Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

Abstract

Objectives: The use of imagery to improve golf performance is well established and recognised as a key psychological technique in developing and maintaining excellence. However, the relationship between a golfer's imagery ability and their imagery use is still poorly understood. The current study examined differences in participants vividness of movement imagery and imagery use and the extent their vividness of movement imagery predicted functions of imagery use.

Methods: One hundred and one male skilled golfers (M_{age} = 27.80, *SD* = 11.03) with CONGU recognised handicaps ranging from plus 4 to 5 ($M_{handicap}$ = 1.32, *SD* = 2.74) completed both the Vividness of Movement Imagery Questionnaire-2 (Roberts et al. 2008) and Sports Imagery Questionnaire (Hall et al. 1998).

Results: The results demonstrated no significant differences between Internal and External visual imagery, however, Kinaesthetic imagery scores were significantly higher than External visual imagery scores. Significant differences in imagery use were recorded with participants reporting higher Cognitive specific imagery use scores compared to other functions of imagery use. Regression analyses indicted that golf handicap accounted for 12% in the variance of Cognitive specific imagery use with an additional 12% accounted for by Internal visual imagery and 7% Kinaesthetic imagery. For Cognitive general imagery use golf handicap accounted for 4% of the variance with Internal visual imagery adding a further 5% to the model.

Conclusion: Our findings highlight that vividness of movement imagery; specifically, Internal and Kinaesthetic imagery ability are significant predictors of skilled golfers Cognitive specific and Cognitive general imagery use.

Keywords: imagery, ability, use, skilled, golfers

Introduction

> *I never hit a shot, even in practice, without having a very sharp, in-focus picture of it in my head. It's like a color movie.* (Jack Nicklaus, 1974 p.79)

The above description from golf's greatest major winner highlights the importance Jack Nicklaus placed on the systematic use of specific clear and controlled visual images prior to executing a golf shot. Considerable empirical evidence now supports utilising volitional symbolic sensory experiences (Hardy & Jones, 1994) as an effective psychological technique to enhance aspects of golf performance (e.g., McCaffrey & Orlick, 1989; Bernier & Fournier, 2010; Marshall & Wright, 2016). More specifically, research has established that putting (e.g., Woolfolk, Parish, & Murphy, 1985; Thomas & Fogarty, 1997; Marshall & Wright, 2016), pitch shots (Brouziyne & Molinaro, 2005), full swing shots (Swainston et al., 2012), and bunker shot performance (Smith, Wright, & Cantwell, 2008) improve when imagery is the covert rehearsal technique of choice. Indeed, the aforementioned evidence supports why top touring professionals report using imagery as a key mental factor in developing and maintaining excellence (Mccaffrey & Orlick, 1989).

One facet of mental imagery research that has garnered considerable interest is what purpose imagery serves. The accurate mapping of function (i.e., purpose of the image) to outcome (i.e., images primary effect) has been specified an important determinant in how imagery successfully contributes to an athlete's target behaviours (e.g., Martin, Moritz, & Hall, 1999; Smith et al., 2008). Pavio's (1985) analytic framework suggests that imagery can serve both cognitive and motivational functions at either a specific or general level. Building on Pavio's model Hall and colleagues (1998) developed the Sport Imagery Questionnaire (SIQ) to measure the frequency athletes adopt five functions of imagery use. These include,

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

cognitive general (CG) imagery which relates to images of strategies and game scenarios. Cognitive specific (CS) images are used when athletes are imaging the unfolding of a specific movement sequence. When athletes imagine goals and outcomes they would like to achieve, they are adopting motivational specific (MS) images. Motivational general-arousal (MG-A) images enable athletes to simulate the emotions and arousal levels experienced during competition and practice. Whereas, motivational-general mastery (MG-M) imagery is used to rehearse one's ability to triumph during challenging circumstances. Although there has been debate regarding the extent the SIQ can account for whether athletes use the same image for various reasons (Cumming & Williams, 2013; Fournier, Deremaux, & Bernier, 2008; Murphy, Nordin, & Cumming, 2008), it continues to be successfully applied across a number of sports (e.g., Simpson, Munroe-Chandler, & Paradis, 2020) and has been adapted to investigate specific athletic populations (see Gregg & Hall, 2005; Parker & Lovell, 2009; Simonsmeier & Buecker, 2017).

Specific to golf, Gregg and Hall (2006) identified that golfers frequently employ MG-M imagery followed by CS and CG imagery, but were less likely to use MG-A and MS images. Bernier and Fournier (2010), adopting an interview-based investigation, examined the functional and characteristic aspects of imagery use in a sample of expert golfers (i.e., amateur golfers with handicaps between -2 and 6). Their results highlighted that expert golfers used imagery to "learn the perfect technique, prepare strategic and tactical aspects of their game, manage psychological states, and evaluate shot making capabilities". Furthermore, Gregg and Hall reported that some golfers experienced changes in the vividness of mental images due to shot difficulty and their current level of confidence. Bernier and Fournier's study also reported that golfers preferred adopting an internal visual imagery perspective (i.e., seeing the image through one's own eyes) compared to an external visual imagery perspective (i.e., seeing the image as if watching a video recording of oneself). Indeed, both these investigations highlight that golfers adopt imagery to serve a variety of functions facilitated by a capability to image using different perspectives with imagery vividness variable dependent on specific conditions, thus leading some researchers to contend imagery ability (an individual's capability to create and control vivid images) should be conceptualised as a constellation of skills rather than a fixed trait (Marshall & Wright, 2016). While the effectiveness of imagery is influenced by the image's vividness (i.e., clarity and sharpness of the image) (see Baddeley & Andrade, 2000).

There is growing support that a positive relationship exists between imagery ability and imagery use (see Slimani, Chamari, Boudhiba & Chéour (2016). For example, Gregg, Hall, and Nederhof (2005) reported that track athletes with higher visual and kinaesthetic imagery ability recorded increased CS imagery use. In a similar, yet extended investigation, Gregg and colleagues (2011) using hierarchical regression found that visual, kinaesthetic, and motivational imagery ability significantly predicted all five functions of imagery use. Simonsmeier and Buecker (2017) investigating the interrelationship between imagery use, imagery ability, and gymnastic performance in sample of gymnasts between 7 and 16 years found a small to medium positive association between the subscales of the measures used to record participants imagery use and imagery ability. These aforementioned studies contribute to an emerging consensus that imagery is more effective for athletes who possess better imagery ability skills (Nordin & Cumming, 2008), and why imagery ability is considered by scholars to be an important characteristic that contributes to the effectiveness of imagery interventions (e.g., Collet, Guillot, Lebon, MacIntyre, & Moran, 2011; Cumming & Williams, 2013; Martin, Moritz, & Hall, 1999).

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

The relationship between imagery ability and imagery use has been measured using the Movement Imagery Questionnaire (Hall, Pongrac, & Buckloz, 1985) and Movement Imagery Questionnaire-Revised (Hall & Martin, 1997). Typically, these assessment tools present participants with the description of a variety of movements followed by instructions to physically perform the movement. In turn each movement is then imaged adopting visual and kinaesthetic imagery with participants rating themselves on a Likert scale relative to the difficulty by which they experience seeing and feeling the image. More recently Simonsmeier and Buecker (2016) adopted Williams and Cumming's (2011) Sport Imagery Ability Questionnaire which consists of five imagery ability subscales (i.e., skill, strategy, goal, affect and mastery). Participants are asked to rate themselves on a 7-point Likert scale relative to the ease by which they can image specific sporting scenarios. One draw back to the above measures are that they fail to distinguish between which visual imagery perspectives participants are imaging from. This appears to be an important omission as internal and external visual perspectives have been shown to aid skill acquisition in different ways relative to the type of task being performed (see White & Hardy, 1998).

An imagery ability measure that delineates between different visual imagery perspectives is the Vividness of Movement Imagery Questionnaire-2 (Roberts, Callow, Hardy, Markland, & Bringer, 2008). Although, similar to the MIQ and MIQ-R in that both visual and kinaesthetic modalities are measured, the VMIQ-2 provides the additional assessment of visual imagery perspectives which are deemed to be a key consideration in imagery ability research (Callow & Roberts, 2010). For example, White and Hardy (1995) demonstrated that improvements in the speed of task performance were related to an internal visual perspective while enhanced movement precision associated with an external visual perspective. More recently Dana and Gozalzadeh (2017) reported improvements in tennis serve performance in participants adopting an internal visual imagery perspective. Adding additional support to previous empirical evidence that stipulates closed skills may benefit more from an internal visual imagery perspective (McLean & Richardson, 1994), with external imagery adopted more frequently by participants performing open skills (Spittle & Morris, 1999a, 2001). Furthermore, empirical investigations have presented a case for integrating the kinaesthetic imagery modality (imagery that recreates the feel and forces of moments) with either of the visual imagery perspectives. For example, Callow and colleagues (2017) using a driving simulator task reported beneficial performance effects for participants combining internal visual imagery with kinaesthetic imagery over those adopting internal visual imagery. In consideration of Bernier and Fournier's (2010) observation that elite golfers experience variations in the vividness of their images and report a preference for using an internal perspective, it appears beneficial to employ the VMIQ-2 as it is an introspective self-report measure that can provide additional quantification of these imagery ability characteristics and the relationship they have with imagery use, which to date has received sparse empirical attention particularly amongst golfers. Furthermore, although the Movement Imagery Questionnaire-3 (see Williams et al., 2012) was also validated to separately assesses external and internal imagery perspectives, it does so without specifically measuring an images vividness. Of which has proven to be a reliable individual difference that can distinguish between vivid and nonvivid imagers based on self-report responses as well as accompanied by distinct variations in neural activation (see Marks & Isaac).

To this end our study sought to examine the differences in skilled golfers VMIQ-2 and SIQ scores and the extent participants vividness of movement imagery predicted functions of imagery use. Similar to previous literature (e.g., Gregg, Hall, & Nederhof, 2005) we hypothesised movement imagery ability would be strongly associated with CS and CG

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

imagery use due to the activities these functions ordinarily serve, but with the additional opportunity to record the unique contribution made by both internal and external visual imagery perspectives. Finally, based on the findings of Bernier and Fournier (2010) and Callow and colleagues (2017) we predicted that internal visual imagery would be the strongest predictor of these two functions followed by kinaesthetic imagery.

Method

Participants

A total of 101 male skilled golfers (M_{age} = 27.80, *SD* = 11.03) volunteered to participate in the current study. Their ages ranged from 18 to 53 years and had participated in golf for (M_{years} = 14.19, *SD* = 8.91). All participants had a recognized handicap from The Council of National Golf Unions (CONGU) ranging from plus 4 (four below 0) to 5 (*M* = 1.32, *SD* = 2.74). The investigation adhered to the British Psychological Society's guidelines and had received institutional ethical approval. Participants were presented with an information sheet outlining the purpose of the study after which written consent was provided in the knowledge that as a participant they could withdraw from the study at any time.

Measures

Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al. 2008). The VMIQ-2 uses twelve movements (e.g., running upstairs, riding a bike) to measure the vividness aspect of imagery ability for internal visual imagery (IVI), external visual imagery (EVI), and kinaesthetic imagery (KI). Participants are instructed to rate the vividness of their images on a 5-point Likert scale ranging from 1 (perfectly clear and vivid as normal vision) to 5 (no image at all, you only know that you are thinking of the skill). Roberts et al. (2008) have documented that the VMIQ-2 possesses strong factorial credentials alongside good construct and concurrent validity scores. The reliability analysis for IVI, EVI imagery, and KI subscales has recorded Cronbach alpha scores of .95, .95, and .93 respectively (Roberts et al., 2008).

Sports Imagery Questionnaire (SIQ: Hall et al. 1998). The SIQ assesses cognitive and motivational functions of imagery use: CS (*"When imaging a particular skill, I consistently perform it perfectly in my mind"*); CG ("*I make up new plans/strategies in my head"*); MS ("*I imagine other athletes congratulating me on a good performance"*); MG-A ("*I imagine the emotions I feel while doing my sport"*) and MG-M ("*I imagine giving 100%").* For the purposes of this investigation we adopted Gregg and Hall's (2006) version of the SIQ where the wording of items was modified to make the measure more specific to golf (e.g., CG: *"I image each section of a game"* (e.g., par 5's, front nine)). The SIQ-golf consists of thirty questions with between 5-7 items that are added together to record the frequency of each imagery function. Items are anchored on a seven-point Likert scale with 1 representing (*rarely use that function of imagery use*) and 7 (*often use that function of imagery*). The SIQ-golf has satisfactory internal reliability scores with alpha coefficients that range from .77 to .88 (Gregg & Hall, 2006).

Procedure

Following ethical approval, participants were approached at their local golf course after completing a round of golf and presented with an information letter that explained the purpose of the investigation. For those who agreed to take part a consent form was completed, followed by the two imagery measures; VMIQ-2 and SIQ. To reduce order effects the questionnaires were counterbalanced across the sample. Participants were asked to provide their current CONGU handicap as this was deemed to give the most precise and

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

current indication of skill level. Prior to the imagery questionnaires being completed participants were provided with a definition of what imagery is, which imagery modalities were under consideration (i.e., visual, kinaesthetic), and that images needed to be of the self. In addition, examples were provided to contextualize the two imagery perspectives under investigation. There was no specified time limit to complete the questionnaires.

Data Analysis

Data Analysis was conducted upon all SIQ and VMIQ-2 subscales using SPSS (version 26; SPSS inc., Chicago, IL, USA). We conducted Little's Missing at Random (MCAR) test and no missing values were reported. Standardized scores for skewness and kurtosis were calculated with z-scores highlighting four of the eight subscales violated normality (Ghasemi & Zahediasl, 2012). Based on evidence that parametric tests are robust against non-normal distributions (Carroll, 2017), we decided to use the original scores. Estimates of internal reliability (Cronbach's α) for all variables exceeded Nunnally and Bernstein's (1994) recommendation of $\alpha > .70$ (see Table 1). Mean and standard deviations for each subscale across the sample were calculated (see Table 1). Two one-way repeated measures ANOVA's with post-hoc analyses were performed to examine differences between the subscales of the SIQ and VMIQ-2. A Pearson bivariate correlation across all variables was conducted followed by five bivariate hierarchical regressions to determine the extent vividness of movement imagery predicted imagery function.

Results

Main Analysis

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

To examine differences in participants VMIQ-2 and SIQ scores we conducted two repeated measures ANOVA's. For the VMIQ-2 Mauchly's Test reported the assumption of sphericity had been violated ($\chi^{(2)} = 22.08$, $p < .05$), consequently we adopted Greenhouse-Geisser estimates of sphericity (ε = .83) to correct the degrees of freedom. The results demonstrated there was a significant difference in vividness of movement imagery scores $F(1.70, 166.7) = 13.03$, $p < .001$, $\eta^2 = .12$, power = .99. Interpretation of Bonferroni post-hoc pairwise comparisons demonstrated participants had recorded higher KI vividness scores than EVI scores. There were no significant differences between the IVI and KI subscales. For differences in SIQ scores the assumption of sphericity was also violated ($X^{(9)} = 37.90$, $p < .05$) resulting in adopting Greenhouse-Geisser estimates of sphericity (ε = .83) to correct the degrees of freedom. The results recorded a significant difference in imagery use $F(3.31, 300.7) = 158.74$, $p < .001$, $\eta^2 = .61$, power = 1.00. Post-hoc pairwise comparisons recorded significantly higher CS scores compared to all other imagery functions. CG imagery was used significantly more frequently than MS and MG-A imagery use. MG-M was used significantly more frequently than both MG-A and MS imagery (see Table 1).

Table 1: Descriptive statistics for imagery ability and imagery use

Variable	*Mean*	*SD*	α
Age	27.80	11.00	
GH	1.30	2.74	
EVI	3.57	0.96	.94
IVI	4.01	0.84	.94
KIN	3.93	0.97	.95
CS	5.52	0.99	.82
CG	5.29	1.11	.72
MS	4.44	1.40	.75
MG-A	4.43	1.17	.70
MG-M	5.22	1.14	.80

Abbreviations: GH = golf handicap, EVI = external visual imagery, IVI = internal visual imagery, KIN: kinaesthetic imagery, CS = cognitive specific, CG = cognitive general, MS = motivational specific, MG-A = motivational general-arousal, MG-M = motivational general-mastery

Note: VMIQ data was recoded so that 5 represents high vividness and 1 no image at all

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

Pearson bivariate correlations were calculated for the VMIQ-2 and SIQ subscales (see Table 2)

Table 2: Pearson bivariate correlations for golf handicap and imagery variables

Variables	1	2	3	4	5	6	7	8	9
1. GH	1.00								
2. EVI	-.22*	1.00							
3. IVI	-.37*	.48**	1.00						
4. KIN	-.33**	.23*	.62**	1.00					
5. CS	-.35**	.21*	.45**	.50**	1.00				
6. CG	-.19	.16	.29**	.23*	.63**	1.00			
7. MS	-.05	.06	-.01	.03	.22*	.39**	1.00		
8. MG-A	-.22*	.17	.07	.09	.39**	.47**	.51**	1.00	
9. MG-M	-.11	.12	.16	.18	.66**	.61**	.46**	.52**	1.00

Abbreviations: GH = golf handicap, IVI = internal visual imagery, EVI = external visual imagery, KIN = kinaesthetic imagery, CS = cognitive specific, CG = cognitive general, MS = motivational specific, MG-A = motivational general-arousal, MG-M = motivational general-mastery

Finally, five hierarchical regression analyses were conducted with golf handicap entered into the model first to control for differences in skill level as it has previously been reported to influence self-report scores when using imagery measures. For example, Gregg and Hall (2006) found that golf handicaps, a normative and objective measure of skill level, was a significant predictor of all five functions of imagery use. Based on the results of our repeated measures ANOVA and previous empirical evidence we elected to enter IVI in step 2, followed by KI then EVI (see Table 3).

Table 3: Hierarchical Regression for golf handicap and vividness of movement imagery ability predicting imagery use

Variable		*B*	*SEB*	*β*	R^2	ΔR^2	R^2_{change}
CS	Step 1: GH	-.88	.24	-.35**	.12	.11	.12
	Step 2: KIN	-.28	.06	.44**	.29	.27	.17
	Step 3: IVI	.12	.08	.18	.31	.29	.09
	Step 4: EVI	.01	.06	.02	.31	.28	.05
CG	Step 1: GH	-.48	.25	-.19*	.06	.05	.03
	Step 2: KIN	.11	.06	.19*	.05	.05	.03
	Step 3: IVI	.12	.09	.18	.07	.07	.03
	Step 4: EVI	.03	.07	.04	.06	.06	.01
MS	Step 1: GH	-.13	.26	-.05	.01	-.01	.00
	Step 2: KIN	.02	.07	.03	.03	-.02	.00
	Step 3: IVI	-.05	.09	.09	.01	-.03	.01
	Step 4: EVI	.06	.08	.09	.01	-.03	.00

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

MG-A	Step 1: GC	-.56	.26	-.22*	.05	.04	.05
	Step 2: KIN	-.01	.07	.02	.05	.03	.00
	Step 3: IVI	-.03	.04	-.05	.05	.02	.00
	Step 4: EVI	.12	.08	.18	.05	.04	.02
MG-M	Step 1: GH	-.28	.26	-.11	.01	.00	.01
	Step 2: KIN	.10	.07	-.16	.04	.02	.02
	Step 3: IVI	.05	.08	.07	.04	.01	.00
	Step 4: EVI	.04	.07	.07	.04	.00	.00

Abbreviations: GH = golf handicap, IVI = internal visual imagery, EVI = external visual imagery, KIN = kinaesthetic imagery, CS = cognitive specific, CG = cognitive general, MS = motivational specific, MG-A = motivational general-arousal, MG-M = motivational general-mastery

Discussion

The purpose of this study was to investigate differences in skilled golfers' vividness of movement imagery ability and their functions of imagery use and to examine the extent vividness of movement imagery ability predicted functions of imagery use. Previous studies have demonstrated that golfers use all five functions of imagery use (Gregg & Hall, 2006), however, there is a paucity of research concerning the association between vividness of movement imagery ability and imagery function, especially in skilled golfers.

The results of our study demonstrated that there were no significant differences between IVI and KI scores, however, participants recorded significantly higher KI scores than EVI scores. These are similar results to a series of studies conducted by Parker and Lovell (2011, 2012) who reported in samples of youth sports performers higher levels of vividness for IVI and KI than their EVI scores. In the current investigation, based on the VMIQ-2's response scales, these golfers present vividness of imagery scores which are broadly clear and reasonably vivid (see Roberts et al. 2008). Regarding imagery use, participants used all five functions of imagery use, however, higher CS scores were recorded than any of the other SIQ's imagery functions. Our result differs to that of Gregg and Hall (2006) who demonstrated that golfers used MG-M imagery more frequently followed by CS.

These different findings could be a result of the greater range of golfing handicaps (i.e., 0-25+) contained in their sample. Indeed, the mean averages in our sample for both CS and MG-M functions of imagery use are higher than those reported by Gregg and Hall (2006) and could indicate what functions of imagery use golfers in a high skill category are likely to adopt (see Slimani, et al., 2016). Finally, in using CS and CG imagery more frequently than the other functions of imagery use the golfers in our study display a similar imagery use profile as the elite level golfers interviewed in Bernier and Fournier's (2010) investigation who reported using imagery to perfect technique and develop tactical and strategic aspects of their golf games.

The first regression model indicated that golf handicap (R^2 = .12) significantly accounted for the variance in cognitive specific scores with further independent contributions made by IVI (R^2 = .12) followed by KI (R^2 = .07). EVI was not a significant predictor in this model. For CG imagery use, golf handicap (R^2 = .04) made a significant contribution to the model followed by IVI (R^2 = .05). KI and EVI made no additional improvements to the CG model. The final model to reach significance was MG-A with golf handicap (R^2 = .05) a significant predictor of this function of imagery use.

The results echo previous work that has shown that a golfer's skill level is associated with imagery use (see Gregg & Hall, 2006). Of note, our sample in comparison to Gregg and Hall's (2006) was exclusively composed of participants with golf handicaps from plus 4 (four below 0) to 5, often referred to as category 1 players (see CONGU). These results indicate that within this category sufficient skill level differences existed to significantly predict imagery use. Furthermore, inspection of the standardized beta weights indicated that lower handicaps in our sample resulted in participants reporting a higher frequency of CS, CG, and MG-A imagery use (see table 3). It is apparent this result highlights imagery ability is a cognitive skill where expertise differences can manifest within a narrow range of golf handicaps. Therefore, researchers and practitioners should be mindful that these homogenous categories (e.g., category 1 handicaps) may contain sufficient variation in skilled behaviors to warrant controlling for its effects and consider that a one size fits all regarding imagery interventions is possibly best avoided.

As hypothesised IVI was the most significant predictor of CS and CG imagery use. Regarding the CS function this result aligns with investigations that have shown that movement sequences when performed in a stable and predictable environment, with objects acted on by the individual, and executed in a self-paced fashion experience better imagery results when using an internal visual perspective (e.g., Cumming, Nordin, Horton, & Reynolds, 2006). CS imagery usually pertains to imagery that is used for the purposes of skill rehearsal. Previous empirical research has reported skilled golfers use imagery to perfect their technique (Bernier & Fournier, 2010) with a preference for utilising an internal perspective. Similarly, the golfers in our sample are likely using CS imagery to provide information about the sequence and position of their golf swings from a 1st person perspective (i.e., seeing the imaged movements through their own eyes). Although this result can be anticipated based on studies that have reported there are advantages for closed skills when internal imagery is used (Dana & Gozalzadeh, 2017), the contribution of both KI ability and IVI suggests modality and perspective may play a collaborative role in the images these golfers generate when creating CS imagery content. Indeed, Callow and colleagues (2017) propose that the cumulative contribution of these modalities and the internal visual perspective is likely to create images that provide a richer representation. Therefore, practitioners should monitor modality, perspective, and function integration to ensure the best imagery outcome for golfers.

The current investigation was not without limitations. As with previous research (e.g., Gregg & Hall, 2005), our results suggest that the VMIQ-2 does not successfully predict the MS, MG-A, and MG-M functions of imagery use. Therefore, scholars should utilise imagery ability measures that can more widely assess a golfer's imagery ability. For example, Greg and Hall (2006) designed the Motivational Imagery Ability Measure (MIAMS) to measure the ease by which participants experienced generating motivational general images and the subsequent emotion these images create. However, a noteworthy drawback is worth highlighting when employing the MIAMS in that it does not measure MS and cognitive imagery functions of imagery use. An additional candidate is Williams and Cumming's (2011) Sport Imagery Ability Questionnaire (SIAQ) which assesses athletes' skill, strategy, goal, affect, and mastery imagery ability. The SIAQ was designed by adopting similar content found in the SIQ, therefore it is plausible that it will better predict the SIQ's motivational functions than the VMIQ-2. However, the VMIQ-2 provides additional information regarding the vividness aspect of movement imagery ability, two imagery modalities, plus both visual imagery perspectives which have been found to have an independent effect on skilled performance (Callow et al., 2017). Therefore, we encourage practitioners to consider adopting these measures in tandem to achieve the most accurate measurement and means of screening a golfer's imagery ability.

In conclusion, the present study demonstrated that skilled golfers IVI and KI ability are significant predictors of CS and CG functions of imagery use. In addition, golf handicap accounted for a significant proportion of the variance in CS, CG, and MG-A imagery use with lower handicaps associated with increased levels of imagery use. Players, coaches, and practitioners should therefore consider the implications of these results based on the following recommendation. Interventions should in the initial stages target creating imagery scripts that develop skilled golfers IVI and KI ability with an orientation towards script content that pertains to cognitive specific and cognitive general imagery use. Indeed, our results highlight that that elite/skilled golfers have more vivid IVI than EVI and that increases in vividness for IVI alongside the contribution made by KI may play an important role in determining the frequency by which skilled golfers deploy CS and CG imagery use.

References

Baddeley, A. D., & Andrade, J. (2000). Working memory and the vividness of imagery. *Journal of Experimental Psychology: General*, *129*(1), 126-145. https://doi.org/10.1037/0096-3445.129.1.126

Bernier, M., & Fournier, J. F. (2010). Functions of mental imagery in expert golfers. *Psychology of Sport and Exercise*, *11*(6), 444-452. https://doi.org/10.1016/j.psychsport.2010.05.006

Brouziyne, M., & Molinaro, C. (2005). Mental imagery combined with physical practice of approach shots for golf beginners. *Perceptual and Motor Skills*, *10*(1), 203-211. https://doi.org/10.2466/pms.101.1.203-211

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

Callow, N., Jiang, D., Roberts, R., & Edwards, M. (2017). Kinesthetic imagery provides additive benefits to internal visual imagery on slalom task performance. *Journal of Sport and Exercise Psychology*, *39*(1), 81-86. https://doi.org/10.1123/jsep.2016-0168

Callow, N., & Roberts, R. (2010). Imagery research: an investigation of three issues. *Psychology of Sport and Exercise*, *11*(4), 325-329. https://doi.org/10.1016/j.psychsport.2010.03.002

Carroll, R. J. (2017). *Transformation and weighting in regression*. Routledge: Chapman and Hall.

Collet, C., Guillot, A., Lebon, F., MacIntyre, T., & Moran, A. (2011). Measuring motor imagery using psychometric, behavioral, and psychophysiological tools. *Exercise and Sport Sciences Reviews*, *39*(2), 85-92. doi: 10.1097/JES.0b013e31820ac5e0

Cumming, J., Nordin, S. M., Horton, R., & Reynolds, S. (2006). Examining the direction of imagery and self-talk on dart-throwing performance and self-efficacy. *The Sport Psychologist*, *20*(3), 257-274. https://doi.org/10.1123/tsp.20.3.257

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. https://doi.org/10.1051/sm/2013098

Dana, A., & Gozalzadeh E. Internal and external imagery effects on tennis skills among novices. *Perceptual and Motor Skills*, *124*(5), 1022-1043. https://doi.org/10.1177/0031512517719611

Fournier, J. F., Deremaux, S. & Bernier, M. (2008). Content, characteristics and function of mental images. *Psychology of Sport and Exercise*, *9*(6), 734-748. https://doi.org/10.1016/j.psychsport.2007.12.003

Ghasemi, A. & Zahediasl, S. (2012). Normality tests for statistical analysis. a guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486-489. doi: 10.5812/ijem.3505

Gregg, M., Hall, C., & Nederhof, E. (2005). The imagery ability, imagery use and performance relationship. *The Sport Psychologist*, *19*, 93–99. doi: 10.1123/tsp.19.1.93

Gregg, M., & Hall, C. (2006). The relationship of skill level and age to the use of imagery by golfers. *Journal of Applied Sport Psychology*, *18*(4), 363-375. https://doi.org/10.1080/10413200600944140

Gregg, M., & Hall, C. (2006). Measurement of motivational imagery abilities in sport. *Journal of Sports Sciences*, *24*(9), 961-971. https://doi.org/10.1080/02640410500386167

Gregg, M., Hall, C., McGowen, E., & Hall, N. (2011). The relationship between imagery ability and imagery use among athletes. *Journal of Applied Sport Psychology*, *23*(2), 129-141. https://doi.org/10.1080/10413200.2010.544279

Hall, C. R., Mack, D. E., Paivio, A., & Hauesenblas, H. A. (1998). Imagery use by athletes: development of the sport imagery questionnaire. *International Journal of Sport Psychology*, *29*, 73-89.

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.

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006

Hall, C. R., Pongrac, J., & Buckolz, E. (1985). The measurement of imagery ability. *Human Movement Science*, *4*(2), 107-118. https://doi.org/10.1016/0167-9457(85)90006-5

Hardy, L., & Jones, G. (1994). Current issues and future directions for performance-related research in sport psychology. *Journal of Sports Sciences*, *12*(1), 61-92. https://doi.org/10.1080/02640419408732158

Marks, D. F., & Isaac, A. R. (1995). The topographical distribution of EEG activity accompanying visual and motor imagery in vivid and non-vivid imagers. *British Journal of Psychology*, *86*(2), 271-282. https://doi.org/10.1111/j.2044-8295.1995.tb02561.x

Marshall, B., & Wright, D. J. (2016). Layered stimulus response training versus combined action observation and imagery: effects on golf putting performance and imagery ability characteristics. *Journal of Imagery Research in Sport and Physical Activity*, *11*, 35-46. https://doi.org/10.1515/jirspa-2016-0007

Martin, K. A., Moritz, S. E., & Hall, C. (1999). Imagery use in sport: a literature review and applied model. *The Sport Psychologist*, *13*(3), 245-268. https://doi.org/10.1123/tsp.13.3.245

McCaffrey, N., & Orlick, T. (1989). Mental factors related to excellence among top professional golfers. *International Journal of Sport Psychology*, *20*, 256-276.

McLean, N., & Richardson, A. (1994). The role of imagery in perfecting already learned physical skills. In *imagery in sports and physical performance*, ed. A. A. Sheikh and E. R. Korn, 59-73. Amityville, NY: Baywood Publishing.

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 ed., pp. 297-324). Champaign, IL: Human Kinetics.

Nicklaus, J. (1974). *Golf my way*. William Heinemann Ltd.

Nordin, S. M., & Cumming, J. (2008). Types and functions of athletes imagery: testing predictions from the applied model of imagery use by examining effectiveness. *International Journal of Sport and Exercise Psychology*, *6*(2), 189–206. https://doi.org/10.1080/1612197X.2008.9671861

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill: New York.

Paivio, A. (1985). Cognitive and motivational functions of imagery in human performance. *Canadian Journal of Applied Sport Sciences*, *10*, 22S-28S.

Parker, J. K., & Lovell, G. P. (2009). Characteristics affecting the use of imagery: a youth sports academy study. *Journal of Imagery Research in Sport and Physical Activity*, *4*, 1–15. https://doi.org/10.2202/1932-0191.1034

Parker, J. K., & Lovell, G. (2011). The influence of experience upon imagery perspective in adolescent sport performers. *Journal of Imagery Research in Sport and Physical Activity*, *6*, 1-17. https://doi.org/10.2202/1932-0191.1048

Parker, J. K., & Lovell, G. (2012). Age differences in the vividness of youth sport performers imagery ability. *Journal of Imagery Research in Sport and Physical Activity*, *7*, 1-13. https://doi.org/10.1515/1932-0191.1069

Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (2008). Movement imagery ability: development and assessment of a revised version of the vividness of movement imagery questionnaire. *Journal of Sport and Exercise Psychology*, *30*(2), 200-221. https://doi.org/10.1123/jsep.30.2.200

Simonsmeier B. A., & Buecker, S. (2017). Interrelations of imagery use, imagery ability, and performance in young athletes. *Journal of Applied Sport Psychology*, *29*(1), 32-43. https://doi.org/10.1080/10413200.2016.1187686

Simpson, J., Munroe-Chandler, K. J., & Paradis, K. J. (2020). The relationship between passion and imagery use in competitive youth gymnastics. *Science of Gymnastics Journal*, *12*(1), 49-59.

Slimani, M., Chamari, K., Boudhiba, D., & Chéour, F. (2016). Mediator and moderator variables of imagery use-motor learning and sport performance relationships: a narrative review. *Sport Sciences for Health*, *12*(1), 1-9. https://doi.org/10.1007/s11332-016-0265-1

Smith, D., Wright, C. J., & Cantwell, C. (2008). Beating the bunker: the effect of PETTLEP on golf bunker shot performance. *Research Quarterly for Exercise and Sport*, *79*(3), 385-391. https://doi.org/10.1080/02701367.2008.10599502

Spittle, M., & Morris, T. (1999a). Training of imagery perspectives. *Proceedings of the 5th International Olympic Committee world Congress on Sport Sciences*, 142. Sydney, Australia.

Spittle, M., & Morris, T. (2000). Imagery perspective preferences and motor performance. *Australian Journal of Psychology*, 52S, 112.

Swainston, S., Gentner, N., Biber, D., Czech, D. R., Joyner, B., & Easton, L. E. (2012). The effect of PETTLEP imagery in pre-shot routine on full swing golf shot accuracy: a single subject design. *International Journal of Golf Science*, *1*(2), 140-163.

Thomas, P. R., & Fogarty, G. J. (1997). Psychological skills training in golf: the role of individual differences in cognitive preferences. *The Sport Psychologist*, *11*(1), 86-106. https://doi.org/10.1123/tsp.11.1.86

Williams, S. E., & Cumming, J. (2011). Measuring athlete imagery ability: the sport imagery ability questionnaire. *Journal of Sport and Exercise Psychology*, *33*(3), 416-440. https://doi.org/10.1123/jsep.33.3.416

Williams, S. E., Cumming, J., Ntoumanis, N., Nordin-Bates, S. M., Ramsey, R., & Hall, C. (2012). Further validation and development of the movement imagery questionnaire. *Journal of Sport and Exercise Psychology*, *34*(5), 621-646. https://doi.org/10.1123/jsep.34.5.621

White, A., & Hardy, L. (1995). Use of different imagery perspectives on the learning and performance of different motor-skills. *British Journal of Psychology*, *86*, 169-180. https://doi.org/10.1111/j.2044-8295.1995.tb02554.x

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*(4), 387-403. https://doi.org/10.1123/tsp.12.4.387

Woolfolk R. L., Parrish, M. W., & Murphy, S. M. (1985). The effects of positive and negative imagery on motor skill performance. *Cognitive Therapy and Research*, *9*, 335-341. https://doi.org/10.1007/BF01183852

Accepted manuscript of Parker, J. K., Lovell, G. P., & Jones, M. I. (2021). An examination of imagery ability and imagery use in skilled golfers. *Journal of Imagery Research in Sport and Physical Activity*, *16*, no. 1, pp. 20210006. https://doi.org/10.1515/jirspa-2021-0006