL EQUIVALENCE

Examining the Emotion Aspect of PETTLEP-based Imagery with Penalty Taking in Soccer

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Abstract

The current study investigated the Emotion element of the PETTLEP model of motor imagery using penalty kicks in soccer. Two six-week PETTLEP-based imagery interventions were compared to a stretching group (control). Both imagery interventions (skill-based and emotion-based) were facilitative and differed only in their emotional content. Thirty-three participants' penalty taking performance, self-efficacy and interpretations of anxiety were measured prior to and following the intervention period. Post-intervention performance scores for both imagery groups were significantly greater than the stretching group. However, there were no differences between the two imagery groups. In addition, there were no beneficial effects of either imagery intervention on self-efficacy or interpretations of anxiety symptoms when compared to the stretching intervention. These data offer further support for the effectiveness of the PETTLEP model in designing performance facilitating imagery interventions. We propose that the inclusion of emotional content into imagery practices may be more influential in competitive rather than practice situations.

Introduction

Considerable scientific research has demonstrated imagery to be an influential tool in sport psychology (see Driskell, Copper, & Moran, 1994). However, the imagery literature has been criticised for not providing a detailed mechanism for explaining how performance is modified (Murphy, Nordin, & Cumming, 2008). To this end, recent developments in brain imaging techniques have suggested that representing an action through imagery and actual execution of action access similar neural regions of the brain (Ehrsson, Geyer, & Naito, 2003; Fadiga et al., 1999). This overlap in brain activation has been termed 'functional equivalence' by some researchers (for a review of functional equivalence theory, see Murphy et al., 2008), and is considered one reason why imagery leads to beneficial effects on physical performance. The theory of functional equivalence shares a basic tenet of Lang's bio-informational theory (Lang, 1977, 1979). That is, an emotional image will produce a physiological response analogous to the actual behavior. For example, Hecker and Kaczor, (1988) reported competitively anxious imagined scenes produced elevated heart rates in a sample of athletes. Importantly, it has been proposed that imagery's effectiveness depends on how well these co-active neural regions are activated through imagery (Holmes & Collins, 2002).

Supporting this notion of functional equivalence, recent empirical studies have highlighted the potential for more compelling findings when functionally equivalent imageries are compared to imagery that is less equivalent with physical performance (Callow, Roberts & Fawkes, 2006; Smith & Collins, 2004; Smith, Holmes, Whitemore, Collins & Devonport, 2001; Smith & Holmes, 2004; Smith, Wright, Allsopp & Westhead, 2007). For example, Smith and Holmes (2004) explored the effects of differing imagery modalities on golf putting performance. In their study, individuals either performed imagery after reading a script or whilst listening to an audio or video recording (internal perspective) of them performing a golf putt. They found that modalities producing greater equivalence with actual performance (i.e., personalised audio or video footage) were more effective at improving performance than less equivalent imagery practice (i.e., written scripts). Evidence from these studies consistently suggests that performance facilitation is more pronounced following imagery practice that is more functionally equivalent to performance.

In applying functional equivalence to the field of sport psychology, Holmes and Collins (2001) developed the PETTLEP model of motor imagery. The PETTLEP model is a framework used to heighten the functional equivalence between imagery and physical performance of a motor task. The model proposes seven elements that when manipulated can increase functional equivalence (those being **P**hysical, **E**nvironment, **T**ask, **T**iming, **L**earning, **E**motion, and **P**erspective). The **P**hysical element is the degree to which the physical nature of imagery reflects that of actual performance. For example, when mentally practicing a soccer skill one should assume a characteristic posture, wear typical sportswear, and image the physical responses that would occur in real performance of the skill. The **E**nvironment element refers to the physical environment that the imagery is performed in being similar (if not identical) to the actual performance environment. For example, imagery of soccer skills should ideally be performed on a soccer pitch. The **T**ask element refers to the imaged task corresponding as closely as possible to the actual task. That is, the specific content of imagery performed should specifically mimic actual performance. The **T**iming element refers to the imagined performances taking place at the same pace as actual performance (i.e., real time). The **L**earning element suggests individual’s imagery should match their current stage of learning and adapt as skill level develops. The **E**motion element suggests that imagery should incorporate all emotions and arousal typically experienced during actual performance. The last element, **P**erspective, suggests that imagery should be performed from a visual perspective that most closely reflects the view taken by the athlete when actually performing the task (i.e., internal or external). Individuals may find it necessary to switch between perspectives depending on the demand of the task being imaged.

In a test of the PETTLEP model, Smith et al., (2007) implemented two separate six-week imagery interventions with hockey players and gymnasts respectively. In Experiment 1 (hockey penalty flicks), the Physical and Environment components of the PETTLEP model were manipulated. Three intervention groups performed imagery of 10 penalty flicks daily for six weeks while; a) wearing hockey clothes whilst stood on a hockey pitch (i.e., physical + environment), b) wearing hockey clothes whilst stood at home (i.e., physical only), or c) wearing normal clothes whilst sat down at home (i.e., no PETTLEP elements). The control group read hockey literature instead of performing any imagery. The results demonstrated that more functionally equivalent imagery (i.e., wearing hockey clothes whilst stood on a hockey pitch) produced a greater impact on performance in the post-test.

In a second experiment (using a Full Turning Straight jump on a gymnastics beam), Smith et al. (2007) compared two imagery conditions to physical practice and a control group (who performed a stretching routine). The two imagery groups either performed; a) PETTLEP imagery consisting of all seven elements of the model, or b) stimulus imagery using a written script. The stimulus imagery script only included descriptive information about the environment and task (i.e., stimulus propositions). Each condition performed their task three times per week for six weeks. The results demonstrated that the physical practice group and the PETTLEP imagery group performed better than the other two groups in the post-test. Additionally, there were no differences between the physical practice group and PETTLEP imagery group. Thus, these performance findings are very encouraging for the effectiveness of PETTLEP-based imagery to facilitate motor performance.

Altogether, the experimental studies highlighted above have supplied evidence to suggest that increasing imagery’s functional equivalence with actual performance is an effective way to enhance motor performance. In particular, empirical evidence demonstrates that manipulating the ‘Physical’ and ‘Environment’ (Smith & Collins, 2004; Smith et al., 2001; Smith et al., 2007) elements of the PETTLEP model as well as combining all seven elements (Smith et al., 2007) can be beneficial to performance. This initial research testing the PETTLEP model is promising but as suggested by Holmes and Collins (2001), further testing in a range of settings is required. Moreover, it would also be useful to test each element in isolation as well as examining the additive and interactive effects of the different elements. For example, there is no specific evidence thus far to support the inclusion of the ‘Emotion’ element in the model.

There are grounds to assert that imagery should include the Emotion element of the PETTLEP model, which can be traced to Lang’s bio-informational theory (Lang, 1977, 1979). Lang’s theory posits that every image includes stimulus (i.e., information concerning the stimuli in the environment) and response propositions (i.e., the cognitive, behavioural, and affective responses of an individual to given stimulus in an environment). Thus, emotional responses to a sporting scenario (the ‘Emotion’ element of the PETTLEP model) constitute a fundamental aspect of response propositions. Importantly, it has been demonstrated that imagery including response propositions can induce physiological responses similar to which actually occur in reality (Cumming, Olphin, & Law, 2007; Gallego, Denot-Ledunois, Vardon, & Perruchet, 1996; Hecker and Kaczor, 1988; Pietrini, Gauzelli, Basso, Jaffe, and Grafman, 2000). Furthermore, this inclusion of response propositions can result in a beneficial effect on subsequent behaviour (Smith & Collins, 2004). Finally, previous research has demonstrated that imagery has the potential to foster facilitative interpretations of the symptoms associated with anxiety symptoms (e.g., Hale & Whitehouse, 1998; Hanton & Jones, 1999; Hanton, Mellalieu & Hall, 2004) and improve self-efficacy (e.g., Feltz & Riessinger, 1990). These are two psychological characteristics that are viewed as important predictors of successful sporting performance (Williams & Krane, 2001).

Consequently, there is a theoretical and empirical base for why imagery should include the equivalent emotions experienced during actual motor performance. However, the 'Emotion' element of the model has not yet been empirically tested in isolation. Thus, pragmatic evidence delineating the impact of imagery practice that includes emotions functionally equivalent with actual performance is still needed. Importantly, such research should include measures beyond that of performance alone in order to gain greater insight into the PETTLEP model.

The aim of the current study was to compare the impact of two imagery interventions that differed only in their emotional equivalence to actual performance. To do so, self-efficacy and interpretations of anxiety were measured prior to the performance of a penalty taking task in soccer (i.e., kicks from the penalty mark). The two imagery interventions (skill-based vs. emotion-based) differed only in their emotional equivalence to performance. The skill-based imagery group received a facilitative script containing stimulus propositions about performance (i.e., descriptive information about the environment and task). The emotion-based imagery group received a similar facilitative script that also contained a detailed description of the appropriate emotions experienced during performance of the task. Following the intervention we predicted that both imagery groups would display superior penalty taking performance, higher levels of self-efficacy and more facilitative interpretations of the symptoms associated with anxiety compared to the stretching group (control). In addition, we predicted that emotion-based imagery would demonstrate greater improvements on the same measures compared to the skill-based imagery group. Lastly, the control group's performance, self-efficacy and anxiety were expected to remain constant following the intervention.

Method

Participants

Participants (N = 52) were all members of a Men's (n = 22) and Women's (n = 30) University Soccer Club with a mean age of 19.87 (SD = 1.36). The mean playing experience of the participants was 9.19 years (SD = 4.03).

Equipment

During performance tests, standard size 5 soccer balls were used and penalties were taken 12 yards from the centre of the goal line towards a rectangular goal with standard English Football Association dimensions (7.32 m x 2.44 m). A Sony DVD Handycam was used to record task performance.

Measures

Screening. The Movement Imagery Questionnaire, Revised (MIQ-R; Hall & Martin, 1997) was employed to assess the general level of imagery ability amongst the participants. The MIQ-R is an 8-item questionnaire asking participants to first physically perform, and then visually or kinesthetically image four simple movements. Following imagery performance, participants rate their ability to visually or kinesthetically image the movement on a 7-point Likert scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). The items were then averaged to form visual and kinesthetic subscales. Both subscales had acceptable levels of internal reliability with Cronbach alpha coefficients being .87 for visual imagery and .79 for kinesthetic imagery. Consistent with previous research, a minimum score of 16 on both subscales was required to take part in the experiment and nobody was excluded on this basis (Ramsey, Cumming, & Edwards, 2008).

Performance. The goal was divided into 13 sections and a rating system employed based on where the ball ended in a similar fashion to Smith et al. (2007). Points ranged in value from 0 to 5 for each attempt, with more points being rewarded for shots that were closer to the corner of the goal (see Figure 1 for details). This scoring system was explained to all participants prior to the pre-test with a standardised set of instructions.

Self-efficacy. Self-efficacy was assessed using a measure created for the purpose of this study based on Bandura's (1997) recommendations. That is, both the level and strength of belief were assessed. Ten items were used starting with "I believe I can score 5 points on 1 out of 10 attempts". This became incrementally harder with each statement (i.e., "I can score 5 points on 2 out of 10 attempts", "3 out of 10 attempts", …. "on all 10 attempts"). Participants indicated the strength of their belief in each statement in percentage ranging from 0% "*I am very sure I cannot do this*", to 50% "*I am unsure - it could go either way*", and 100% "*I am very sure I can do this*". Scores were averaged across the 10 items to create a measure of self-efficacy.

Anxiety. The intensity of symptoms associated with pre-competitive anxiety was assessed immediately prior to performance using the cognitive and somatic items of the Immediate Anxiety Measurement Scale (IAMS; Thomas, Hanton, & Jones, 2002). As we used a separate scale to measure self-efficacy, it was not necessary to also include the self-confidence items. For both cognitive and somatic anxiety, participants rated the intensity of their feelings on a 7 point Likert scale ranging from 1 (*not at all)* to 7 (*Extremely)*. In addition, participants rated how they regarded these feelings in terms of upcoming performance for both these dimensions of anxiety. This directional measure of anxiety ranged from -3 (*very debilitative/negative*) to +3 (*very facilitative/positive*). Comprehensive instructions were supplied to each participant and all terms were defined clearly prior to use. The IAMS has provided positive correlations with analogous scales on the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1990), which suggests that the IAMS accurately reports symptoms of anxiety.

Weekly diary & evaluation. Participants completed a diary each week, following one testing session, which detailed the number and location of intervention sessions performed. Irrespective of their group allocation, each participant recorded the total number of sessions they performed and the location that each session took place (e.g., on the pitch or at home). Additionally, the imagery performed each week by both imagery groups was assessed. Participants were asked to rate how easy or difficult it was to visually and kinesthetically image the penalty taking task (1 = *very hard to see/feel*, 7 = *very easy to see/feel*). They were also asked to rate the clarity and vividness of their imagery (1 = *extremely unclear*, 7 = *extremely vivid*).

Post- intervention evaluation. Imagery use was also assessed following the intervention. On a 7 point Likert scale (1 = *not at all*, 7 = *very much so*), participants were asked to rate how helpful their intervention was at helping them to view their symptoms associated with anxiety in a more positive manner and at improving their self-efficacy for penalty taking. Additionally, using the same scale, participants rated how useful the intervention was for improving actual penalty taking performance. All participants, including the stretching group, were asked to comment how often they physically practiced taking penalties throughout the six-week period of the study and how many penalties they took in real matches. Also, all participants reported whether they had employed additional psychological strategies during the penalty taking task other than the assigned imagery intervention.

Procedure

Introduction. Ethical approval for the study was gained from the authors' institution before the project commenced. Then, during an initial meeting with the players, the study was explained and information sheets were distributed before consent was obtained. The

Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) was administered and completed by all participants.

Pre-test. All participants took 10 penalties from the standard distance (12 yards) in the presence of one goalkeeper who was positioned on the centre of the goal line. For both men and women, the goalkeeper was a member of their respective university soccer clubs. Performance was digitally recorded using a Sony Handycam DVD camcorder. Immediately before taking their set of penalties, each participant rated their self-efficacy and pre-competitive anxiety for the upcoming task. A £25 cash prize was given for the highest scoring individual performance for both men and women. Although match-like conditions could never be recreated exactly during practice, the cash prize was intended to establish a competitive atmosphere among the players.

Intervention. A number of participants (n = 19) withdrew during the intervention or did not complete both testing sessions for reasons uncontrollable to the investigators, and these participants were removed from the analyses. Participants who completed the intervention and both testing sessions had been randomly assigned to one of three intervention groups: a) skill-based (n = 9; 4 male), b) emotion-based (n = 13; 6 male), or c) stretching (n = 11; 3 male). For both imagery groups, each imagery session consisted of either hearing their imagery script (read by a member of the investigative team) or reading the script themselves, and then mentally taking 10 successful penalties into a corner of the net. This was done in a similar fashion to Smith et al. (2007), and lasted approximately 5 minutes. Both imagery scripts (available from the lead author) similarly described successful completion of the penalty taking scenario, and were devised in consultation with three soccer players not involved in the study. They were asked to describe a typical penalty taking scenario and, in doing so, provided the stimulus (i.e., information about stimuli in a typical penalty taking scenario) and response propositions (i.e., their cognitive, behavioural, and affective responses in a typical penalty taking scenario).

Subsequently, the skill-based imagery script only included stimulus propositions. For example, "…you take the ball and walk towards the penalty spot….as you are walking you look straight at the goal as the goalkeeper makes his/her preparations for the upcoming penalty….you now decide on which corner of the goal you are going to aim for….you see the goalkeeper looking straight back at you....you just concentrate on the corner of the goal you have decided to aim for." In contrast, the emotion-based imagery script included both stimulus and response propositions. Importantly, the response propositions included were largely, but not exclusively, based on the emotions felt during penalty taking. For example, "as you take the ball and walk towards the penalty spot you feel nervous tension build in your leg muscles and butterflies appear in your stomach….these feelings remind you of previous successful penalties….feeling confident you look straight at the goal as the goalkeeper makes his/her preparations….you concentrate on the corner of the goal you are aiming for….you think about scoring into that corner as you have done many times before." The inclusion of response propositions in this latter script prompted the simulation of physical and, particularly, the emotional responses felt during penalty taking performance. The stretching group were given a series of stretches aimed at improving flexibility that could be carried out in approximately the same amount of time as the imagery interventions.

All participants were instructed to perform their task four times each week for six weeks. Participants were normally scheduled for two training sessions per week, and these sessions were attended by the investigative team. Therefore, a proportion of the four weekly sessions took place in the presence of an investigator at a training session. In these sessions, participants wore normal training kit and stood facing the goal just beyond the penalty spot thus simulating common penalty taking preparatory procedure. The experimenter then read the script aloud to the players, and subsequently, each player imaged 10 successful penalties. Further sessions were performed by the participant independent of an experimenter (i.e., in their own time). In these independent sessions, instructions for the imagery groups were to personally read their script and then image 10 successful penalties. To accomplish this, all imagery group participants were given a copy of their script each week. During the independent sessions, the stretching group simply had to follow their routine as before. They were also given a copy of their stretching routine each week. All participants were given weekly diaries to record the sessions they performed during each week. In addition, at the end of each week, participants in both imagery groups also completed a weekly evaluation form which assessed the imagery they performed that week.

Post-test. Participants repeated the pre-test procedures for a second time and completed a post-intervention evaluation.

Results

Preliminary Analyses

A number of preliminary analyses were performed to distinguish if any factors, other than the imagery intervention, had influenced one of the three dependent measures (i.e., performance, self-efficacy and the intensity and direction of state anxiety symptoms). Six separate one-way ANOVAs determined that previous soccer-playing experience (in years) did not influence any of the dependent measures at pre-test. Additionally, six further one-way ANOVAs found no gender differences existed in performance or state anxiety, but differences were found in pre-test self-efficacy levels, $F(1, 30) = 16.18$, $p < 0.001$, $\eta^2 = .35$. Specifically, males (M = 602.69, SD = 138.28) reported greater levels of self-efficacy compared to females (M = 309.11, SD = 153.36). Therefore, gender was included as a covariate in the main analysis of self-efficacy only. A MANOVA also revealed no significant differences in general imagery ability between the two imagery groups on both visual (skill-based *M* = 4.92 *SD* =

1.55, emotion-based *M* = 5.42 *SD* = 0.87) and kinesthetic (skill-based *M* = 4.78 *SD* = 1.30, emotion-based *M* = 5.23 *SD* = 0.64) subscales of the MIQ-R.

Weekly diary & evaluation. In terms of the total intervention sessions completed the skill-based (71%), emotion-based (79%), and stretching (66%) groups adhered to the intervention in similar amounts. A one-way ANOVA found no significant differences in the total sessions performed between the three groups. In addition, all three groups performed a similar proportion of sessions on the pitch wearing their training kit (skill-based = 50%, emotion-based = 49%, stretching = 46%). Similarly, a one-way ANOVA demonstrated no significant differences between the three groups in terms of the sessions performed on the pitch wearing training kit. A MANOVA was performed on the weekly imagery evaluation data (mean average across six weeks) and demonstrated that both imagery groups were able to image their respective scripts in a similar fashion. Means and standard deviations are presented in Table 1a. Specifically, there were no significant differences between the two imagery groups in terms of how well they could see or feel themselves performing the task during imagery. Additionally, there were no differences between the two imagery groups in terms of the vividness of their imagery.

Post-intervention evaluation. A MANOVA further assessed participants' perceptions of imagery use during the intervention. Means and standard deviations are presented in Table 1b. There were no significant differences between the two imagery groups in terms of the perceived benefit to performance of the intervention. However, compared to the skill-based group, the emotion-based group did rate their imagery to be more effective at increasing penalty taking self-efficacy, $F(1, 19) = 5.52$, $p = 0.03$, $\eta^2 = .23$, and more helpful at interpreting anxiety symptoms in a more positive manner, $F(1, 19) = 5.48$, $p = 0.03$, $\eta^2 = .22$.

Throughout the intervention, a total of six participants (skill-based = 1, emotion-based = 4, stretching = 1) reported taking a penalty during a real match. In addition, twelve participants reported physically practicing penalties over the intervention period. Specifically, five participants (skill-based = 3, emotion-based = 2) reported physically practicing once, six participants (skill-based = 1, emotion-based = 3, stretching = 2) reported physically practicing twice and one participant (emotion-based) reported practicing six times. For both the number of penalties taken in real matches and the number of times penalties were physically practiced, Chi-Square analysis demonstrated that there were no group differences. Four participants reported using a psychological strategy in addition to the one given to them during the penalty taking task. One participant reported using self-talk and three reported setting goals. Again, Chi-square analysis determined the use of such strategies did not differ between the experimental groups.

Main Analyses

The main analyses determined whether any differences existed in the three dependent measures (i.e., performance, self-efficacy and intensity and direction of symptoms associated with anxiety) between the three experimental groups. A 3 (experimental group) x 2 (time; pre-test and post-test) mixed-design ANOVA revealed whether the groups differed in performance scores and self-efficacy ratings following the imagery intervention. For these analyses, the experimental group served as the between-groups independent variable and time as the within-groups independent variable. When analysing self-efficacy, gender was included as a covariate. A 3 (experimental group) x 2 (time; pre-test and post-test) mixed design MANOVA explored group differences in the intensity and direction of state anxiety following the intervention.

Performance. There was a significant main effect for time, $F(1, 30) = 5.26$, $p = .029$, $\eta^2 = .15$, with mean scores being greater following the intervention. There was no main effect for group, but there was a significant interaction between time and group, $F(2, 30) = 5.02$, $p = .013$, $\eta^2 = .25$. Tukey post-hoc analysis demonstrated that there were no group differences at pre-test (p >.05) but both imagery groups scored significantly more points compared to the stretching group at post-test (p <.05). Within-group comparison of means using paired samples t-tests (separate analyses for each condition), revealed improvements from pre-test to post-test for both the skill-based, $t(12) = 2.34$, $p = .038$ and emotion-based groups, $t(8) = 2.50$, $p = .037$. This result did not reach significance, however, when a bonferroni correction was applied to the alpha level ($p < .017$). Similar t-tests for the control group revealed no significant differences.

Self-efficacy. There was a significant main effect for time, $F(1, 27) = 9.59$, $p = .005$, $\eta^2 = .26$, with mean scores being greater following the intervention. However, there was no significant main effect for group and no significant interaction between time and group.

Anxiety. There was a significant main effect for time, $F(1, 30) = 3.57$, $p = .018$, $\eta^2 = .37$. Inspection of the univariate analyses demonstrated the intensity of cognitive anxiety to be significantly lower, $F(1, 30) = 5.62$, $p = .024$, $\eta^2 = .16$, and the direction of cognitive anxiety to be significantly higher, $F(1, 30) = 9.09$, $p = .005$, $\eta^2 = .23$, following the intervention. However, there was no significant main effect for group and no significant interaction between time and group.

Discussion

The current study examined the Emotion element of the PETTLEP model using penalty kicks in soccer. The impact of two six-week PETTLEP-based imagery interventions, which differed in their emotional content, were compared to a control group that performed a stretching routine for the same time period. Consistent with predictions, penalty-taking performance was significantly greater following both imagery interventions in comparison to the stretching group (control). In addition, the stretching group's performance did not alter following the intervention. Thus, those who engaged in imagery practice over the six weeks exhibited distinctly superior performance to those who did not.

It should be highlighted that performance did not significantly improve per se, since no within-group effect was observed for either imagery intervention. That is, the number of points scored did not significantly improve from pre-test to post-test. There was a clear trend, however, for both imagery groups to perform better during the post-test compared to pre-test. But this difference marginally missed significance due to a corrected alpha level. Consequently, this trend might also be explained as Type I error. Nevertheless, the data does provide further empirical support for the PETTLEP model as an effective tool for designing performance facilitating imagery interventions (Smith et al., 2007). Simply put, there was a clear performance advantage for those participating in PETTLEP-based imagery practices compared to the stretching group at post-test.

In a previous test of the PETTLEP model, Smith et al. (2007) reported two experiments and found within-group performance effects following PETTLEP-based imagery, which suggests both their interventions were more effective than the one described in the current study. In their first experiment, using hockey penalty flicks, daily imagery sessions were performed whereas in the current study only four weekly-sessions were performed by participants over an equivalent time period. However, a dose-response explanation for the disparity of results is not likely given that participants in the gymnastics experiment (Smith et al.; Experiment 2) only carried out three weekly-sessions and the within-group effects were not jeopardised. A more pertinent account may concern which elements of the PETTLEP model were included in the imagery sessions performed. The current intervention delivery was designed in accordance with the regular training schedule of the soccer teams involved, which permitted only two weekly-sessions to be completed on a soccer pitch standing by the penalty spot. Consequently, only 50% of the imagery sessions satisfied the Physical and Environment elements of the PETTLEP model. This is in contrast to Smith et al., where all imagery sessions performed, in both experiments, satisfied these two elements.

Taken together, these findings add empirical support for the inclusion of the Physical and Environment components of the PETTLEP model within performance-facilitating imagery interventions. Moreover, if these elements are omitted from some imagery sessions, performance facilitation might be compromised to some extent. Albeit a limitation of the study that all imagery sessions did not satisfy the same elements, the intervention is an ecologically valid one. That is, it is fairly realistic for athletes to have limited access to their training facilities and would likely use imagery at home or in other locations (Munroe, Giacobbi, Hall, & Weinberg, 2000; White & Hardy, 1998). Indeed, imagery has previously been advocated as a useful supplement to regular physical practice that can be carried out at any time and in any place (Hall, 2001; Nordin & Cumming, 2005). The evidence from the current study would suggest that, when implementing PETTLEP-based imagery practices, a proportion of the imagery sessions can be performed away from the training venue in normal clothes without adversely affecting the subsequent benefit to performance. This latter interpretation could prove particularly informative for coaches and athletes that train a limited number of times per-week but are keen to use imagery for performance enhancement.

Contrary to our hypotheses, neither imagery intervention led to significant improvements in self-efficacy or the interpretation of symptoms associated with state anxiety. This finding is counter to some previous imagery literature demonstrating beneficial effects of imagery for increasing levels of self-efficacy and facilitating interpretations of the symptoms associated with competitive anxiety (Cumming et al., 2007; Feltz & Riessinger, 1990; Hale & Whitehouse, 1998; Hanton & Jones, 1999; Hanton et al., 2004). It is well established, however, that past performance accomplishments are the most important source, and in turn, the best predictor of self-efficacy levels (Bandura, 1977; 1997). With this in mind, the pre-test performance of 10 penalties may have superseded the additional mental practice performed by the two imagery groups to produce equivocal levels of self-efficacy at post-test. Furthermore, elevated self-efficacy levels, across all three experimental groups, may have enabled all participants to perceive their anxiety symptoms in a positive manner thus overriding any potentially negative interpretations from not using imagery (Hanton et al., 2004; Neil, Mellalieu, & Hanton, 2006).

The post-intervention imagery evaluation did provide some findings of note. The emotion-based group perceived their imagery intervention to be significantly more effective at increasing penalty-taking self-efficacy and more helpful at interpreting anxiety symptoms in a more positive manner. Therefore, individuals who received emotion-based imagery perceived their imagery to be more effective at influencing self-efficacy and anxiety compared to skill-based imagery despite there being no measurable benefit to these variables immediately prior to post-test performance. The nature of the self-efficacy assessment might be responsible for this finding because it only measured participants' efficacy levels at scoring in the corners of the goal. Soccer players do not always aim for the corners of the goal when taking penalties. Rather, players often aim straight down the middle of the goal or first deceive the goalkeeper and then place their penalty in the opposite side of the goal. However, this argument does not seem likely since participants were clearly and explicitly instructed during both test phases that the aim was to score in the corners of the goal and thus achieve the greatest points (this scoring system replicated Smith et al., 2007; Experiment 1). In addition, both imagery interventions described scoring successfully into the corner of the goal.

A more plausible explanation is that the self-efficacy measure did not address other factors related to feeling confident when taking a penalty, such as being confident at remaining calm, keeping focused and making clean contact with the ball. The focus here was assessing the participants' beliefs in their ability to achieve a certain score. Subsequently, differences between the groups in the extent to which they perceived their imagery intervention to be confidence-producing (as measured in the post-intervention evaluation) may reflect increased confidence at a more global level than the one measured in the current study (Vealey & Greenleaf, 1998).

No differences were observed between the two imagery groups across the three dependent measures, contrary to predictions. In terms of performance, the current finding is divergent with previous experimental evidence that demonstrated greater performance facilitation with more functionally equivalent imageries when compared to less equivalent imageries (Callow et al., 2006; Smith & Collins, 2004; Smith et al., 2001; Smith & Holmes, 2004; Smith et al., 2007). There may be good reason for this lack of disparity in the current study between the two imagery groups. Primarily, even though a cash reward was available, the testing environment was that of a typical practice session rather than real competition and these contexts typically differ on a number of parameters (Martin, 2003). It is likely that the importance associated with the penalties taken would be lower in the current study than in real competition where penalties are crucial for the outcome of the match or even the whole tournament. Subsequently, the emotions felt during both testing sessions may have reflected this practice environment (i.e., remained moderate). Support for this point is offered as individuals generally reported neutral directional anxiety interpretations at pre-test and post-test. Therefore, we suggest that the emotion-based imagery group received no greater benefit compared to the skill-based group as the proposed superior functional equivalence of this imagery intervention was founded in the emotions felt during competitive penalty-taking performance. Importantly, these emotions may have been absent during the testing environment, which reflected practice more than competition.

Due to the infrequent occurrence of penalties in real soccer matches we felt it was only viable for testing to take place during practice sessions in the current study. In support of this, only 6 participants took a penalty in a competitive match over the intervention period (see Results). We suggest future research that clarifies practice and competition differences would be a significant step forward for the development of PETTLEP-based imagery. The difficulty simulating real-life sporting situations, such as penalty-taking in soccer, is a major obstacle in the way of this proposed advancement. A more meaningful contribution to the literature may be to test the PETTLEP model using a task that can be suitably measured in both practice and competition settings as the effects could potentially be disparate. Skills that occur more frequently in soccer, such as heading and passing, would be good starting points.

There are some limitations with the current study that are worth noting. Ideally, the sample size would have been maintained somewhere closer to the original sample. However, due to injury, poor weather or post-test absence, a large drop off in the sample size occurred reducing the strength of the statistical tests used. Although a six-week intervention was sufficient to show an effect of imagery compared to control, a longer intervention may have been able to distinguish between the two imagery conditions. Furthermore, although participants had the opportunity each week to provide feedback on the imagery intervention, the imagery scripts were not individualised to each participant. Consequently, the script may have had different meanings to different individuals and thus its effectiveness may have been reduced (Callow & Hardy, 2005; Cumming & Ramsey, 2008). To circumvent this issue, it may be fruitful for future PETTLEP-based imagery research to employ single subject design methodologies to personalise imagery scripts. In doing so, this would complement the growing group-based experimental evidence in the literature.

In conclusion, the current study affirms the viability of using PETTLEP-based imagery interventions for performance enhancement in sport. Furthermore, empirical evidence points towards the Physical and Environment elements to be key factors within this framework. Contrary to predictions, there were no added benefits to performance, self-efficacy or anxiety of including the equivalent emotions that would be experienced during a competitive scenario. We argue that this may reflect upon these emotions not being experienced in experimentally-based environments as these resemble practice rather than competition. Subsequently, a tentative proposal is made that the inclusion of functionally equivalent emotions may have a more profound influence during competition than practice. However, this hypothesis needs to be empirically tested.

References

Bandura, A. (1977). Self-efficacy: Toward a unifying mechanism of behavioral change. *Psychological Review*, 84, 191-215.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Callow, N., & Hardy, L. (2005). A critical analysis of applied imagery research. In D. Hackfort, J. L. Duda, & R. Lidor (Eds.), *Handbook of research in applied sport and exercise psychology: International perspectives* (pp. 21-42). Morgantown, WV: FIT

Callow, N., Roberts, R., & Fawkes, J. Z. (2006). Effects of Dynamic and Static Imagery on Vividness of Imagery, Skiing Performance, and Confidence. *Journal of Imagery Research in Sport and Physical Activity, 1,* 1-13.

Cumming, J., Olphin, T., & Law, M. (2007). Physiological and self-reported responses to different motivational general imagery scripts. *Journal of Sport & Exercise Psychology, 29*, 629-644.

Cumming, J., & Ramsey, R. (2008). Imagery Interventions in Sport. In S. Mellalieu & S. Hanton (Eds.) *Literature Reviews in Applied Sport Psychology*. London: Routledge.

Driskell, J. E., Copper, C., & Moran, A. (1994). Does mental practice improve performance? *Journal of Applied Psychology, 79*, 481-492.

Ehrsson, H. H., Geyer, S., & Naito, E. (2003). Imagery of voluntary movement of fingers, toes, and tongue activates corresponding body-part-specific motor representations. *Journal of Neurophysiology, 90,* 3304-3316.

Fadiga, L., Buccino, G., Craighero, L., Fogassi, L., Gallese, V., & Pavesi, G. (1999). Corticospinal excitability is specifically modulated by motor imagery: a magnetic stimulation study. *Neuropsychologia, 37,* 147-158.

Feltz, D. L., & Reissinger, C. A. (1990). Effects of *in vivo* emotive imagery and performance feedback on self-efficacy and muscular endurance. *Journal of Sport and Exercise Psychology*, *12,* 132-143.

Gallego, J., Denot-Ledunois, S., Vardon, G., & Perruchet, P. (1996). Ventilatory responses to imagined exercise. *Psychophysiology, 33,* 711-719.

Hale, B. D., & Whitehouse, A. (1998). The effects of imagery-manipulated appraisal on intensity and direction of competition anxiety. *The Sport Psychologist, 12,* 40-51.

Hall, C. (2001). Imagery in sport and exercise. In R. N. Singer, H. Hausenblas, & C. M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed., pp. 529-549). New York, NY: John Wiley & Sons.

Hall, C. R., & Martin, K. A. (1997). Measuring movement imagery abilities: A revision of the Movement Imagery Questionnaire. *Journal of Mental Imagery, 21,* 143-154.

Hanton, S., & Jones, G. (1999). The acquisition and development of cognitive skills and strategies: I. Making the butterflies fly in formation. *The Sport Psychologist*, *13,* 1-21.

Hanton, S., Mellalieu, S.D., & Hall, R. (2004). Self-confidence and anxiety interpretation: A qualitative investigation. *Psychology of Sport and Exercise, 5,* 477-495.

Hecker, J. E., & Kaczor, L. M. (1988). Application of imagery theory to sport psychology: Some preliminary findings. *Journal of Sport and Exercise Psychology, 10,* 363-373.

Holmes, P., & Collins, D. (2002). Functional equivalence solutions for problems with motor imagery. In I. Cockerill (Ed.), *Solutions in sport psychology* (1st ed., pp. 120-140). London: Thomson.

Holmes, P. S., & Collins, D. J. (2001). The PETTLEP approach to motor imagery: A functional equivalence model for sport psychologists. *Journal of Applied Sport Psychology, 13,* 60-83.

Lang, P. J. (1977). Imagery in therapy: An Information-processing analysis of fear. *Behavior Therapy, 8,* 862-886.

Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology, 16,* 495-512.

Martin, G. L. (2003). *Sport psychology: Practical guidelines from behavior analysis* (2nd ed.). Winnipeg, Manitoba, Canada: Sport Science Press.

Martens R., Burton, D., Vealey, R. S., Bump, L. A., & Smith D. E. (1990). The Competitive State Anxiety Inventory-2 (CSAI-2). In R. Martens, R. S. Vealey, & D. Burton (Eds.), *Competitive anxiety in sport* (pp. 117-190). Champaign, IL: Human Kinetics.

Munroe, K., Giacobbi, P. R., Hall, C., & Weinberg, R. (2000). The four Ws of imagery use: Where, when, why, and what. *The Sport Psychologist, 14*, 119-137.

Murphy, S., Nordin, S. M., & Cumming, J. (2008). Imagery in sport, exercise and dance. In T. Horn (Ed.), *Advances in sport and exercise psychology* (3rd edition, pp. 297-324), Champagne, IL: Human Kinetics.

Neil, R., Mellalieu, S.D., & Hanton, S. (2006). Psychological skills usage and the competitive anxiety response as a function of skill level in rugby union. *Journal of Sports Science and Medicine, 5,* 415-423.

Nordin, S. M. & Cumming, J. (2005). Professional dancers describe their imagery: Where, when, what, why, and how. *The Sport Psychologist*, *19*, 395-416.

Pietrini, P., Guazelli, M., Basso, G., Jaffe, K., & Grafman, J. (2000). Neural correlates of imaginal aggressive behavior assessed by Positron Emission Tomography in healthy subjects. *American Journal of Psychiatry, 157,* 1772-1781.

Ramsey, R., Cumming, J., & Edwards, M. G. (2008). Exploring a modified conceptualisation of imagery direction and golf putting performance. *International Journal of Sport and Exercise Psychology*, *6,* 207-223.

Smith, D., & Collins, D. (2004). Mental practice, motor performance and the late CNV. *Journal of Sport and Exercise Psychology*, *26*, 412-426.

Smith, D., & Holmes, P. (2004). The effect of imagery modality on golf putting performance. *Journal of Sport and Exercise Psychology*, *26*, 385-395.

Smith, D., Holmes, P., Whitemore, L., Collins, D., & Devonport, T. (2001). The effect of theoretically-based imagery scripts on hockey penalty flick performance. *Journal of Sport Behavior*, *24*, 408-419.

Smith, D., Wright, C., Allsopp, A., & Westhead, H., (2007). It's All in the Mind: PETTLEP-based Imagery and Sports Performance. *Journal of Applied Sport Psychology*, *19*, 80-92.

Thomas, O., Hanton, S., & Jones, G. (2002). An alternative approach to short-form self-report assessment of competitive anxiety: A research note. *International Journal of Sport Psychology*, *33*, 325-336.

Vealey, R.S. & Greenleaf, C.A. (1998). Seeing is believing: Understanding and using imagery in sport. In J. M. Williams (Ed.), *Applied sport psychology: Personal growth to peak performance* (3rd ed., pp. 237-269). Mountain View, CA: Mayfield.

White, A. & Hardy, L. (1998). An in-depth analysis of the uses of imagery by high-level slalom canoeists and artistic gymnasts. *The Sport Psychologist*, *12*, 387-403.

Williams, J. M., & Krane, V. (2001). Psychological characteristics of peak performance. In J. M. Williams (Ed). *Applied Sport Psychology: Personal Growth to Peak Performance* (4th Ed) (pp 162-178). Mayfield.

Table 1

Weekly and Post-Intervention Imagery Evaluation

a) Weekly Evaluation (averaged across six weeks)	Skill-based		Emotion-based	
	M	*SD*	*M*	*SD*
Specific visual imagery ability (1 = *very hard to see*, 7 = *very easy to see*)	4.57	1.17	5.01	1.08
Specific kinesthetic imagery ability (1 = *very hard to feel*, 7 = *very easy to feel*)	3.91	1.10	4.24	0.87
Specific vividness (1 = *extremely unclear*, 7 = *extremely vivid*)	4.48	0.82	4.79	0.79
b) Post-Intervention Imagery Evaluation				
How useful was this intervention….				
…in helping you interpret your anxiety symptoms in a more positive manner when taking penalties? (1 = *not at all*, 7 = *very much so*)	4.11	1.36	5.25*	0.87
…for improving self-efficacy when taking penalties? (1 = *not at all*, 7 = *very much so*)	4.89	0.93	5.75*	0.75
…for improving your penalty taking performance? (1 = *not at all*, 7 = *very much so*)	5.22	1.30	4.92	1.16

Note. * = a between-group significant difference ($p < .05$)

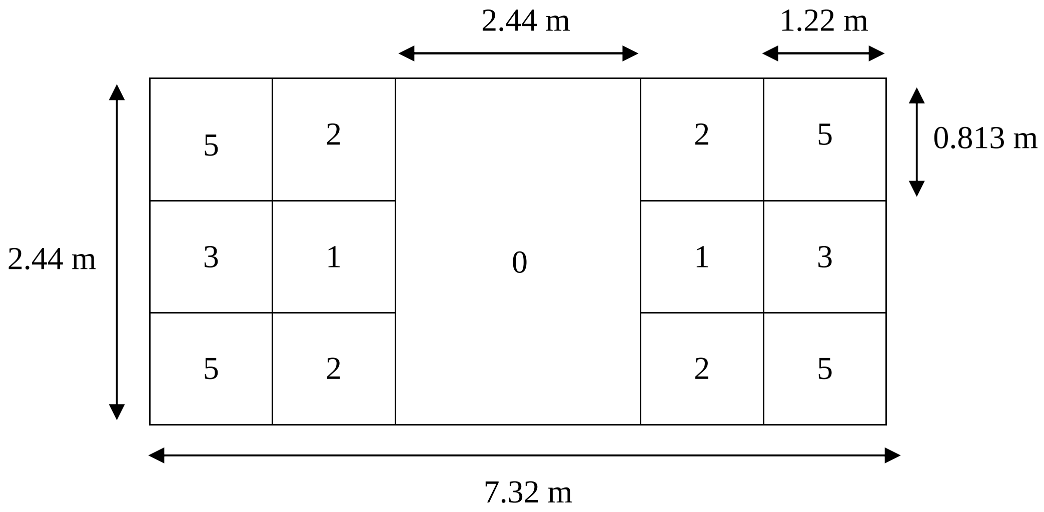
Table 2

Pre-test and Post-test Dependent Variables According to Group

Dependent Variables			Skill based	Emotion based	Stretching
Performance	Pre-test	*M*	15.11	16.15	16.91
		SD	6.13	6.83	5.86
	Post-test	*M*	22.00*	23.08*	13.64
		SD	9.27	10.13	3.50
Self-Efficacy	Pre-test	*M*	462.11	501.75	444.80
		SD	217.26	148.83	196.88
	Post-test	*M*	573.22	621.08	519.10
		SD	211.80	141.63	139.32
Cognitive Intensity	Pre-test	*M*	4.00	3.77	4.27
		SD	1.50	1.48	1.49
	Post-test	*M*	3.78	2.77	3.64
		SD	1.20	1.01	1.12
Cognitive Direction	Pre-test	*M*	- 1.00	.31	- 1.09
		SD	2.06	1.60	1.58
	Post-test	*M*	- .11	1.00	- .45
		SD	1.36	.91	1.57
Somatic Intensity	Pre-test	*M*	3.56	2.77	3.55
		SD	1.88	1.24	1.21
	Post-test	*M*	3.44	2.92	3.55
		SD	2.00	1.04	1.51
Somatic Direction	Pre-test	*M*	-.44	1.00	-1.18
		SD	1.42	1.29	1.25
	Post-test	*M*	-.22	.77	-.45
		SD	1.39	1.36	1.57

*Note.** = significantly greater than the stretching group at post-test ($p < .05$).

Figure 1: A schematic of the scoring system.


2.44 m
1.22 m
0.813 m
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2
2
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7.32 m