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Abstract

This study examined the effect of imagery content and participant skill level on the interpretation (i.e., image meaning) of a negative image (i.e., a golf putt missing the hole), while also investigating the effect of imagery content and skill level on performance, anxiety, and confidence in a golf putting task. Seventy-nine participants (40 novices, 39 expert golfers; *M* age = 19.54 years, *SD* = 1.39) completed a golf putting task in which putting anxiety, confidence, and performance were assessed. Participants were then randomly allocated to one of two imagery scripts; imaging missing the target by 20 cm or imaging missing the target by 40 cm before completing the putting block for a second time. Irrespective of imagery condition, experts perceived the imagery as significantly more unhelpful compared to novices ($p < .01$). At Block 2, the far miss group had significantly higher cognitive ($p < .001$) and somatic ($p = .013$) anxiety intensity than at Block 1 and performed significantly worse ($p = .003$) than the near miss group. However, there were no differences in the perceived helpfulness of the imagery across the imagery groups. Therefore, imagery perception does not always reflect the outcomes experienced. Image meaning is associated with individual characteristics (e.g., skill level).

Keywords: outcome imagery, skill level, revised applied model of deliberate imagery use, golf putting

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Imagery is a psychological technique used by athletes to improve performance (for reviews see Cumming & Williams, 2012; Moran, Campbell, Holmes, & MacIntyre, 2012). One type of imagery known to affect performance is outcome imagery, described as “the imagery of what happens immediately after an action is completed and not the action itself” (Taylor & Shaw, 2002, p. 607). Outcome imagery content can be either positive or negative. For example, sinking a golf putt can improve novices’ performance, whereas imaging missing the hole can reduce novices’ golf putting performance (Short et al., 2002).

However, image content (i.e., positive or negative) does not always reflect the outcomes experienced from using the imagery. A positive image is not always helpful and can have no, or an unhelpful effect on performance (Taylor & Shaw, 2002). Facilitative imagery is defined as, “Imagery designed to have a positive effect on one’s ability to learn and perform, modify important cognitions such as self-efficacy, and regulate arousal and anxiety” (Short et al., 2002, p.49). By comparison, debilitative imagery is, “Imagery designed to impede an individual’s ability” to achieve these same results (Short et al., 2002, p.51). Athletes experience debilitative imagery (Macintyre & Moran, 2007; Van de Braam & Moran, 2011), which has a more powerful and quicker effect on outcomes than facilitative imagery (Nordin & Cumming, 2005). Since imagery is a technique often used in sport and rehabilitation settings to optimize performance and other outcomes such as confidence and anxiety, it is important to fully understand what factors influence the interpretation of an image (i.e., image meaning) and its subsequent impact on cognitive (e.g., confidence), affective (e.g., anxiety), and behavioral (e.g., performance) outcomes.

A lack of clarity in the terminologies used within this area of the literature (i.e., facilitative and debilitative, positive and negative) has made it difficult to compare previous studies. Positive imagery (i.e., positive image content such as serving an ace in tennis) differs from facilitative imagery. For example, a novice player might image themselves serving and just narrowly missing the service box (i.e., a negative outcome), but this content may serve to improve performance capabilities and thus the player experiences an increase in performance (i.e., the image serves as a facilitative image). It is necessary to understand the difference between these terms as positive and negative imagery may not always facilitate and debilitate performance respectively (Beilock et al., 2001; Taylor & Shaw, 2002).

To distinguish between the aforementioned terms, researchers also need to assess the meaning of the image (Cumming & Williams, 2013; Ramsey, Cumming, & Edwards, 2008). Specific imagery content may be interpreted differently and elicit different outcomes (e.g., confidence, anxiety) depending on personal and situational factors such as skill level, age, task efficacy, and previous task experience. Without manipulation checks to consider the imagery meaning, caution must be taken when inferring what consists as, and the effects of, facilitative imagery and debilitative imagery. This oversight also likely explains some of the inconsistencies between previous studies in this area (e.g., Short et al., 2002, Beilock et al., 2001).

Image meaning has become an integral part of imagery research (Cumming & Williams, 2013; Nordin & Cumming, 2005). The concept is rooted in Lang’s (1979) bioinformational theory that highlights meaning propositions, along with stimulus (i.e., situational details) and response propositions (i.e., emotional and physiological responses to the situation), are essential for enhancing imagery effectiveness. Lang proposed that meaning propositions explain the relationship between stimulus and response propositions, and thus influence the perceived importance and effect of the image. However, image interpretation has often been neglected in previous studies (Beilock et al., 2001; Short et al., 2002). Extensive research has demonstrated the benefits of effective imagery, but it is known that many athletes experience unhelpful images under pressure (Van de Braam & Moran, 2011), which can be associated with other detrimental outcomes (e.g., lower confidence; Nordin & Cumming, 2005). Therefore, the rationale behind the current study is to investigate how certain characteristics may impact imagery's meaning and its effectiveness on performance outcomes important for sporting success.

The interpretation of imagery content is also likely to depend on individual characteristics (Cumming & Williams, 2013). In their revised applied model of deliberate imagery use (RAMDIU; Figure 1), Cumming and Williams propose that factors such as age, gender, and personality dispositions (i.e., the "who" component) can affect outcomes resulting from imagery use (e.g., confidence, anxiety, performance) by influencing image meaning. Consequently, these individual characteristics are likely to determine whether an image is facilitative or debilitative on the outcomes being served. For example, a novice golfer imaging narrowly missing a putt may instill feelings of confidence (i.e., facilitative imagery) due to the outcome being outside their current capabilities. Conversely, the same image may lead to feelings of disappointment for an elite golfer (i.e., debilitative imagery). Despite skill level likely influencing the interpretation of different outcome images, this proposition has yet to be sufficiently tested as studies have predominantly included novices (e.g., Nordin & Cumming, 2005) or not verified image meaning (e.g., Ramsey et al., 2008; Short et al., 2002). Athletes of all skill levels use imagery, so if image meaning is associated with skill level, it then follows that image meaning will have important implications for applied practitioners, coaches, and athletes for how imagery should be delivered.

[Figure 1 near here]

According to the RAMDIU, the meaning of an image is also likely to be influenced by the imagery content (i.e., what is imaged; Cumming & Williams, 2013). For example, imaging missing a long putt by a few centimeters might be facilitative but imaging missing by a greater distance might be debilitative. This interpretation is likely to be further influenced by skill level (Cumming & Williams, 2013). It is important to investigate whether imagery content depicting a similar outcome (e.g., missing a target) can be facilitative or debilitative depending on the specific details of the outcome. Together with how this may differ depending on skill level, such information will help researchers better understand the impact of debilitative imagery.

It is important to consider the effectiveness of outcome imagery on other outcomes beyond just performance. Debilitative imagery can reduce things such as self-efficacy and confidence (Nordin & Cumming, 2005; Taylor & Shaw, 2002) whereas facilitative imagery can increase these outcomes (Short et al., 2002). However, similar to performance, findings are inconsistent; for example, self-efficacy and confidence did not improve with facilitative imagery in other studies (e.g., Nordin & Cumming, 2005; Taylor & Shaw, 2002). Interestingly, to our knowledge, no studies have investigated whether imagery perceived as facilitative or debilitative (i.e., image meaning) is associated with affective outcomes such as anxiety. This is particularly surprising given that Short et al.'s (2002) definitions of facilitative and debilitative imagery refer to imagery impacting other outcomes of imagery use.

According to the RAMDIU, it is logical that a similar principle to the image meaning and confidence relationship would apply for anxiety, particularly given the strong association between anxiety and confidence (Hanton, Mellalieu, & Hall, 2004). Williams, Cumming, and Balanos (2010) demonstrated that imagery content perceived as more helpful (i.e., more facilitative image meaning) to a hypothetical competition was associated with more positive anxiety interpretations, whereas imagery perceived as more hurtful was associated with more negative anxiety interpretations. Therefore, it would be worthy to investigate whether outcome imagery can have a facilitative or debilitative effect on anxiety, and examine the association between image meaning and anxiety intensity and interpretation of an actual situation. These findings could have applied implications as it could have a direct impact on how practitioners use imagery work with their clients to regulate anxiety.

Aims and hypotheses

The present study investigated the effects of specific outcome imagery content and skill level on imagery interpretation (i.e., the image meaning), and on golf putting performance, anxiety, and confidence of the putting task. Two outcome images were compared: (a) an image of the ball missing the target by 20 cm (near miss group), and (b) an image of the ball missing the target by 40 cm (far miss group). Expert and novice golfers were compared over both imagery conditions.

Experts and novice athletes likely have different expectations of themselves and performance standards of what is considered acceptable. Therefore, missing a target would likely be deemed as unsuccessful for an expert. However for novice athletes, missing the target by a shorter distance than a typical performance standard (i.e., 20cm) may be considered a successful performance, whereas missing by a further distance than that typically reflected by novices (i.e., 40cm) may be deemed as unsuccessful. Therefore, it was hypothesized that (a) experts would perform better than novices throughout the experiment due to their level of proficiency, and subsequently (b) experts would interpret both images (i.e., near and far miss) as more unhelpful towards performance compared with novices who would interpret the near miss image as more helpful towards performance and the far miss image as more unhelpful. It was further hypothesized that (c) novices in the near miss group would experience reduced anxiety, increased confidence, and facilitated performance compared with baseline, whereas novices in the far miss group and all experts would experience increased anxiety, reduced confidence, and debilitated performance compared with baseline. Finally, (d) image meaning would be associated with Block 2 outcome variables (performance, anxiety, and confidence) and the changes in variable scores between blocks.

Method

Participants

The sample ($N = 79$) consisted of 53 male and 26 female right handed participants ranging in age from 18 to 24 years ($M = 19.54$ years, $SD = 1.39$). Expert golfers ($n = 39$) were defined as participants with a handicap of seven or below, or a professional status (M playing experience = 8.10 years, $SD = 3.24$). Novice golfers ($n = 40$) were defined as participants who had little or no previous golf experience. Expert golfers played golf as their main sport whereas novice golfers represented a variety of sports including football ($n = 14$), rugby ($n = 3$), and athletics ($n = 3$).

Equipment

The equipment consisted of an artificial putting surface made from polypropylene grass (Patiograss), a Golden Bear Claw blade putter (35 in.), and 15 Wilson Ultra golf balls. As illustrated in Figure 2, the putting surface was 5.5 m long and 1.5 m wide and the putting distance was 2.92 m. The target to aim for was an "X" formed using tape that measured 4.5 by 4.5 cm in diameter. A target was chosen instead of a hole to make the task more difficult and ensure that an accurate putt was less likely due to chance. Two additional targets (different colors for clarity) were placed on the surface throughout the experiment to represent the near miss (red) and far miss (blue) putting conditions. The distances representing the near and far miss conditions were pilot tested with experts and novices and subsequently were 20 cm and 40 cm from the target respectively, both behind and to the left of the target (at 140° from the target).

[Figure 2 near here]

Measures

Image meaning. After Block 2 participants were asked to rate whether they perceived the imagery they performed as being helpful or unhelpful towards their performance. Responses ranged from 1 (*entirely unhelpful*) to 7 (*entirely helpful*).

Performance. Putting performance was assessed by measuring the distance (cm) the ball ended up from the center of the target. Distance was measured using a tape measure from the target to the part of the ball closest to the target. Higher scores indicated worse performance. Each block consisted of 15 putts with distances averaged for each block.

State anxiety and self-confidence. Cognitive and somatic anxiety and self-confidence were assessed immediately prior to performance using the Immediate Anxiety Measure Scale (IAMS; Thomas, Hanton, & Jones, 2002). Before completing the questionnaire, participants were provided with definitions of the constructs to ensure understanding. Section one asked participants to rate the extent to which they felt cognitively anxious, somatically anxious and self-confident. Ratings for each construct were made on a 7-point scale from 1 (*not at all*) to 7 (*extremely*). Section two asked participants whether they perceived their cognitive anxiety, somatic anxiety, and self-confidence as positive or negative towards their upcoming performance. Ratings were made on a 7-point scale from -3 (*very debilitative/negative*) to +3 (*very facilitative/positive*). The IAMS has been previously recognized as a valid and reliable measure when assessing state cognitive and somatic anxiety, and self-confidence (Thomas et al., 2002).

Imagery ability. Imagery ability was measured using the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). Imagery ability was measured at the start of the experiment to screen for low levels of imagery ability, which may be a potential confounding variable in later analyses. The SIAQ is a 15 item questionnaire assessing how easily participants can image content reflective of athletes' imagery (i.e., skill, strategy, goal, mastery, and affect images). Participants rated how easy it is to image each item on a 7-point Likert-type scale from 1 (*very hard to image*) to 7 (*very easy to image*). Responses for each subscale were averaged to provide separate scores for each imagery ability subscale. The SIAQ is valid and reliable with good psychometric properties (Williams & Cumming, 2011). Cronbach alpha coefficients were all above .70 in the present study for skill (.85), strategy (.86), goal (.86), mastery (.81), and affect (.80) subscales.

Imagery evaluation form. An imagery evaluation form composed of four items was completed immediately after Block 2. Responses for all items were made on a 7-point Likert-type scale. The first item asked participants how frequently they incorporated the imagery during the putting task ranging from 1 (*not at all*) to 7 (*before all putts*). Two separate questions asked participants how easy it was to see and feel the images they just performed ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). The final question asked participants to rate how vivid their images were from 1 (*no image at all*) to 7 (*perfectly clear*).

Aiming for target. Following each block, participants rated the extent to which they were aiming to get the ball onto the center of the target. Responses were made on a 7-point Likert-type scale from 1 (*not at all*) to 7 (*on every putting attempt*). This item was included to assess whether participants might not have performed well due to a lack of motivation.

Demographic information. On arrival at the lab, participants provided information regarding their gender, age, sport played, competitive level, golf experience, and handicap if relevant.

Procedure

Arrival, Block 1, and screening. Following ethical approval from the university where the authors are based, participants were recruited through emails, social media, and lecture announcements. The majority were undergraduate students who received course credit for taking part. On arrival at the lab, potential participants were informed about the nature of the experiment. It was explained that all data provided would be treated confidentially and participants were free to withdraw at any time. All information was provided by pen and paper surveys. Those willing to participate provided written consent and were randomly allocated to the near miss or far miss group according to pre-determined randomly generated lists devised by the experimenters. Separate lists were used to balance the distribution of expert (near miss = 20, far miss = 20) and novice (near miss = 19, far miss = 20) golfers across both groups based on information provided at the point of recruitment.

For an overview of the experiment protocol, see supplementary Figure 1. Participants had 60 practice putts to become familiar with the putting surface and putter. They were told, "the aim of the putting task is to putt the ball as close to the center of the target as possible. The perfect putt would have the ball stop directly on the X at the end of the mat." Novices were given instructions on how to hold the putter. Participants provided their demographic information half way through the 60 putts to prevent boredom. After the practice putts, participants completed Block 1, consisting of 15 putts (again aiming to putt the ball as close to the X as possible) with the putting distance obtained following each putt. Before performing the block, participants completed the IAMS about how they were feeling about the upcoming block. After the block, participants rated the extent they were aiming for the target.

Imagery intervention. After Block 1, the experimenter gave participants White and Hardy's (1998) definition of imagery. Then, internal (i.e., seeing through your own eyes) and external (i.e., watching yourself on television) visual imagery perspectives were explained before they completed the SIAQ. Before listening to their assigned imagery script, the experimenter delivered layered stimulus response training (Cumming et al., 2016) to ensure all participants could produce images as clearly and as vividly as possible. The procedures, similar to those employed by Williams, Cooley, and Cumming (2013), involved building the imagery up in layers, gradually including more details with each attempt. Next, participants were shown a photo of the outcome of their allocated condition; for the near miss group, the ball on the cross 20 cm behind and to the left of the target, and for the far miss group, the ball on the cross 40 cm behind and to the left of the target. This ensured all participants were aware of what they should be imaging. Participants then listened to the near miss or far miss script[1] twice on a mp3 player while standing on the putting mat, assuming the correct stance, and holding the putter. They were told to image as clearly and vividly as possible from their preferred visual perspective. Scripts emphasized both stimulus (e.g., "Look down and see the white golf ball, resting on the green mat") and response (e.g., "Feel the point of impact when the putter connects with the ball") propositions (Lang, 1979). Scripts lasted just over 2 min and were identical except for the outcome, where the script described the ball "at the last second miss the target and end up about [20 cm or 40 cm] further behind and to the left of the target."

Block 2 and debrief. Immediately after the intervention, participants completed Block 2 and filled out the IAMS about how they felt about the upcoming block and then completed the putts. This block was identical to the first except that before each putt participants imaged the scenario they had previously imaged while listening to the script. Immediately after the block, participants completed the imagery evaluation form and rated their image meaning and the extent they were aiming for the hole. Finally, participants were debriefed on the experiment and thanked for their participation. Participants were also informed that potential sources of support were available if the imagery led to feelings of distress. The experiment lasted between 90 and 120 min.

[1] The full scripts are available from the lead author

Data analyses

Data was analyzed using SPSS (version 22). For the preliminary analyses, two MANOVAs examined differences between groups in imagery ability and 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVAs analyzed imagery frequency, ease of imaging (see and feel), and image vividness. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA with repeated measures on the first factor was conducted to analyze the extent to which participants were aiming to get the ball onto the center of the target.

For the main analyses, two separate 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVAs with repeated measures on the first factor were conducted to analyze performance and confidence scores. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) x 2 Skill level (novice, experts) MANOVA with repeated measures on the first factor analyzed differences in cognitive and somatic anxiety intensity and direction. A 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) factorial ANOVA analyzed image meaning. In all MANOVAs, the Box's M test was not violated, but Pillai's Trace values were still reported as this is the most robust multivariate significant test (Olson, 1976). For ANOVAs and MANOVAs involving repeated measures, if Mauchly's test of sphericity was violated, Greenhouse Geisser values were reported.

To investigate the imagery meaning outcome relationship, pearson's bivariate correlations were conducted to explore the relationship between image meaning and Block 2 outcomes. Participants were then divided into meaning groups depending on their imagery perception: those who perceived the imagery as unhelpful (i.e., 1-3 on the Likert scale; n = 42) and those who perceived the imagery as helpful (i.e., 5-7 on the Likert scale; n = 29). Participants who scored 4 (*neither helpful nor unhelpful*) were excluded from this analysis (n

= 8). Differences between blocks were calculated for performance, confidence, and anxiety intensity and direction by subtracting Block 1 from Block 2 scores. One-way ANOVAs then compared these differences between those interpreting the imagery as helpful and those interpreting it as unhelpful.

The probability value threshold for all analyses was set at .05. All significant effects were followed up with bonferroni post hoc pairwise comparisons.

Results

Preliminary analyses

Imagery ability. Results revealed there were no significant differences in imagery ability according to imagery content, Pillai's Trace = .051, $F(5, 73) = .79$; $p = .559$, $\eta_p^2 = .05$, or skill level, Pillai's Trace = .038, $F(5, 73) = 0.57$; $p = .721$, $\eta_p^2 = .04$.

Imagery evaluation form. There were no significant imagery content or skill level differences for frequency of imaging, ease of visual or kinesthetic imagery, or imagery vividness (p's > .05). There were no significant imagery content by skill level interactions. Means and standard deviations are reported in Table 1. Consequently, imagery ability was not considered as a variable to be controlled for in the main analyses.

[Table 1 near here]

Aiming for target. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for block, $F(1,75) = 6.69$, $p = .012$, $\eta_p^2 = .08$, 95% CI [0.08, 0.64]. Participants were aiming for the target significantly more at Block 1 ($M = 6.49$, $SD = 0.97$) than Block 2 ($M = 6.13$, $SD = 1.35$). There were no significant main effects for imagery content or skill level, and no significant block by imagery content, block by skill level, imagery content by skill level, or block by imagery content by skill level interactions.

Main analyses

Image meaning. A 2 Imagery content (near miss, far miss) × 2 Skill level (novices, experts) factorial ANOVA revealed a significant main effect for skill level, $F(1,75) = 7.88$, $p = .006$, $\eta_p^2 = .10$, 95% CI [-1.67, -0.28]. Novices perceived imagery to be more helpful ($M = 4.00$, $SD = 1.47$) than experts ($M = 3.03$, $SD = 1.61$; $p = .006$). To give context to these ratings, experts interpreted the imagery as somewhat unhelpful whereas novices perceived the imagery to be neither helpful nor unhelpful. There was no significant main effect for imagery content and no imagery content by skill level interaction.

Performance. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for block, $F(1,75) = 13.58$, $p < .001$, $\eta_p^2 = .15$, 95% CI [-6.02, -1.8] a significant main effect for skill level, $F(1,75) = 118.23$, $p < .001$, $\eta_p^2 = .61$, 95% CI [-24.14, -16.66] and a significant block by imagery content interaction, $F(1,75) = 9.49$, $p = .003$, $\eta_p^2 = .11$, 95% CI [-10.88, -2.24]. Mean scores indicated that novices ($M = 42.84$, $SD = 12.67$) performed significantly worse than experts ($M = 22.38$, $SD = 5.58$; $p < .001$) irrespective of the block. Post hoc analyses examining the interactions indicated that although there were no differences between the imagery content groups at Block 1, at Block 2 the far miss group performed significantly worse ($M = 37.81$, $SD = 15.53$) than the near miss group ($M = 31.00$, $SD = 13.16$; $p = .003$). The far miss group also performed significantly worse in Block 2 ($M = 37.81$, $SD = 15.53$) than it did in Block 1 ($M = 30.64$, $SD = 13.9$; $p < .001$), but the performance of the near miss group did not change across blocks. Means and standard errors depicting the block by imagery content interaction can be found in Figure 3. There was no significant main effect for imagery content, and no significant block by skill level (Figure 4), imagery content by skill level, or block by imagery content by skill level interactions.[2]

[2] See supplement Table 1 for all means and standard deviations.

[Figures 3 and 4 near here]

Anxiety. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) MANOVA revealed at the multivariate level there was a significant block by imagery content interaction, Pillai's Trace = .159, F (4, 72) = 3.41, p = .013, η_p^2 = .16. Univariate analyses revealed this was for cognitive intensity, F(1,75) = 12.78, p = .001, η_p^2 = .15, 95% CI [-1.46, -0.37], and somatic intensity, F(1,75) = 4.03, p = .048, η_p^2 = .05, 95% CI [-1.11, -0.14]. For cognitive anxiety, post hoc analyses revealed that at Block 2, the far miss group had higher levels of cognitive intensity (M = 3.1, SD = 1.34) than the near miss group (M = 2.18, SD = 1.14; p = .001). There were no differences between imagery content groups at Block 1. In the far miss group, cognitive intensity was higher at Block 2 (M = 3.1, SD = 1.34) than compared with Block 1 (M = 2.3, SD = 1.02; p < .001). For somatic anxiety, the far miss group experienced significantly higher somatic anxiety intensity at Block 2 (M = 2.78, SD = 1.48) compared with Block 1 (M = 2.15, SD = 1.05; p = .013). There were no differences in cognitive or somatic intensity between blocks for the near miss group. Means and standard errors depicting the block by imagery content interactions for cognitive and somatic intensity are displayed in Figure 3. There was no significant univariate block by imagery content interaction for cognitive direction or somatic direction (Figure 3). At the multivariate level there were no significant main effects for block, skill level, or imagery content, and no significant block by skill level (Figure 4), imagery content by skill level, or block by imagery content by skill level interactions.

Confidence. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for skill level, F(1, 75) = 10.87, p = .001, η_p^2 = .13, 95% CI [0.28, 1.15], and a significant block by skill level interaction, F(1,75) = 7.17, p = .009, η_p^2 = .09, 95% CI [-1.09, -0.02]. Post hoc analyses revealed at Block 1, novices were significantly less confident (M = 3.72, SD = 1.34) than experts (*M* = 4.95, *SD* = 1.11; $p < .001$), but there were no differences between imagery content groups at Block 2. Furthermore, novices were significantly more confident at Block 2 (*M* = 4.28, *SD* = 1.38) than they were at Block 1 (*M* = 3.72, *SD* = 1.34; $p = .04$), but experts' confidence did not change over blocks. Means and standard errors depicting the block by skill level interaction are displayed in Figure 4. There were no significant main effects for block or imagery content, and no significant block by imagery content (Figure 3), imagery content by skill level, or block by imagery content by skill level interactions.

Imagery meaning outcome relationship

There were no significant correlations between image meaning and any Block 2 outcomes[3]. A one-way ANOVA revealed a significant difference in performance due to meaning group, $F(1, 69) = 7.44$, $p = .008$. The unhelpful group experienced a greater increase in putting error (*M* = 6.81, *SD* = 10.18) than the helpful group (*M* = .68, *SD* = 7.86). There were no significant differences in confidence, anxiety intensity, or direction due to meaning group (*p*'s > .05).

Discussion

The present study investigated the effect of skill level (i.e., expert and novice) and imagery content (i.e., near miss and far miss) on image meaning, and on anxiety, confidence, and performance of a golf putting task. Results predominantly confirmed our first hypothesis that experts would perform better than novices throughout the experiment. Similarly, results partly support our second hypothesis that experts would interpret the near and far miss images as more unhelpful than novices. This is likely due to the imagery content not reflecting their performance capabilities. However, contrary to our hypothesis, novices interpreted the imagery as similarly helpful regardless of condition. This is likely due to the image content of missing by 40 cm reflecting the novices' performance capabilities (Block 1

[3] See supplement Table 2 for all correlations.

mean novice performance = 40.41 cm). Consequently, the far miss condition is likely to have still been helpful for novices. These interpretations support the task and learning elements of the PETTLEP (Physical, Environment, Task, Time, Learning, Emotion, Perspective) model of imagery (Holmes & Collins, 2001), and highlight the importance of matching the image content to the current performance level. Previous facilitative and debilitative imagery studies considering skill level have neglected to report image meaning (Ramsey et al., 2008). Therefore these findings are the first to demonstrate that individual characteristics, such as skill level, are directly associated with image meaning (Cumming & Williams, 2013).

Although image meaning was related to skill level, it did not differ according to the content of the imagery. According to RAMDIU (Cumming & Williams, 2013), image meaning bridges the gap between imagery function and content to influence the outcomes experienced. Our findings suggest that imagery function likely plays a key role in influencing the relationship between image meaning and content. As image function was not measured in this study, future research investigating image meaning should also consider the function and content of the image to more comprehensively understand the relationships between these components outlined by RAMDIU. Importantly, however, and supporting our hypotheses, image content did alter the outcomes experienced (e.g., performance and anxiety intensity).

Results for performance and anxiety partially supported our hypotheses. These outcomes seemed to be determined by the image content (i.e., near miss or far miss) rather than skill level. Although experts reported the imagery as being more unhelpful than novices, both skill levels in the far miss group experienced a decline in performance. Moreover, experts in the near miss group reported the imagery as being unhelpful to performance, yet they experienced no change in performance across blocks. This is a similar finding to Nordin and Cumming (2005) in which facilitative imagery was interpreted as helpful but did not alter performance or self-efficacy. Together with a lack of significant relationships between image meaning and Block 2 variables, our findings suggest a lack of awareness from participants concerning the impact imagery could have on outcomes. Therefore, while it is important to assess individuals' perceptions of imagery, this may not always reflect the pronounced impact it could have.

We did not find any significant effects for anxiety direction, which might be more strongly influenced under conditions where performance is more important (e.g., under explicit pressure). This finding can also be explained by self-confidence; that is, imagery can protect against negative anxiety symptoms by maintaining high self-confidence (Cumming, Olphin, & Law, 2007). In support of our hypothesis, novices (who perceived the imagery as more helpful than experts) experienced an increase in confidence following the imagery. This replicates findings that outcome imagery can alter confidence (Taylor & Shaw, 2002), but suggests this is associated with the image meaning which can be related to an individual's characteristics.

Overall results highlight the importance of image meaning; an important component of the RAMDIU (Cumming & Williams, 2013), which we define as an individuals' interpretation of an image as helpful or unhelpful, and how this is influenced by individual characteristics (e.g., skill level, confidence, prior performance). The RAMDIU, along with previous theories (e.g., Lang's bioinformational theory, 1979), suggests that the most effective imagery will occur when it is meaningful and personalized to the athlete. We hypothesized that imagery would have either a facilitative or debilitative effect upon various outcomes, but did not hypothesize that there would be no effects (i.e., as for experts' confidence). Based on these theories and models, it may be worthy to consider that participants are unlikely to experience the intended, if any, effect when imagery is not relevant and meaningful.

Strengths and limitations

A strength of the study was that only the outcome of the image was manipulated unlike previous studies that have manipulated both outcome and other aspects such as performance execution (Nordin & Cumming, 2005; Taylor & Shaw, 2002). Therefore we can be more confident that results are due to the imagery outcome. Additionally, participants completed 60 practice putts to prevent performance changes due to task acclimatization. Finally, our criterion for expert golfers ensures that we were able to compare the effects of outcome imagery on novices with truly elite participants.

A possible limitation is that participants aimed for the target significantly more at Block 1 than Block 2. However, this could be due to the imagery content (i.e., missing the target) making participants despondent and possibly lowering motivation levels. Similarly, Nordin and Cumming (2005) found that individuals imaging hitting the bull's eye aimed significantly more for the bull's eye compared to individuals who imaged missing the bull's eye. This reduction in the present study was equal across groups suggesting it did not influence the interactions from the main analyses. Future research should examine the influence outcome imagery has on effort and motivation. Using a target instead of a hole might be another limitation because participants may have responded differently to the task if an actual golf hole was used, which is also more ecologically valid. However, a target was chosen in the present study to ensure an accurate putt was less likely due to chance and this procedure has been successfully implemented in previous research (e.g., Gray, Allsop, & Williams, 2013). Future research could compare both methods to investigate potential differences.

Applied implications and future research

Results of the present study have important implications for applied practice. In support of Williams, Cooley, Newell, Weibull, and Cumming (2013), findings suggest that coaches and applied practitioners should consider athletes' personal characteristics and develop imagery scripts and exercises alongside the athlete to ensure the content is interpreted as intended. Findings emphasize the need for a systematic, theoretical approach when exploring athletes' imagery experiences, providing further support for the RAMDIU (Cumming & Williams, 2013) as a framework for future interventions and applied practice. Future research should investigate the effect of other characteristics (e.g., age, gender, and personality) that might also influence image meaning.

Results also suggest caution should be taken when discussing image meaning with athletes as they are not always accurate about images being helpful or unhelpful. For example, novices said the imagery was not unhelpful but still had a reduction in performance. These individuals may display poorer meta-imagery: the awareness and control an individual has over their own imagery (Moran, 2004). It is possible that people who are more aware of how to use imagery for different benefits might be more accurate in stating whether an image is helpful or unhelpful. Future research should investigate whether certain characteristics (e.g., meta-imagery proficiency, mindfulness) are associated with greater accuracy in whether an image is helpful or unhelpful. Finally, although beyond the scope of the present manuscript, a worthy avenue for future research to pursue is to comprehensively investigate how the various components of the RAMDIU relate to each other, for example through structural equation modelling.

In conclusion, the present study investigated whether skill level (i.e., expert or novice) and imagery content (i.e., missing a target by 20 or 40 cm) impacted image meaning, and outcomes of imagery use (i.e., anxiety, confidence, and performance of a golf putting task).

Associations between image meaning and these outcomes were then examined. Findings demonstrated that skill level is associated with how imagery content is interpreted (i.e., image meaning), but also that imagery content (regardless of skill level and image meaning) influenced other outcomes. However, image meaning did not significantly relate to the outcome variables. Findings support the RAMDIU that suggests an individual's characteristics (e.g., skill level) are related to image meaning. However, image meaning does not always reflect the outcomes experienced and thus caution should be taken when trying to obtain information about the image meaning from an athlete.

References

Beilock, S. L., Afremow, J. A., Rabe, A. L., & Carr, T. H. (2001). " Don't miss!" the debilitating effects of suppressive imagery on golf putting performance. *Journal of Sport and Exercise Psychology, 23*, 200-221. Retrieved from http://journals.humankinetics.com/jsep

Cumming, J., Cooley, S. J., Anuar, N., Kosteli, M., Quinton, M. L., Weibull, F., & Williams, S. E. (2016). Developing imagery ability effectively: A guide to layered stimulus response training. *Journal of Sport Psychology in Action*, *7,* 1-11. doi:10.1080/21520704.2016.1205698

Cumming, J., Olphin, T., & Law, M. (2007). Self-reported psychological states and physiological responses to different types of motivational general imagery. *Journal of Sport and Exercise Psychology*, *29*, 629-644. Retrieved from http://journals.humankinetics.com/jsep

Cumming, J., & Williams, S. E. (2012). The role of imagery in performance. In S. Murphy (Ed.), *The Oxford handbook of sport and performance psychology* (pp. 213-232). Oxford: Oxford University Press.

Cumming, J., & Williams, S. E. (2013). Introducing the revised applied model of deliberate imagery use for sport, dance, exercise, and rehabilitation. *Movement & Sport Sciences*, *82*, 69-81. doi:http://dx.doi.org/10.1051/sm/2013098

Gray, R., Allsop, J., & Williams, S. E. (2013). Changes in putting kinematics associated with choking and excelling under pressure. *International Journal of Sport Psychology*, *44*, 387-407. doi:10.7352/IJSP2013.44.387

Hanton, S., Mellalieu, S. D., & Hall, R. (2004). Self-confidence and anxiety interpretation: A qualitative investigation. *Psychology of Sport & Exercise*, *5*, 477-495. doi:10.1016/S1469-0292(03)00040-2

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. doi:10.1080/10413200109339004

Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology, 16*, 495–512. doi:10.1111/1469-8986.197901511.

MacIntyre, T., & Moran, A. P. (2007) A qualitative investigation of meta-imagery processes and imagery direction among elite athletes. *Journal of Imagery Research in Sport and Physical Activity*, *2*, 1-20. doi:10.2202/1932-0191.1022

Moran, A. O. (2004). *Sport and exercise psychology: A critical introduction*. Hove, East Sussex: Routledge.

Moran, A., Campbell, M., Holmes, P., & MacIntyre, T. (2012). Mental imagery, action observation and skill learning. In N. Hodges & M. Williams (Eds.), *Skill Acquisition in sport: Research, theory and practice* (pp. 2-19). London: Routledge.

Nordin, S., & Cumming, J. (2005). More than meets the eye: Investigating imagery type, direction, and outcome. *The Sport Psychologist*, *19*, 1-17. Retrieved from http://journals.humankinetics.com/tsp

Olson, C. L. (1976). On choosing a test statistic in multivariate analysis of variance. *Psychological Bulletin*, *83,* 579-586. Retrieved from http://www.apa.org/pubs/journals/bul/

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*, 207-223. Retrieved from http://www.tandfonline.com/toc/rijs20/current

Short, S. E., Bruggeman, J. M., Engel, S. G., Marback, T. L., Wang, L. J., Willadsen, A., & Short, M. W. (2002). The effect of imagery function and imagery direction on self-efficacy and performance on a golf putting task. *The Sport Psychologist, 16*, 48-67. Retrieved from http://journals.humankinetics.com/tsp

Taylor, J. A., & Shaw, D. F. (2002). The effects of outcome imagery on golf-putting performance. *Journal of Sports Sciences*, *20*, 607-613. doi:10.1080/026404102320183167

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. Retrieved from http://www.ijsp-online.com/

Van de Braam, M., & Moran, A. (2011). The prevalence and effects of negative mental imagery in tennis. *Journal of Medicine and Science in Tennis, 16*, 34-37. Retrieved from http://www.stms-web.org/journal.html

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. Retrieved from http://journals.humankinetics.com/tsp

Williams, S. E., Cooley, S. J., & Cumming, J. (2013). Layered stimulus response training improves motor imagery ability and movement execution. *Journal of Sport and Exercise Psychology, 35*, 60-71. Retrieved from http://journals.humankinetics.com/jsep

Williams, S. E., Cooley, S. J., Newell, E., Weibull, F., & Cumming, J. (2013). Seeing the difference: Developing effective imagery scripts for athletes. *Journal of Sport Psychology in Action*, *4*, 109-121. doi: 10.1080/21520704.2013.781560

Williams, S. E., & Cumming, J. (2011). Measuring athlete imagery ability: The sport imagery ability questionnaire. *Journal of Sport and Exercise Psychology*, *33*, 416-440. Retrieved from http://journals.humankinetics.com/jsep

Williams, S. E., Cumming, J., & Balanos, G. M. (2010). The use of imagery to manipulate challenge and threat appraisal states in athletes. *Journal of Sport and Exercise Psychology*, *32*, 339-358. Retrieved from http://journals.humankinetics.com/jsep

Word count: 6852

Table 1

Manipulation check means and standard deviations for imagery content group and skill level

	Imagery content group		Skill level	
Manipulation check	Near miss	Far miss	Experts	Novices
Frequency of imaging	5.87 (1.22)	6.3 (.72)	6.13 (.97)	6.05 (1.07)
Ease of imagery (see)	4.62 (1.48)	4.6 (1.37)	4.73 (1.58)	4.49 (1.23)
Ease of imagery (feel)	4.13 (1.49)	4.03 (1.51)	4.1 (1.66)	4.05 (1.32)
Vividness of imagery	4.23 (1.31)	4.28 (1.32)	4.28 (1.41)	4.23 (1.2)

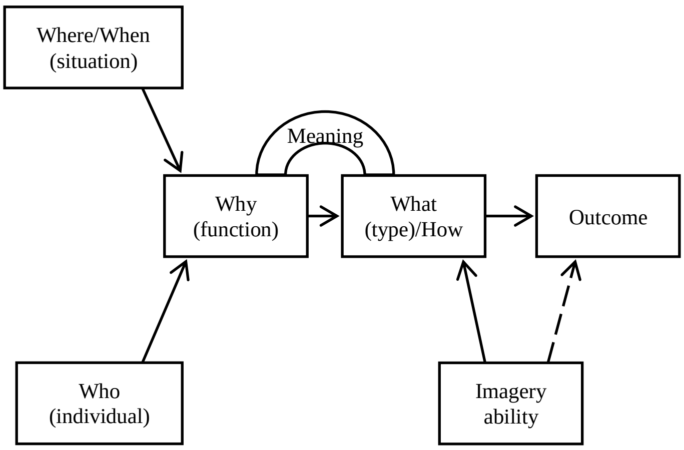


Figure 1. The revised applied model of deliberate imagery use. Adapted from "Introducing the revised applied model of deliberate imagery use for sport, dance, exercise, and rehabilitation", by J. Cumming & S. E. Williams, 2013, *Movement & Sport Sciences*, *82*, 69-81. doi:http://dx.doi.org/10.1051/sm/2013098. Copyright 2013 by EDP Sciences. Adapted with permission.

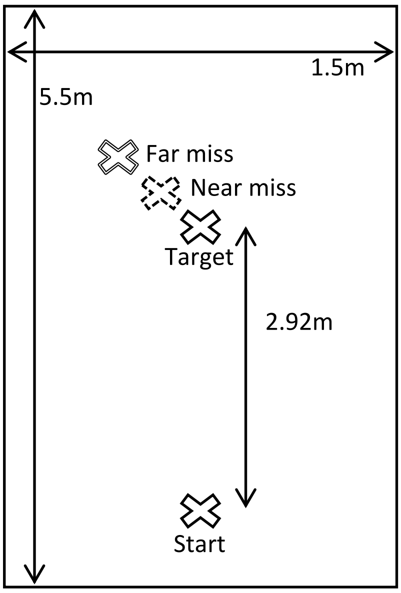


Figure 2. Experiment setup.

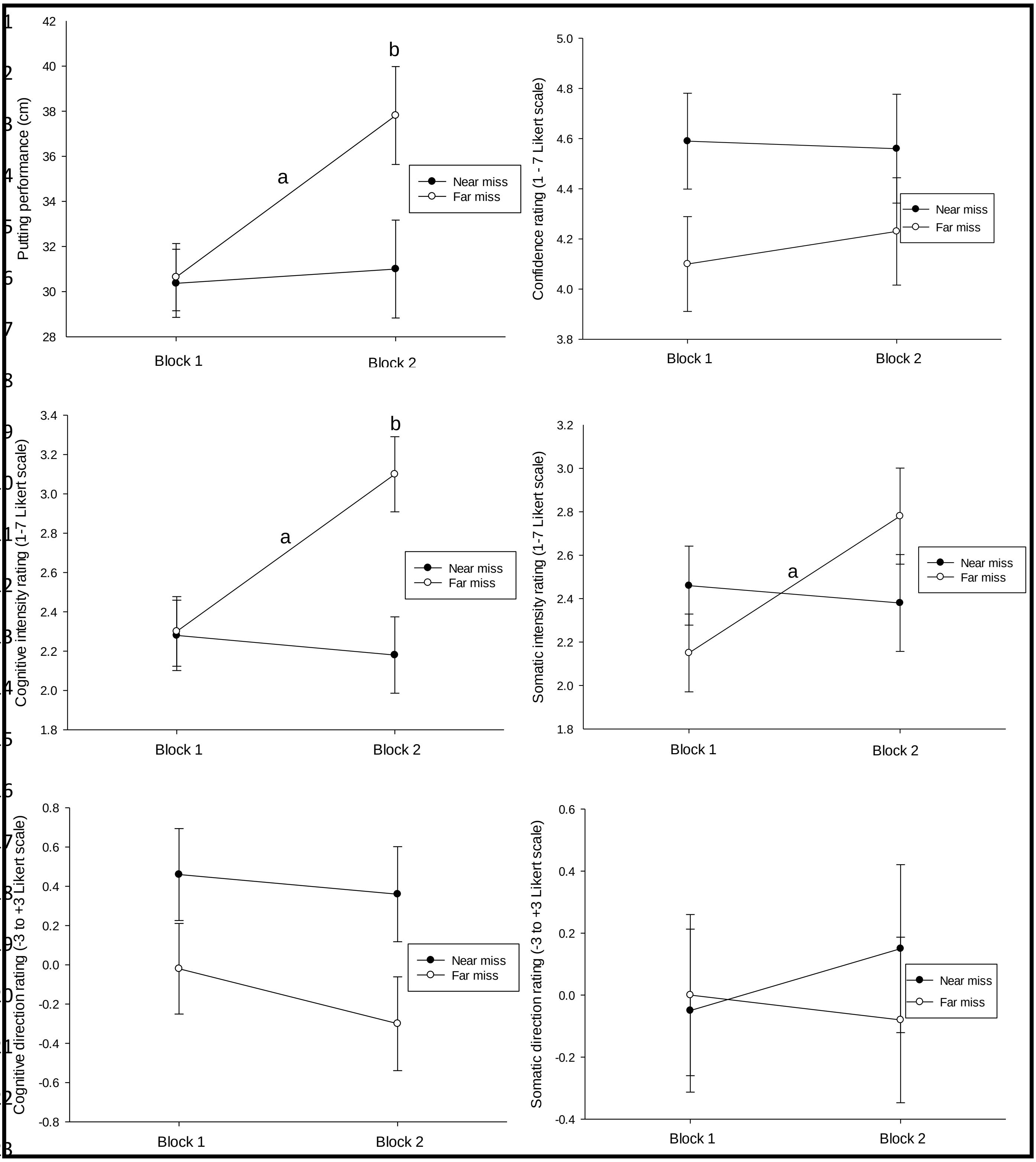


Figure 3. Mean and standard errors for imagery content group by block interactions (-●- near miss, -○- far miss). Presented from top left to bottom right across the page are: putting performance, confidence, cognitive anxiety intensity, somatic anxiety intensity, cognitive anxiety direction, and somatic anxiety direction.

Note. [a] Far miss group significantly greater at Block 2 than Block 1. [b] At Block 2, far miss group significantly greater than near miss group.

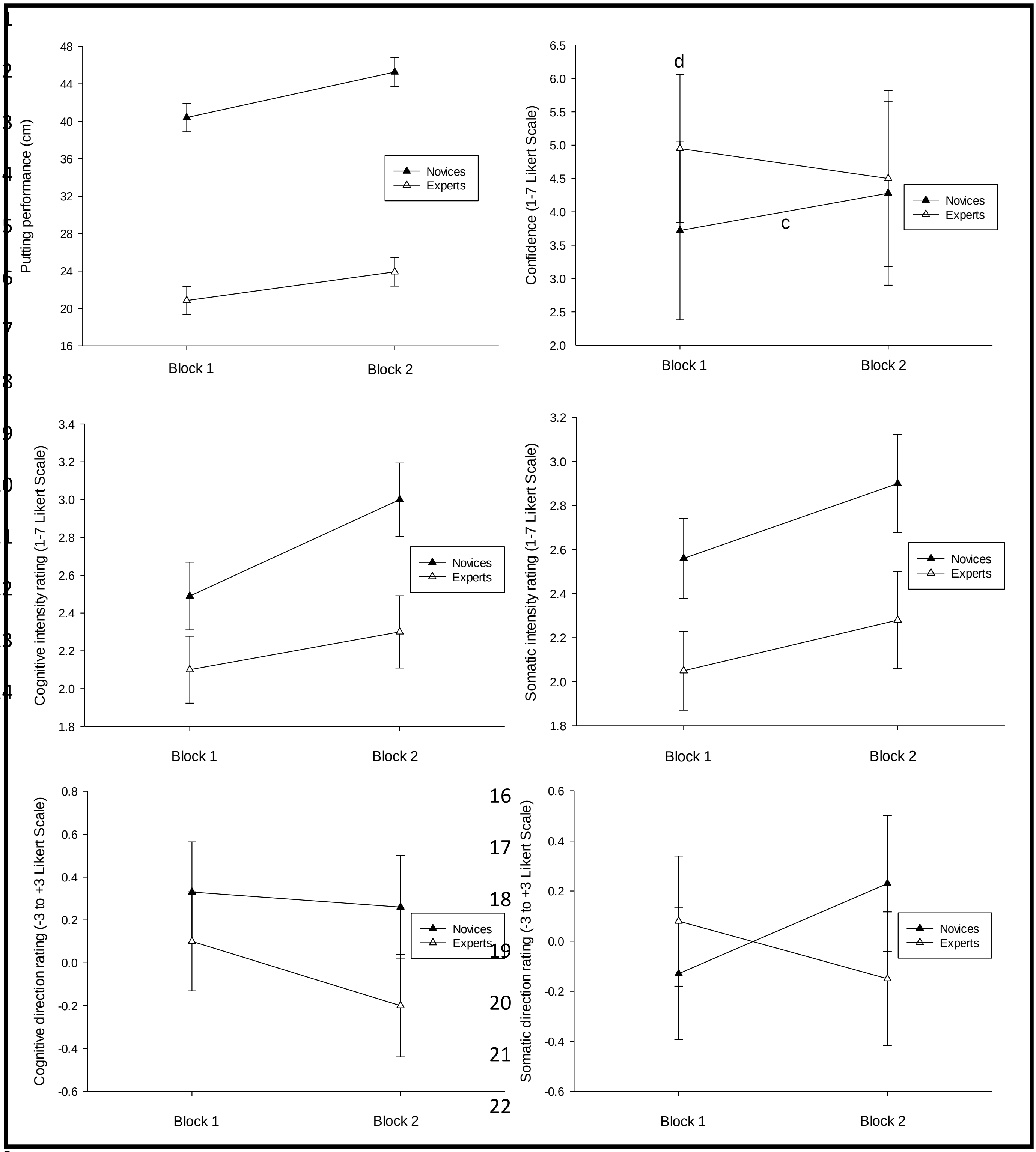


Figure 4. Mean and standard errors for skill level by block interactions (-▲- novices, -△- experts). Presented from top left to bottom right across the page are: putting performance, confidence, cognitive anxiety intensity, somatic anxiety intensity, cognitive anxiety direction, and somatic anxiety direction.

Note. [c] Novices significantly greater at Block 2 than Block 1. [d] At Block 1, novices significantly less than experts.

Supplement Table 1

Means (standard deviation) for performance and psychological variables by block, imagery content group, and skill level

	Block 1			Block 2		
Imagery group	Experts	Novices	Total	Experts	Novices	Total
			Performance			
Near miss	21.14 (5.19)	40.08 (12.52)	30.37 (13.40)	21.66 (4.45)	40.84 (12.06)	31.00 (13.16)
Far miss	20.55 (4.30)	40.72 (12.80)	30.64 (13.90)	26.15 (7.39)	49.47 (12.40)	37.81 (15.53)
Total	20.85 (4.71)	40.41 (12.50)		23.91 (6.44)	45.27 (12.84)	
			Confidence			
Near miss	4.95 (.76)	4.21 (1.18)	4.59 (1.04)	4.65 (1.27)	4.47 (1.17)	4.56 (1.21)
Far miss	4.95 (1.40)	3.25 (1.33)	4.10 (1.60)	4.35 (1.39)	4.10 (1.55)	4.23 (1.46)
Total	4.59 (1.11)	3.72 (1.34)		4.50 (1.32)	4.28 (1.38)	
			Cognitive anxiety intensity			
Near miss	1.95 (1.00)	2.63 (1.38)	2.28 (1.23)	1.85 (1.00)	2.53 (1.21)	2.18 (1.14)
Far miss	2.25 (1.16)	2.35 (.88)	2.30 (1.02)	2.75 (1.37)	3.45 (1.23)	3.10 (1.34)
Total	2.10 (1.08)	2.49 (1.14)		2.30 (1.27)	3.00 (1.30)	
			Cognitive anxiety direction			
Near miss	.45 (1.57)	.47 (1.39)	.46 (1.47)	.55 (1.91)	.16 (1.46)	.36 (1.69)
Far miss	-.25 (1.62)	.20 (1.24)	-.02 (1.44)	-.95 (1.32)	.35 (1.27)	-.30 (1.44)
Total	.10 (1.61)	.33 (1.31)		-.20 (1.79)	.26 (1.35)	
			Somatic anxiety intensity			
Near miss	2.10 (1.21)	2.84 (1.21)	2.46 (1.25)	1.90 (1.02)	2.89 (1.52)	2.38 (1.37)
Far miss	2.00 (1.12)	2.30 (1.00)	2.15 (1.05)	2.65 (1.66)	2.90 (1.29)	2.77 (1.48)
Total	2.05 (1.15)	2.56 (1.12)		2.28 (1.41)	2.90 (1.39)	
			Somatic anxiety direction			
Near miss	.10 (1.71)	-.21 (1.32)	-.05 (1.52)	.25 (2.00)	.05 (1.31)	.15 (1.68)
Far miss	.05 (1.82)	.40 (1.67)	.00 (1.73)	-.55 (1.79)	.40 (1.57)	-.08 (1.73)
Total	.08 (1.75)	-.13 (1.49)		-.15 (1.92)	.23 (1.44)	

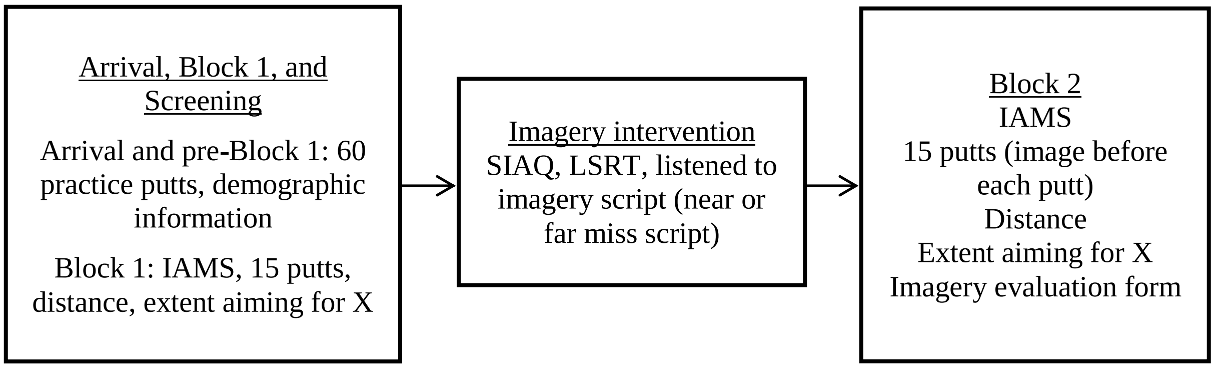
Supplement Table 2

Correlation matrix for image meaning and Block 2 variables

Variable	1.	2.	3.	4.	5.	6.
1. Image meaning						
2. B2 performance	.13					
3. B2 cognitive anxiety intensity	-.05	.41**				
4. B2 somatic anxiety intensity	-.02	.21	.51**			
5. B2 confidence intensity	.04	-.06	-.23*	-.31**		
6. B2 cognitive anxiety direction	.12	.06	-.21	-.14	.12	
7. B2 somatic anxiety direction	.05	.10	-.14	-.21	.07	.69**

Note. B2 represents Block 2.

*p < .05. **p < .01



Supplement Figure 1. Experiment protocol.