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Imagery perspectives, imagery ability and personality

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Imagery Perspectives, Imagery Ability, and Personality

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LIST OF APPENDICES

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SUMMARY

This thesis is written as a collection of three research papers detailing six studies, through which imagery perspectives, imagery ability, and personality, were investigated. Studies 1 and 2 explored the effects of internal visual imagery and external visual imagery on the performance of slalom-based motor tasks that require an effective use of line for a successful performance. Study 1 provided support for the beneficial effects of internal visual imagery over external visual imagery for the performance of slalom-based tasks; however Study 2 only provided some additional support. In Studies 3-5, an existing imagery ability questionnaire was adapted to bring it in line with contemporary views on imagery perspectives and kinaesthetic imagery. More specifically, in Study 3, the instructional set of this questionnaire was altered so as to be able to assess 3 factors: internal visual imagery, external visual imagery and kinaesthetic imagery ability. Following confirmatory factor analysis procedures and item deletion an acceptable model fit was provided, supporting the 3-factor structure of the questionnaire. Further analyses also supported the delineation of internal visual imagery and kinaesthetic imagery as separate modalities. Study 4 confirmed the factorial validity of this questionnaire with a different sample, and Study 5 provided initial support for the concurrent and construct validity of this questionnaire. Study 6 examined the effect of narcissism on the efficacy of imagery perspectives on golf putting performance. High narcissists using external visual imagery displayed performance improvements, whereas high narcissists using internal visual imagery did not. The performance of low narcissists remained relatively constant regardless of imagery perspective used. The results highlight narcissism as a moderator of imagery perspective effectiveness.

CHAPTER 1

General Introduction

Imagery

Within sport, imagery is one of the most popular techniques used in psychological skills training (e.g., Short et al., 2002). Imagery is often employed for a variety of functions such as: to facilitate the learning and performance of specific motor skills (e.g., Blair, Hall, & Leyshon, 1993); to increase confidence (Callow, Hardy, & Hall, 2001; Feltz & Reissinger, 1990); to control anxiety (cf. Hanton & Jones, 1999); and to aid rehabilitation from injury (e.g., Evans, Hare, & Mullen, 2006). The fact that imagery is used for so many functions signifies its importance as a variable of interest within Sport Psychology. This importance is further highlighted by the views of Olympic medallists, who perceive that imagery plays a key role in aiding performance (cf. Greenleaf, Gould, & Dieffenbach, 2001; Orlick & Partington, 1988).

Research examining the efficacy of imagery has largely focused on the learning and performance of motor skills (e.g., see Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983; Hinshaw, 1991 for meta-analyses). These meta-analyses have reported varying effect sizes (.48, .26, and .68 respectively), leading to the conclusion that imagery has a small to moderate effect on performance. Despite these mixed results, the received view within the literature (e.g., Hall, 2001; Holmes & Collins, 2001) is that imagery does enhance the performance of motor skills. However, researchers have identified a number of variables that influence the perceived effectiveness of imagery. These variables include: imagery perspective (e.g., Hardy, 1997; Morris, Spittle, & Watt, 2004); imagery ability (e.g., Martin, Moritz, & Hall, 1999); cognitive style (O'Halloran & Gauvin, 1994); expertise at a task (cf. Hardy & Callow, 1999); imagery preference (Hall, 1997); confidence in using imagery (Short, Tenute, & Feltz, 2005); and personality (cf. Hardy, Jones, & Gould, 1996). The present thesis focuses on three of these variables; namely, imagery perspective, imagery ability and personality, with imagery perspectives underpinning the latter two.

Imagery Perspective

Imagery perspective relates to whether a performer imagines performing a task through their own eyes (a first person or internal perspective), or whether they actually imagine watching themselves perform the task (a third person or external perspective). Mahoney and Avener (1977) first distinguished between internal and external imagery perspectives. Internal imagery was defined as "an approximation of the real life phenomenology such that a person actually imagines being inside his/her body and experiencing those sensations that might be expected in the actual situation" (p.137). External imagery was defined as "when a person views himself from the perspective of an external observer" (p.137).

Using these conceptualisations, Mahoney and Avener (1977) examined whether imagery perspectives were related to performance. Their findings revealed that successful Olympic gymnasts reported using more internal imagery than external imagery. However, follow-up studies have failed to replicate this result, and have produced equivocal findings. For example, Ungerleider and Golding (1991) found that successful Olympic track and field athletes reported a greater use of external imagery than internal imagery, and stronger physical sensations, than non-successful track and field athletes. Further to this, no differences in the use of imagery perspectives have been reported in other sports, such as diving (Highlen &

Bennett, 1983) and racquetball (Meyers, Cooke, Cullen, & Liles, 1979). Several experimental studies (e.g., Epstein, 1980; Gordon, Weinberg, & Jackson, 1994) have also reported no differences between imagery perspectives in enhancing motor performance. However, internal imagery has been shown to produce greater muscle EMG activity than external imagery (Hale, 1982).

In order to account for these equivocal findings, three explanations have been offered in the literature. The first explanation is that kinaesthetic imagery and internal visual imagery have been confused in their conceptualisations. To expand, Mahoney and Avener's (1977) internal imagery definition has been criticised as it assumes that internal imagery comprises both the visual and kinaesthetic imagery modalities, thereby failing to differentiate between first person visual imagery (i.e., internal visual imagery) and kinaesthetic imagery (Hardy, 1997; White & Hardy, 1995). This differentiation between modalities is important because imagery modality and imagery perspective are not the same (Holmes, 2007; Morris et al., 2004). Imagery modality refers to the sensory modality that the image is experienced in (i.e., visual, kinaesthetic, auditory etc.). Imagery perspective is solely concerned with the visual modality, and refers to the view taken by the imager when they are visually imaging a movement (i.e., internal visual imagery or external visual imagery).

The confusion over what modalities are actually involved in internal imagery has led to differences in the way internal imagery is operationalised within the literature. For example, some researchers (e.g., Hale, 1982) consider internal imagery to be a multi-modal imagery perspective incorporating visual and kinaesthetic imagery. However, others (e.g., Cumming & Ste-Marie, 2001; Glisky, Williams & Kihlstrom, 1996) consider it a visual perspective (i.e., internal *visual* imagery), where kinaesthetic imagery can be experienced concurrently as a separate modality. This difference in conceptualisations may explain some of the equivocal results from previous studies, as when researchers report the use of internal imagery based on Mahoney and Avener's (1977) definition, it is impossible to know whether internal visual imagery, kinaesthetic imagery, or indeed a combination of the two is being used (cf. Hardy, 1997). So it is, perhaps, unsurprising that greater muscle EMG activity occurs during internal imagery than external imagery (Hale) as it is likely that kinaesthetic imagery is actually being assessed. Consequently, it is important that researchers do indeed try and separate these two modalities, as visual and kinaesthetic imagery have been shown to result in differential effects on performance (Hardy & Callow, 1999).

Further support for the separation of these modalities comes from dual-task interference studies. Research by Smyth and Waller (1998) and Stevens (2005) indicates that visual and kinaesthetic imagery are operated by different processing mechanisms, as imaging in these modalities is differentially affected by modality specific secondary tasks. Specifically, visual imagery is more affected by visual secondary tasks than kinaesthetic imagery, and kinaesthetic imagery is more affected by kinaesthetic secondary tasks than visual imagery. Although, imagery perspective was not described in these dual-task studies, they do indicate that visual and kinaesthetic imagery are separate modalities, and therefore, implicitly, support the notion that internal visual imagery and kinaesthetic imagery should be treated separately. This line of reasoning is also evidenced by neuroscientific research. Using transcranial magnetic stimulation, Fourkas, Ionta, and Aglioti (2006) have reported differences in corticospinal activity between internal visual imagery and kinaesthetic imagery.

The second explanation for the equivocal results points to the fact that it has, incorrectly, been assumed that kinaesthetic imagery can only be experienced from an internal perspective. Although some researchers (cf. Collins & Hale, 1997; Hale, 1982) have suggested that kinaesthetic imagery can only be experienced from an internal perspective, a large number of studies (e.g., Calmels, Holmes, Lopez, & Naman, 2006; Cumming & Ste-Marie, 2001; Glisky et al., 1996; Hardy & Callow, 1999; Holmes, 2007; White & Hardy, 1995) have demonstrated that kinaesthetic imagery can be experienced through an external visual imagery perspective, which appears to refute this suggestion. This finding is not controversial, as visual and kinaesthetic (motor) images are encoded using different neural networks in the brain (Jeannerod, 1994) and can be activated at the same time (Klatzky, 1994). Further, significant relationships between external visual imagery and kinaesthetic imagery have also been demonstrated (Callow & Hardy, 2004).

However, an important issue to consider when examining the relationship between external visual imagery and kinaesthetic imagery is that of behavioural agency. Behavioural agency concerns whether the performer imagines watching *themselves* when using external visual imagery, or whether they imagine watching *somebody else*. Within much of the sport psychology literature (e.g., Cumming & Ste-Marie, 2001; Hardy & Callow, 1999; Glisky et al., 1996), external visual imagery is considered as imagery of the self from an external point of view. Conversely, within the neuroscientific literature, external visual imagery is often conceptualised as imagery of someone else (e.g., Fourkas, Avenanti, Urgesi, & Aglioti, 2006; Ruby & Decety, 2001). Although this difference in agency may appear trivial, self and other imagery activate different neural areas within the brain (Ruby & Decety) and may involve different cognitive processes (Denis, Englekamp,

& Mohr, 1991). To expand, Denis et al. suggest that self imagery may involve visual representations that are likely to be enriched by the evocation of motor programs and kinaesthetic sensations. However, imagery of someone else is suggested to predominantly involve the visual system. Therefore, it could be proposed that kinaesthetic imagery is more likely to be experienced when external visual imagery is of the self, as opposed to someone else. Indeed, research shows that when the performer is made the agent of the image, the relationship between external visual imagery and kinaesthetic imagery is stronger than when external visual imagery of someone else is performed (Callow & Hardy, 2004). In fact, Callow and Hardy demonstrated no significant relationship between external visual imagery and kinaesthetic imagery when participants were asked to form external visual images of someone else.

The final explanation for the equivocal findings is that certain imagery perspectives may be more useful for certain tasks than for others. Highlen and Bennett (1979) proposed that imagery may be more beneficial in closed skill sports such as gymnastics as opposed to open skill sports such as wrestling, as in gymnastics athletes can image performing at their own pace. Furthermore, they would not be required to image the performance of opponents (something that would be required in open skills such as wrestling). In addition, it has also been suggested that open skills may benefit from the use of external visual imagery, and closed skills may benefit more from the use of internal visual imagery (Mclean & Richardson, 1994; Morris et al., 2004). However, the exact reasons for why open and closed skills may be more suitable for different imagery perspectives have not been offered.

Hardy and colleagues (Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995) have investigated this task characteristics proposal, and have offered two hypotheses. They hypothesised that external visual imagery would be superior to internal visual imagery for tasks relying heavily on the use of form (such as gymnastics), whereas internal visual imagery would be superior to external visual imagery for the performance of slalom-based tasks that require a performer to follow a line around or through a set course (such as canoe-slalom). These hypotheses were based on the rationale that imagery exerts a beneficial effect on performance only to the extent that the images that are created supplement existing information to the performer (Hardy, 1997). Therefore, for tasks relying heavily upon the use of form, external visual imagery may allow a performer to see the desired shape associated with the correct movements. This information would not be available from an internal visual image. For slalom-based tasks internal visual imagery may allow a performer to see the precise spatial and temporal locations at which key movements (such as braking or changing direction) should be initiated so as to be able to stay on the correct line. Further to this, Hardy also suggested that performers should use kinaesthetic imagery with either visual perspective, so as to be able to match the timing and feel of the movements with the visual images created.

In order to explore these hypotheses, White and Hardy (1995) examined the relative efficacy of internal visual imagery and external visual imagery for the performance of two motor tasks, one relying heavily on the use of form (a rhythmic gymnastics routine), and the other requiring a line to be followed through a set course (a wheelchair slalom task). In the gymnastics routine participants using external visual imagery made fewer errors than those using internal visual imagery, thus supporting Hardy and colleagues' (1995, 1997, 1999) external visual imagery hypothesis. However, in the wheelchair slalom task, results were not fully supportive of Hardy and colleagues' hypothesis concerning internal visual imagery. In this task, the use of internal visual imagery improved the accuracy of performance (as less errors were made); however the use of external visual imagery resulted in the course being completed in a quicker time. In both tasks, White and Hardy also assessed the experience of kinaesthetic imagery during internal and external visual imagery. Results revealed no difference in the experience of kinaesthetic imagery between either imagery perspective, regardless of the task.

More recently, Hardy and Callow (1999) extended research into the effectiveness of imagery perspectives for the performance of form based tasks. Using a series of three ecologically valid tasks; a karate kata with experienced karateka, a gymnastics routine with novice gymnasts, and a technical climbing task with expert climbers, Hardy and Callow demonstrated superior performance gains for external visual imagery over internal visual imagery in each task. In addition to this, kinaesthetic imagery was manipulated with both visual perspectives in the gymnastic routine and climbing task. For the gymnastics routine, kinaesthetic imagery had no effect on performance. However, in the climbing task, kinaesthetic imagery had a beneficial effect on performance over and above the effects of visual imagery. These findings were interpreted in line with Whiting and den Brinker's (1981) image of the act (the general framework required for performance) and image of the achievement (precise muscular forces required to perform the movement). In each of the three tasks, external visual imagery was proposed to have provided participants with an image of the act, as external visual imagery may have allowed performers to see the desired shape associated with the correct movement. In the climbing task, where expert performers were used, kinaesthetic imagery was proposed to have provided participants with an image of achievement, as these expert climbers would have knowledge of how the correct movements should feel. Hardy and Callow suggested that kinaesthetic imagery did not have a beneficial effect in the gymnastics routine, as the participants used were novices, and so were unable to use kinaesthetic imagery effectively to form an image of achievement.

To summarise, the literature investigating the effects of internal and external visual imagery on the performance of form based tasks (e.g., Hardy & Callow, 1999; White & Hardy, 1995) has provided support for Hardy and colleagues' (1995, 1997, 1999) external visual imagery hypothesis. Further to this, Hardy's (1997) suggestions concerning the use of kinaesthetic imagery along with each visual perspective have received some support, although it appears that a degree of expertise at the task is required to make effective use of kinaesthetic imagery.

However, to date, White and Hardy (1995) are the only researchers to have examined Hardy and colleagues' (1995, 1997, 1999) hypothesis concerning the proposed superiority of internal visual imagery over external visual imagery for the performance of slalom-based tasks. Therefore, the findings from their wheelchair slalom task have yet to be re-examined and substantiated. Furthermore the ecological validity of wheelchair slalom can be questioned. Consequently, the aim of the first two studies of the thesis (Chapter 2) was to re-examine the effects of different imagery perspectives with more ecologically valid slalom based tasks. An additional criticism of the wheelchair slalom task used by White and Hardy (1995) concerns the movement characteristics associated with it. As the wheelchair slalom task was performed on a flat surface, a key characteristic in order for a quick performance time to be achieved was the generation of speed. However, the types of slalom based tasks that Hardy and colleagues hypothesised would be benefited by internal visual imagery, such as slalom skiing and canoe slalom, do not have speed generation as one of the key task components. Rather, they require a much faster speed to be controlled. In these tasks, due to the force of water or steepness of the slope, a good performance depends on being able to control speed in relation to the line taken. Consequently, Studies 1 and 2 of the thesis (Chapter 2) used experimental tasks that required speed to be controlled rather than generated[1].

Imagery Ability

Imagery ability has been identified as an important moderator of imagery interventions (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; Hall, Buckolz, & Fishburne, 1989), such that imagery interventions are more effective for athletes reporting higher levels of imagery ability (e.g., Isaac, 1992). Two key characteristics of imagery ability are vividness and controllability (Callow & Hardy, 2005; Holmes, 2007; Start & Richardson, 1964). Vividness refers to the clarity and realism of the image, whilst controllability refers to the ability to manipulate and direct the image (Murphy & Martin, 2002).

Imagery ability is usually assessed through the use of validated self-report questionnaires that differ with respect to the stimuli that are imagined. Within the motor domain two sets of questionnaires are commonly used. The first set of questionnaires comprises the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), and the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986). These questionnaires assess imagery vividness specifically. The VVIQ assesses visuo-spatial imagery via imagination of people,

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[1] A research note is presented in Appendix A that examines the effects of internal visual imagery and external visual imagery on the performance of a slalom-based hockey dribbling task. Due to limitations in the experimental design, it is not included as a chapter. However, because the study guided the development of studies 1 and 2, it is included as an Appendix.

places and scenes, and the VMIQ is designed to assess the ability to visually and kinaesthetically image a variety of motor tasks (e.g., running downhill and jumping off a high wall). The other set of questionnaires used comprise the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983) and its revised version the MIQ-R (Hall & Martin, 1997). The MIQ and MIQ-R both assess the ability to image movements using visual and kinaesthetic imagery. Although vividness is an important aspect of these questionnaires, as respondents are required to create as vivid an image as possible of a particular motor task, it is not measured specifically as the MIQ and MIQ-R focus on imagery ability in general (see Hall, 1998).

Image controllability measures do exist within the literature (e.g., Gordon, 1949) however image control is not assessed as often as vividness. This is because vividness is an easier variable to manipulate and assess than control is, and, furthermore, imagery vividness and controllability are linked such that control is a pre-requisite for vividness (Marks, 1999).

Within the motor domain, the VMIQ and MIQ-R are the most commonly used measures of imagery ability. When questionnaires such as these have been used, they have been able to capture the theoretically proposed effects of imagery ability. For example, imagery ability moderates the imagery use-performance relationship (Gregg, Hall, & Nesterhoff, 2005) and good imagers have been shown to be able to produce accurate movement patterns more quickly than poor imagers (Goss, et al. 1986; Hall et al., 1989). Trampolinists reporting high levels of imagery ability have demonstrated greater performance improvements following an imagery training program than those reporting low imagery ability, regardless of level of expertise (Isaac, 1992). Further to this intervention studies (e.g., Short et al., 2002;

Smith & Holmes, 2004) that have used specific imagery ability criteria as pre-intervention requirements have obtained significant performance effects.

The research listed above indicates that imagery questionnaires involving imagery vividness are useful measures of imagery ability. However, the use of vividness has been criticised. For example, Dean and Morris (2003) contend that the use of vividness incorrectly assumes that imagery ability is a one-dimensional construct. They purport that imagery ability should be considered more from a multi-dimensional perspective as a collection of abilities, including image generation, maintenance and transformation (cf. Kosslyn, 1994). Further, they propose that vividness should not be used as the independent variable to reflect imagery ability, as there is often no relationship between imagery vividness scores and the performance of spatial tests (see Burton & Fogarty, 2003 for a review of related literature on this issue).

In responses to these criticisms, it makes intuitive sense that vividness could reflect the processes of imagery formation, maintenance, and transformation. For example, when imaging a movement (e.g., climbing over a high wall) the process of imagery formation, maintenance, and transformation would have to occur to be able to see the image from start to finish of the movement. If an individual's transformation of the imagery is poor, then it makes sense that the image would not be vivid (i.e., he/she would not be able to see his/herself move from one side or the wall to the other clearly) and consequently his/her vividness score would be low. This suggestion is further substantiated by a consideration of the role of working memory in imagery vividness. Image generation (formation) processes occur in long term memory, whereas image maintenance requires working memory resources (Rangananth, 2006). Imagery vividness reflects the richness of the representation that is displayed within working memory (Baddeley & Andrade, 2000). Therefore, for an image to be vivid it would require the retrieval of information stored in long term memory to be fed into short term working memory, and so would likely involve the processes of formation, maintenance and transformation.

Regarding Dean and Morris' (2003) second criticism of vividness, that vividness is unrelated to the performance of spatial ability tests, other research indicates that the lack of relationship between vividness and spatial tasks is not due to a "problem" with vividness. Rather, it is due to the nature of the tasks being explored in these studies. For example, Marks (1999) argues that such tests (e.g., mental rotation tasks) can be performed by using detailed point-by-point comparison of shapes that are presented simultaneously, and so do not require the use of imagery. Further to this, several researchers (e.g., Blajenkova, Kozhevnikov, & Motes, 2006) have suggested that the reason many imagery vividness questionnaires (such as the VVIQ) are unrelated to spatial ability tests is because these questionnaires are concerned with "object imagery" (i.e., imaging items such as people and places that are constructed from long term memory), and not spatial imagery (e.g., transformation elements of imagery). Therefore, there is no reason to expect a correlation. Finally, it is notable that this second criticism of vividness is in relation to spatial tasks specifically. In other domains of psychology, vividness has been shown to be an important construct, as vivid imagery has been shown to produce changes in behaviour (Lang, Melamed, & Hart, 1970) and appears to be a vital pre-requisite for using imagery to aid motor performance (see Isaac, 1992; Smith & Holmes, 2004).

Dean and Morris (2003) also make recommendations for the re-examination of imagery questionnaires, as they suggest that the stimuli that appear on questionnaires are often very different from the experimental tasks used. More specifically, questionnaires such as the VVIQ require participants to imagine a variety of real-life tasks which are either recalled or constructed from elements stored in long term memory. Shapes that are manipulated in mental rotation tasks, on the other hand, are usually unseen and perceived, and then held or manipulated in short term memory. This difference in stimuli may also explain the lack of relationship between vividness and spatial task performance. While this explanation may be appropriate for the performance of spatial tasks, it does not sit comfortably with the performance of motor skills. The items on the VMIQ and MIQ-R actually require participants to imagine a variety of movements. These questionnaires are most commonly used to assess the imagery ability of participants prior to the undertaking of an imagery intervention to aid the performance of different motor skills (see for example, Short et al., 2002; Smith & Holmes, 2004). Therefore, the items on the questionnaire and the task being imaged share greater congruence.

With these responses in mind, in the present author's opinion, movement imagery questionnaires that involve imagery vividness such as the VMIQ and MIQ-R are appropriate to use to assess imagery ability. However, the present author does share Dean and Morris' (2003) view that imagery questionnaires should be re-examined, as a closer inspection of the VMIQ and MIQ-R reveals that these questionnaires do have two limitations associated with them.

The first limitation involves the assessment (or lack of) of imagery perspectives within these questionnaires. Although the VMIQ is designed to assess visual and kinaesthetic imagery vividness, the kinaesthetic factor requires the respondent to imagine "doing" the movements "yourself", making no explicit instruction to use kinaesthetic imagery and not internal visual imagery.

Consequently, this factor could be interpreted as requiring respondents to use internal visual imagery rather than kinaesthetic imagery, or, perhaps, a combination of the two. The imprecise nature of "doing it yourself" confounds internal visual imagery and kinaesthetic imagery, in a similar vein to Mahoney and Avener's (1977) definition of internal imagery. As kinaesthetic and visual imagery do have differential effects (Hardy & Callow, 1999; Stevens, 2005), it is a limitation of the VMIQ that internal visual imagery and kinaesthetic imagery are not distinguished. Therefore, at present, researchers cannot obtain data corresponding to the ability to use these different modalities. Second, as the visual subscale requires the imager to "imagine watching somebody else" performing the movements, the imager is not made the agent of the image. Given the importance of agency for kinaesthetic imagery to be experienced from an external perspective (Callow & Hardy, 2004), it is surprising that the VMIQ does not consider this. Moreover, the vast majority of intervention studies that involve external visual imagery (e.g., Cumming & Ste-Marie, 2001; Glisky et al., 1996; Hale, 1982; Hardy & Callow, 1999) require participants to use external visual imagery of the self. Consequently, as imagery ability moderates imagery effectiveness, it is problematic that the VMIQ does not allow for an assessment of external self visual imagery ability. In contrast, the instructional set of the MIQ-R explicitly states that visual and kinaesthetic imagery ability are assessed in this questionnaire. However, a limitation of the MIQ-R is that the visual subscale makes no distinction between imagery perspectives, therefore any differences in the ability to use internal visual imagery or external visual imagery cannot be explored.

The second limitation of the VMIQ and MIQ-R is that their psychometric properties have not been assessed using thorough psychometric analysis. Although both questionnaires display adequate construct validity (cf. Isaac & Marks, 1994; Hall & Martin, 1997), the factor structure of the VMIQ has only been assessed using exploratory factor analysis techniques (e.g., Atienza, Balaguer, & Garcia-Merita, 1994; Campos & Perez, 1990). Further, although the factor structure of the original MIQ has been supported through the use of exploratory factor analysis (Atienza et al.), the structure of the MIQ-R is yet to be tested. In order to test the underlying factor structure of questionnaires, researchers (Biddle, Markland, Gilbourne, Chatzisarantis, & Sparkes, 2001) have advocated the use of confirmatory factor analysis (CFA) as a preferred and more rigorous method than exploratory factor analysis (EFA). This is because CFA utilises a theory driven approach (i.e., how well does the instrument support the underlying theory that is being assessed?). Conversely, EFA utilises a data driven approach where researchers may seek to adjust the factor structure of an instrument based on the results obtained, with no consideration for an underlying theory. In reference to EFA, Biddle et al. suggest that "there is an element of flawed logic to the whole process. If one has an a priori model of the factor structure of an instrument it surely makes sense to attempt to directly test that model by determining whether the data are consistent with the hypothesised relationships among the factors and observed items" (p.785). Therefore, CFA should be the preferred analysis for the examination of the underlying factor structure of imagery questionnaires.

It is apparent that no measure currently exists within the literature that assesses both visual and kinaesthetic imagery, makes a distinction between imagery perspectives, considers internal visual imagery and kinaesthetic imagery as separate modalities, and displays evidence of an acceptable factor structure. Consequently, the aim of Chapter 3 (Studies 3-5) was to revise the VMIQ in order to make it an accurate assessment of imagery perspectives and kinaesthetic imagery, with satisfactory factorial validity.

Personality

Personality has been identified as a fundamental attribute for psychological preparation (Hardy et al., 1996). Hardy et al. proposed a conceptual model where psychological skills such as imagery would interact with personality characteristics in order for peak performance to be reached. Based on this it could be proposed that personality may influence the effectiveness of imagery. However, this proposal remains to be examined as research (e.g., Campos, Chiva, & Moreau, 2000; Mantani, Okamoto, Shirao, Okada, & Yamawaki, 2005; Morris & Gale, 1974) has only considered the relationship between imagery and personality. Specifically, Morris and Gale found extraversion to be positively related to imagery vividness. Both Campos et al. and Mantani et al. demonstrated that individual differences in alexithymia (a personality variable related to the inability or lack of desire to express or understand one's feelings; see Taylor, Bagby, & Parker, 1997) impacted on reported imagery vividness. More precisely, in both studies, individuals higher in alexithymia reported lower imagery vividness. While not examining the role of a personality variable per se, Abma, Fry, Relyea, and Li (2002) did find differences in imagery use and imagery ability between high and low *trait* confident athletes.

Although imagery and personality are related, personality has yet to be considered within imagery perspective research. Given the above findings demonstrating a link between personality and imagery, and Hardy et al's. (1996) conceptual model, it would be interesting to explore if personality interacts with imagery perspectives to influence their effectiveness. Therefore, the final study of this thesis (Study 6) investigated whether a particular personality variable (narcissism) would impact on the effectiveness of different imagery perspectives. When describing narcissism in the present thesis, narcissism is treated as a continuous personality variable rather than a clinical personality disorder. Therefore the terms "narcissist" or "high narcissist" are used interchangeably to refer to "relatively 'normal' people who simply possess more narcissistic qualities than others" (Wallace, Baumeister, & Vohs, 2005, p. 436). Narcissists consider themselves to be special people who are superior to others (Gabriel, Critelli, & Ee, 1994; John & Robins, 1994). They are also vain individuals (Raskin & Terry, 1988) who take pleasure in admiring themselves from other peoples' point of view, such as on video or through mirrors (Robins & John, 1997).

Narcissism has yet to be investigated within imagery research; however there are strong theoretical grounds to suggest that narcissism may moderate imagery perspective effectiveness. Because narcissists like to watch themselves performing, it was expected that external visual imagery would be superior to internal visual imagery for narcissists, as external visual imagery would allow narcissists to *see themselves* perform. Moreover, when narcissists do watch themselves perform, their self-enhancement motives are activated (Robins & John, 1997). Narcissists perform better when there is an opportunity for self-enhancement (Wallace & Baumeister, 2002), so increasing the opportunity to self-enhance is important for narcissists. External visual imagery may provide a similar opportunity for narcissists to activate their self-enhancement motives. Individuals who are low in narcissism are less concerned with self-enhancement, so it was expected that the performance of these individuals would be less affected by the imagery perspective used.

Motivational Functions of Imagery Perspectives

Thus far, this introduction has largely focused on the effects of imagery perspectives on motor learning and performance. However, imagery can serve other functions as well as aiding performance. Indeed, Paivio (1985) proposed that imagery serves both a cognitive and motivational function in human performance, with these functions operating at a specific and general level. The cognitive function is associated with the development of skills (cognitive specific function) and strategies of play (cognitive general function). The motivational specific function of imagery involves imaging goal-oriented behaviour such as achieving goals, and the motivational general function involves arousal and affect. Further examination of the motivational general function of imagery has revealed two separate functions, motivational general-mastery imagery and motivational general-arousal imagery (Hall, Mack, Paivio, & Hausenblas, 1998). Motivational general-mastery imagery involves using imagery to stay focused and confident when confronted by problems, whereas motivational general-arousal imagery involves using imagery to imagine the emotions associated with performance. Athletes report the use of all of these functions of imagery (e.g., Abma et al., 2002; Munroe, Hall, Simms, & Weinberg, 1998). Correlational studies (e.g., Callow & Hardy, 2001; Moritz, Hall, Martin, & Vadocz, 1996; Vadocz, Hall, & Moritz, 1997) have demonstrated relationships between certain imagery functions and cognitions such as confidence and anxiety. Intervention studies have also shown that imagery can serve a motivational function, in terms of increasing self-efficacy (Short et al., 2002), sport-confidence (Callow et al., 2001), and motivation (Martin & Hall, 1995).

As imagery is used for motivational functions, it would not be surprising to expect imagery perspectives to serve motivational functions. Indeed, Hardy (1997) suggested that external visual imagery may enhance competitive drives, whereas internal visual imagery may increase self-efficacy, as the performer can identify with the image more easily (cf. Bandura, 1986). In line with Hardy's suggestion, White and Hardy (1995) posited that external visual imagery may have enhanced the competitive drives of participants in their wheelchair slalom task, leading to increases in speed. Despite these suggestions, examination of the motivational functions of imagery perspectives has been scarce, with most studies focusing on learning and performance as dependent variables. A notable exception is Cumming and Ste-Marie (2001), who explored the effects of an imagery perspective training program on skaters' use of different imagery functions. Regardless of imagery perspective, athletes increased their use of the cognitive function of imagery, but not the motivational function of imagery. Initially, this finding may appear to question the motivational function of imagery perspectives. However, it is important to note that Cumming and Ste-Marie examined whether an imagery perspective intervention would increase the *use* of motivational functions of imagery, not whether imagery perspectives could *serve* motivational functions such as increasing confidence or controlling anxiety.

In light of theoretical reasoning (e.g., Bandura, 1986; Hardy, 1997) it seems reasonable to suggest that imagery perspectives may serve a motivational function in terms of increasing confidence, especially when research investigating a related sensory modality (kinaesthetic imagery) is considered. Specifically, Hardy and Callow (1999) found that participants using kinaesthetic imagery were more confident about performing a gymnastics routine successfully than participants not using kinaesthetic imagery. These results were extended by Callow and Waters (2005), who examined the effects of a kinaesthetic imagery intervention on the confidence of high level jockeys. The findings from this study were supportive of kinaesthetic imagery increasing confidence, and were interpreted in line with self-efficacy theory (Bandura, 1997). Specifically, kinaesthetic imagery was proposed to have provided the performers with performance accomplishment information by allowing them to mirror the sensations of how to perform the task successfully, thereby increasing their confidence.

Research examining the possibility that imagery perspectives can serve a motivational function in terms of increasing confidence is lacking. Therefore, a secondary aim of the thesis was to explore this possibility. Specifically, Studies 1 and 2 (Chapter 2) examined the effects of different imagery perspectives on the confidence to complete a slalom-based task. To allow for continuity between studies in the thesis, Study 6 (Chapter 4) also examined whether imagery perspectives could aid confidence.

Theoretical Underpinnings of Imagery Effects

Imagery research has been criticised for its narrow focus of existing theories that explain imagery's effects on motor performance (Murphy, 1990). This problem is hindered by the fact that imagery has such a large number of potential effects, making it extremely difficult to develop a theory that is capable of explaining all of these effects (Callow & Hardy, 2005). A variety of theories and models currently exist within the literature that attempt to explain imagery's beneficial effects. While some of the theories and models have received more support than others, it is important to note that none are comprehensive enough to account for all the effects imagery has. It is not the aim of this section to provide an exhaustive review of each theory and model, rather an overview of the main tenets of each theory and model, along with associated research, is provided. This is so that the theoretical underpinnings used in the research chapters can be placed within the context of current theories and models of imagery.

Psychoneuromuscular Theory

Psychoneuromuscular theory (Jacobsen, 1930) proposes that during imagery of a particular task, localised muscle activity occurs. This muscular activity is said to be identical in pattern to the actual muscular activity when the task is performed, but occurs at a much lower magnitude. It is the localised muscle activity during the imagined movement that provides feedback to strengthen the motor program of the imager. Although Jacobsen has provided support for this theory, demonstrating that localised muscular activity is the same during imagined and actual movements; many researchers have failed to replicate these findings. For example, Slade, Landers, and Martin (2002) found that imagery of dumbbell curls increased muscle EMG activity, but the pattern of this activity was not the same as actually performing the dumbbell curls. Further to this, there is no evidence showing relationships between imagined muscle activity during imagery, and subsequent performance (Callow & Hardy, 2005; Murphy & Martin, 2002). Consequently, it has been suggested that the muscle activation that occurs during imagery should be seen as an important part of effective imagery rehearsal, rather than an explanation for how imagery improves performance (cf. Hecker & Kaczor, 1988).

Symbolic Learning Theory

Symbolic learning theory (Sackett, 1934) proposes that imagery allows the rehearsal of movements as symbolic components of the task. According to this theory only the cognitive elements of a task will be enhanced by imagery. Support for this theory has been obtained (e.g., Ryan & Simons, 1981), with greater improvements in performance being displayed for cognitive tasks (e.g., finger mazes) as opposed to motor or strength tasks (e.g. stabilometers). Feltz and Landers' (1983) meta-analysis also offers support for symbolic learning theory, as larger imagery effects were reported for cognitive tasks than motor tasks. However, other research (e.g., Lee 1990) has shown positive effects for imagery on motor tasks that have few cognitive or symbolic elements. Symbolic learning theory also suggests that imagery will only be effective in the early stages of learning, as it is in the early stages of learning that cognitive cues are utilised (e.g., Fitts & Posner, 1967). However, this prediction fails to account for the positive effects of imagery for highly skilled performers (e.g., Blair et al., 1993; Isaac, 1992). The failure of symbolic learning theory to accurately address its predictions has led this theory to be rejected as too simplistic an explanation for the beneficial effects of imagery.

The Triple Code Model

The triple code model (Ahsen, 1984) is concerned with three aspects of an image that are connected, these are the image itself (I), the somatic response produced by the image (S), and the meaning of the image to the performer (M). The model suggests that these three aspects can occur in any order (such as SIM or IMS), however most often the aspects occur in the ISM order. One of the improvements of this model over the psychoneuromuscular and symbolic learning theories is that it considers the meaning that an image has to the individual, so therefore allows for individual differences in the meaning of images (see Murphy, 1990). However, the model was not based in sport psychology, rather on clinical examples, and fails to explain some of the underlying processes and mechanisms of how and why imagery may benefit performance (Callow & Hardy, 2005).

Bio-informational Theory

Bio-informational theory (Lang, 1977, 1979, 1984) assumes that an image is stored by the brain as a functionally organised set of propositions. Three types of propositions are proposed to exist; stimulus propositions, response propositions, and meaning propositions. Stimulus propositions describe the scene to be imagined, and response propositions describe the imagers' response to that image. Finally, meaning propositions infer the meaning of the image to a performer. The theory also assumes that the image contains a motor program instructing the imager how to respond to the image. Response propositions are a crucial aspect of the theory, as they are double coded within the propositional network, and are linked to the motor program. Images that include response propositions (in comparison to images that only include stimulus propositions) are associated with more efferent outflow (in terms of physiological responses) and more vivid images. Therefore, the creation or modification of a vivid image will result in a change in behaviour. Research has provided support for bio-informational theory. First, evidence exists demonstrating that imagery is associated with muscle EMG responses (e.g., Hale, 1982; Jacobsen, 1930; Slade et al., 2002). Studies by Lang and colleagues (e.g., Lang, Kozak, Miller, Levin, & Mclean, 1980) have shown that imagery scripts containing stimulus and response propositions incorporate greater physiological activity, such as increases in heart rate and skin conductance, and more vivid imagery. Vivid imagery has been shown to produce greater changes in behaviour (Lang et al., 1970). Studies in the sport literature have also provided support for bio-informational theory. Hecker and

Kaczor (1988), and Cumming, Olphin, and Law (2007) have demonstrated that imaging scenes containing response propositions results in higher heart rates than scenes that do not contain response propositions. Further to this, Bakker, Boschker, and Chung (1996) have shown that greater muscle EMG activity occurs with scripts containing stimulus and response propositions in comparison to scripts that contained only stimulus propositions. Smith, Holmes, Whitemore, Collins, and Devonport (2001) extended bio-informational theory research by examining the effects of stimulus and response proposition images on motor performance. Hockey players receiving response proposition laden imagery scripts improved penalty flick performance to a significantly greater degree than those receiving stimulus proposition only imagery scripts.

The PETTLEP Model

The PETTLEP model (Holmes & Collins, 2001) is based on the notion of functional equivalence, the assumption that imagery and motor performance share common neural mechanisms (e.g., Grezes & Decety, 2001; Jeannerod, 1994). The model highlights seven elements that are proposed to improve the functional equivalence between imagery and motor performance, and therefore improve the effects of imagery. These seven elements are Physical, Environment, Task, Timing, Learning, Emotion, and Perspective. For a full discussion of the PETTLEP model, interested readers are referred to Holmes and Collins. The basic premise behind the PETTLEP model is that imagery interventions are more successful when elements of the PETTLEP model are included, and more specifically, the more PETTLEP elements are included in the intervention, the more functionally equivalent, and therefore effective, the imagery intervention will be. Research examining the efficacy of the

PETTLEP model is in its infancy, however findings appear supportive. Research by Smith and colleagues (Smith, Wright, Allsopp, & Westhead, 2007; Wright & Smith, 2007), has shown that imagery interventions based on the PETTLEP model have more impact on performance than imagery interventions that do not. Furthermore, imagery interventions that utilise the entire PETTLEP model appear more effective than interventions that only use some aspects of the PETTLEP model (Smith et al.).

An interesting aspect of the PETTLEP model is that a link is made between bio-informational theory and functional equivalence, especially regarding the perspective component of the model. With regards to perspective, internal visual imagery has been proposed to be more functionally equivalent than external visual imagery as it matches the viewpoint taken during actual performance (cf. Smith et al., 2007). However, Holmes and Collins (2001) also offer an explanation, based on functional equivalence and bio-informational theory, for why external visual imagery provides greater performance benefits than internal visual imagery in form based tasks. They suggest that using external visual imagery may enhance the performance of form based tasks because "external visual imagery may contain sufficient propositional information to access the motor representation and allow neural network strengthening." (p. 76). Therefore, from this, it could be suggested that for form based tasks external visual imagery may be *more* functionally equivalent than internal visual imagery. Extending this link to the slalom based motor tasks examined in studies 1 and 2; the expected superior performance of internal visual imagery over external visual imagery (cf. Hardy, 1997) could be due to internal visual imagery being *more* functionally equivalent for these types of task.

Overview of Thesis and Research Program

This thesis contains six studies that examine imagery perspectives, imagery ability, and personality. The studies stand in the own right as a collection of three papers. Studies 1 and 2 (Chapter 2) explore the effects of different visual imagery perspectives on the performance of slalom based motor tasks. The results of Studies 1 and 2 are discussed in terms of the suitability of imagery perspectives for specific motor tasks. Studies 1 and 2 are currently under review as a combined manuscript at the Journal of Applied Sport Psychology.

The findings from Studies 1 and 2, in conjunction with previous literature examining imagery perspectives and performance (e.g., Hardy, 1997; Hardy & Callow, 1999), and imagery ability (e.g., Goss et al., 1986), guided the rest of the thesis. Specifically, imagery ability moderates the effectiveness of imagery interventions (e.g., Hall et al., 1989), and imagery perspectives and modalities appear to have differential effects on performance (Stevens, 2005; White & Hardy, 1995). However, no imagery ability measure currently exists within the literature that allows for an assessment of the ability to image using internal visual imagery, external visual imagery and kinaesthetic imagery. Consequently, Studies 3 to 5 (Chapter 3) adapt an already existing imagery ability questionnaire to allow for an assessment of internal visual imagery ability, external visual imagery ability and kinaesthetic imagery ability. The results are discussed in relation to the delineation of internal visual imagery and kinaesthetic imagery as separate modalities, and the potential applicability of this new imagery ability questionnaire to further the understanding of the processes involved in imagery effects. These studies also form a combined manuscript that is currently in press at the Journal of Sport and Exercise Psychology.

Study 6 (Chapter 4) examined the effects of imagery perspectives on performance, but explored whether individual differences in personality might moderate the effectiveness of imagery perspectives. The personality variable of narcissism was considered, as research (Robins & John, 1997) has suggested that narcissists enjoy watching themselves perform, which has similarities to using an external visual imagery perspective. The results demonstrated that narcissism did indeed moderate the effectiveness of imagery perspectives, and are discussed in terms of the role of external visual imagery in activating the self-enhancement motive of narcissists, and the importance of manipulating self-enhancement level in order for narcissists to perform well. This study is currently in preparation for submission to the Journal of Experimental Social Psychology.

All studies have been presented at various national and international Sport Psychology conferences. The general introduction and general discussion serve as a link between the studies. The general introduction provided an overview of three factors, relevant to the thesis, within imagery research that influence the effectiveness of imagery; namely, imagery perspectives, imagery ability and personality. The general discussion summarises the main findings from the thesis and presents implications from these findings. Strengths and limitations of the research programme are highlighted, and future research directions are offered. As the studies contained in the thesis are independent but linked, at times there is necessary overlap between chapters. This is in accordance with the policy of the School of Sport, Health, and Exercise Sciences.

Research Questions

The thesis addressed the following research questions:

1. What are the effects of internal visual imagery and external visual imagery on the performance of slalom-based motor tasks?

2. Can the VMIQ be adapted in order for it to be a valid assessment of internal visual imagery ability, external visual imagery ability, and kinaesthetic imagery ability, in line with contemporary conceptualisations?

3. Do individual differences in narcissism moderate the effectiveness of imagery perspectives on motor performance?

CHAPTER 2

Effects of Different Visual Imagery Perspectives on the Performance of Slalom-Based Tasks[2]

Abstract

Two studies examined the effects of different visual imagery perspectives on the performance of, and confidence to complete, slalom-based motor tasks. In Study 1, participants performed a downhill slalom running task in a significantly quicker time using internal visual imagery than when using external visual imagery. No significant difference in confidence was revealed. In Study 2, prior to executing a slalom-based skiing task, participants performed either external visual or internal visual imagery or a control condition of stretching. The internal visual imagery group was significantly more accurate than the stretching group, with no differences between groups regarding the time taken to complete the task. There was a significant difference in confidence between the internal visual imagery group and the control group. The results are discussed in relation to the effectiveness of different visual imagery perspectives for slalom-based tasks where responses are required to changes in the visual field.

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[2] This chapter is currently under review as Callow, N., Roberts, R., & Hardy, L. (under review). Effects of Different Visual Imagery Perspectives on the Performance of Slalom Based Tasks. *Journal of Applied Sport Psychology*. The present author would like to thank Dave Waugh for the data collection for Study 2.

Introduction

Research examining the effects of different imagery modalities on motor learning and performance (i.e., on the cognitive functions of imagery) has focused mainly on the visual and kinaesthetic imagery modalities (e.g., Fourkas, Ionta, et al., 2006; Hardy & Callow, 1999). Within this literature, two visual imagery perspectives have been identified; internal visual imagery (the view performers would get if they imagined looking out through their own eyes) and external visual imagery (the view performers would get if they imagined watching themselves from a third person perspective). Kinaesthetic imagery is described as involving "…the sensations of how it feels to perform an action, including the force and effort involved in movement and balance, and spatial location…" (Callow & Waters, 2005, p. 447).

Research that has focused on internal and external visual imagery has produced equivocal results. For example, Mahoney and Avener (1977) found that successful qualifiers for the U.S. Olympic gymnastic team used internal imagery more than non-qualifiers. However, Ungerleider and Golding (1991) found that successful U.S. track and field athletes used more external visual imagery than non-successful athletes. Three possible explanations have been provided for these inconsistent results: (a) that specific visual imagery perspectives produce greater performance gains for certain motor tasks than for others (e.g., Hardy, 1997; Highlen & Bennett, 1979); (b) that internal imagery and kinaesthetic imagery have been confounded (cf. Hardy & Callow, 1999); and (c) the incorrect assumption that kinaesthetic imagery can only be experienced with an internal perspective (cf. Callow & Hardy, 2004; Holmes, 2007; Glisky et al., 1996).

Hardy and associates (Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995) have examined the task difference explanation, and have offered two hypotheses for the effects of visual imagery perspectives on different motor tasks. They posited that external visual imagery (EVI) would be superior to internal visual imagery (IVI) for tasks relying heavily upon the use of form, but IVI would be superior to EVI for slalom-based tasks, where a performer has to follow a "line" through or around a set course (e.g., downhill slalom skiing). A theoretical rationale for these hypotheses has been provided by Hardy (1997). Specifically, Hardy suggested that imagery exerts a beneficial effect on performance only to the extent that the images generated supplement the information that is already available to the performer. Thus, for tasks relying heavily upon the use of form, EVI may be more suitable to use than IVI because EVI would allow a performer to see the desired form associated with the correct movement. Conversely, for slalom-based motor tasks, IVI may allow a performer to see the precise temporal and spatial locations where key movements need to be initiated (e.g., changing direction or "braking"). Moreover, these temporal and spatial locations would be identified with reference to the performer's position while *actually on* the line being taken. However, with EVI, the identification of precise locations with reference to performer's position while actually on the line would not occur because the performer takes a third person perspective.

These two hypotheses were first investigated by White and Hardy (1995) using a rhythmic gymnastics routine (relying heavily upon the use of form) and a wheelchair slalom task (requiring a line to be followed through a set course of gates). In the gymnastics routine, EVI proved to be superior to IVI as the EVI groups made fewer errors in performance, thereby supporting the EVI hypothesis.

Hardy and Callow (1999) confirmed this finding with a series of ecologically valid tasks relying heavily upon the use of "form" for their successful completion; namely, a karate kata, a gymnastics floor routine, and a technical rock climbing task. In all three tasks, the use of EVI was found to be superior to the use of IVI. In the gymnastics and climbing tasks, kinaesthetic imagery was also manipulated and was found to have a beneficial effect over and above visual imagery in the climbing task.

However, White and Hardy's (1995) findings in the wheelchair slalom task were less clear and did not fully support the IVI hypothesis. Specifically, after initial practice on an acquisition course, participants using IVI completed a transfer trial with significantly fewer errors than those participants using EVI, therefore resulting in a more accurate performance; but participants using EVI completed the course significantly quicker than participants using IVI. These results were interpreted in terms of a speed-accuracy trade-off, where IVI led to a more accurate performance (less errors were made), as participants may have been able to rehearse the responses required at each gate. In contrast, EVI improved the speed at which the task was performed, possibly through enhancing the competitive drive of the participants.

More recently, in their PETTLEP model of motor imagery, Holmes and Collins (2001) provide a conceptual link between Hardy and colleagues (1995, 1999) results and the notion of functional equivalence through Lang's (1979, 1984) bio-informational theory. The PETTLEP model is based on three concepts: (a) that imagery, motor preparation and motor performance share common brain mechanisms (i.e., they can be functionally equivalent); (b) that the effectiveness of imagery will depend on the degree of functional equivalence between the imagery and motor performance; and (c) in order to increase functional equivalence, the seven areas of the PETTLEP model should be taken into account. These areas are

Physical, Environmental, Task, Timing, Learning, Emotion and Perspective. In the model Holmes and Collins make direct reference to bio-informational theory, where imagery is suggested to be a set of propositional statements stored in the brain that act as a template for overt responding. In reference to perspectives, Holmes and Collins proposed that EVI may be effective for form based tasks because "external visual imagery may contain sufficient propositional information to access the motor representation and allow neural network strengthening." (p. 76). Extending this link in relation to Hardy's (1997) rationale, we suggest that for form-based tasks, EVI will contain more *functionally equivalent* propositional information than IVI. For slalom-based tasks we suggest that IVI will provide more *functionally equivalent* propositional information than EVI.

Although the research evidence supports the effectiveness of EVI for form-based tasks, the evidence with regard to slalom-based tasks is less clear cut. Indeed, to date, the IVI hypothesis has yet to be re-examined. Further to this, the appropriateness of White and Hardy's (1995) wheel-chair slalom task for examining the IVI hypothesis can be questioned. Specifically, the wheel-chair slalom task was performed on a flat surface and therefore required participants to generate their own speed in order to achieve a quick performance time. However the slalom-based tasks hypothesized by Hardy and colleagues to benefit from the use of IVI, such as downhill slalom skiing or canoe slalom, actually require speed to be controlled rather than generated. Indeed, because of the force of water or steepness of the slope, a good performance depends on being able to control much faster speed in relation to the line taken. This notion of controlling rather than generating speed is perhaps relevant with regard to the effect that IVI would have on the performance of slalom-based tasks. In particular, IVI would inform the participant about how quickly the location (of the required change in direction) is approaching and the nature of the location (e.g., the particular terrain). The combination of this information would allow decisions to be made about the appropriate speed for the best line, which would arguably stop the need for continual checking of speed, allowing quicker performance times (speeds) to be achieved. Although we acknowledge that EVI might provide information about location and terrain where the change in direction is required, it would not provide accurate information about how *quickly* this location is approaching from the perspective of the performer on the *actual line that he/she is taking*. Thus, from both a research and applied perspective there is a need to examine the effects of visual imagery perspectives on slalom-based tasks where speed needs to be controlled rather than generated. Consequently, the present research re-examined Hardy and associates' (1995, 1997, 1999) hypothesis that IVI will produce superior performance to EVI on slalom-based tasks using more appropriate tasks, namely downhill slalom running and slalom skiing. Furthermore, the speed-accuracy trade-off between imagery perspectives was explored in Study 2.

In addition to serving a cognitive function, imagery can have important motivational functions such as enhancing confidence (Paivio, 1985). Visual imagery perspectives have also been suggested to serve differential motivational effects (Hardy, 1997). In view of this, Study 1 and 2 also had a secondary purpose of examining the motivational function of visual imagery perspectives. For Study 1 it was hypothesised that using IVI would result in significantly higher levels of confidence than when EVI was used. In Study 2 it was hypothesised that those participants using IVI would have significantly higher levels of confidence than participants using EVI and participants in the control group. These hypotheses were based on the notion that the information provided by IVI would allow a performer to gain performance accomplishment information (i.e., information in relation to the precise temporal and spatial locations of the line to be taken). Bandura (1997) proposes that performance accomplishment information is the strongest antecedent of self-efficacy (i.e., situational specific confidence), so IVI may enhance confidence by providing performance accomplishment information to a performer.

To summarise, Study 1 and 2 examined the hypotheses that IVI would produce superior performance to EVI on slalom-based tasks, and that IVI would produce significantly higher confidence than EVI. Additionally, in Study 2 the speed-accuracy trade-off was explored.

Study 1

Method

Participants

An opportunistic sample of 23 sports science students (*M* age = 22.52 years, *SD* = 3.01; 18 men, 5 women) was recruited for the study. All participants gave consent to take part in the study. Ethics approval was obtained from the School's ethics committee.

Design

A fully repeated measures (condition x trial) design was employed for both the practice and experimental task. In each treatment condition participants completed five trials at the practice task, followed by two trials at the experimental task. The treatment conditions were performed on two consecutive days. The order in which participants experienced the treatment conditions was counterbalanced.

Practice and Experimental Task

For the practice and experimental task, participants completed a downhill slalom running course. Downhill running was chosen because, in comparison to wheelchair slalom, it has greater congruence with actual sport tasks such as canoe slalom and slalom skiing.

The practice and experimental courses were performed outdoors on a disused road that sloped downhill at an angle of 5 degrees. Both courses were 55 metres in length with 13 cones. The courses differed in the fact that the experimental course required participants to make more extreme changes in direction, through the use of "tighter" turns, in comparison with the practice course. The participants were instructed to run on the outside of the first cone at the top of the hill, and run in and out of the rest of the cones as quickly as possible. The cones were set out in a non-uniform fashion so that a quick and accurate performance depended on the participant taking the most appropriate line through the cones; that is by achieving the "key" place in the line so to get as close to the cones as possible but without touching them. If participants took a wide line around each of the cones then a poorer (i.e., slower) performance resulted.

Treatments

Two experimental treatment conditions were employed; an internal visual imagery condition (IVI), and an external visual imagery condition (EVI). Participants performed the first three trials, in each condition, without imagery. Then, prior to performing the fourth and fifth practice trials, and the two experimental trials, participants were administered an imagery script that corresponded to their treatment condition (see procedure section).

Performance

Performance was assessed by recording the time taken to complete each trial, using automatic timing gates placed at the top and bottom of the course.

Pilot testing

Two participants who did not participate in the experimental study were recruited for pilot testing (*M* age = 24.05 years, *SD* = 1.41, 1 man, 1 woman). Pilot testing of 3 sets of 12 practice trials and 2 experimental trials, with a five minute break between sets and a two minute rest between trials, revealed fatigue and negative motivational effects at trial 8 of each set. Consequently, the practice trials were reduced to five trials. To maintain ecological validity, two experimental trials were used because this is the number of competitive runs in ski and canoe slalom.

During the practice trials, four styles of running were tested; wide lines, running then braking, small steps, and side-stepping. The mean speeds for these styles were 24.19s, 20.97s, 20.70s, and 19.29s respectively. Due to side-stepping being the fastest style, participants were encouraged to use this style during the experimental study (see procedures section).

Measures

Vividness of Movement Imagery Questionnaire (VMIQ: Isaac et al., 1986). To measure internal visual and external visual imagery, an adapted version of the VMIQ was administered. The VMIQ assesses the ability to image 24 movements using a Likert scale ranging from 1 (*perfectly clear*) to 5 (*no image at all*), and has an acceptable level of test-retest reliability, *r* = .76 (Isaac et al.). For the present study the external visual imagery instructional set asking participants to image from someone else's perspective, that is "watching someone else", was changed to "watching yourself do it", thereby enabling participants to experience imaging themselves from both an internal visual and external visual perspective (cf. Callow & Hardy, 2004).

Movement Imagery Questionnaire – Revised (MIQ-R: Hall & Martin, 1997). To measure visual and kinaesthetic imagery, the MIQ-R was administered. The MIQ-R consists of 8 items assessing both visual and kinaesthetic imagery ability measured on a Likert scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). Significant correlations ($r = -.77, p < .001$) have been obtained between the subscales of the MIQ-R and the original Movement Imagery Questionnaire (MIQ: Hall & Pongrac, 1983), indicating that the MIQ-R is an acceptable revision of the MIQ, and can be used to measure visual and kinaesthetic imagery ability (Hall & Martin, 1997). The negative correlation is due to the fact that the scales from the MIQ are scored in the opposite direction to those in the MIQ-R.

Procedure

One week prior to the commencement of the study, the participants were administered the VMIQ (Isaac, et al., 1986) and the MIQ-R (Hall & Martin, 1997). To ensure participants were able to image proficiently, two criteria were set. Specifically, only participants who scored below 72 on each of the subscales of the VMIQ (low score = high imagery ability), and above 16 on each of the subscales of the MIQ-R (high score = high imagery ability), were included in the study. These cut-off criteria have been used in previous research and have produced significant effects for imagery interventions (Callow et al., 2001). One participant failed to meet these criteria, thus 22 participants were involved in the testing phase. These 22 participants were randomly assigned to a counterbalanced order of receiving the treatment conditions.

All participants were tested individually. On arriving at the site, participants were equipped with wrist and hand protectors and clothing to cover all the body. This equipment served as protection in case any participants fell while running.

Participants were told that the purpose of the study was to examine the effects of different imagery scripts on a motor task. In order to control for demand characteristics, standardised instructions were read informing participants to complete the task as quickly as possible. The instructions also stated that participants could use any particular running style that they wanted while running around the cones, but pilot testing had revealed that "side stepping" around the cones gave the quickest time. Finally, a definition of the two visual imagery perspectives to be used was given to the participants. IVI was defined as the view participants would get if they imagined looking out through their own eyes, and EVI was defined as the view obtained if participants imagined watching themselves performing the task from a third person perspective. Participants performed five practice trials on the practice course. Participants were given a 3 minute rest between trials. For the first three practice trials participants were given feedback regarding their running technique, for example, whether they were side stepping or not. Prior to the final two practice trials the participants were read an imagery script by the experimenter. The scripts only contained visual imagery, and were from either an internal visual or external visual imagery perspective depending on the condition and took approximately 25 seconds to administer (see Appendix B for imagery scripts). The participants were instructed to employ imagery from the specified perspective while the script was being read and then before completing each trial. No restriction was placed on the amount of time the participants were given to image, and no performance feedback was provided for these trials.

After a five minute break, participants then entered the experimental phase of the study. Prior to performing the first experimental trial, participants were read the same standardised instructions as before, and were allowed to look at the new course and walk down the side of it. Participants were then asked to complete a pre-experimental question that rated their confidence to complete the task as quickly as possible. This was scored on a Likert-type scale from 1 (*not at all*) to 11 (*greatly*). Following this, participants were administered the same imagery script as in practice, and were asked to employ imagery before completing each experimental trial. They then completed the task. At the end of each experimental trial, to ensure that the participants complied with the instructions, participants were asked to rate to what extent they ran as fast as possible down the course. This experimental manipulation question was rated on the same 11 point Likert-type scale as the pre-experimental questionnaire. If participants reported a score of 5 or less, then they were asked to repeat the trial to ensure that they had run as fast as they could so that accurate predictions could be made regarding the imagery effects. On completion of the second experimental trial, a manipulation/post-experimental questionnaire was completed. The questionnaire examined the extent to which participants adhered to their treatment conditions, how suitable they thought the condition was for the task, the experience of kinaesthetic imagery, the extent to which the treatment helped their confidence to complete the task quickly, and the extent to which they switched between imagery perspectives. These questions were scored on the same Likert-type scale used previously. A final question asked participants to report on the nature of any other strategies they used to aid their performance.

The participants returned the following day and performed the exact same procedure; however, they used the other imagery perspective on this occasion. On completion of the manipulation/post-experimental questionnaire this time, the participants were de-briefed as to the nature of the study and thanked for their participation.

Results

Manipulation Check

Analysis of the manipulation/post-experimental questionnaire revealed that 4 out of the 22 participants were unable to adhere to the treatment conditions; specifically, within conditions, they switched between imagery perspectives during the experimental trials. The data from the 4 participants were excluded, and the analyses conducted on 18 participants. These 18 participants reported that they ran each of the experimental trials as quickly as they could, thus no trials were repeated. Tests of assumptions revealed that these data were normally distributed. The participants' confidence levels prior to performing the experimental trials were analysed using a dependent *t*-test. The analysis revealed no significant difference in the participants' confidence levels prior to performing each experimental condition.

Performance Data

A two factor, condition by trial (2x5), fully repeated measures analysis of variance was used to analyse the practice performance data. A second two factor condition by trial (2x2) repeated measures analysis of variance was used to analyse the experimental performance data.

Practice Trials. Mauchly's test revealed that sphericity could be assumed for the condition main effect and the condition by trial interaction, but not the trial main effect, χ^2 (9) = 18.79, $p < .03$. Thus, the Greenhouse-Geisser correction factor was applied to the trial main effect, but not the other effects. The analysis of variance revealed no main effect for condition, F (1, 17) = 2.01, $p > .13$, $\eta^2 = .04$, $1\text{-}\beta = .32$. However, there was a significant trial main effect, F (2.33, 39.63) = 22.58, $p < .01$, $\eta^2 = .32$, $1\text{-}\beta = 1.00$. The condition by trial interaction was not significant, F (4, 68) = .66, $p > .62$, $\eta^2 = .005$, $1\text{-}\beta = .02$. Follow up Tukey's tests on the significant trial main effect revealed that performance was significantly different at trials 3, 4, and 5, compared to trial 1, and at trials 4 and 5, compared to trial 2. Visual inspection of the means indicated that the course was completed significantly quicker at trials 3, 4, and 5, compared to trial 1, and at trials 4 and 5, compared to trial 2 (see Table 1 for descriptive statistics).

Experimental Trials. The sphericity assumption held for both main effects and the interaction for the experimental trials. The analysis of variance revealed a significant main effect for condition, $F\ (1, 17) = 4.61, p < .05, \eta^2 = .14, 1\text{-}\beta = .53$. Inspection of the cell means revealed that the course was completed significantly quicker in the IVI condition than in the EVI condition. There was also a significant main effect for trial, $F\ (1, 17) = 12.90, p < .01, \eta^2 = .13, 1\text{-}\beta = .92$. Inspection of the cell means indicated that trial 2 was completed significantly quicker than trial 1. There was no significant interaction (see Table 1 for descriptive statistics).

The experimental manipulation question asking participants to what extent they ran as fast as they could on each of the experimental trials was also analysed using a two factor, condition by trial (2x2) fully repeated measures analysis of variance. No significant condition main effect was found. However, there was a significant main effect for the trials, $F\ (1, 17) = 30.11, p <. 01, \eta^2 = .48$. Examination of the cell means revealed that participants felt they ran faster on the second trial. There was no significant interaction.

Taken together the results from the experimental manipulation question, and experimental performance analysis indicated a difference in time taken across the two experimental trials. Consequently, in order to ensure that we had captured the actual effects that were occurring, the raw data were screened to see which trial the participants ran the fastest in for each condition. The fastest trial data, for each condition, were then used for a subsequent analysis. Specifically, a dependent *t*-test was employed to examine the effects of the visual imagery perspective for the trial in which participants ran the fastest. Results revealed a significant difference for condition, $t\ (17) = -2.35, p < .03, \eta^2 = .25, 1\text{-}\beta = .60$. Inspection of the cell means revealed that the course was completed significantly quicker in the IVI condition than in the EVI condition (see Table 1 for descriptive statistics).

Table 1

Means and Standard Deviations (in parentheses) for performance in Study 1

Condition	Practice					Experimental		Fastest
	1	2	3	4	5	1	2	
IVI	15.18	14.89	14.60	14.27	14.30	15.98	15.75	15.69
	(1.28)	(1.03)	(1.03)	(.89)	(.99)	(1.27)	(1.23)	(1.22)
EVI	15.29	15.08	14.74	14.60	14.57	16.35	15.99	15.98
	(1.43)	(1.23)	(1.14)	(1.16)	(1.16)	(1.19)	(1.21)	(1.20)

Manipulation/Post-Experimental Data

Three questions from the manipulation/post-experimental questionnaire required statistical analysis; these were the questions relating to the perceived suitability of the two conditions, the extent to which the two treatments helped the participants' confidence to perform the task quickly, and the experience of kinaesthetic imagery. These three questions were analysed using dependent *t*-tests, with a Bonferroni adjusted alpha level of .017. There was no significant difference regarding the perceived suitability of the two treatment conditions, both conditions being deemed to be suitable (*M* = 8.58, *SD* = 2.06). There was no significant difference regarding the extent that the participants thought the treatment conditions helped their confidence. It appeared that both treatments in general aided confidence to perform (*M* = 7.61, *SD* = 1.68). There was a significant difference in the amount of kinaesthetic imagery experienced during the experimental conditions, $t\,(17) = 2.65$, $p < .02$, $\eta^2 = .29$, $1\text{-}\beta = .71$. The cell means revealed that kinaesthetic imagery was experienced to a greater extent during the IVI condition.

Given that kinaesthetic imagery can cause performance gains over and above those caused by visual imagery (Hardy & Callow, 1999), it was important to establish if the differences between the kinaesthetic imagery experiences in the two conditions could have caused a systematic bias in the experimental performance results. Consequently, the relationships between kinaesthetic imagery and the average time in each condition, and between kinaesthetic imagery and the fastest trial in each condition were examined. Specifically four correlations were conducted, results revealed no significant correlation between kinaesthetic imagery and average time taken for IVI ($r = .14$, $p > .58$) or for EVI ($r = .08$, $p > .75$), and no significant correlation between kinaesthetic imagery and the fastest trial for IVI ($r = .19$, $p > .46$) or for EVI ($r = .15$, $p > .54$). Thus, because the correlations were below .3, indicating that no significant relationship existed between the kinaesthetic imagery and performance, there was no basis for performing an analysis of covariance to control for the effects of kinaesthetic imagery (cf. Pedhazur, 1982).

Discussion

The aim of this first study was to examine the hypothesis that IVI would produce superior performance in comparison to EVI on a slalom-based task. The performance results for the IVI condition appear to support this hypothesis. It is also notable that when the fastest experimental trial was used in the analysis the effect size increased. However, analysis of the manipulation/post-experimental questionnaire data revealed that in the IVI condition, kinaesthetic imagery was experienced significantly more than in the EVI condition. Given that kinaesthetic imagery can produce an additional performance effect over and above visual imagery (Hardy & Callow, 1999), then the greater use of kinaesthetic imagery in the IVI group could be attributed to the superior performance for this group. This hypothesis was not supported as subsequent analyses revealed no significant relationship between the experience of kinaesthetic imagery and time taken.

The lack of relationship between kinaesthetic imagery and time taken can be retrospectively explained. Specifically, as the experimental downhill running task was relatively novel, with only two trials in the experimental phase, it is arguable that the participants were relatively inexperienced at the task. Indeed, as the participants ran significantly faster in experimental trial 2 than in trial 1, they were perhaps still learning the novel task. It has been suggested that performers only make use of kinaesthetic cues during later stages in learning (Fleishman & Rich, 1963) and that kinaesthetic imagery only appears to provide a beneficial effect when performers become more skilled (cf. Hardy & Callow, 1999). Consequently, despite using more kinaesthetic imagery in the IVI condition these relatively inexperienced participants may not have been able to make *effective* use of the kinaesthetic imagery, thus leading to the lack of correlation between kinaesthetic imagery and time taken. Of course, this argument is speculative and requires empirical substantiation.

Contrary to the hypothesis that IVI would produce significantly more confidence than EVI, no significant results were found. This result is somewhat surprising. However, further examination of the nature of the task may provide an explanation for the lack of a significant difference. Although the task was novel, it was not particularly complex or difficult, thus confidence would have been high (Bandura, 1997), leading to a possible ceiling effect. This ceiling effect may have caused confidence levels not to differ across conditions.

The results of the present study support the IVI hypothesis from Hardy and colleagues (1995, 1999). The theoretical and applied implications from the results of this study will be discussed in the general discussion and conclusion section.

Study 2

Study 2 further explored the effects of visual imagery perspectives on slalom-based motor tasks but used a different task, namely, downhill slalom skiing. Both time-taken and accuracy were assessed, so that the speed-accuracy trade-off reported by White and Hardy (1995) could be further explored. A second purpose was to examine the motivational function of imagery. It was highlighted in the introduction that tasks such as slalom skiing require a fast speed to be controlled rather than generated. Thus because the participant is not trying to generate speed, then the suggested motivational function of EVI (White & Hardy) would, perhaps, be redundant. Consequently, it was hypothesised that IVI would produce significant performance gains over EVI for both time-taken and accuracy. In terms of exploring the motivational function of imagery, in relation to the hypothesis outlined in the introduction, and the notion that a ski-slalom task is more complex that the downhill running task from Study 1, it was hypothesised that IVI would produce significantly higher confidence than EVI.

Method

Participants

An opportunistic sample of 30 recreational skiers (*M* age = 24.79 years, *SD* = 4.77, 23 men, 7 women) was recruited for the study. Although all participants could ski with their skis parallel, none had any experience of slalom skiing. All participants gave their written consent to take part. Ethics approval from the School's ethics committee was obtained.

Design

A between groups design was used. Specifically, stratified randomisation based on gender was used to allocate participants to one of three groups; an internal visual imagery group (IVI), an external visual imagery group (EVI), or a control group. Participants performed two trials at the experimental task.

Experimental Task

The slalom skiing task was performed on a downhill ski slalom course, on an outdoor artificial ski slope. The course sloped downhill at an angle of 20 degrees, and was 120 metres long. The participants were asked to ski both trials as quickly and as accurately as possible.

Treatments

Participants in the imagery groups were shown a video of a skier completing a slalom course from either an internal visual or external visual imagery perspective dependent on which imagery group they were in. The internal visual perspective was recorded from a helmet-mounted camera and showed the skier completing the course from a first person perspective. The external visual perspective video showed a skier completing a slalom course, from a third person perspective. The videos were shown to the participants once and were used to ensure that the participants correctly understood the required visual imagery perspective (Hale, 1982; Hall & Erffmeyer, 1983). In addition to viewing the video, and after inspecting the course, and prior to the experimental trials, participants in the imagery groups were administered an imagery script that corresponded to their treatment groups (i.e., IVI participants were administered an IVI script). The scripts instructed the participants to create an image of themselves skiing the course and directed them to create, in their image, the terrain, position of the poles, and the line that they should take (see Appendix C for imagery scripts). The participants were instructed to employ imagery before each trial (see procedure section). The participants in the control group were given a series of light stretches, which were conducted while participants watched their respective videos.

Performance

Performance was assessed by recording the time taken to complete the course, and the accuracy of the line taken. Automatic timing gates were placed at the start and finish points of the course and recorded the time taken to complete each trial. To measure accuracy of line, each performance was videotaped and subsequently judged by an experienced slalom coach blind to the nature of the study. Two criteria were used for accuracy, closeness to the pole and choice of line. Each of these criteria was scored on a Likert-type scale from 1 (*far away from pole/very sharp change of direction*) to 10 (*just missing the pole/perfectly smooth change of direction*). These sub scores were combined to give a total score for accuracy.

Procedure

One week prior to the experimental phase of the study, participants were asked to complete the VMIQ and the MIQ-R. The same imagery ability criteria as used in Study 1 were employed to determine whether participants would be accepted for the experimental phase of the study. All participants reached these criteria. Participants were then randomly assigned treatment groups and to one of two experimental sessions.

At the start of each of the two experimental sessions (conducted in the evening on consecutive days) participants were allowed a warm-up period of 20 minutes in which to ski. Participants were then randomly assigned numbered bibs (1-15) to indicate the order in which they would conduct the experimental task, and were then divided into their treatment groups. Participants were shown the video from their respective imagery perspective group, or conducted light stretches. Participants in the imagery groups were read the imagery script and were asked to image themselves skiing the course from the respective imagery perspective. In addition to this, all participants were asked to ski as quickly and as accurately as possible. During this time, the slalom course was erected. All participants were then allowed to walk and inspect the slalom course. This inspection lasted approximately 10 minutes. The participants then assembled in the changing room and were called individually (in bib order) to start the experimental phase. Prior to performing the first trial, participants in the imagery groups were read the imagery script and were asked to image themselves skiing the course from the respective imagery perspective or conduct light stretches. Each participant then completed his/her first trial. On average there was 30 minutes between the inspection of the course and the participant's first trial. The second trial took place in reverse bib order and was conducted on average 30 minutes after the first trial. Prior to performing the second trial, each participant read the imagery script and were asked to image themselves skiing the course from the respective imagery perspective or complete the light stretches. Participants were reminded to ski as quickly and as accurately as possible.

For both trials, no time restrictions were placed on the participant to complete the imagery. No practice runs or discussion between participants was allowed in the changing room or while inspecting the course, and at no point during the study did any participant watch another participant's performance.

On completion of both trials, all participants completed a manipulation/post-experimental questionnaire. The questionnaire assessed; adherence to the imagery perspectives, the perceived suitability of each imagery perspective for completing the task quickly and accurately, the extent their treatment aided their confidence to perform the task quickly and accurately, and the experience of kinaesthetic imagery for the two imagery groups. These questions were all scored on a Likert-type scale from 1 (*not at all*) to 10 (*greatly*). Also, participants were asked to report if they had used any other strategies to aid performance.

Results

Two participants from the control group were unable to complete both runs, leaving a sample of 28 participants. Inspection of the manipulation/post-experimental questionnaire revealed that all participants in the imagery groups reported being able to adhere to their required imagery perspective. None of the participants in the control group reported using imagery to aid their performance. The data were analysed for normality; however, this analysis revealed that the data were significantly skewed and kurtotic, with 2 significant outliers (one from the EVI group and one from the control group). These data points were removed and subsequent checks were found to be within accepted limits. This resulted in the main analysis being performed on the remaining 26 participants, and in line with Study 1 the fastest trial was used in the analysis. Separate single-factor analyses of variance were used to analyse the time-taken and accuracy data. Homogeneity of variance was satisfied for both analyses.

Time-taken

The analysis of variance revealed no significant differences among the groups for time-taken, F (2, 23) = 1.22, $p > .32$, $\eta^2 = .10$, 1-β = .24. Table 2 displays the descriptive statistics.

Accuracy

The analysis of variance revealed a significant difference among the groups, for accuracy F (2, 23) = 3.59, $p < .04$, $\eta^2 = .24$, 1-β = .61. Tukey's follow up test indicated a significant difference between the IVI group and the control group. The cell means revealed the IVI group to be more accurate than the control group (see Table 2).

Table 2

Means and standard deviations (in parentheses) for time taken and accuracy in Study 2

	Group		
	IVI	EVI	CON
Time taken	20.26	21.26	23.36
	(4.10)	(2.78)	(5.26)
Accuracy	12.00	11.00	9.86
	(1.94)	(1.73)	(.69)

Manipulation/Post-Experimental Questionnaire

Five questions from the manipulation/post-experimental questionnaire required analysis. Five separate single factor analyses of variance were used to analyse these data, with a Bonferroni adjusted alpha level of .01. Homogeneity of variance was satisfied for all five analyses. There was no significant difference between the two imagery groups regarding their experience of kinaesthetic imagery, F (1, 17) = 1.38, $p > .26$, $\eta^2 = .08$, $1\text{-}\beta = .20$. The means and standard deviations were as follows: IVI, $M = 7.4$, $SD = 1.43$, EVI $M = 6.3$, $SD = 2.45$. There were also no significant differences regarding the perceived suitability of the two imagery treatments for completing the task quickly and accurately. There were, however, significant differences between the three groups regarding the extent that their treatment aided confidence to perform the task quickly, F (2, 23) = 9.71, $p < .01$, $\eta^2 = .46$, $1\text{-}\beta = .97$ and accurately, F (2, 23) = 12.09, $p <. 01$, $\eta^2 = .51$, $1\text{-}\beta = .99$. For both of these results, follow-up Tukey's tests indicated that the IVI group was more confident about performing the task quickly and accurately than the control group. No other differences were significant. The means and standard deviations were as follows: confidence to perform quickly, IVI, $M = 7.5$, $SD = 1.65$; EVI, $M = 5.7$, $SD = 1.72$, CON, $M = 4.3$, $SD = .76$; confidence to perform accurately, IVI, $M = 7.7$, $SD = 1.25$, EVI, $M = 5.78$, $SD = 2.27$, CON, $M = 3.86$, $SD = .69$.

Discussion

The results of this study do not offer support for the hypothesis that IVI would produce significant performance gains, in terms of time taken and accuracy, over EVI. However, participants using IVI were significantly more accurate in completing the course in comparison to the control group and more accurate than the EVI group. Despite the lack of a significant difference between the groups in relation to time-taken, two points are worthy of note. First, the IVI group was 1 second quicker than the EVI group, and 3 seconds quicker than the control group. These differences correspond to small and moderate effect sizes of .30 (IVI and EVI) and .66 (IVI and control) respectively (cf., Cohen, 1988). Second, the direction of the results offers no evidence that the IVI group's enhanced accuracy of line was obtained at the expense of time-taken. This contrast with the results of White and Hardy (1995) could be because the participants were performing a task that required them to control rather than generate speed. However, it must be highlighted that only crude interpretations can be made with regard to the speed-accuracy trade-off because time taken is not a true measurement of speed (i.e., velocity) and time taken is derived partially as a result of accuracy.

From the manipulation/post-experimental data it can be seen that kinaesthetic imagery was experienced to some extent by participants in both imagery groups. While this may seem problematic at first, the non-significant difference between the groups suggests that kinaesthetic imagery did not have a significant effect. In addition to this, the post-experimental data revealed that the IVI group was significantly more confident than the control group with regard to both time taken and accuracy. Thus it can be seen that, in relation to the control condition, IVI does have a motivational function for confidence. The theoretical and applied implications of these findings will be discussed in the general discussion and conclusions.

General Discussion and Conclusions

The purpose of the present research was to examine the effects of IVI and EVI on the performance of slalom-based tasks. Taken together, the results of the two studies offer mixed support for the IVI hypothesis proposed by Hardy and associates

(Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995). Specifically, Study 1 demonstrated performance benefits for time taken but Study 2 failed to provide additional support. Interpretation of these findings in light of the functional equivalence of imagery perspectives (cf. Holmes & Collins, 2001), provides only limited support for the suggestion that IVI contains more functionally equivalent propositional information than EVI for slalom-based tasks. Despite the lack of support for the IVI hypothesis in Study 2, interestingly, interpretation of the results reveals no speed-accuracy trade-off, with the IVI group being significantly more accurate than the control group and non-significantly quicker than the control group. As these results are contradictory to those of White and Hardy, future research should explore this issue with more precise measurements of the sub-components of trade-off, perhaps through process measures of velocity (i.e., moment to moment speed) and accuracy (i.e., moment to moment accuracy).

The results of the present studies can be interpreted in accordance with the notion that kinaesthetic imagery can be used with both visual perspectives (e.g., Callow & Hardy, 2004; Glisky, et al., 1996). Of note was that in Study 1 more kinaesthetic imagery was experienced with an internal visual perspective than with an external visual perspective. However there was no correlation between kinaesthetic imagery and time taken. Thus, despite experiencing more kinaesthetic imagery in the IVI condition, the relative inexperience of the participants may have resulted in an inability to make *effective* use of the kinaesthetic imagery. In line with Hardy and Callow (1999), this interpretation can be related to Whiting and den Brinker's (1981) notion of the image of the act and image of achievement. The image of the act refers to the general framework for performance, whereas the image of achievement refers to a template of precise muscular forces that must be produced in order to perform the movement. Thus, it could be that the participants could form an image of the act, from the information provided by IVI, but due to their relative inexperience could not acquire a detailed feel for the required movements (image of achievement), and so could not make effective use of kinaesthetic imagery. Future research examining the differential effects of both visual and kinaesthetic imagery is required so that the exact effects of these two imagery modalities on slalom-based tasks can be gleaned. Additionally, an examination of the level of expertise at which kinaesthetic imagery can be used *effectively* would be pertinent. Indeed, Holmes and Collins (2001) propose that the interaction between the individual and task should be taken into account because in expert performers, who have a well-developed memory trace for a task, the visual imagery perspectives may access other elements of the representation (e.g., kinaesthetic, olfactory) through mechanisms such as the interactive multimodal coding of information in memory (e.g., Paivio, 1986) and connected neural networks (Rosenzweig, 1996).

Data from the manipulation/post-experimental questionnaire provided evidence for imagery's motivational function (Paivio, 1985). In Study 1, although there were no significant differences between the conditions regarding confidence, the results from the manipulation/post-experimental questionnaire suggested that both imagery perspectives helped the participant's confidence to perform. In Study 2, the result was even clearer; those participants using IVI were the most confident about performing quickly and accurately. Although no differential effects were gained for the visual imagery perspectives, based on the argument that IVI would provide relevant performance accomplishment information about the precise temporal and spatial locations of the line to be taken and the notion that performance accomplishment information is an antecedent of self-efficacy (e.g., Bandura, 1997) the motivational function of increasing confidence by IVI in comparison to the control condition is not surprising. However, future research should explore the motivational functions of imagery in more detail. Indeed, based on White and Hardy's (1995) view that EVI might enhance the competitive drive of performers, it would be pertinent for future research to examine the effect of different visual imagery perspectives on dependent variables such as effort.

Several applied implications are associated with the results of this research. First, the importance of considering task characteristics, when recommending to athletes which imagery perspective may be more beneficial to use is again highlighted. Second, for tasks requiring an effective use of line, where a performer is required to make precise changes in direction at precise spatial locations, there is some evidence to suggest that IVI appears to be the best imagery perspective to use, particularly to aid the accuracy of performance. Third, depending on the expertise of a performer using kinaesthetic imagery may also be beneficial. Fourth, some tasks require both form and changes in direction at precise spatial location (e.g., a double straight-back somersault in gymnastics), thus with these types of task, switching between IVI and EVI might be relevant. Further to this, the present research did not explore the actual angle of the EVI perspective taken by performers (e.g., side-wards, behind, from above). It could be that the angle of EVI has beneficial effects for certain outcomes/tasks. Indeed, anecdotally the primary author has worked with International sailors who use the "from above" EVI perspective to imagine the fleet of boats they are competing against, the effect of the wind and tide on the fleet, and, as a consequence of these factors, the best position for their boat. Thus, future research should explore the most appropriate angle of EVI for different outcomes/tasks. Finally, performers using imagery are likely to be more confident to perform these types of task successfully, than those not using imagery.

Certain strengths and limitations can be associated with this research. Using manipulation checks in both studies can be seen as a strength, as it enabled greater experimental control (cf. Murphy & Jowdy, 1992). Using specific imagery ability criteria, based on previous evidence (e.g., Callow et al., 2001), to accept or reject participants to the experimental phase of both studies can also be seen as a strength of the research, allowing potential confounds such as differences in imagery ability to be minimised (cf. Goss et al., 1986). The main limitation appearing from this research was the lack of control over participants' kinaesthetic imagery experiences. Not controlling for kinaesthetic imagery provided a potential confound in Study 1, making it difficult to interpret the effects of the visual perspectives. Future research should explicitly control for kinaesthetic imagery in these types of task. However, while this may result in greater experimental control, artificial restrictions could be placed on the imagery experiences of the participants (cf. White & Hardy, 1995). Another potential limitation of the present research was the low power in relation to the time taken and kinaesthetic imagery analyses for Study 2 (i.e., $1-\beta = .24$ and $1-\beta = .20$ respectively), despite moderate eta squared values (i.e., $\eta^2 = .10$ and $\eta^2 = .08$ respectively). Thus, the non-significant result for time taken and kinaesthetic imagery for Study 2 could have been due to a Type II error. Future research should replicate Study 2 with a larger sample size.

To conclude, the results of this research provide some evidence for the use of IVI to enhance performance on slalom-based tasks, and interpretation of the results leads to the suggestion that there is no speed-accuracy trade-off on this type of task.

Clearly, as the speed-accuracy trade-off results are contradictory to the results of White and Hardy (1995), future research should explore this issue.

CHAPTER 3

Movement Imagery Ability: Development and Assessment of a Revised Version of the Vividness of Movement Imagery Questionnaire[3]

Abstract

The purpose of this research was to amend the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986) in line with contemporary imagery modality and perspective conceptualisations, and to test the validity of the amended questionnaire (i.e., the VMIQ-2). Study 3 had 351 athletes complete the 3-factor (internal visual imagery, external visual imagery, and kinaesthetic imagery) 24-item VMIQ-2. Following single-factor confirmatory factor analyses, and item deletion, a 12-item version was subject to correlated traits correlated uniqueness (CTCU) analysis. An acceptable fit was revealed. Study 4 used a different sample of 355 athletes. CTCU analysis confirmed the factorial validity of the 12-item VMIQ-2. In Study 5 the concurrent and construct validity of the VMIQ-2 was supported. Taken together, the results of the 3 studies provide preliminary support for the revised VMIQ-2 as a psychometrically valid questionnaire.

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[3] This chapter is currently in press as Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (in press). Movement Imagery Ability: Development and Assessment of a Revised Version of the Vividness of Movement Imagery Questionnaire. *Journal of Sport & Exercise Psychology*. The VMIQ-2 can be seen in the appendix.

Introduction

Mental imagery is a central element in human functioning. For example, imagery is involved in the planning and execution of goal directed movements (Jeannerod, 2001; Jeannerod & Jacob, 2005) and facilitates motor learning and performance (e.g., Driskell et al., 1994). Imagery is proposed as a building block of conscious experience (Marks, 1999) and has been implicated within working memory (Bywaters, Andrade, & Turpin, 2004). Across these areas of functioning, individual differences in imagery ability underlie the effectiveness of imagery (e.g., Isaac & Marks, 1994; Mantani, et al., 2005).

Two key characteristics of imagery ability are vividness and controllability (Callow & Hardy, 2005; Start & Richardson, 1964). Imagery ability is often measured via introspective reports of the vividness (i.e., the clarity and realism) of imagery experiences through validated questionnaires. Within the sport domain one of most commonly used questionnaires is the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986). The VMIQ is designed to measure visual and kinaesthetic imagery of a variety of motor tasks (e.g., running downhill and jumping off a high wall).

When the VMIQ has been used in imagery research, it has captured the theoretically proposed effects of imagery ability. For example, differences in neural activation, in terms of electroencephalographic (EEG) activity, have been demonstrated between vivid and non-vivid imagers when imaging tasks from the VMIQ (Marks & Isaac, 1995). Behavioural research (e.g., Isaac, 1992) has demonstrated a moderating effect of vividness on motor performance, with greater performance improvements for participants reporting more vivid imagery. Differences in VMIQ scores have also been obtained between high and low level athletes, with high level athletes reporting more vivid imagery (Eton, Gilner, & Munz, 1998; Isaac & Marks, 1994). Further to this, intervention studies (e.g., Hardy & Callow, 1999; Smith & Holmes, 2004) have shown effects on sport performance when specific vividness criteria on the VMIQ have been set as a pre-intervention requirement. In addition, the psychometric performance of the VMIQ has been shown to be acceptable, with test-retest reliability, and concurrent validity being established (Isaac et al., 1986), and high internal consistency values reported (e.g., Lequerica, Rapport, Axelrod, Telmet, & Whitman, 2002).

While this research supports the use and validity of the VMIQ, and therefore imagery vividness as a measure of imagery ability, it is worth noting that using vividness to assess imagery ability has been criticised. Indeed, Dean and Morris (2003) suggest that there is no a priori reason for choosing vividness to measure imagery ability. They propose that imagery is a collection of abilities (namely image formation, maintenance, and transformation; Kosslyn, 1994), rather than a single ability; and that the functional role of imagery in spatial ability tests is unrelated to imagery vividness. Although Dean and Morris' suggestions concerning vividness have some legitimacy, it is worth noting that their argument relates specifically to spatial ability tests, as opposed to motor tasks (where the ability to create vivid images is important for performance, see Isaac, 1992; Smith & Holmes, 2004). Furthermore, it makes intuitive sense to suggest that vividness could, at least to some extent, reflect the processes of formation, maintenance and transformation, especially when the role of working memory in imagery vividness is considered. Image generation (formation) processes are activated by long term memory, and image maintenance processes by working memory resources (see Ranganath, 2006). The vividness of a resulting image reflects the richness of the representation displayed in working memory (Baddeley & Andrade, 2000), and is likely to be a result of such processes as formation, maintenance and transformation.

As vividness does appear to capture imagery ability effects, the present authors disagree with Dean and Morris' (2003) position that imagery vividness is not an appropriate way to measure imagery ability. However, for three reasons, we feel that the VMIQ should be re-examined to improve it as a measure of imagery ability. First, there has been confused conceptualisation within the imagery literature between the visual imagery modality (i.e., what an imager sees) and the kinaesthetic imagery modality (i.e., imaging the feel of the movement). This confusion has perpetuated into the VMIQ. To expand, Hardy and colleagues (Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995) have proposed that the confusion between the visual and kinaesthetic modalities stems from different interpretations of Mahoney and Avener's (1977) definition of "internal" imagery. Specifically, Mahoney and Avener propose that internal imagery is "an approximation of the real life phenomenology such that a person actually imagines being inside his/her body and experiencing those sensations that might be expected in the actual situation" (p.137). As this definition refers to the imager "being inside his or her body" and "experiencing those sensations", internal imagery could be interpreted as either the kinaesthetic modality, or the visual modality (i.e., first person visual imagery; IVI), or a combination of both (Hardy, 1997). Similarly, in the VMIQ, the kinaesthetic component requires participants to imagine *doing* movements *themselves*, with no explicit instruction to use the kinaesthetic modality and not the visual modality. The ambiguity surrounding this conceptualisation is not surprising, as in some cases IVI and kinaesthetic imagery are viewed as always occurring together in so-called, motor imagery. Indeed, based on Jeannerod's (1994) original work, motor imagery has been defined as "introspective kinaesthetic feelings of moving the limb in a first person view" (Lotze & Halsband, 2006, p. 389). This requires the combined use of internal visual imagery and kinaesthetic imagery. However, this definition fails to delineate between modalities, which is vital especially as kinaesthetic imagery can affect performance over and above the effects of visual imagery (Hardy & Callow, 1999). This does not mean that the two modalities cannot be used together, indeed they can (cf. Glisky et al., 1996); rather it is important that the modalities *can* be measured separately, thereby making it possible to examine their differential effects. Further, a recent investigation using transcranial magnetic stimulation supports this separation, as differences in corticospinal activity between first person visual imagery (i.e., IVI) and kinaesthetic imagery have been obtained (Fourkas, Ionta, et al., 2006). Given that IVI and kinaesthetic imagery have been identified as separate modalities, it is vital that this differentiation translates into imagery ability questionnaires, so that conceptually meaningful data can be obtained. Consequently, the present study sought to develop and validate an imagery ability questionnaire, with IVI and kinaesthetic imagery considered as separate modalities.

The second reason for re-examining the VMIQ relates to the precise conceptualisation of external visual imagery. External visual imagery has been defined as either watching someone *else* perform an action (e.g., Ruby & Decety, 2001), or watching *oneself* perform an action from a third person perspective (White & Hardy, 1995). While this difference in definitions at first appears trivial, it has been suggested that self and other imagery may involve different cognitive processes (cf. Denis et al., 1991; Callow & Hardy, 2004) and neurological profiles (cf. Farrer & Frith, 2002). Indeed, the relationship between external visual imagery and kinaesthetic imagery is stronger when the imager imagines him or herself from an external perspective than when he or she imagines someone else from an external perspective (Callow & Hardy). With this in mind, it is surprising that the visual subscale of the VMIQ directs participants to create an image of someone *else*, as opposed to watching *oneself* performing. This perhaps limits the VMIQ because it fails to assess external self imagery, which is more commonly experimentally manipulated in comparison to external other imagery (e.g., Glisky et al., 1996). In the present study external visual imagery was defined as third person imagery of the *self*, specifically external self visual imagery (EVI).

The third reason for our agreement that the VMIQ should be re-examined relates to a lack of rigorous psychometric testing of this instrument. Within imagery research, psychometric testing of questionnaires is seen as a crucial part of assessing the integrity of particular measures (McKelvie, 1994). For example, the VMIQ has been shown to display acceptable temporal stability and convergent validity (Isaac et al., 1986). However, the factor structure of the VMIQ has only been assessed using exploratory factor analysis (e.g., Atienza et al., 1994; Campos & Perez, 1990), as opposed to more rigorous testing procedures using confirmatory factor analysis techniques. Confirmatory factor analysis (CFA) has been advocated as a superior method to test the underlying factor structure of an instrument, in comparison to exploratory factor analysis. This is because CFA utilises a theory-driven approach, whereas exploratory factor analysis employs a data driven approach (Biddle et al., 2001). Therefore, CFA would seem a more acceptable way to test the factor structure of the VMIQ, allowing imagery researchers to be confident in the factorial integrity of the questionnaire.

Consequently, the general purpose of the present research program was to create an appropriately modified version of the VMIQ that was psychometrically valid. To this end, the instructional set of the VMIQ was altered so as to be able to assess IVI and kinaesthetic imagery as separate modalities, and EVI as third person imagery of the self. The psychometric properties of this questionnaire were then tested. Thus, the present research comprised three studies. Study three examined the factorial validity of an amended version of the VMIQ (VMIQ-2) using CFA techniques. In the fourth study the aim was to further examine the factor structure of a revised VMIQ-2 using CFA. Finally, the aim of the fifth study was to assess the concurrent and construct validity of the VMIQ-2.

Study 3

Method

Participants

An opportunistic sample of 351 British athletes (*M* age = 20.44, *SD* = 3.59 years, *n* = 189 males, *n* = 159 females, *n* = 3 sex not given) was recruited for the study. All gave their written consent to take part in the study. Athletes had an average of 7.61 years (*SD* = 3.86) of competing in their sport, and were from a variety of team and individual sports. The level of competition ranged from recreational to international and/or professional or semi professional (recreational *n* = 30, club *n* = 87, county *n* = 35, university *n* = 113, national *n* = 34, international and/or professional or semi-professional *n* = 28, level not reported *n* = 24).

Measures

Vividness of Movement Imagery Questionnaire (VMIQ). The purpose of the VMIQ is to assess the ability to visually and kinaesthetically image a variety of movements, and is comprised of 24 items. When completing the VMIQ, participants are required to imagine each item twice. First, by imagining watching somebody else perform the movement, and second, by imagining performing the movement themselves. Thus, there are 48 responses in total. The 24 items fall into six groups, with four items in each group. The groups are; items relating to basic body movements (items 1-4), items relating to basic movements with more precision (items 5-8), items relating to movement with control but some unplanned risk (items 9-12), items relating to movement controlling an object (items 13-16), items relating to movements which cause imbalance and recovery (items 17-20), and items relating to movements demanding control in aerial situations (items 21-24). The test-retest reliability of the VMIQ has been demonstrated over a 3 week period with a group of physical education students, $r = .76$ (Isaac et al., 1986). The VMIQ has also demonstrated adequate concurrent validity with the VVIQ with novice, experienced and international level trampolinists. The correlations were 0.75, 0.45, and 0.65 respectively (Isaac et al., 1986).

Adaptation of the VMIQ (VMIQ-2)

In order to provide an assessment of IVI, EVI and kinaesthetic imagery (KIN) ability, the instructional set of the VMIQ was adapted. The wording on the existing factors was changed to assess IVI, EVI and KIN in line with current conceptualisations. Specifically, IVI was defined as first person visual imagery, EVI as third person imagery of the self, and KIN as imagery of the feel of the movement (e.g., Glisky et al., 1996; Hardy & Callow, 1999).Thus, the IVI factor asks a participant to imagine the items as if "you are looking out through your own eyes". The EVI factor asks a participant to imagine the items as if "you are watching yourself performing the movement" from an external perspective. The KIN factor asks a participant to "imagine feeling yourself doing the movement". The original 24 items were kept, with each item imaged in three ways (e.g., the item for jumping off a high wall was imaged using IVI, EVI and KIN), thus there were 72 responses in total. To measure the vividness of each image, the likert scale from the original VMIQ, from 1 (*perfectly clear and vivid*) to 5 (*no image at all, you only know that you are "thinking" of the skill*), was used. Four experts in imagery and measurement examined the questionnaire for face validity, and deemed it acceptable.

To facilitate accurate completion of the VMIQ-2, the layout of the questionnaire was changed. In the original VMIQ participants are asked to read the rating scale, image an item and insert the relevant number into the blank area beside the item. Following discussion between the authors and based on reports from participants in previous studies using the VMIQ who reported difficulties with remembering the direction of the rating scale (low scores correspond to more vivid imagery), it was deemed easier for participants to circle the appropriate number for each item imaged. Therefore, beside each item on the VMIQ-2 all possible responses were listed, and participants were asked to circle the most appropriate response for each item that was imaged.

Procedure

All participants completed the VMIQ-2 in a quiet environment, either in training sessions or at home, in groups of not more than 15. They were asked to complete all items on the questionnaire without conferring with others, and were assured of the confidentiality of their responses. The order in which participants were asked to complete the three factors on the questionnaire was counter-balanced to prevent ordering effects. The questionnaire was blocked by factor. That is, participants were asked to complete all 24 items using the first factor, then all items using the second factor, and finally all items using the third factor.

Testing procedure and data analysis

In the present study, the ideal testing procedure to examine the factorial structure of the 24 item VMIQ-2 would be to employ a multi-trait multi-method (MTMM) approach to CFA using a correlated traits/correlated uniqueness (CTCU) model. This is because the 24 item VMIQ-2 uses the same item (e.g., kicking a stone) across each of the three factors (i.e., IVI, EVI, and KIN) thus shared method variance exists for each item across each of the factors. MTMM takes this measurement artefact and random error into account. Specifically, the approach allows for the true relationship among traits (factors) to be determined when shared method variance is present. The CTCU model does this by correlating the traits and inferring the method effects from the correlated uniqueness (of error) among the three responses that share the same method (i.e., there are 24 methods or items). See Figure 1 for an example 12-item CTCU model with 3 factors. Although four different MTMM models have been proposed, the CTCU model is viewed as the preferred model, because it results in proper solutions for all sizes of matrices and samples tested (Kenny & Kashy, 1992; Marsh & Grayson, 1995). However, with the present questionnaire and a MTMM CTCU model, there are over 200 parameters to be measured which results in the need for a sample size greater than 2000 (cf. Tabachnick & Fidell, 2001). Therefore, an alternative sequential model testing strategy was adopted.

Based on recommendations in the literature (e.g., Biddle et al., 2001; Jöreskog, 1993) each factor was examined separately, using confirmatory factor analysis. These three analyses were performed in order to identify any potential items for removal, and retain only those items which were good indicators of their underlying latent variable (factor). Following item removal a 12-item VMIQ-2 was generated. With a 12-item model there are fewer parameters to be estimated, thus fewer participants are required. Consequently an MTMM CTCU analysis was performed.

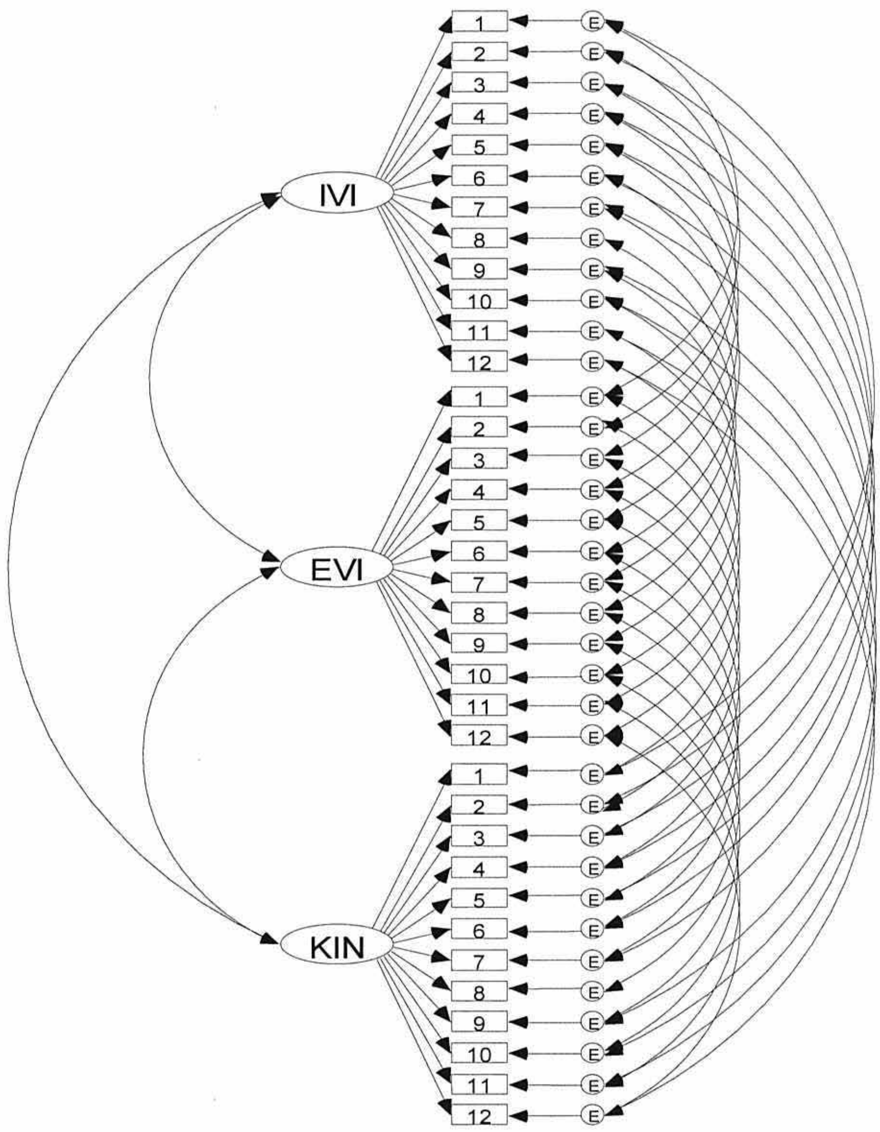

Figure 1. Example CTCU model with 12 items per factor. Ellipses correspond to the 3 factors, IVI = internal visual imagery, EVI = external visual imagery, KIN = kinaesthetic imagery. Numbers in rectangles correspond to example items. Circles containing an E are error variances.

All analyses were conducted using LISREL 8.54 (Jöreskog & Sorbom, 2003) with the maximum likelihood estimation. To assess model fit for both the single factor analyses and the CTCU analysis the following fit indices were employed; the Satorra-Bentler chi-square statistic (Satorra & Bentler, 1994), the root mean square error of the approximation (RMSEA; Steiger & Lind, 1980), the comparative fit index (CFI; Bentler, 1990), the non-normed fit index (NNFI; Tucker & Lewis, 1973), and the standardised root mean square residual (SRMR; Bentler, 1995). The Satorra-Bentler chi-square was used to correct for non-normality where the data showed departure from multivariate normality (indicated by large Mardia coefficients; Mardia, 1970).

The criteria set for a good model fit included a non-significant Satorra-Bentler chi-square (p >.05). However it has been recommended that the chi-square be used more subjectively as an index of fit rather than a test statistic, with large chi-square values relative to degrees of freedom indicating a poor fit, and small values indicating a good fit (Jöreskog & Sorbom, 1989). For assessing the fit indices, Hu and Bentler's (1999) relatively conservative criteria were also used (cf. Markland, 2007). Specifically, a RMSEA of less than .06 was taken to indicate a close fit, less than .08 a reasonable fit, and greater than 1.0 was taken as a poor fit. In addition, the probability that the RMSEA was larger than .06 was examined with the alpha level set at p >.05. Further, CFIs and NNFIs of greater than .95, and SRMRs of less than .08 were all taken to indicate a good fit (cf. Hu & Bentler, 1999).

It has recently been argued (Hayduk & Glaser, 2000), that the only criterion to adequately test model fit is the chi-square test statistic, and that incremental fit indices should not be used at all (Barrett, 2007). However, this issue is the subject of much discussion within the literature (e.g., Barrett; Markland, 2007). Consequently, a combination of Hu and Bentler's (1999) criteria, with a recognition that these are not "golden rules" (see Marsh, Hau, & Wen, 2004), along with an examination of the chi-square/degrees of freedom ratio was employed to provide a balanced approach to testing model fit.

Results

Data screening revealed no missing data, so the data from all 351 participants were analysed.

Single Factor Models. The single factor analyses revealed poor fits for each of the three factors (see Table 3 for fit statistics). Item removal was based on two criteria. First, items were considered for removal if they displayed low factor loadings and/or highly positive or negative standardised residuals. Low factor loadings demonstrate items that are poor indicators of their underlying factor, and problem residuals can mean that the model is either under or over parameterised. Second, items not related to movement (e.g., standing) were also considered for removal. Consideration of both of these criteria was used to identify potential items for removal. Based on these criteria, two items from each of the six groups (e.g., items related to basic body movements, items demanding control in aerial situations) were removed leaving 12 items in each factor. Items that were a "problem" in one factor were also a problem in the other factors. Consequently, the same items were deleted across each of the three factors. Re-analysis of the single-factor models revealed that the chi-square/degrees of freedom ratio was still high for each factor, with the RMSEA being problematic for two of the factors (see Table 4 for fit statistics). These poor fits are not surprising given that the single factor analyses fail to account for method effects. Given the issue of shared method variance, and the reduction in items from 24 to 12, the more appropriate CTCU analysis was conducted to test the three-factor structure of the 12-item VMIQ-2.

Table 3

Fit statistics for the single factor CFAs for the 24-item questionnaire

Factor	S-B χ^2	df	χ^2/df	RMSEA	CFI	SRMR	NNFI
IVI	748.55*	252	2.97	0.08*	0.97	0.06	0.96
EVI	978.13*	252	3.88	0.09*	0.96	0.06	0.96
KIN	920.87*	252	3.65	0.09*	0.95	0.06	0.95

* = p <.001

Table 4

Fit statistics for the 12-item single factor CFAs

Factor	S-B χ^2	df	χ^2/df	RMSEA	CFI	SRMR	NNFI
IVI	143.62*	54	2.65	0.07*	0.97	0.04	0.96
EVI	175.58*	54	3.25	0.09*	0.97	0.05	0.96
KIN	146.28*	54	2.71	0.09*	0.95	0.06	0.95

* = p <.01

CTCU analysis. The three-factor CTCU analysis performed on the 12-item questionnaire revealed an acceptable fit; S-B χ^2 (555) = 840.65, $p < .001$; RMSEA = .038, $p = 1.00$; CFI = .98; SRMR = .044, NNFI = .97. Factor loadings ranged from .60-.78, with the following interfactor correlations; IVI and EVI = .39, IVI and KIN = .63, EVI and KIN = .41. Although the scaled chi-square was still significant, the chi-square to degrees of freedom ratio was substantially reduced to 1.5. The other fit indices were in line with Hu and Bentler's (1999) recommendations.

Closer inspection of the correlated error variances revealed that although most had significant correlations, some of the correlations between error variances (8 of a total of 36) were not significant. As some of the correlations were non-significant, a second CTCU analysis was therefore performed, with the eight non-significant correlations being fixed to zero (i.e., they were not allowed to correlate). Again, the analysis revealed an acceptable model fit, with similar fit statistics as in the previous analysis (see Table 5 for fit statistics, the model is labelled as CTCU-12a). Inspection of the correlated errors revealed that two new error variances that had been significantly correlated in the earlier model were now no longer significant. Thus, a third CTCU analysis was run with the new non-significant correlations between error variances being fixed to zero (i.e., in total 10 non-significant error terms were fixed to zero). This third CTCU model (labelled as CTCU-12b) revealed an acceptable fit, with similar fit statistics as in the previous two CTCU analyses (see Table 5 for fit statistics). All of the remaining correlated errors were significant.

Table 5

Fit statistics for the CTCU models

CTCU Model	S-B χ^2	df	χ^2/df	RMSEA	CFI	SRMR	NNFI
12-item	840.65*	555	1.51	0.04 (ns)	0.98	0.04	0.97
12a	848.08*	563	1.51	0.04 (ns)	0.98	0.04	0.97
12b	856.24*	565	1.52	0.04 (ns)	0.98	0.04	0.97

* = p <.001, ns = non-significant.

In order to compare the model fit of the three 12-item CTCU models, Satorra and Bentler's (2001) scaled difference chi-square test was used. The test revealed no significant differences between the original 12-item CTCU model and models CTCU-12a and CTCU-12b. However, there was a significant difference between model CTCU-12a and CTCU-12b ($p < .01$), with model CTCU-12a fitting significantly better than model CTCU-12b. The fact that no difference in fit was obtained between the original hypothesised 12-item model (all error terms correlating) and the two subsequently produced CTCU models (CTCU-12a and CTCU-12b) provides support for the model fit of the original 12-item model with all error terms correlated.

Although the CTCU analyses supported the three-factor structure of the VMIQ-2, it is worth noting that the correlation between the IVI and KIN factors was .63, indicating a significant relationship. Consequently, because of this correlation and the view that IVI and KIN can occur together in terms of motor imagery (e.g., Lotze & Halsband, 2006), the data were subjected to a re-analysis. The aim of this re-analysis was to examine whether, from a measurement perspective, having IVI and KIN as separate factors or motor imagery is more factorially valid. Specifically, two analyses were performed. The first was a two-factor CTCU analysis treating the IVI and KIN factors as separate. The second analysis simulated a one-factor model, specifically IVI and KIN were simulated as one factor by fixing their correlation to 1.0. The analyses revealed the following fit statistics; two-factor CTCU, S-B $\chi 2$ (239) = 416.35, $p < .001$; RMSEA = .05, $p > .81$; CFI = .98; SRMR = .04; NNFI = .98; simulated one-factor, S-B $\chi 2$ (240) = 2320.63, $p < .001$; RMSEA = .16, $p < .001$; CFI = .92; SRMR = .10; NNFI = .90. A Satorra-Bentler (2001) scaled difference chi-square test revealed that the fit of the two-factor model was significantly better than the simulated one-factor model ($p < .05$). Further to this, the difference in CFI between the two models was greater than .01, with higher a CFI for the two-factor model, indicating that the two models were not invariant (cf. Cheung & Rensvold, 2002).

Discussion

The aim of Study 3 was to examine the factorial validity of an adapted version of the VMIQ (VMIQ-2). The single factor CFA's revealed poor fits to the data; however following item deletion, the three-factor CTCU analysis revealed an acceptable model fit, especially given the number of parameters in the model. When the three different 12-item models were tested, there was no difference in fit between the original 12-item model (all error terms correlated) and models 12a (eight uncorrelated error terms) and 12b (10 uncorrelated error terms), thus indicating all models were of an equally acceptable fit. However, because the original model is based on theory as opposed to being computed following post-hoc model adjustment, the original model is the model of choice (cf. Biddle et al., 2001).

The support provided for the three-factor structure of the VMIQ-2 by the CTCU analysis suggests that from a measurement perspective at least, IVI and KIN should be treated as separate modalities. This was further confirmed by the subsequent re-analysis comparing IVI and KIN as separate modalities in a two-factor model, against the simulated one-factor model (where IVI and KIN were considered as one modality). In this analysis, the two factor model displayed a significantly better fit than the simulated one-factor model, indicating that despite their significant correlation IVI and KIN should be considered separately (cf. Glisky, et al., 1996).

With the factor structure of the VMIQ-2 initially established, study 4 sought to further examine the factorial validity of the VMIQ-2 with a different sample.

Study 4

Method

Participants

An opportunistic sample of 355 British athletes (*M* age = 20.05, *SD* = 3.24 years, *n* = 235 males, *n* = 119 females, *n* = 1 sex not reported) was recruited for the study. All gave their written consent to take part in the study. Athletes had an average of 7.32 years (*SD* = 4.08) of competing in their sport, and were from a variety of team and individual sports. The level of competition ranged from recreational to international and/or professional or semi professional (recreational *n* = 48, club *n* = 51, county *n* = 10, university *n* = 103, national *n* = 47, international and/or professional or semi-professional *n* = 27, level not reported *n* = 69).

Measures

The 12-item VMIQ-2 from Study 3 was administered.

Procedure

As in Study 3, all participants completed the VMIQ-2 in a quiet environment, either in training or at home, in groups of not more than 15. Participants were asked to refrain from conferring with others, and confidentiality of their responses was assured. The order in which participants were asked to complete the three factors on the questionnaire was randomised to prevent ordering effects.

Data Analysis

CFA using the CTCU approach was employed. Specifically, in line with Study 3, a three-factor CTCU analysis with all error terms correlated was performed. In addition, the same criteria for assessing model fit were used.

Results

Data screening revealed that 19 participants had missing data points (2% of the total number of data points). When missing data points are 5% or less than the total number of data points, exclusion of data from participants with missing data points is an appropriate strategy (cf. Tabachnick & Fidell, 2001). Consequently, the data from the 19 participants were removed, with the analysis performed on data from 336 participants.

The CTCU analysis revealed the following fit statistics; S-B χ^2 (555) = 1242.76, $p < .001$; RMSEA = .06, $p <. 001$; CFI = .98; SRMR = .06, NNFI = .97. Factor loadings ranged from 0.64-0.82, with the following interfactor correlations; IVI and EVI = .51, IVI and KIN = .62, EVI and KIN = .43. Although the chi-square was significant, and the chi-square to degrees of freedom ratio was rather high, the rest of the fit statistics were within recommended limits (cf. Hu & Bentler, 1999).

To provide continuity with Study 3, a comparison of a two-factor CTCU analysis with IVI and KIN as separate factors against a simulated one-factor model was performed. The analyses revealed the following fit statistics for the two-factor CTCU model, S-B $\chi 2$ (239) = 638.07, $p < .001$; RMSEA = .07, $p > .001$; CFI = .97; SRMR = .05; NNFI = .97. However, the simulated one-factor model would not converge. Therefore, in order to be able to compare whether IVI and KIN should be treated as separate factors or one factor, a "true" one-factor model was run, where all 24 items (12 IVI and 12 KIN) loaded onto one factor. This model revealed the following fit statistics, S-B $\chi 2$ (240) = 3150.36, $p < .001$; RMSEA = .19, $p < .001$; CFI = .90; SRMR = .11; NNFI = .89. In comparing the two-factor model against the one factor model, the two-factor model resulted in the lowest consistent Akaike information criterion (1055.17 vs. 3560.62). This suggests, based on parsimony, that the two-factor model may be a better model (cf. Byrne, 1998). Further to this, the CFI's of the two models were compared, as in Study 3. Consistent with the first study, the difference in CFI was greater than .01; with the two-factor model again reporting a higher CFI. Taking these two results together provides additional support for the delineation of IVI and KIN as separate modalities.

Discussion

In Study 4 the factorial validity of the VMIQ-2 was further explored. The results of the three-factor CTCU analysis revealed a satisfactory model fit. However, it must be noted that the chi-square test was significant and larger than in the previous study. However, the fit indices were acceptable and were similar to the results of the first study. Comparing whether IVI and KIN should be treated as separate or the same factor revealed similar findings to Study 3. Specifically the two-factor model was the most parsimonious, with a CFI that was greater than the one-factor model by more than .01.

Despite the significant chi-square and relatively high chi-square/degrees of freedom ratio in Study 4, taking the results from studies 3 and 4 together, there appears to be initial support for the validity of the three-factor structure of the VMIQ-2. This suggests that the VMIQ-2 has the potential to be a useful measure of movement imagery ability. Study 3 had a fairly low chi-square/degrees of freedom ratio and for both studies the fit indices met or exceeded proposed criteria (cf. Hu & Bentler, 1999). While these criteria should not be viewed as "golden rules" (Marsh et al., 2004), it is encouraging that at the very least they were met or surpassed in both studies. With support provided for the factorial validity of the VMIQ-2, the final study assessed the concurrent and construct validity of this measure.

Study 5

The aim of Study 5 was to assess the concurrent and construct validity of the VMIQ-2. Concurrent validity relates to whether the VMIQ-2 correlates with already validated imagery ability measurement tools (cf. Thomas, Nelson, & Silverman, 2005). As with many studies it is difficult to test this form of validity because there is often no gold standard criterion. Nevertheless, in the present study the MIQ-R (Hall & Martin, 1997) seemed a suitable criterion choice as its internal consistency and reliability have been demonstrated. However, it is important to note that there are limitations associated with using the MIQ-R. First, the MIQ-R does not measure vividness specifically rather it is a measure of the ease/difficulty to create an image. Second, there is no distinction made between visual imagery perspectives (i.e., IVI and EVI). Third, the factorial validity of the MIQ-R has not been assessed using CFA. Nevertheless, the MIQ-R does at least make a distinction between visual and kinaesthetic imagery, thus the concurrent validity of the VMIQ-2 factors can be partially assessed. A further strength of using the MIQ-R to assess concurrent validity is that the VMIQ-2 and MIQ-R may overlap in the processes they reflect. Indeed, it was suggested in the introduction that vividness may reflect the processes of formation, transformation and maintenance, and it is also likely that the ease of image creation assessed by the MIQ-R requires the same processes[4].

Construct validity can be assessed using a variety of methods (cf. Cronbach & Meehl, 1955; Thomas et al., 2005). One such method is to find expected differences between distinct groups. In relation to imagery ability, research has demonstrated significant differences in reported imagery ability between athletes of varying skill levels. For example, elite athletes have reported more vivid imagery

[4] The present author would like to thank an anonymous reviewer for this suggestion.

than non-elite athletes (Oishi & Maeshima, 2004). In addition, research involving the original VMIQ has demonstrated significant differences between varsity and non-athletes (Eton et al., 1998), and between elite athletes and non elite matched controls (Isaac & Marks, 1994). In both cases, higher level athletes reported greater vividness. Evidence for the construct validity of the VMIQ-2 could therefore be obtained by demonstrating differences in imagery ability scores in elite and non-elite athletes.

Thus in the present study it was expected that concurrent validity would be supported by significant correlations being obtained between requisite factors of the VMIQ-2 and MIQ-R. Specifically, it was expected that the visual imagery factor of the MIQ-R would correlate significantly with the IVI factor from the VMIQ-2 and also the EVI factor. The kinaesthetic imagery factors from the two questionnaires were expected to correlate significantly. To support construct validity, it was expected that elite athletes would report significantly greater imagery ability than non-elite athletes.

Method

Participants

Concurrent validity. An opportunistic sample of 71 athletes (*M* age = 21.72, *SD* = 3.39, *n* = 55 males, *n* = 16 females) was voluntarily recruited for the study. All gave their written consent to take part. Athletes had an average of 8.26 (*SD* = 4.35) years of competing in their sport, and were from a variety of team and individual sports. The level of competition ranged from recreational to international (recreational *n* = 16, club *n* = 8, university *n* = 35, national *n* = 8, international *n* = 2, level not reported *n* = 2).

Construct validity. To test the construct validity of the VMIQ-2, the samples from all three studies were combined, making a total of 777 participants. From this sample, 146 high level and 240 low level athletes were then identified. In line with previous research (e.g., Isaac & Marks, 1994; Eton et al., 1998), the high level athletes were defined as those who participated in their sport at a national level and above, and low level athletes were those who participated in their sport at a recreational and club level. To ensure that each sport was represented equally in each group, participants were matched for sport-type across the two groups. Where sports were not matched, the respective data were deleted from the sample. This resulted in a sample of 198 sport-matched participants, 99 per group.

Measures

Vividness of Movement Imagery Questionnaire-2 (VMIQ-2). The 12-item VMIQ-2 was used as the predictor.

Movement Imagery Questionnaire-Revised (MIQ-R). The MIQ-R served as the criterion variable. The MIQ-R comprises eight items that measure both visual and kinaesthetic imagery ability. Participants are asked to assume a starting position, and then perform a movement, such as raising their right knee as high as possible, and then lowering their leg back to the starting position. They are then asked to either visually or kinaesthetically image themselves performing the movement and are asked to rate the ease or difficulty with which this is done. The factorial validity of the original Movement Imagery Questionnaire (MIQ) has been supported by Atienza et al., (1994). The reliability of the MIQ has also been demonstrated as acceptable, with test-retest coefficients of .83 for a one week interval being reported (Hall, Pongrac, & Buckolz, 1985). Significant correlations between the MIQ and

MIQ-R have been obtained, for both the visual and kinaesthetic subscales, suggesting the MIQ-R to be a suitable revision of the MIQ.

Procedure

Participants completed the questionnaires in a quiet environment in groups of not more than five. Confidentiality of responses was assured and participants were asked not to confer with anyone else. The order in which groups of participants received the MIQ-R and VMIQ-2 was counterbalanced. To facilitate accurate completion of the MIQ-R, participants were guided through its completion. Specifically, the primary author read out each movement to be completed by the participants, and watched each participant to make sure that all actions were performed fully (cf. Short & Short, 2002).

Analysis

Concurrent Validity. Pearson's product-moment correlations were calculated to assess the strength of relationships between the scores on each factor of the VMIQ-2 with corresponding scores on the factors of the MIQ-R. For example, the kinaesthetic imagery factor on the VMIQ-2 was correlated with the kinaesthetic factor of the MIQ-R, and each visual imagery factor of the VMIQ-2 was correlated with the visual imagery factor of the MIQ-R. Based on their reliability coefficients, the strength of the correlations between the requisite factors was adjusted so as to take any possible measurement error into account (cf. Biddle et al., 2001). Further, as multiple correlations were conducted, an adjustment was made to the critical r to reduce the likelihood of a Type I error occurring (Schutz & Gessaroli, 1993).

Construct Validity. In order to compare differences between the high and low level athletes, independent samples t-tests were performed on each of the three factors. To control for a Type I error, the alpha level for each *t*-test was adjusted to .017 using a Bonferroni correction.

Results

Concurrent Validity

The data were analysed for normality; however this revealed significantly skewed data, with eight outliers. These data were removed and subsequent checks were within accepted limits. The correlation analyses were therefore performed on the remaining 63 participants. To control for Type I error when performing multiple correlations an adjustment needs to be made to the critical r. This adjustment is based on the number of tests to be performed and the degrees of freedom. Consequently, in the present study with 3 tests and 61 degrees of freedom, the critical r for a significant correlation at $p < .05$ was $r = .308$ (cf. Shavelson, 1988). Reliability analysis revealed the following alpha coefficients for the VMIQ-2; IVI = .95, EVI = .95, KIN = .93. For the MIQ-R the alpha coefficients were .85 for visual imagery and .79 for kinaesthetic imagery.

The results revealed that both the IVI and EVI factors were significantly correlated with the visual factor of the MIQ-R, IVI and visual imagery, r = -.342 ($p < .05$), EVI and visual imagery r = -.647 ($p < .01$). The KIN factors were both significantly correlated, KIN and kinaesthetic imagery, r = -.736 ($p < .01$). The negative correlations are due to the two measures being scored in opposite directions.

Using Meng and colleagues' (1992) adjusted z-score equation the strength of the correlations between IVI (VMIQ-2) and visual imagery (MIQ-R), and EVI (VMIQ-2) and visual imagery (MIQ-R) were compared. The analysis revealed a significant difference between the two correlations ($z = 2.22$, $p < .03$).

Construct Validity

The assumption of homogeneity of variance was met for the analyses performed on the EVI factor, but not on the IVI and KIN factors. Consequently, equal variance not assumed *t*-tests were used to analyse the data from the IVI and KIN factors. The *t*-tests revealed significant differences between the high and low level athletes for each variable; for IVI, t (181.66) = -2.56, $p < .01$ $d = .36$; for EVI, t (196) = -2.55, $p < .01$ $d = .36$; and for KIN, t (186.49) = -2.87, $p < .005$ $d = .40$. Inspection of the cell means revealed that in all cases the high level athletes had greater imagery ability indicated by lower mean scores (see Table 6 for descriptive statistics).

Table 6

Means and standard deviations (in parentheses) for factor scores on the 12-item VMIQ-2.

	Factor		
Group	IVI	EVI	KIN
High level	23.48 (8.47)	26.53 (9.62)	23.95 (8.95)
Low level	27.14 (11.31)	30.22 (10.76)	28.10 (11.26)

Discussion

The aim of Study 5 was to examine the concurrent and construct validity of the VMIQ-2. Taken together the results of Study 5 provide initial support for the concurrent and construct validity of the VMIQ-2.

In general, the concurrent validity analysis revealed the expected results. Specifically, the kinaesthetic imagery factors of the VMIQ-2 and MIQ-R were correlated, as were the EVI and visual imagery factors, and IVI and visual imagery factors. Of note was that the correlation between EVI and visual imagery was significantly greater than the IVI and visual imagery correlation. While it might initially be expected that the correlations between the two visual imagery perspectives from the VMIQ-2 and the visual imagery scale from the MIQ-R would be similar (as the MIQ-R makes no distinction about which visual perspective should be used to image from), examination of the items contained in the MIQ-R suggests that a stronger relationship should exist between EVI (VMIQ-2) and visual imagery than between IVI (VMIQ-2) and visual imagery. To expand, the items on the MIQ-R require participants to perform movements that depend heavily on form for their successful execution (cf. Callow & Hardy, 2004), and previous research (e.g., Hardy & Callow, 1999; White & Hardy, 1995) has demonstrated that EVI is superior to IVI for the acquisition and performance of tasks where form is important. Hardy (1997) suggests that these effects are caused by imagery providing additional information to the performer that would otherwise be unavailable. In particular, in tasks where form is important, EVI provides additional information about the shape of the body as it moves. Consequently, the items on the MIQ-R might have led participants to adopt an external visual perspective or to produce more vivid EVI, leading to a stronger correlation between EVI (VMIQ-2) and visual imagery. The significant differences in the correlations should, therefore, be seen as a strength of the VMIQ-2.

The data from the construct validity analyses were also encouraging. In all three analyses (IVI, EVI, KIN) the high level athletes reported significantly more vivid imagery than the low level athletes. These results support previous research (e.g., Isaac & Marks, 1994; Oishi & Maeshima, 2004) that has demonstrated greater imagery ability in higher level athletes. As imagery ability is a skill that can be improved through practice (Rodgers, Hall & Buckolz, 1991), the above result is not surprising. High level athletes engage in more deliberate imagery practice than low level athletes (Cumming & Hall, 2002), so greater imagery ability would be expected. Of note was that high and low level athletes differed in their kinaesthetic imagery ability. Kinaesthetic imagery may be particularly important for high level performers because it may help them gain a detailed feel for movements (Hardy & Callow, 1999).

General Discussion

The general purpose of this program of research was to amend the VMIQ by taking into account specific imagery modality and perspective conceptualisations (cf. Hardy & Callow, 1999; White & Hardy, 1995), in order to provide a more comprehensive and psychometrically acceptable assessment of movement imagery ability.

Taken together, the results of the three studies provide preliminary support for the VMIQ-2 as an improved revision of the original VMIQ that displays factorial, concurrent and construct validity. Studies 3 and 4 also provided support for the delineation of IVI and KIN into separate modalities. These results indicate that, from a measurement perspective at least, imagery modalities and visual perspectives should be treated separately, and conceptually should not be confused. These results corroborate findings from both behavioural (e.g., Glisky et al., 1996) and neuroscientific (e.g., Fourkas, Ionta, et al., 2006) research which demonstrates the delineation of internal visual and kinaesthetic imagery.

Several potential implications, and one limitation, can be identified from the present research. With reference to the implications, to provide further information concerning individual imagery experiences, it has been recommended that a combination of measures, both objective (e.g., autonomic nervous system recordings) and subjective (e.g., questionnaires) are used (Guillot & Collet, 2005). As the VMIQ-2 appears to be a valid measure of movement imagery ability, its use in combination with other imagery tests may allow for more complete assessments of imagery ability to be made. A second implication is that the use of the VMIQ-2 may aid in the precision of brain functioning research in relation to perspectives and modality. Indeed, Ruby and Decety (2001) recently demonstrated both common and unique neural areas associated with first and third person (of someone else) imagery. However, modality (i.e., IVI or KIN) was not defined in first person imagery and the participant was not the agent of the image in the external perspective. Also, a distinction between first person visual imagery and kinaesthetic imagery has only been made in some studies (e.g., Fourkas, Ionta et al., 2006). As the VMIQ-2 requires the participant to be the agent of the image, administering the VMIQ-2 could allow for a check of the participant's imagery ability in the different modalities and perspectives, and may provide the relevant delineation which may lead to more precise assessment of brain function during imagery. Thus, in certain situations EVI of self rather someone else should be employed.

Within the sport setting the VMIQ-2 has the potential to be of use to sport psychologists and coaches to use with athletes. Because imagery ability moderates the effectiveness of interventions (e.g., Isaac, 1992), using the VMIQ-2 could provide a comprehensive assessment of an athlete's imagery ability, prior to undertaking an imagery intervention. Furthermore, as task characteristics moderate the efficacy of imagery perspectives on performance (Hardy & Callow, 1999; White & Hardy, 1995), completion of the VMIQ-2 would provide a coach or practitioner with information about an athlete's ability to image movements using different perspectives. This information would be particularly useful for implementing the most appropriate intervention for the athlete and the type of sport that is played. Finally, reducing the number of items in the VMIQ-2, and therefore the time required for its completion, is noteworthy. Specifically, athletes are known to dislike lengthy paperwork (cf. Beckmann & Kellmann, 2003), so the shortened length of the VMIQ-2 may result in athletes being more willing to complete the questionnaire.

A limitation of the present research was that a direct comparison between the VMIQ-2 and the original VMIQ was not made. A systematic examination of this comparison along with an exploration of predictive validity (e.g., does the three-factor 12-item VMIQ-2 predict more variance in performance than the two factor original VMIQ?), would be a worthy avenue for future research. Indeed, previous research (Gregg et al., 2005) has demonstrated a moderating effect of imagery ability on the imagery use/performance relationship. Additionally, high imagers, as measured by the original VMIQ, have been shown to display greater performance improvements following imagery training programs than low imagers (Isaac, 1992). Replication of these findings using the VMIQ-2 would support the validity of this measure.

To conclude, the present study provided an amended version of the VMIQ (VMIQ-2) based on contemporary modality and perspective conceptualisation that had its factor structure assessed using confirmatory factor analytic techniques and construct validity tested. Preliminary support for the factor structure, concurrent validity, and construct validity was obtained, indicating that the VMIQ-2 appears to be a useful and psychometrically acceptable measure of movement imagery ability.

CHAPTER 4

Interactive Effects of Different Visual Imagery Perspectives and Narcissism on Motor Performance[5]

Abstract

The present study examined the interactive effects of visual imagery perspectives and narcissism on motor performance. Forty-seven right-handed males completed the Narcissism Personality Inventory (NPI-40; Raskin & Hall, 1979) and then performed a golf putting task using either internal visual imagery or external visual imagery. The task was completed under conditions of low self-enhancement opportunity and high self-enhancement opportunity. Based on a median split of NPI-40 scores, high and low narcissist groups were formed. Results revealed that high narcissists using external visual imagery significantly improved their performance from the low to the high self-enhancement condition, and performed significantly better in the high self-enhancement condition than high narcissists using internal visual imagery. Low narcissists remained relatively constant in performance across self-enhancement conditions, regardless of imagery perspective used. The results highlight the importance of considering personality characteristics when examining the effects of visual imagery perspectives on motor performance.

[5] This chapter is currently in preparation as Roberts, R., Callow, N., Hardy, L., & Woodman, T. (in preparation). Interactive Effects of Different Visual Imagery Perspectives and Narcissism on Motor Performance. *Journal of Experimental Social Psychology*.

Introduction

The visual imagery perspective used by performers to aid motor learning and performance has been recognised as a key variable that influences the effectiveness of imagery interventions (Callow & Hardy, 2005; Calmels et al., 2006). Within this literature two visual imagery perspectives have been identified: internal visual imagery (IVI) and external visual imagery (EVI). IVI is described as the view performers would get if they imagined looking out through their own eyes. EVI is described as the view performers would get if they imagined watching themselves performing a task from a third person perspective (i.e., as if watching themselves on television).

Hardy (1997) has proposed that imagery exerts a beneficial effect on performance only to the extent that the images created provide more information to a performer than would otherwise be available. In line with this rationale, research has demonstrated that the relative effectiveness of both IVI and EVI is moderated by task characteristics. To expand, EVI is more beneficial to performance than IVI in tasks where form of body movement is important, such as gymnastics (Hardy & Callow, 1999). The superior performance of EVI in these types of task has been attributed to EVI allowing a performer to see the desired shape associated with the correct movement, thereby providing them with more information (cf. Hardy). Conversely, for slalom-based tasks that require a performer to follow a "line" around a set course (such as canoe or ski slalom) where accuracy is important IVI is more beneficial for performance than EVI (White & Hardy, 1995). This is because IVI allows a performer to rehearse the precise spatial and temporal locations at which key movements need to be initiated with reference to the location of him/herself actually on the line being taken (cf. Hardy; White & Hardy).

While these results show that task characteristics are an important moderator of the imagery perspective/performance relationship, it is likely that individual differences in personality may also play a role. Indeed, personality characteristics are considered as fundamental attributes for psychological preparation, and have been proposed to interact with psychological skills in order for peak performance to be achieved (Hardy et al., 1996). Therefore, it could be hypothesised that personality may influence the psychological skills used by athletes, and their resultant effectiveness. However, this hypothesis remains to be tested. With regards to imagery perspectives, one particular personality variable that may be relevant is narcissism.

Narcissism is associated with a grandiose self-concept (Campbell, Bosson, Goheen, Lakey, & Kernis, 2006; Emmons, 1984). Narcissists think highly of their own abilities (Gabriel et al., 1994; John & Robins, 1994) and report high levels of confidence (Campbell, Goodie, & Foster, 2004). They also enjoy focusing attention on themselves and displaying their (perceived) talents to others (Morf & Rhodewalt, 2001). Further, narcissists take pleasure in looking at themselves from the point of view of others (Robins & John, 1997), and one of the underlying components of narcissism is an admiration of the self from an external point of view (i.e., vanity; Raskin & Terry, 1988).

Despite narcissists' belief that they are exceptional performers, literature examining the effects of narcissism on performance has revealed that narcissists generally do not perform any better on tasks than low narcissists (e.g., Ames & Kammrath, 2004; John & Robins, 1994; Judge, LePine, & Rich, 2006). However, Wallace and Baumeister (2002) suggest that the performance of narcissists will be moderated by the degree of self-enhancement opportunity afforded by the task. In tasks that offer a high degree of self-enhancement opportunity (e.g., performing difficult tasks, performing under pressure, or performing in front of an audience), narcissists should outperform low narcissists. This is because these situations offer an opportunity for narcissists to display their perceived superiority and to gain admiration. However, in situations that do not afford a self-enhancement opportunity narcissists should perform relatively poorly. In a series of four experiments, Wallace and Baumeister consistently demonstrated that narcissists performed better when self-enhancement opportunity was high rather than low.

The findings from Wallace and Baumeister (2002) indicate that manipulating self-enhancement opportunity leads to performance improvements for narcissists. Given that imagery has a positive effect on performance (see Callow & Hardy, 2005 for a review) one might expect that as long as self-enhancement opportunity is manipulated, the use of either IVI or EVI may lead to performance improvements for narcissists. However, we suggest that narcissists will only perform better in high self-enhancement conditions when EVI is used. This is because when narcissists look at themselves performing a task from an external point of view, such as a mirror or on video, their self-enhancement motive is activated (Robins & John, 1997). Thus, the use of EVI may provide a similar opportunity. That is, when using an external perspective, narcissists could see *themselves* performing a task successfully. With this in mind, it seems reasonable to suggest that when self-enhancement opportunity is high, narcissists using EVI will perform better than when self-enhancement opportunity is low because their self-enhancement motives are activated through the use of EVI. In contrast, the use of IVI would not allow narcissists to see *themselves* performing. As a result, it is unlikely that self-enhancement motives would be activated through the use of IVI. Thus, performance would be no better when self-enhancement is high than when it is low. Low narcissists are less affected by self-enhancement (cf. Morf & Rhodewalt, 2001; Wallace & Baumeister), so one might expect that the performance of low narcissists would remain relatively consistent under conditions of low and high self-enhancement opportunity, regardless of imagery perspective used.

Consequently, the aim of the present study was to examine whether narcissism would moderate the effects of different visual imagery perspectives on performance, under conditions of low and high self-enhancement opportunity. For high narcissists an interaction between imagery perspective and self-enhancement condition was hypothesised. Specifically, the use of EVI was hypothesised to result in an improvement in performance across the two self-enhancement conditions, whereas the use of IVI was not expected to improve the performance of high narcissists. For low narcissists, it was hypothesised that performance would remain relatively constant across conditions, regardless of imagery perspective used.

Method

Participants

An opportunistic sample of 47 right-handed male novice golfers (*M* age = 22.14 years, *SD* = 4.75) was recruited for the study. To be considered as novices, participants were required to have not played a full round of golf within the previous 12 months, or less than 5 rounds in their entire life. All participants gave their written informed consent to take part in the study. Ethics approval was obtained from the School's ethics committee.

Task and Apparatus

A golf putting task, performed on an indoor putting green, was employed for the present study. Golf putting was used because, in relation to the task characteristics literature presented in the introduction, this task did not favour one particular perspective. Furthermore, it was deemed that for novice performers, both perspectives could provide useful information for performance (i.e., IVI could provide information about the line of the putt from the participants view, whereas EVI could provide information relating to body stance). Participants were required to putt golf balls into a hole 10.8cm in diameter from a distance of 2.26 metres. To increase task difficulty, there was an incline of 25% between the participant and the hole. Standard golf balls and a standard "blade" putter were used by all participants. A digital camera placed on the ceiling directly above the hole was used to measure the distance each putt finished from the hole.

Design

A mixed model design was employed. Specifically, participants were randomly allocated to one of two treatment groups: an IVI group or an EVI group. Participants completed the experimental task individually under three conditions: practice, low self-enhancement opportunity, and high self-enhancement opportunity.

Experimental Conditions

Practice. The practice condition consisted of 50 putts which were not recorded by the computer. Participants received standardised instructions informing them that they would receive £10 (approximately U.S. $20) if a satisfactory performance level was achieved throughout the experiment. Participants were given short breaks (i.e., five minutes) after 20 and 40 putts. For the first 40 practice putts participants did not use imagery. However, for the last 10 practice trials the primary experimenter administered an imagery script to participants that corresponded to their treatment group (i.e., participants in the IVI group received a script written from an IVI perspective). The imagery scripts (see Appendix D for imagery scripts) contained stimulus and response propositions, but emphasised response propositions where appropriate (cf. Lang et al., 1980). Participants read the script to themselves twice while seated. They then listened to the primary experimenter read the script and imaged while in their putting position. Following this, participants were then asked to image performing the task, while in their putting position, prior to each putt. Participants were asked to image "dynamically" (i.e., image in their putting position and holding equipment), as this has been shown to increase the vividness of imagery experiences, in comparison to imaging whilst staying still (Callow, Roberts, & Fawkes, 2006).

Low self-enhancement condition. The low self-enhancement condition consisted of 20 putts which were recorded by the computer. Before the first putt the primary experimenter administered the same imagery script as in the practice condition. As in practice, participants read the script twice while seated, and then imaged in position as they listened to the primary experimenter read the script. Participants were then asked to image performing the task from their particular perspective prior to each trial.

High self-enhancement condition. The high self-enhancement condition also consisted of 20 putts which were recorded. In order to create a condition that offered the opportunity for self-enhancement, participants received standardised evaluative instructions informing them that their intended payment of £10 (U.S. $20) for achievement of a satisfactory performance level could change during the 20 putts. Specifically, participants were told that for every putt that they holed, 70 pence (U.S. $1.40) would be added to their total, thereby making a total payment of £24 (U.S. $48) available. However, they were also informed that for every putt missed, £1 (U.S. $2) would be removed from the starting payment of £10 (U.S. $20).

Furthermore, participants were told that another prize was available for taking part in the study: £15 (U.S. $30) was available for the best score; £10 (U.S. $20) for the second best and £5 (U.S. $10) for the third best score. Finally, participants were informed that their scores would be made public, by posting them on department notice boards, and that their performance was to be videoed (by a video camera placed at the end of the putting surface) for later analysis by a golf professional.

Before starting the first putt participants followed the same procedures for imaging the task as used in the low self-enhancement condition.

Performance

Performance was assessed using mean radial error (MRE). MRE is a two-dimensional error score, which calculates the distance the ball lies from the hole using both *x* and *y* coordinates (see Hancock, Butler, & Fischman, 1995), and was used to measure accuracy. Mean MRE scores were calculated for the low and high self-enhancement conditions.

Measures

Vividness of Movement Imagery Questionnaire – 2 (VMIQ-2: Roberts, Callow, Hardy, Markland, & Bringer, in press*)*. The VMIQ-2 is a revision of the original VMIQ (Isaac et al., 1986) and comprises 12 items that assess the ability to image a variety of movements visually and kinaesthetically. The visual aspect is further sub-divided into external and internal visual imagery. Participants are required to image each of the 12 items in three ways, using internal visual imagery, external visual imagery and kinaesthetic imagery. The vividness of each item imaged is rated on a scale of 1 (*perfectly clear and vivid*) to 5 (*no image at all*). The VMIQ-2 displays acceptable factorial, concurrent, and construct validity (Roberts et al.).

Narcissism Personality Inventory–40 (NPI-40; Raskin & Hall, 1979*)*. The NPI-40 is a 40 item forced choice inventory. Each item consists of two statements, one narcissistic and one non- narcissistic. For each item, participants are asked to choose the statement that best represents their own feelings. The total number of narcissistic responses is summed to give a total score. Considerable evidence exists (e.g., see Raskin & Terry, 1988 for a review) supporting the internal consistency, factorial validity, and construct validity of the NPI. A copy of the NPI-40 can be found in Appendix I.

Manipulation/Post-experimental Questionnaire. On completion of the low and high self-enhancement conditions, participants completed a manipulation/post-experimental questionnaire. This questionnaire comprised six questions and assessed the following: the extent to which the particular imagery perspective was adhered to, the suitability of the imagery perspective for the task; the extent to which the imagery perspective aided their confidence to complete the task, the extent to which participants switched between imagery perspectives, and their experience of kinaesthetic imagery. These questions were scored on a Likert-type scale from 1 (*not at all*) to 11 (*greatly*). Participants were also asked if they used any other strategies to aid their performance. This question was left open-ended with space for participants to write their responses.

Procedure

Two weeks before the start of the experiment participants completed the NPI-40, the VMIQ-2, and the consent form. To ensure participants could image proficiently, only participants who scored below 36 on each of the subscales of the VMIQ-2 were considered for the study. This score corresponds to participants' ability to produce images that are at least moderately clear and vivid. Similar cut-off criteria have been used in previous studies and have resulted in significant effects for imagery interventions (e.g., Hardy & Callow, 1999). All participants fulfilled these criteria.

Participants were tested individually. On arrival at the laboratory participants received standardised instructions informing them that the purpose of the study was to examine the effects of different imagery perspectives on golf putting performance and that we intended to pay them £10 if they achieved a satisfactory performance level. Participants then completed the practice condition. On completion of the practice condition participants were given a five-minute break.

Following the break participants entered the low self-enhancement condition. On completion of this condition participants completed the post-experimental questionnaire and were given a five minute break. After this the high self-enhancement condition was performed. Participants were read the standardised evaluative instructions and then performed the 20 putting trials in this condition. On completion of these trials participants completed the post-experimental questionnaire for a final time. They were then fully de-briefed about the study, thanked for their participation, and were given any money won.

Results

Manipulation Check

Inspection of the manipulation/post-experimental questionnaire revealed that 11 of the 47 participants reported either being unable to adhere to their particular treatment group, or switched excessively between imagery perspectives during the experimental conditions. These data were excluded from further analysis. Data screening also revealed one outlier in the data set. This was subsequently removed, leaving a sample of 35 participants. In order to create high and low narcissistic groups a median split was performed on NPI-40 scores (median = 12). As the NPI-40 scores from two participants (one in the IVI group and one in the EVI group) lay on the median, we excluded these participants from further analysis. This resulted in 17 participants (*n* = 10 IVI, *n* = 7 EVI) being classified as low narcissists and 16 (*n* = 7 IVI, *n* = 9 EVI) as high narcissists. An independent samples *t*-test revealed a significant difference in NPI scores between the high (*M* = 21.00, *SD* = 6.99) and low narcissistic (*M* = 6.12, *SD* = 2.71) groups, t (19.19) = -7.97, $p <. 01$.

Performance

A 2 (narcissism; high/low) x 2 (imagery perspective; IVI/EVI) x 2 (self-enhancement opportunity; low/high) ANOVA with repeated measures on the self-enhancement opportunity factor was used to analyse the MRE data. Box's M test for the equality of covariance matrices and Mauchly's test of sphericity were satisfied for this analysis. The three-factor mixed model ANOVA revealed a trend toward significance for the condition main effect, F (1, 29) = 3.60, $p < .07$, $\eta^2 = .09$, $1\text{-}\beta = .45$. Of more central interest, a significant three-factor interaction was revealed, F (1, 29) = 5.80, $p < .02$, $\eta^2 = .15$, $1\text{-}\beta = .64$. Figure 2 displays the nature of the interaction. Separate two-factor (imagery perspective x self-enhancement opportunity) repeated measures ANOVAs were performed for low and high narcissists to follow up the significant three-factor interaction. For low narcissists, no significant interaction or main effects emerged. However, for high narcissists the two-factor interaction was significant, F (1, 14) = 6.88, $p < .02$, $\eta^2 = .30$, $1\text{-}\beta = .68$. Tukey's tests revealed that high narcissists using EVI were significantly more accurate (indicated by lower MRE scores) in the high self-enhancement condition compared to the low self-enhancement condition. High narcissists using EVI were also significantly more accurate in the high self-enhancement condition compared to high narcissists using IVI. No other effects were significant.

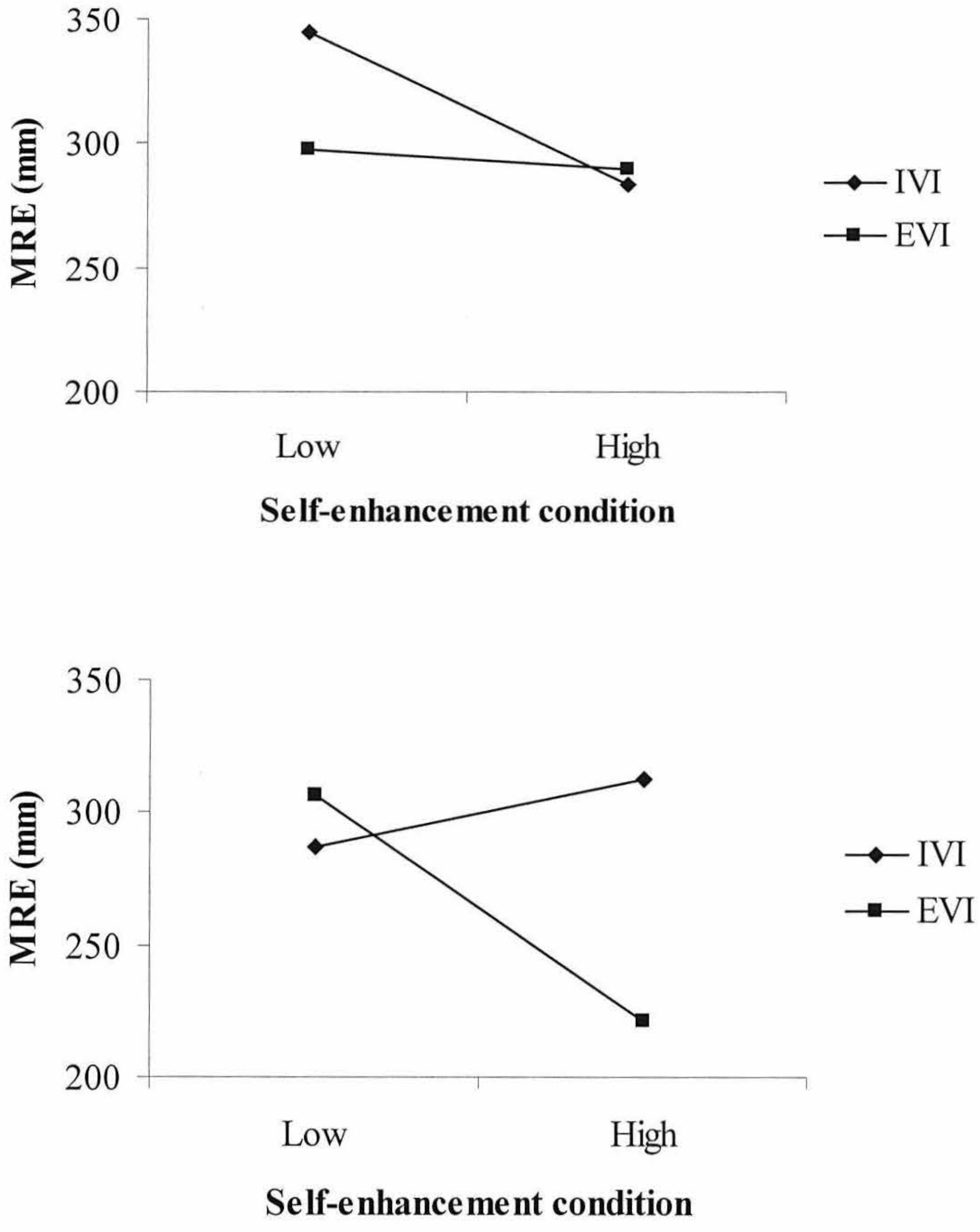

Figure 2. MRE scores (mm) for low narcissists (top graph) and high narcissists (bottom graph).

Manipulation/Post-experimental Questionnaire

Three questions from the manipulation/post-experimental questionnaire required statistical analysis. These were the questions relating to suitability, confidence and kinaesthetic imagery. These questions were also analysed using 3-factor repeated measures ANOVAs, with a Bonferroni adjusted alpha level of .017. The analyses revealed no significant main effects or interactions for any of the analyses (all p's > .10). Inspection of the mean data indicated that participants felt that the imagery treatments were generally suitable (Low SE M = 8.86, SD = 1.7; High SE M = 9, SD = 1.53) and aided their confidence to perform the task (Low SE M = 7.71, SD = 2.15; High SE M = 7.47, SD = 2.29). Participants also reported experiencing kinaesthetic imagery in both conditions (Low SE M = 7.69, SD = 2.19; High SE M = 7.14, SD = 2.53).

Discussion

The aim of the present study was to examine whether narcissism might moderate the effectiveness of imagery perspectives on motor performance. It was hypothesised that the use of EVI would result in improved performance for narcissists when perceived self-enhancement opportunity was high, whereas IVI would not. For low narcissists, performance was hypothesised to remain relatively consistent across conditions, regardless of imagery perspective used.

The present results provide some support for the hypotheses. Specifically high narcissists using EVI significantly improved their performance from the low to high self-enhancement condition, whereas those using IVI did not. The improved performance of high narcissists in the EVI group can be interpreted in line with the view that EVI may have served to activate narcissists' self-enhancement motives (cf. Robins & John, 1997) because they may have been able to see themselves performing using EVI. The fact that high narcissists using IVI did not improve could have been because IVI failed to enhance narcissists' self-enhancement motives. Thus, the present findings are consistent the view that the performance of narcissists is dependent on self-enhancement opportunity (Wallace & Baumeister, 2002). However, the present findings actually extend the literature on narcissism and performance. Indeed, as only high narcissists using EVI displayed improved performance, it would seem that the self-enhancement effect only appears to hold when narcissists are able to get feedback on themselves performing (in this instance, through the use of EVI).

The performance of low narcissists revealed the expected result, as there was no change in performance across conditions. However, the post-experimental data revealed two interesting findings. First, low narcissists thought that their imagery treatments were just as suitable for the task as high narcissists. Therefore, despite no performance improvement, these participants thought using imagery was a suitable strategy. Second, there was no difference between high and low narcissists in the extent to which participants reported that their respective imagery interventions aided confidence to perform the task. Thus, imagery aided the confidence of low narcissists to the same extent as high narcissists. As low narcissists lack the confidence of high narcissists (cf. Rhodewalt & Morf, 1995), this intriguing result highlights the possibility of using imagery as a strategy to aid the confidence of low narcissistic individuals. However, given that the confidence measures in the present study only required single item responses, it would be worth investigating whether imagery does aid the confidence of low narcissists using validated measures.

Several applied implications are associated with the present study. First, in terms of psychological skills training, the "one size fits all" approach (where all athletes are encouraged to use psychological skills in a uniform fashion, e.g., Thelwell & Maynard, 2003) is seriously challenged. The results from the present study indicate that for at least one psychological skill (i.e., imagery) personality characteristics do moderate effectiveness. Therefore, applied practitioners should consider personality characteristics, as well as task characteristics, when recommending to athletes which imagery perspectives to use. Furthermore, practitioners may wish to consider personality characteristics when recommending other psychological skills (e.g., relaxation, goal-setting etc.) to athletes. Considering that the performance of narcissists is dependent on self-enhancement opportunity, strategies that limit the self-enhancement opportunity for narcissists should perhaps be avoided. Finally, if narcissists are to use imagery, they may benefit more from an external visual perspective than an internal visual perspective.

Certain strengths and limitations are associated with the present study. Using detailed manipulations checks enabled greater experimental control, and resulted in the removal of participants who were unable to comply with their treatments. Furthermore, using specific imagery ability criteria with which to accept or reject participants for the study allowed for any differences in imagery ability to be minimised. Due to the removal of 11 participants, the resulting sample size was relatively small. However, it was sufficiently large to yield significant interactions in a complex design, and large effect sizes (cf. Cohen, 1988), suggesting that sample size was not a major issue. However, clarification of these effects would be worthwhile.

As this is the first study to examine the role of personality on the effects of imagery perspectives on performance, future research should look to replicate and extend these findings in a different setting. For example, it would be useful to ascertain whether these effects generalise to expert performers (cf. Greenspan & Feltz, 1989). Furthermore, there is now evidence that both task (cf. Hardy, 1997) and personality characteristics, in the form of narcissism, appear to moderate the effect of imagery perspectives. Therefore, future research may wish to investigate the interactive effects of imagery perspectives and narcissism on a task with particular characteristics (e.g., form or slalom based). This would enable researchers to ascertain if task or personality characteristics, or indeed a combination of both, have the greatest impact on the effectiveness of imagery perspectives on motor performance.

CHAPTER 5

General Discussion

Introduction

This chapter brings together and discusses the findings that emanate from the various studies contained within this thesis. The chapter comprises five main sections. The first section provides a summary of the major findings from the thesis. The second section discusses the main theoretical implications arising from the thesis. The third section offers applied recommendations. Section four presents strengths and weaknesses of the thesis, and section five offers suggestions for future research. Finally, concluding remarks are presented.

Summary

The purpose of this thesis was to examine imagery perspectives, imagery ability, and personality. The first two studies (Chapter 2) examined the proposal that internal visual imagery is more beneficial for the performance of slalom based motor tasks external visual imagery (cf. Hardy, 1997). In Study 1 participants completed a downhill running task significantly quicker when internal visual imagery rather than external visual imagery was used. Study 2 found mixed support for the effectiveness of internal visual imagery over external visual imagery. A downhill slalom skiing task was completed significantly more accurately by recreational skiers using internal visual imagery than by control participants. However, the treatment groups did not differ in the time taken to complete the course. A secondary aim of Studies 1 and 2 was to explore the motivational function of imagery perspectives, in terms of enhancing confidence. The findings offered some support for the confidence enhancing function of imagery perspectives. Specifically, Study 1 revealed no difference in confidence across internal visual imagery and external visual imagery conditions, although both conditions appeared to be beneficial in enhancing confidence. In Study 2, participants using internal visual imagery were significantly more confident about performing the task than control group participants.

Studies 3 to 5 (Chapter 3) sought to develop and validate a revised version of the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986). The VMIQ has been used in a great deal of imagery research within Sport Psychology (e.g., Eton et al., 1998; Isaac, 1992; Smith & Holmes, 2004), however it is limited in its present form in terms of what it is actually assessing (i.e., does it assess imagery perspectives or modalities, or a combination of both?), and its psychometric properties have not been rigorously examined. Study 3 altered the VMIQ so that the revised version (the VMIQ-2) was clearly assessing internal visual imagery, external visual imagery and kinaesthetic imagery. Following correlated traits correlated uniqueness confirmatory factor analysis, and subsequent item removal, a 12-item version revealed an acceptable model fit. Results also supported the differentiation of internal visual imagery and kinaesthetic imagery as separate modalities (cf. Callow & Hardy, 2004; Fourkas, Ionta et al., 2006; Glisky et al., 1996). Further confirmation of the fit of the 12-item VMIQ-2 was provided by Study 4. Study 5 explored the concurrent and construct validity of the VMIQ-2. Concurrent validity was supported by obtaining significant correlations between factors of the VMIQ-2 and the MIQ-R. To examine construct validity, differences in imagery ability between high and low level athletes were examined, with the expectation that high level athletes would report more vivid imagery (cf. Isaac & Marks, 1994; Oishi & Maeshima, 2004). This proved to be the case, as high level athletes reported greater imagery ability on each factor.

The final study of the thesis (Chapter 4) investigated the personality variable of narcissism as a potential moderator of the imagery perspective-performance relationship. High and low narcissistic individuals were assigned to either internal visual imagery or external visual imagery groups, and performed a golf putting task under conditions of low and high self-enhancement. Results revealed that narcissism did moderate the effectiveness of imagery perspectives as high narcissists using external visual imagery significantly improved in their performance from the low to high self-enhancement conditions, whereas high narcissists using internal visual imagery did not. Furthermore, in the high self-enhancement condition, high narcissists using external visual imagery outperformed high narcissists using internal visual imagery. The performance of low narcissists did not change significantly across conditions, regardless of imagery perspective used.

Theoretical Implications

The aim of this section is to draw together the main theoretical implications from the thesis. Four areas will be discussed in this section: the effects of imagery perspectives on performance; the measurement of imagery ability; the experience of visual and kinaesthetic imagery; and the motivational function of imagery perspectives.

Effects of Imagery Perspectives on Performance

The findings from Chapters 2 and 4 (i.e., Studies 1, 2 and 6) provide some evidence to suggest that the effectiveness of imagery perspectives on motor performance is dependent on at least two factors, task type and personality type. The theoretical implications specific to these studies have already been discussed in their respective chapters. However, these findings can be drawn together and explained theoretically using bio-informational theory (Lang, 1979) as a framework.

In line with bio-informational theory, the superior performance effects of internal visual imagery over external visual imagery in Study 1 could be explained by the fact that more relevant propositional information was provided by internal visual imagery. To expand, the information offered by internal visual imagery was relevant to performance while performers were on the line taken. Therefore, this may have prompted the retrieval of a greater number of stimulus (e.g., what the performer could see as they ran down the course) and response propositions (e.g., how the performer should respond to changes in direction) than external visual imagery. This greater retrieval of response propositions in particular would have, perhaps, had more effect on performance (cf. Lang et al., 1970; Smith et al. 2001). Taking this line of reasoning to the findings of Study 2, internal visual imagery may have provided more relevant propositional information than external visual imagery to enhance both the accuracy of performance and time taken to complete the course. However, it is of note that only the analysis relating to accuracy was significant. Nonetheless, the analysis for time taken suffered from low power, and the resulting effect size calculations (ranging from $d = .30$ to $d = .66$; Cohen, 1988) indicated that internal visual imagery did appear to have some effect.

The findings from Study 6 can also be explained through bio-informational theory. Specifically, as the use of external visual imagery may have activated narcissists' self-enhancement motives (cf. Robins & John, 1997), narcissists using external visual imagery may well have interpreted their images more favourably than those narcissists using internal visual imagery. This is because during external visual imagery narcissists could see themselves performing the task successfully.

Thus, the use of external visual imagery may have provided more relevant propositional information for high narcissists in terms of meaning propositions. Because propositions are stored as conceptual links within a network, the accessing of a greater number of meaning propositions may well have either had a direct effect on performance, via the activation of self-enhancement motives, or may have prompted the retrieval of more response propositions. The retrieval of response propositions would then lead to greater activation of the motor program and greater impacts on performance.

Imagery research has previously been criticised for its lack of theoretical base (Murphy, 1990). As has been highlighted in this thesis, it would seem that bio-informational theory provides an appropriate theoretical underpinning with which to account for some of the effects of imagery. Furthermore, in an attempt to move the theoretical base of imagery research forward, a consideration of bio-informational theory along with functional equivalence explanations (e.g., Grezes & Decety, 2001) may provide an improved theoretical stance. This would allow for the combination of a sound theoretical underpinning, alongside evidence relating to the neural basis of imagery. Therefore, future research may wish to follow this combined approach, allowing for a greater theoretical understanding of imagery's effects.

Measurement of Imagery Ability

In order for imagery researchers to obtain and be confident in their effects, studies need to be systematically designed incorporating key methodological components (cf. Goginsky & Collins, 1996). Given that that imagery ability is a key component of imagery research (cf. Martin et al., 1999), it is vital that valid imagery ability measurement instruments are available. The findings from Chapter 3 (Studies 3, 4, and 5) appear to support the VMIQ-2 as a valid measure of imagery ability, as evidence of factorial, concurrent and construct validity was provided in these studies. In addition, the analyses performed in Studies 3 and 4 indicated that internal visual imagery and kinaesthetic imagery should be treated as separate modalities. These findings provide support from a measurement perspective to corroborate previous research (cf. Fourkas, Ionta et al., 2006; Glisky et al., 1996; Stinear, Byblow, Steyvers, Levin, & Swinnen, 2006).

Thus, the VMIQ-2 provides researchers with a tool that can satisfy a vital methodological component of research design. As valid measurement instruments are vital for the development of knowledge within a particular subject area (cf. Ekkekakis & Petruzello, 2000), the use of the VMIQ-2 has the potential to aid in the advancement of knowledge regarding visual imagery perspectives and kinaesthetic imagery. For example, if researchers are to further the theoretical understanding of the precise situations in which imagery perspectives and kinaesthetic imagery exert their beneficial effects, it is crucial that these variables are accurately assessed.

Experience of Visual and Kinaesthetic Imagery

Inspection of the results from five of the six studies indicates that kinaesthetic imagery *can* be experienced with either visual perspective[6]. Thus, the findings from the present thesis confirm previous research demonstrating that kinaesthetic imagery can be experienced with internal visual imagery and external visual imagery (e.g., Calmels et al., 2006; Cumming & Ste-Marie, 2001; Glisky et al., 1996; Hardy & Callow, 1999; Holmes, 2007; White & Hardy, 1995).

[6] The only study not to show this result was Study 5. However, Study 5 examined the concurrent and construct validity of the VMIQ-2, and so the extent to which kinaesthetic imagery was experienced with either visual perspective was not of interest in this study.

However, in Study 1 more kinaesthetic imagery was experienced in the internal visual imagery condition than in the external visual imagery condition. Furthermore, in Studies 3 and 4, the correlation between internal visual imagery and kinaesthetic imagery was significantly greater than the correlation between external visual imagery and kinaesthetic imagery, as determined by Meng, Rosenthal, and Rubin's (1992) adjusted z-score equation ($z = 4.64$, $p < .001$ for Study 3 and $z = 4.38$, $p < .001$ for Study 4). In contrast, in Studies 2 and 6, there was no difference between imagery perspectives in the experience of kinaesthetic imagery.

These mixed results are difficult to explain with any certainty due to the lack of experimental manipulation of kinaesthetic imagery. However, two explanations may account for these mixed findings. First, a consideration of task complexity in Studies 1, 2 and 6 provides a potential explanation for why Study 1 was the only experimental study to show that kinaesthetic imagery was experienced to a greater extent during internal visual imagery. Study 1 used a downhill running task, while Studies 2 and 6 used slalom skiing and golf putting respectively. Therefore, of the three tasks used, the downhill running task in Study 1 was, arguably, the *least* complex. Thus, participants in Study 1 may have possessed a *greater* level of expertise *in comparison* to participants in Studies 2 and 6. Consequently, although there was no main effect on performance for kinaesthetic imagery in Study 1, the level of expertise of the participants may have allowed for a more vivid image of achievement (cf. Whiting & den Brinker, 1981) than in Studies 2 and 6. As a result, kinaesthetic imagery was experienced to a greater extent in Study 1. Further to this, when performers have a high degree of expertise at a task, the use of a particular visual perspective may allow access to other sensory modalities, such as kinaesthetic imagery (cf. Holmes & Collins, 2001). This access may be enhanced by the suitability of a perspective for the task. Thus, there may be an interaction between expertise and the suitability of a perspective. Specifically, the downhill running task used in Study 1 was a slalom-based task that benefited more from the use of internal visual imagery than external visual imagery. Because of the suitability of internal visual imagery for the task, the *greater* level of expertise of participants in Study 1 may have allowed for greater access to kinaesthetic imagery (cf. Holmes & Collins), resulting in more kinaesthetic imagery being experienced.

The second potential explanation for the mixed findings accounts for the differences between the results of Studies 3 and 4 and previous research (e.g., Callow & Hardy, 2004). The findings from Studies 3 and 4 (that a stronger relationship existed between internal visual imagery and kinaesthetic imagery) were in direct contrast to those of Callow and Hardy who obtained a stronger relationship between external visual imagery and kinaesthetic imagery. Callow and Hardy suggested that their findings may have been due to the fact that the MIQ was used to assess kinaesthetic imagery, and the nature of the items on the MIQ is such that respondents are required to image movements that rely heavily on the use of form. Previous research (e.g., Hardy & Callow, 1999; White & Hardy, 1995) has demonstrated that tasks relying heavily on the use of form (e.g., gymnastics) benefit more from the use of external visual imagery than internal visual imagery, because external visual imagery provides information about the shape of the body as it moves (cf. Hardy, 1997). Therefore, there is likely to be greater matching between external visual imagery and kinaesthetic imagery, leading to the stronger correlation between external visual imagery than internal visual imagery.

An examination of the nature of the items on the VMIQ-2 may provide some explanation for why the relationship between internal visual imagery and kinaesthetic imagery was stronger than the relationship between external visual imagery and kinaesthetic imagery. The items on the VMIQ-2 (e.g., running, bending to pick up a coin, jumping off a high wall) require respondents to image movements that are less reliant on the use of form, in comparison to items on the MIQ. Furthermore, the movements contained within the VMIQ-2 require changes in direction (or movement) at precise spatial and temporal locations (i.e., jumping off a high wall requires changes in the movements of the legs at a particular temporal location in preparation for landing). Thus, it could be proposed that the movements that are imaged on the VMIQ-2 have some similarity to slalom-based tasks that require changes in direction at precise spatial and temporal locations. According to Hardy and colleagues (1995, 1997, 1999), slalom-based tasks benefit more from the use of internal visual imagery than external visual imagery. As a result, the nature of the items on the VMIQ-2 may have led to a greater matching between internal visual imagery and kinaesthetic imagery, which may explain why the correlation between internal visual imagery and kinaesthetic imagery was significantly greater than the correlation between external visual imagery and kinaesthetic imagery.

While these explanations do have some appeal, they remain speculative and would benefit from empirical substantiation. However, despite this, it seems worthwhile to suggest that researchers investigating the experience of visual and kinaesthetic imagery, or indeed the precise relationship between these modalities, give some consideration to the nature of the tasks being used and the expertise level of participants. At the very least this would allow for the explanations offered here to receive some support, or enable them to be discounted in favour of alternative explanations.

Motivational Functions of Imagery Perspectives

The potential motivational function of imagery perspectives, in terms of aiding confidence, was explored in Studies 1, 2, and 6. Taken together, the results indicate that in general, both imagery perspectives do appear to aid confidence, thus providing support for their motivational function (cf. Hardy, 1997). However, the results also indicate that imagery perspectives may have differential effects on confidence in certain situations.

In Study 1, because the task required an accurate line to be taken through the downhill running course, it was expected that internal visual imagery would lead to higher confidence than external visual imagery. This was because internal visual imagery might provide performance accomplishment information in terms of the precise locations of the course where key changes in direction needed to be made in order to stay on the best line. Furthermore, this information would be with reference to the performer's position while they were actually on the line being taken. However, results revealed no difference in confidence between internal visual imagery and external visual imagery. Given that the task of downhill running is not particularly complex, it is perhaps not surprising that no differences emerged between the perspectives. On simple tasks confidence is usually high (Bandura, 1997), so a ceiling effect may have emerged. Thus, when performing relatively simple tasks both internal and external visual imagery appear to aid confidence to the same degree.

However, in Study 2, when a more complex task was used (slalom skiing) differences in confidence emerged between imagery perspectives. Specifically, internal visual imagery had a greater effect on confidence than external visual imagery. This result suggests that on complex tasks, where confidence would not be so high as if the task were easy, internal visual imagery may provide performance accomplishment information, leading to increases in confidence. Nevertheless, this result does not necessarily mean that internal visual imagery will always result in higher confidence levels. The performance of the tasks used in Studies 1 and 2 were expected to be benefited more from internal visual imagery because, as they were slalom-based tasks, internal visual imagery would provide them with more beneficial information than external visual imagery (cf. Hardy, 1997). Internal visual imagery was also expected to result in higher levels of confidence because the information provided by internal visual imagery would be most relevant in terms of performance accomplishment information (i.e., it would provide each performer with information about where to make key changes in direction so as to be able to stay on the correct line). This indicates that the nature of the task may determine the extent to which imagery perspectives enhance confidence. If this suggestion is extended to form based tasks, then because external visual imagery provides more beneficial information in tasks that rely heavily upon the use of form such as gymnastics (cf. Hardy & Callow, 1999), external visual imagery may produce higher levels of confidence than internal visual imagery because external visual imagery may provide more performance accomplishment information in terms of the correct body shape required for performance. The results of Study 6 also support the implication that task characteristics may impact on the effectiveness of imagery perspectives in enhancing confidence. Specifically, in Study 6 (using golf putting), there were no differences between imagery perspectives in the extent to which they aided confidence, although both appeared to aid confidence. Given the nature of the task, this is not surprising. Golf putting was chosen as the criterion task, as it was felt that both imagery perspectives could provide useful information with which to aid performance. Therefore, the information provided by both imagery perspectives may have provided relevant performance accomplishment information, leading to increases in confidence regardless of perspective.

If the confidence enhancing effects of imagery perspectives are indeed dependent on task characteristics, then this provides a complimentary explanation, or an extension, to Hardy's (1997) rationale for the beneficial effects of imagery perspectives. Recall that Hardy suggests imagery exerts a beneficial effect on performance only to the extent that the images provide more information to a performer than would otherwise be available. The superior information provided by the particular imagery perspectives in their respective tasks (i.e., external visual imagery provides more information for form tasks, and internal visual imagery for slalom) could actually be interpreted as performance accomplishment information leading to increases in confidence. Thus, the increases in performance for imagery perspectives may not be directly because of the information provided, but by the increases in confidence due to the information provided. However, increases in confidence would only occur in situations where there would be no ceiling effect (i.e., in relatively complex tasks). If imagery perspectives improve performance by increasing performers' confidence levels, then this highlights confidence as a mediator of the imagery perspective-performance relationship. This is an intuitively appealing suggestion, however research has yet to examine whether confidence does mediate the effects of imagery perspectives on performance.

Applied Implications

Considering the thesis as a whole, along with related literature, several implications can be forwarded for applied practitioners. First, the characteristics of the task and the individual should be considered, when recommending to athletes which imagery perspective to use. Second, if the task is slalom based and requires changes in direction at precise spatial locations, then internal visual imagery may be more beneficial for performance than external visual imagery. However, if the task relies heavily on the use of form (such as gymnastics for example) then external visual imagery may be more beneficial for performance than internal visual imagery (cf. Hardy & Callow, 1999). Fourth, some tasks require both form and changes in direction at precise spatial locations (such as a double back somersault in gymnastics). With these types of tasks, switching between imagery perspectives may actually prove most beneficial. Fifth, if the task has no discernible characteristics that lead the practitioner to believe that it would be benefited more from an internal or external visual perspective (i.e., if the task is not form or slalom based), it may be worth considering the individual personality characteristics. Indeed, if performers are narcissistic then the use of external visual imagery should, perhaps, be recommended. Sixth, performers should be encouraged to use kinaesthetic imagery, although practitioners should be aware that kinaesthetic imagery may not provide an additional benefit until performers have reached a degree of expertise at the task. With this in mind, practitioners may wish to emphasise how correct movements should feel to performers, and allow them opportunities to develop this, possibly through the use of dynamic imagery (cf. Callow et al., 2006; Gould & Damarjian, 1996). This may then aid performers in utilising kinaesthetic imagery more effectively. Seventh, if practitioners and coaches are to begin imagery interventions with their athletes that will utilise a particular imagery perspective, then the ability of performers to image using that particular imagery perspective can be assessed prior to the intervention commencing and at various occasions throughout the intervention. The VMIQ-2 would seem like a useful tool for this process.

At a more general level, practitioners involved in psychological skills training may wish to consider how personality may interact with other psychological skills apart from imagery. Although the interaction between only one particular personality variable (narcissism) and one psychological skill (imagery) was investigated in this thesis, it is likely that other psychological skills and personality variables will interact. For example, the use of goal setting may be highly effective for extraverts during training sessions, as goals may reduce distractibility in training, and improve the quality of preparation (cf. Zourbanos, Hardy, & Woodman, 2003). Mastery forms of imagery (i.e., motivational general-mastery imagery) and self-talk may lead low optimistic performers to interpret anxiety symptoms as more facilitative, because these particular psychological skills may increase perceived ability to cope (cf. Hardy, Gammage, & Hall, 2001; Martin et al., 1999). Relaxation strategies may be particularly effective for individuals low in emotional stability in reducing anxiety; however the same strategy may have adverse effects for narcissists, as these individuals thrive under pressure situations (cf. Wallace & Baumeister, 2002).

Strengths of the Research Program

The current research program has several strengths associated with it. A variety of methodologies (e.g., experimental studies, survey-based studies) were used in order to try and answer the questions in the thesis. In the present authors' opinion, this has allowed for a firm foundation in research training. Further to this, the different methodologies required different analyses (e.g., ANOVA, confirmatory factor analysis, correlations) to be performed on the data sets, providing the present author with opportunities to expand his knowledge of research design and analysis.

An additional strength of the research program was that the experimental studies (Studies 1, 2, and 6) all used specific imagery ability criteria as a pre-intervention requirement. Participants were only retained for these experiments if they were able to meet the criteria used. This allowed for greater experimental control, and served to minimise potential differences in imagery ability which may have confounded the results. In addition, during the completion of Studies 1 and 2, dissatisfaction arose with one of the imagery ability questionnaires (the VMIQ) being used to assess participants imagery ability. Therefore, a second strength of this thesis is that an attempt was made to actually improve on this measure of imagery ability, so that better imagery ability instruments could be used in future studies. This was indeed the case, as Study 6 utilised the VMIQ-2 as the imagery ability measure. Experimental control was further established through the use of manipulation checks (cf. Murphy & Martin, 2002; Wollman, 1986). These manipulation checks allowed for an understanding of how well participants were able to adhere to the instructions given to them, and were used to exclude participants who reported being unable to comply with the experimental treatments.

In addition, a further strength was the use of multi-study experiments. Obtaining repeatable effects in multiple experiments allows researchers to be more confident in interpreting their findings in line with hypotheses, as opposed to spurious occurrences or random error. Chapters 2 and 3 both used multiple studies in order to try and answer their specific questions. These multiple study experiments allowed for any effects that were obtained to be replicated and extended, either through the use of different samples, or with different experimental situations.

Finally, throughout the thesis, statistical rigour was maintained. Whenever multiple analyses were being performed, adjustments were made to the alpha level, in order to protect against Type I errors. When multiple ANOVAs or *t*-tests were performed, such as when analysing post-experimental data (Studies 1, 2, and 6) or examining differences between high and low level athletes on the factors of the VMIQ-2 (Study 5), Bonferroni corrections (i.e., the alpha level divided by the number of analyses) were applied. The correlation analyses in Study 5 used a similar correction to protect against Type I errors, although this correction was based on degrees of freedom and the number of analyses performed. The confirmatory factor analyses performed in Studies 3 and 4 all used stringent criteria in assessing model fit. There is a great deal of discussion and disagreement within structural equation modelling literature in terms of how to assess model fit (e.g., Bentler, 2007; Goffin, 2007; Markland, 2007). Therefore, in Studies 3 and 4, an attempt was made to adopt a balanced approach to model fit assessment. Chi-square values were reported, along with degrees of freedom, and a variety of approximate fit indices. Furthermore, all fit indices were interpreted with a level of caution so as not to be too lenient when examining the quality of the model fit.

Weaknesses of the Research Program

Despite the strengths associated with this thesis, several weaknesses are apparent. First, some of the experimental studies were subject to low power, leading to inflated Type II error rates. Study 2 was particularly affected by power. The analysis of the time taken data in this study revealed a non-significant difference between treatment groups, and power of .24. However, inspection of the mean data indicated potentially meaningful differences between the groups, which were further substantiated through effect size analyses. For example a medium effect size ($\eta^2 = .10$) was reported for the time taken analysis. Therefore, the failure of the ANOVA to produce a significant effect may have been due to the low power. A larger sample size may have clarified these findings.

A second weakness concerns the lack of control groups, as Study 2 was the only experimental study to use a control group. Imagery research has been previously criticised (e.g., Wollman, 1986) for its failure to use control groups appropriately. As the majority of the studies in the present thesis did not use a control group, it could be argued that it is difficult to attribute any effects obtained to the particular imagery treatments used, as opposed to another intervening variable, as there is no control group to compare to. However, it is important to bear in mind several issues. First, while the lack of control groups does not completely rule out the issue that other intervening variables, such as physical practice, may have caused the results reported in this thesis, it is doubtful that they can explain all of the results. For example, the complex three-factor interaction obtained in Study 6 could not be explained by physical practice effects, as not all treatment groups showed improved performance. Second, although control groups could have been used to a greater extent within the thesis, an issue arises with what the control group should actually do. For example, giving a control group a distracting task may actually lead to confounds in the results, as differences between groups could be a result of control groups performing worse as opposed to treatment groups performing better (see Callow & Hardy, 2005). This may provide a potential explanation for some of the findings in Study 2, as the stretching condition may have actually caused a negative effect on the accuracy of performance of control participants, as opposed to internal visual imagery actually aiding performance. However, considering the findings of

Study 2 in line with Study 1 (that also showed beneficial effects for internal visual imagery) suggests that it is, perhaps, not the case. A third issue to consider is that certain control conditions (e.g., reading) may actually cause participants to spontaneously use imagery (cf. Smith & Holmes, 2004). This then changes the control group to more of an "uncontrolled" treatment group, which uses some form of imagery but does not have the specific intervention that treatment groups would get. Studies where this occurs are then subject to the same potential limitations as studies that do not use control groups, as strictly speaking, these studies have no control group.

The measurement of confidence during the research program could also be considered a weakness. Whenever confidence was measured (i.e., Studies 1, 2, and 6), it was done so using single-item measures. Single-item confidence measures have been shown to have lower predictive and convergent validity than composite measures (cf. Lee & Bobko, 1994), and by their very nature (i.e., single-item) do not allow for an assessment of reliability. Furthermore, single-item confidence measures assume that confidence is a uni-dimensional construct. While some theories may support this (e.g., Vealey's, 1986 sport confidence theory) others do not. For example, self-efficacy (situational specific confidence) is conceptualised as a multi-dimensional construct, containing dimensions such as strength and level (cf. Bandura, 1997; Moritz, Feltz, Fahrbach, & Mack, 2000). Finally, single-item measures of confidence can be prone to ceiling effects (Feltz & Chase, 1998).

In defence of the way confidence was measured in the present thesis, it is worth noting that other imagery perspective research (e.g., Hardy & Callow, 1999) has also used single-item confidence measures, and has been able to obtain significant effects. Therefore, using single-item measures in the present research allowed for comparisons to be made with previous research. Further to this, the measurement of confidence was not the central variable in the thesis, as performance was considered the primary dependent variable in most of the studies. Therefore, it was felt that using a single-item measure would be appropriate to use as it would be quick and simple, and would not overburden participants.

The final limitation of the research program is that imagery perspective preference was not considered. In the present thesis, participants were required to be able to image from both perspectives, and so perspective preference was not assessed. Imagery preference is a variable that is mentioned in the literature (e.g., Hall, 1997; Holmes, 2007). However, it has not been systematically investigated. Athletes that have a particular preference for one imagery perspective may be more likely to use this perspective, and perhaps, might be better at imaging from this perspective. Therefore, imagery preference could have been used in the present thesis to allocate participants to groups; that is, participants with preferences for external visual imagery would be given external visual imagery interventions, and those with internal visual imagery preferences would be given internal visual imagery interventions. Doing this may have helped to prevent participants switching perspectives, and make them more likely to adhere to their respective interventions, therefore making participant removal less likely. Also, imaging in their preferred perspective may have led participants to create more vivid images, which would have had a greater impact on performance. For example, in Study 2, a consideration of imagery preference may have led to more conclusive results being produced.

However, at present, no validated measure of imagery preference exists within the literature. The only existing measures require single-item likert responses (e.g., Cumming & Ste-Marie, 2001), which are subject to the same issues (e.g., ceiling effects and reliability) as other single items measures highlighted previously. Other researchers (e.g., Holmes, 2007) have suggested that imagery preference can be obtained through imagery ability assessments, as greater imagery ability for a particular imagery perspective or modality would reveal the imager's preference. However, the precise relationship between imagery preference and imagery ability is unknown, and although some athletes may have strong preferences for a particular imagery perspective, they may still be able to image from other perspectives. Therefore, a consideration of the precise relationship between imagery ability and imagery preference would allow for appropriate imagery preference measures to be designed and then implemented in future research.

Future Research Directions

The findings from the present thesis offer a number of directions for future research. The results of Chapter 2 offered some support for the proposal that internal visual imagery is superior to external visual imagery for slalom based tasks. However, in these studies, kinaesthetic imagery was not manipulated explicitly as an independent variable, and expert performers were not used. Kinaesthetic imagery has been shown to demonstrate additional performance benefits over visual imagery, when expert performers are used (Hardy & Callow, 1999), so it would be interesting to see if this effect occurs for the performance of slalom based tasks. It would also be worthwhile to ascertain whether imagery perspectives may affect different aspects of the same task. For example in golf putting, external visual imagery may aid the form with which the putt is made, but internal visual imagery may benefit the choice of line for the putt. The use of motion analysis equipment could provide accurate information regarding these different aspects of the task. This would also extend imagery research, as much of the existing literature has focused on the outcome of movement execution, as opposed to the actual processes underlying the movement. A consideration of imagery preference in the aforementioned proposed studies would also be pertinent.

Taking the findings from Chapter 2 and Chapter 4 together, it appears that task characteristics and personality characteristics (in the form of narcissism) influence the effectiveness of imagery perspectives. It would be valuable to combine these two characteristics and examine the effects of imagery perspectives and narcissism on a form-based or slalom-based task. This would then allow researchers to assess whether one of these characteristics had a greater influence on the effectiveness of imagery perspectives than the other, or whether task and personality characteristics interact in some way.

Two issues surrounding external visual imagery warrant further investigation. First, a consideration of the angle of external visual imagery that performers use would be timely. When imaging from an external perspective, a performer could imagine watching themselves from a variety of angles (top, side, behind etc.). However, no systematic investigation has taken place to examine where athletes image from when using external visual imagery. Imaging from different external angles may lead to more information in the image, and therefore more impact on performance. Imaging from particular angles may also impact on the vividness of the image produced. The second issue concerns the order in which visual and kinaesthetic imagery are experienced. Several studies (e.g., Cumming & Ste-Marie, 2001; Glisky et al., 1996) have indicated that kinaesthetic imagery can be experienced from an external perspective, suggesting that visual and kinaesthetic imagery are experienced at the same time. However, other researchers (e.g., Collins, Smith, & Hale, 1998) have suggested that the order with which these modalities are experienced is visual and *then* kinaesthetic imagery. Therefore, closer examination of the order with which external visual imagery and kinaesthetic imagery are experienced is warranted. It would also be useful to explore this with internal visual imagery and kinaesthetic imagery. If research shows that visual and kinaesthetic imagery can be experienced in different "orders" (i.e., visual then kinaesthetic or kinaesthetic then visual) it would provide further evidence for the differentiation of internal visual imagery and kinaesthetic imagery as separate modalities.

In the general introduction, and indeed in Chapter 3, it was highlighted that the use of vividness to assess imagery ability is not without its critics (e.g., Dean & Morris, 2003), who posit that imagery ability should be considered more multi-dimensionally in terms of image generation, maintenance, and transformation. Whilst a rationale was made for vividness reflecting these abilities to an extent, an examination of the precise relationship between imagery vividness and these other abilities would provide evidence for this rationale. Indeed, if vividness and generation, transformation and maintenance are related it would indicate that vividness does indeed reflect these properties. However, if these variables predict more variance in imagery ability than vividness alone, it would indicate the importance of considering imagery abilities separately. The VMIQ-2 could be adapted to allow for assessments of vividness as well as image generation, transformation, and maintenance.

The VMIQ-2 may be applicable in neuroscientific research to aid the investigation of the precise neural areas activated by internal visual imagery, external visual imagery (of the self), and kinaesthetic imagery. Further to this, the use of the VMIQ-2 in line with neuroscientific techniques (e.g., fMRI) may allow for greater investigation of the underlying processes involved in imagery perspectives. To expand, a link between imagery perspectives and spatial coding has been proposed, whereby internal visual imagery is said to be egocentrically coded, and external visual imagery is allocentrically coded (see Fourkas, 2002). Egocentric coding is viewer based, as it involves coding the spatial location of an object from the point of view of an individual. Allocentric coding is object centred, as it involves coding the spatial location of an object in relation to the environment. Egocentric coding operates within the dorsal stream of the brain, and allocentric coding within the ventral stream (see Fourkas, 2002; Milner & Goodale, 1995). Therefore, using the VMIQ-2 along with brain imaging techniques would allow for exploration of the extent to which internal and external visual imagery are egocentrically and allocentrically coded, and the extent to which they operate within the dorsal and ventral streams respectively. Because no theory currently exists to explain all of imagery's effects within motor performance (Hall, 2001) investigating the similarity between allocentric and egocentric coding and imagery perspectives would strengthen the theoretical base of imagery, and provide evidence of some of the underlying processes involved in internal visual imagery and external visual imagery. Indeed, neuroscientisits (e.g., Fourkas, Avenanti et al., 2006) have used Sport Psychology conceptualisations of imagery perspectives and modalities with which to further the neural understanding of imagery. As the VMIQ-2 appears to be an accurate assessment of internal visual imagery, external visual imagery and kinaesthetic imagery, its use along with neuroscientific techniques should provide even greater understanding of the processes that might underlie the effectiveness of imagery perspectives.

The VMIQ-2 also has the potential to be of use in other contexts. For example, within injury (e.g., Evans et al., 2006) and stroke rehabilitation research (see Holmes, 2007), imagery is a popular intervention strategy. However, accurate imagery ability measurements are often not used in these areas. Therefore, the applicability of the VMIQ-2 to be used in other settings could be investigated by those interested in imagery's effects in rehabilitation.

As Chapter 4 demonstrated that narcissism did moderate the effectiveness of imagery perspectives, it shows that at least one personality variable influences the effectiveness of imagery interventions. It would be worthwhile, therefore, to explore whether other personality variables (e.g., extraversion, optimism) moderate the effectiveness of imagery perspectives, or other types of imagery. For example, optimism might moderate the effects of motivational general-mastery imagery on anxiety. The moderating role of personality could also be considered in the wider context of psychological skills (e.g. relaxation, goal setting and self-talk). Extraversion may play a moderating role on the effects of instructional self-talk on distractibility in training, such that the use of instructional self-talk may reduce distractibility for extraverts, by providing an appropriate attentional focus (cf. Hatzigeorgardis, Theodorakis, & Zourbanos, 2004). Further to this, variables such as narcissism and emotional stability may moderate the effectiveness of anxiety control strategies in reducing performance anxiety, such that anxiety control strategies may be particularly effective for individuals who are low in emotional stability and narcissism. If personality does play a moderating role, it would provide more evidence to refute the "one size fits all" approach to psychological skills training.

Conclusion

To conclude, this thesis has examined imagery perspectives, imagery ability, and personality. The thesis has provided papers that have contributed to and extended the imagery literature, and has considered variables (e.g., personality) that have been lacking in imagery research. The findings from this thesis have opened up a number of exciting directions that should receive attention in the future from interested researchers.

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APPENDIX A

Effects of Different Visual Imagery Perspectives on the Performance of a Slalom-Based Hockey Task (Research note)

Abstract

The present study examined the effectiveness of internal visual imagery and external visual imagery on the performance of a slalom-based hockey dribbling task. Twenty seven participants were assigned to one of three groups: an internal visual imagery group, an external visual imagery group or a control group, and performed the task under learning and transfer conditions. Time taken to complete the course and the accuracy of the line taken were measured. No significant differences emerged between the three groups for time taken to complete the course and accuracy of line in both the learning and transfer conditions. Limitations of the study are identified that may explain the lack of performance effects.

Introduction

Previous research (White & Hardy, 1995) has provided some evidence to support the proposal offered by Hardy and colleagues (Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995) that internal visual imagery is superior to external visual imagery for the performance of slalom-based motor tasks. However the ecological validity of the wheelchair slalom task used by White and Hardy can be questioned. Therefore the primary aim of this study was to examine the effects of internal visual imagery and external visual imagery on the performance of a slalom-based hockey dribbling task. The time taken to complete the task, and the accuracy of line taken were measured in order to further explore the speed/accuracy trade-off reported by White and Hardy.

Theoretical reasoning (e.g., Bandura, 1986; Hardy, 1997) has suggested that, as well as aiding performance, imagery perspectives may also serve motivational functions such as increasing confidence. However, research investigating the motivational function of imagery perspectives is lacking. Therefore, the second aim of the present study was to examine the effects of internal visual imagery and external visual imagery on the confidence to perform the hockey task

Method

Participants

An opportunistic sample of 33 sport science students (*M* age = 22.09 years, *SD* = 3.05; 25 men, 8 women) was recruited for the study. All participants gave their written consent to take part. Ethics approval was obtained from the School's ethics committee.

Design

A between groups design was employed. Specifically, stratified randomisation, based on gender, was used to allocate participants to one of three treatment groups. The study comprised two phases, a learning phase and a transfer phase. In the learning phase participants performed the experimental task in six blocks of three trials. The participants were given two minutes rest in between each block. The transfer test comprised one block of three trials.

Experimental Task

The experimental task was a slalom-based hockey dribbling task performed in a sports hall. Participants were required to dribble a hockey ball around a course of cones, and then shoot at a specific target in a designated corner of a hockey goal. The course was 15 metres in length, comprising nine cones to be dribbled around, with a shooting area placed 1.5 metres after the ninth cone. The cones were placed 1.5 metres apart, in a straight line. The area from which the participants had to shoot from was the size of an A4 sheet of paper (approx. 30cm x 21cm). The task was constructed so as to try and imitate the spatial and temporal locations that may occur during a game of hockey. For example, dribbling round the cones was designed to imitate dribbling round opponents.

The transfer phase used a similar task to the learning phase. However, the cones were placed at one metre intervals from each other as opposed to 1.5 metres in order to increase task difficulty.

Treatments

Three treatment groups were used in the study: an internal visual imagery (IVI) group, an external visual imagery (EVI) group, and a control group (CON). Participants in the imagery conditions received an imagery intervention that was relevant to their treatment group (i.e., IVI participants received an IVI intervention). Participants in the EVI group were asked to imagine watching themselves perform the task from a "side-on" view. Before the first trial of each block, participants listened to an imagery script read by the experimenter. The script instructed participants to score in either the bottom left or bottom right hand corner of the goal. The scripts were varied so that participants were instructed to shoot at different corners of the goal in different blocks. Participants were asked to image from their particular perspective while listening to the script, and then before completing the trial. No restriction was placed on the time participants were given to image. Before the second and third trials of each block participants were asked to image themselves performing the task, however this was done without the aid of the script.

Control group participants were informed of the specific corner of the goal to be shooting in before the first trial of each block.

Performance

Performance was assessed by recording the time taken to complete the course, and the accuracy of the line taken. Time taken was recorded using a hand held stopwatch which was started when the participants left the start line, and was stopped when the ball entered the shooting area. A mean time for each block was then calculated.

Accuracy was measured by taking the maximum distance of the ball to each dribbling cone. Prior to the study commencing, the course was set out with twelve marking strips placed on the floor running parallel with the course. Six marking strips were placed on the left hand side of the cones and six were place to the right. The strips were set out at 25 cm intervals from the cones, such that the first strip was placed 25cm away from the cones, and the second strip placed 50cm away from the cones. This was continued until all strips had been placed, at a total distance of 1.5 metres away from the cone, on either side. The course was videoed and then presented on a television screen, an acetate was placed over, and the line of strips drawn on the acetate. The strips were then removed for the duration of the study. Each trial was videoed, and then viewed on the television with the acetate placed over it. The maximum distance from each cone, in the dribbling path, was then measured on the acetate. Due to the perspective distortion that occurs when measuring distance on a camera, a correction factor was applied so that the distance covered on the acetate was the same as the distance covered in the sports hall. The actual maximum distances from each cone were then summed to give an accuracy score for each trial, and then a mean accuracy score for each block was then calculated.

Measures

Vividness of Movement Imagery Questionnaire (VMIQ: Isaac et al., 1986). To measure internal visual and external visual imagery an adapted version of the VMIQ was administered. The VMIQ assesses the ability to image 24 movements using a Likert scale ranging from 1 (*perfectly clear*) to 5 (*no image at all*), and has an acceptable level of test-retest reliability, $r = .76$ (Isaac et al., 1986). For the present study the external visual imagery instructional set asking participants to image from someone else's perspective, that is "watching someone else", was changed to "watching yourself do it", thereby enabling participants to experience imaging themselves from both an internal visual and external visual perspective (cf. Callow & Hardy, 2004).

Movement Imagery Questionnaire – Revised (MIQ-R: Hall & Martin, 1997). To measure visual and kinaesthetic imagery the MIQ-R was administered. The

MIQ-R consists of 8 items assessing both visual and kinaesthetic imagery ability measured on a Likert scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). Significant correlations ($r = -.77, p < .001$) have been obtained between the subscales of the MIQ-R and the original Movement Imagery Questionnaire (MIQ: Hall & Pongrac, 1983), indicating that the MIQ-R is an acceptable revision of the MIQ, and can be used to measure visual and kinaesthetic imagery ability (Hall & Martin). The negative correlation is due to the fact that the scales from the MIQ are scored in the opposite direction to those in the MIQ-R.

Pre-Experimental Questionnaire. Prior to both the learning and transfer phases, the participants were asked to rate their confidence for completing the task quickly and accurately. This was scored on an eleven point Likert scale ranging from 1 (*not at all confident*) to 11 (*very confident*).

Manipulation/Post-Experimental Questionnaire. On completion of the learning and transfer phases the participants completed a manipulation/post-experimental questionnaire. The questionnaire examined the extent to which participants adhered to their treatment groups, how suitable they thought the treatment group was for the task, the experience of kinaesthetic imagery (in the two imagery groups), the extent to which the treatment helped their confidence to complete the task, and the extent to which they switched between imagery perspectives. These questions were scored on a Likert scale ranging from 1 (*not at all*) to 11 (*greatly*). A final question asked participants to report on the nature of any other strategies they used to aid their performance. This question was left open ended.

Procedure

One week prior to the commencement of the study, the participants were administered the consent form, the VMIQ and the MIQ-R. To ensure participants were able to image proficiently, two criteria were set. Specifically, only participants who scored below 72 on each of the subscales of the VMIQ (low score = high imagery ability), and above 16 on each of the subscales of the MIQ-R (high score = high imagery ability), were included in the study. These cut-off criteria have been used in previous research and have produced significant effects for imagery interventions (Callow et al., 2001). Five participants failed to meet these criteria, thus 27 participants were involved in the testing phase. The 27 participants were assigned to one of the three treatment groups through stratified randomisation (based on gender).

All participants were tested individually. On arrival at the sports hall participants were read standardised instructions informing them that the primary objectives of the study were to complete the task as quickly and as accurately as possible, and that they should dribble past the first cone on the left hand side. Participants were then allowed to view the course. Following this the pre-experimental questionnaire was completed.

Each participant then received his/her respective treatment and completed the six blocks of learning trials. In between each block participants were given a two minute rest period, and those in the imagery groups were asked not to use imagery. On completion of the learning phase the manipulation/post-experimental questionnaire was completed.

One week later participants returned for the transfer phase. Prior to the first trial the participants in the imagery treatment groups were administered an imagery script corresponding to their treatment group, instructing them to score in one of the corners of the goal as in the learning phase. Before the second and third trials of this phase the participants were asked to form an image of themselves performing the task from the same perspective as the imagery script. The participants in the control group were told which corner of the goal to shoot in. On completion of the transfer phase the manipulation/post-experimental questionnaire was completed for a final time. Participants were then de-briefed, and thanked for their participation.

Results

Manipulation check

Analysis of the manipulation/post-experimental questionnaire revealed that one participant switched between imagery perspectives during the trials. The data from this participant were excluded, and the analyses were conduced on the remaining 26 participants. Participants' confidence levels prior to the learning and transfer tests were analysed separately, each using a single factor analyses of variance (ANOVA's). The analyses revealed no significant differences between the groups prior to the learning and transfer phases.

Performance data

The time taken and accuracy data from the learning phase were analysed using separate two factor (group x block) mixed model analyses of variance (ANOVA's), with repeated measures on the block factor. The data from the transfer phase were analysed using separate single factor ANOVA's.

Time taken. Analysis of the learning data revealed that Box's M test for equality of Covariance matrices was significant. Data transformations applied to the data, including $\log_e x$, $\log_{10} x$ and $1/x$, failed to rectify this problem. However Stevens (2002) states that if Box's M test is significant with approximately equal group sizes, then Type I error rate will only be slightly affected, although power will be weakened. It appears relatively safe, therefore, to interpret highly significant effects because they have been robust enough to appear despite low power (cf. Hardy & Callow, 1999). Thus, the results from the two factor Analysis of variance on the *raw* data are reported. Mauchly's test revealed that sphericity could not be assumed, so the Greenhouse-Geisser correction factor was used on all of the analyses involving the block factor. The analysis of variance revealed a significant main effect for block, F (2.97, 68.28) = 33.75, $p < .01$, $\eta^2 = .59$. There was no significant group effect, F (2, 23) = 0.44, $p > .65$, $\eta^2 = .04$, or interaction, F (2.97, 68.28) = 0.34, $p > .91$, $\eta^2 = .01$. Follow up Tukey's test on the block main effect indicated that speed was significantly faster at blocks 2-6, in comparison to block 1, and at blocks 4-6 compared to block 2 (see Figure 4).

For the transfer data, the assumption of homogeneity of variance was satisfied. The analysis of variance revealed no significant difference between the groups for time taken in the transfer phase, F (2, 23) = 0.42, $p > .67$, $\eta^2 = .04$. Figure 4 also displays the results from the transfer phase.

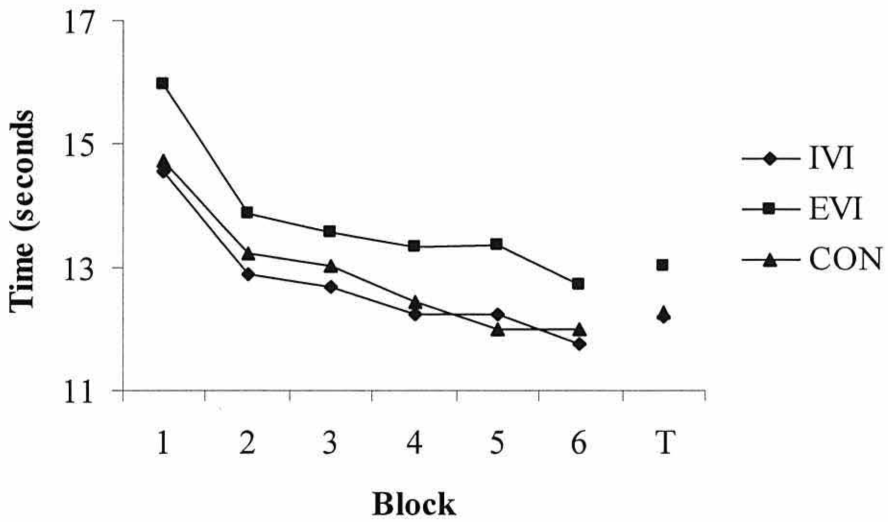

Figure 4. Time taken for the hockey task, in seconds.

Accuracy. Box's M test was non-significant for the learning data; however, Mauchly's test revealed that sphericity could not be assumed, so the greenhouse-geisser correction factor was again used on all of the analyses involving the block factor. The analysis of variance revealed a significant effect for block, F (3.33, 76.59) = 7.03, $p < .01$, $\eta^2 = .23$. There was no significant group main effect, F (2, 23) = 1.36, $p > .28$, $\eta^2 = .11$, or interaction, F (6.66, 76.59) = 0.55, $p > .79$, $\eta^2 = .04$. Follow-up Tukey's tests on the block effect indicated that accuracy was significantly better at blocks 4, 5 and 6, compared to block 1. Figure 5 displays the results from the learning phase.

For the transfer data, the assumption of Homogeneity of Variance was again satisfied. The analysis of variance revealed no significant differences between the groups in terms of accuracy, F (2, 23) = 0.01, $p > .91$, $\eta^2 = .008$. Figure 5 also displays the results from the transfer phase.

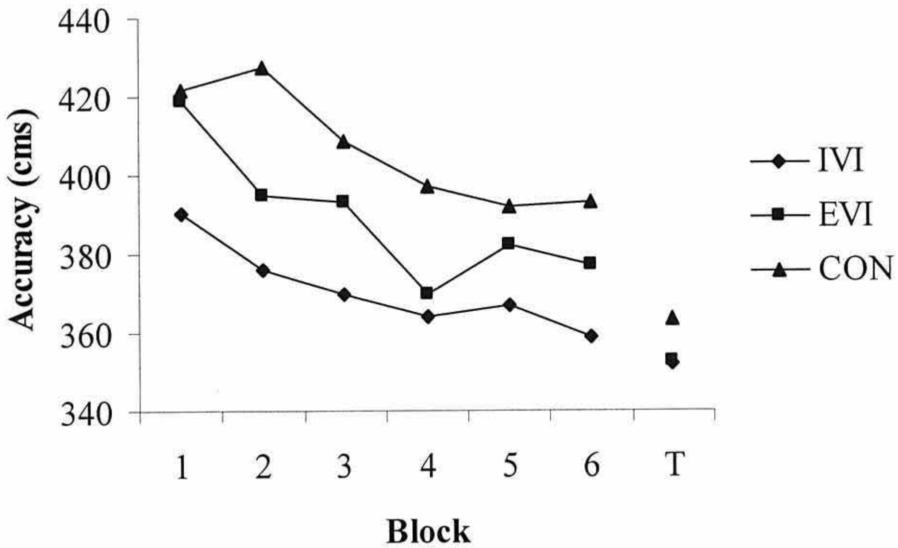

Figure 5. Mean accuracy scores for the hockey task, measured in centimetres.

Manipulation/Post-experimental Questionnaire

The data from three questions on the manipulation/post-experimental questionnaire were statistically analysed for the learning and transfer phases; these were the questions regarding suitability, the experience of kinaesthetic imagery, and the extent to which the condition helped the participant's confidence to perform the task quickly and accurately. Each question was analysed using separate single factor analyses of variance with a Bonferroni adjusted alpha level of .017.

For the learning data, homogeneity of variance was assumed for the analyses concerning suitability and kinaesthetic imagery, but was not assumed for the analysis relating to confidence. However, violations of this assumption do not radically change the *F*-value in single-factor ANOVA (Stevens, 2002), so it was deemed appropriate to continue with this analysis for the confidence data. There were no significant differences between the groups regarding the suitability of the treatments, $F\ (2, 23) = 0.79, p > .47, \eta^2 = .06$, and also the experience of kinaesthetic imagery, $F\ (1, 15) = 0.00, p = 1.00, \eta^2 = .00$. There was, however, a significant difference regarding the extent the participants thought their treatment group helped their confidence to perform the task quickly and accurately, $F\ (2, 23) = 7.06, p < .01$, $\eta^2 = .38$. Tukey's test indicated that the only significant difference was between the control and IVI group, the IVI group were more confident about performing the task well than the control group.

For the transfer data, homogeneity of variance was assumed for the suitability and kinaesthetic imagery analyses but not for the confidence analysis. The analysis of variance revealed no significant differences between the groups for any of the analyses; suitability, $F\ (2, 23) = 1.12, p > .34, \eta^2 = .09$, kinaesthetic imagery, $F\ (1, 15) = .10, p > .76, \eta^2 = .01$, confidence, $F\ (2, 23) = 2.45, p > .11, \eta^2 = .18$.

Discussion and Methodological Considerations for Studies 1 and 2 in the Present Thesis

This study had three purposes: to examine the effects of IVI and EVI on a slalom-based motor task; to explore the speed/accuracy trade-off reported by White and Hardy (1995); and finally, to examine the potential motivational functions of IVI and EVI in terms of enhancing confidence.

The results from the present study offer no support for the proposal from Hardy and colleagues that IVI is more beneficial than EVI for the performance of slalom based tasks, and do not corroborate any of White and Hardy's (1995) findings. A potential explanation for this lack of any performance effects, and also lack of consistency with White and Hardy, is that the results displayed evidence of a ceiling effect. The block main effects for both speed and accuracy indicated that the learning paradigm was effective in improving performance. However, performance did not significantly improve after block 4 for accuracy, and block 2 for speed. It could be, therefore, that the participants were not able to improve anymore after these blocks with the information they were given. The potential ceiling effect may have also been a function of the difficulty of the task. Within each trial, the distance between each cone was the same. Therefore, the nature of the required changes in direction was similar for each cone. These issues were considered during the development of Studies 1 and 2. Specifically, Studies 1 and 2 used slalom-based tasks with less regular changes in direction, therefore the nature of the change in direction at each cone was different.

Another explanation for why the results from present study differ from White and Hardy's (1995) findings concerns the nature of the EVI intervention. In the present study participants using EVI were asked to image from side on, whereas

White and Hardy did not specify the angle of their EVI intervention. Therefore, White and Hardy's EVI participants could have imaged themselves performing the task from behind. If this were the case then, perhaps, this angle may have enabled them to see themselves approaching their goal of completing the course. By seeing themselves progress towards their goal, EVI may have served a motivational function for these participants, as White and Hardy suggested, thereby leading to quicker performance times. The EVI participants in the present study imaged from side on, so it is possible that this angle was less effective than imaging from behind in bringing about quick performance times, because participants would not be *as able* to see themselves moving toward their goal of scoring. While this suggestion is appealing it remains speculative, as White and Hardy did not report the angle of EVI used by their participants. Despite the speculative nature of this conclusion, it was deemed worthy of consideration in the development of Studies 1 and 2. Consequently, the EVI manipulations used in Studies 1 and 2 did not restrict participants to use EVI from a particular angle.

Several limitations can also be levelled at this study that may explain the non-significant findings. Further, the limitations identified may also explain why the results of the present study contrast those of White and Hardy (1995). First, the way of measuring accuracy in the present study was fairly crude, in terms of placing the strips on the ground and overlaying the acetate onto the television screen. Also, due to external factors outside the experimenter's control, the video camera was not able to remain in the hall for the duration of the study. While every effort was made to keep the exact position the same, small adjustments in set-up could well have affected the way each performance was presented on screen, thereby decreasing the accuracy how each performance was recorded. In addition, taking the maximum distance that the ball was away from each cone (i.e., the distance when the ball was horizontal to the cone), may not have actually been indicative of an accurate performance. The present study could have used an approach similar to White and Hardy's and assessed number of errors, and cone touches as accuracy assessments. In light of these issues, a greater level of precision was used in the design and data collection of Studies 1 and 2. For example, automatic timing gates and expert judges were used to assess performance.

Another issue that requires consideration is that the type of task used in the present study. The hockey task, along with the wheelchair slalom task used by White and Hardy (1995), was performed on a flat surface. Therefore, a key aspect of these tasks was for participants to be able to generate their own speed in order for a quick performance time to be achieved. However the types of tasks that Hardy and colleagues suggest will be benefited through the use of IVI (e.g., slalom skiing or canoe slalom) do not have speed generation as a central component. Rather, because of the gradient of the slope that is skied down or the force of the water, these tasks actually require a much faster speed to be controlled rather than generated if participants are to stay on the correct line and therefore achieve a quick performance. Therefore, Studies 1 and 2 used slalom tasks that required speed to be controlled rather then generated.

Despite the lack of performance effects, analysis of the manipulation/post-experimental data revealed two noteworthy findings. First, there was no difference in the extent to which kinaesthetic imagery was experienced across the two groups, which confirms previous findings (e.g., Cumming & Ste-Marie, 2001; White & Hardy, 1995). Second, the post-experimental data from the learning phase indicated that internal visual imagery may have been serving a motivational function, as participants in this group were more confident about performing well than control group participants. This finding highlighted the importance of assessing whether imagery perspectives aided confidence to perform the tasks used in Studies 1 and 2.

To conclude, this study aimed to substantiate the proposal that IVI is superior to EVI for the performance of slalom-based motor tasks. The findings revealed no differences in performance between IVI and EVI. The limitations that were identified in an attempt to explain the lack of performance effects informed the methods and design of Studies 1 and 2 in the present thesis.

APPENDIX B

Imagery scripts used in Study 1

IVI Script

When I read the imagery script, you can have your eyes open or closed....if you wish to close them do so now.....take a few long slow exhalations to relax yourself.....focus on breathing out long and slow....I am going to take you through a guided route of the task that you are about to perform....Imagine yourself from inside your body as if you are actually doing the task, that is from an internal visual imagery perspective.

Imagine being at the top of the road....looking down the course. What can you see?... Imagine looking at the course again...notice the way that the cones are set out, there are 13 of them. Imagine the line that you are going to take, so that you will be able to complete the course as quickly as possible.

Imagine starting down the course... as you approach the first cone imagine it getting larger in your view, you can see the precise moment that you will have to change direction in order to move to the next cone. As you pass the first cone...Imagine the cone disappearing from your view and keeping your head up so you can see the line to take to the next cone...As you continue down the course and pass the cones...imagine each cone getting larger in your view as you approach it and seeing the exact moment that you will change direction...Each time that you pass a cone...imagine it disappearing from your view and keeping your head up so that you can see the line that you will take to the next cone...remember you are watching yourself from an internal visual perspective...

EVI Script

When I read the imagery script, you can have your eyes open or closed....if you wish to close them do so now..... take a few long slow exhalations to relax yourself.....focus on breathing out long and slow ....I am going to take you through a guided route of the task that you are about to perform.... Imagine yourself from outside of your body as if you are watching yourself doing the task, that is from an external visual imagery perspective.

Imagine looking at yourself standing at the top of the road looking down the course. What can you see?...notice the way that the cones are set out, there are 13 of them. Imagine the line that your body is going to take, so that you will be able to complete the course as quickly as possible.

Imagine starting down the course...notice the shape of your body, your arms and knees are bending and straightening as you run, and your head is looking forward... as you reach the first cone imagine seeing your body lean inwards slightly as you begin to change direction and head to the next cone. As you pass the first cone...imagine seeing your head up looking in the direction of the line that you are going to take to the next cone, and the shape of your body as you change direction...As you continue down the course and pass the cones...imagine each time that you pass a cone imagine seeing your body lean inwards slightly and your head looking forward in the direction of the line that you are going to take to the next cone, and the shape of your body as you change direction...remember you are watching yourself from an external visual perspective...

APPENDIX C

Imagery Scripts in Study 2

Internal Visual Imagery

After watching the video footage you have seen what an internal visual perspective is. Described verbally, an internal visual perspective is the visual perspective you have when looking through your own eyes, out onto your surroundings. You are asked to use only this internal visual perspective when preparing for the race.

The course has been divided into three sections; A, B, & C. You have been given imagery scripts for each of the three sections these scripts will help you prepare for the race. You should read each script corresponding to the section of the course, then image the section, and then move down to the next section. Once you have finished all sections, and prior to the race, take some time to image each of the sections again and then link the sections together to image the whole course and the path you will take. The imagery scripts are detailed on the handout and should be carried with you during the inspection. Please do not show these scripts to anyone else.

Internal Visual Imagery Script

While you are visually inspecting the section I would like you to take notice of the following 3 areas;

1. The terrain that is between the poles.
2. The position of the poles relative to each other.
3. The distancing of the poles vertically and horizontally between the poles

Once you have done this, read the corresponding Internal visual imagery script below. Once you have finished this, please image yourself skiing the section from an internal visual perspective.

Section A Script

You are at the start of the course. You are inside your body looking down Section A. Imagine looking at the terrain, is it steep or flat…What effect will the terrain have on your line to, and beyond, the first pole?...Images how you would see the position of the poles, are they in line down the hill, or are they offset left or right?...What effect will their position have on your speed and accuracy of line?...Image from an internal perspective the distance's between the poles, is the distance short or long?...Are the poles down, or across the slope?...What effect will these distances have on your speed and accuracy?

Now image yourself skiing the fastest and most accurate line down Section A.

Section B Script

You are now looking at Section B…Imagine the point at which you enter this section from section A…Image from an internal perspective the effect that the terrain will now have on your line, does the slope get more or less steep?...Images how you would see the position of the poles in Section B, are they in line down the hill or are they offset left or right?...What effect will their position have on your speed and accuracy of line?...Image from an internal perspective the distances between the poles, is the distance short, or long, down and across the slope?...What effect will these distances have on your speed and accuracy?

Now image yourself skiing the fastest and most accurate line down Section B.

Now image yourself skiing the fastest and most accurate line down Section A and B.

Section C Script

You are now looking at Section C…Imagine the point at which you enter this section from section B…Image from an internal visual perspective the effect that the terrain will now have on your line, does the slope get more or less steep?...Image how you would see the position of the poles in Section C, are they in line down the hill or are they offset left or right, what effect will their position have on your speed and accuracy of line?...Image from an internal perspective the distances between the poles short or long, down and across the slope…What effect will these distances have on your speed and accuracy?...Imagine seeing the finish line approaching as you ski as fast and as accurately towards it.

Now image yourself skiing the fastest and most accurate line down Section C.

Now image yourself skiing the fastest and most accurate line down Section B and C.

Now image yourself skiing the fastest and most accurate line down Section A, B and C.

Pre Race

I would like you to link all the internal visual images of Sections A, B and C together, and image the fastest and most accurate line down the whole of the slalom course.

External Visual Imagery

After watching the video footage you have seen what an External Visual Perspective is. Described verbally, an External Visual Perspective is the visual perspective you have when looking at yourself as if you were on TV. You are asked to use only this External Visual Perspective when preparing for the race.

The course has been divided into three sections A, B, & C. You have been given imagery scripts for each of the three sections these scripts will help you prepare for the race. You should read each script corresponding to the section of the course, then image the section, and then move down to the next section. Once you have finished all sections, and prior to the race, take some time to image each of the sections again, and then link the sections together to image the whole course and the path you will take. The imagery scripts are detailed on the handout and should be carried with you during the inspection. Please do not show these scripts to anyone else.

External Visual Imagery Script

While you are visually inspecting the section I would like you to take notice of the following 3 areas;

1. The terrain that is between the poles.
2. The position of the poles relative to each other.
3. The distancing of the poles vertically and horizontally between the poles

Once you have done this, read the corresponding External visual imagery script below. Once you have finished this, please image the section.

Section A Script

You are at the start looking at yourself from the outside you see the shape of your body, your skis and what you are wearing down Section A...Imagine looking at the terrain you are preparing to ski, is it steep or flat?...What effect the terrain will have on your line to, and beyond, the first pole...Image how you would see the position of the poles, is they in line down the hill or are they offset left or right...What effect will their position have on your speed and accuracy of line?...Image from an external perspective the distance's between the poles...Is the distance short or long...Are the poles down, or across the slope?...What effect will these distances have on your speed and accuracy?

Now image yourself skiing the fastest and most accurate line down Section A.

Section B Script

You are now looking at Section B...Imagine the point at which you enter this section from section A...Image from an external perspective the effect that the terrain will now have on your line, does the slope get more or less steep?...Image how you would see the position of the poles in Section B...Are they in line down the hill or are they offset left or right?...What effect will their position have on your speed and accuracy of line?...Image from an external perspective the distances between the poles short or long, down and across the slope, what effect will these distances have on your speed and accuracy?

Now image yourself skiing the fastest and most accurate line down Section B.

Now image yourself skiing the fastest and most accurate line down Section A and B.

Section C Script

You are now looking at Section C...Imagine the point at which you enter this section from section B...Image from an external visual perspective the effect that the terrain will now have on your line, does the slope get more or less steep?...Image how you would see the position of the poles in Section C, are they in line down the hill or are they offset left or right, what effect will their position have on your speed and accuracy of line?...Image from an external perspective the distance's between the poles short or long, down and across the slope?...What effect will these distances have on your speed and accuracy…Imagine seeing the finish line approaching as you ski as fast and as accurately towards it.

Now image yourself skiing fastest and most accurate line down Section C.

Now image yourself skiing fastest and most accurate line down Section B and C.

Now image yourself skiing fastest and most accurate line down Section A, B and C.

Pre Race

I would like you to link all the external visual images of Sections A, B and C together and image the fastest and most accurate line down the whole of the slalom course.

APPENDIX D

Imagery scripts used in Study 6

IVI script

While I read out this imagery script you can have your eyes open or closed. If you wish to close them do so now... Take a couple of long slow exhalations to relax yourself…focus on breathing out long and slow…

I am about to take you through the task you are about to perform. Imagine yourself from inside your body looking out through your own eyes, as if you are actually performing the task…that is from an internal visual imagery perspective

Imagine standing on the putting surface…Your head is bent toward the ground so you can see that you are standing parallel to the ball, feet shoulder width apart, with your knees slightly bent...As you look down you can see the ball below you on the ground…with the putter lined up directly behind the ball… your wrists are held firm and your arms are slightly bent at the elbow…imagine how you are feeling…Imagine your view change as you take one look at the hole so that you can see the line the ball will take…and then returning your view to the golf ball…imagine how you are feeling…imagine seeing your arms taking the club back slowly and smoothly away from the ball moving like a pendulum…you bring the putter back toward the ball in a pendulum like motion, see your arms stay straight and firm…the putter hits the ball in the centre and you continue to see the putter follow through with a pendulum like swing…Your head stays still for a second and then your view changes as you look up to see the ball go up the slope and into the hole…imagine how you are feeling…remember you are imaging yourself from an internal visual perspective…

EVI script

While I read out this imagery script you can have your eyes open or closed. If you wish to close them do so now... Take a couple of long slow exhalations to relax yourself...focus on breathing out long and slow...

I am about to take you through the task you are about to perform. Imagine yourself from outside of your body as if you are watching yourself performing the task...that is from an external visual imagery perspective...

Imagine watching yourself standing on the putting surface...You are standing parallel to the ball, feet shoulder width apart, with your knees slightly bent... You can see that your head is positioned over the ball...with the putter lined up directly behind the ball... your wrists are held firm and your arms are slightly bent at the elbow...imagine how you are feeling...As you look at yourself notice the triangle that is made between your two arms and the horizontal line between your shoulders...Imagine watching yourself take one look at the hole and then returning your view to the golf ball...watch yourself take the club back slowly and smoothly away from the ball with the triangle of your arms and shoulders moving like a pendulum...watch yourself bring the putter back toward the ball in a pendulum like motion, see your arms stay straight and firm...the putter hits the ball in the centre and you watch yourself continue to follow through with your pendulum like swing...You see your head stay still for a second and then look up to see the ball go up the slope and into the hole...imagine how you are feeling...remember you are imaging yourself from an external visual perspective...

APPENDIX E

Vividness of Movement Imagery Questionnaire used in Chapter 2

Movement imagery refers to the ability to imagine a movement. The aim of this test is to determine the vividness of your movement imagery. The items of the test are designed to bring certain images to your mind. You are asked to rate the vividness of each item by reference to the 5-point scale. After each item, write the appropriate number in the box provided. The first box is for an image obtained watching yourself from an external point of view* (see end of questionnaire), and the second box is for an image obtained doing it yourself. Try to do each item separately, independently of how you may have done other items. Complete all items obtained watching yourself from an external viewpoint* and then return to the beginning of the questionnaire and rate the image obtained doing it yourself. The two ratings for a given item may not in all cases be the same. For all items please have your eyes CLOSED.

Think of each of the following acts, and classify the images according to the degree of clearness and vividness as shown on the RATING SCALE.

Item	Watching yourself do it	Doing it yourself
1. Standing		
2. Walking		
3. Running		
4. Jumping		

RATING SCALE. The image aroused by each item might be:

Perfectly clear and as vivid as normal vision	....	RATING 1
Clear and reasonably vivid	....	RATING 2
Moderately clear and vivid	....	RATING 3
Vague and dim	....	RATING 4
No image at all, you only "know" that you Are thinking of the skill.	....	RATING 5

Item	Watching yourself do it	Doing it yourself
5. Reaching for something on tiptoe		
6. Drawing a circle on paper		
7. Kicking a stone		
8. Bending to pick up a coin		

RATING SCALE. The image aroused by each item might be:
Perfectly clear and as vivid as normal vision .... RATING 1
Clear and reasonably vivid .... RATING 2
Moderately clear and vivid .... RATING 3
Vague and dim .... RATING 4
No image at all, you only "know" that you .... RATING 5
Are thinking of the skill.

Think of each of the following acts, and classify the images according to the degree of clearness and vividness as shown on the RATING SCALE.

Item	Watching yourself do it	Doing it yourself
9. Falling forwards		
10. Running up stairs		
11. Jumping sideways		
12. Slipping over backwards		

	Watching yourself do it	Doing it yourself
13. Catching a ball with two hands		
14. Throwing a stone into water		
15. Kicking a ball in the air		
16. Hitting a ball along the ground		

	Watching yourself do it	Doing it yourself
17. Running downhill		
18. Climbing over a high wall		
19. Sliding on ice		
20. Riding a bike		

	Watching yourself do it	Doing it yourself
21. Jumping into water		
22. Swinging on a rope		
23. Balancing on one leg		
24. Jumping off a high wall		

* In the original questionnaire this statement reads, "watching somebody else". It has been slightly altered for the purposes of this study.

APPENDIX F

Movement Imagery Questionnaire-Revised

This questionnaire concerns two ways of *mentally* performing movements which are used by some people more than others, and are more applicable to some types of movements than others. The first is attempting to form a visual image or picture of a movement in your mind. The second is attempting to feel what performing a movement is like without actually doing the movement. You are requested to do both of these mental tasks for a variety of movements in this questionnaire, and then rate how easy/difficult you found the tasks to be. The ratings that you give are not designed to assess the goodness or badness of the way you perform these mental tasks. They are attempts to discover the capacity individuals show for performing these tasks for different movements. There are no right or wrong ratings or some ratings that are better than others.

Each of the following statements describes a particular action or movement. Read each statement carefully and then actually perform the movement as described. Only perform the movement a single time. Return to the starting position for the movement just as if you were going to perform the action a second time. Then depending on which of the following you are asked to do, either (1) form as clear and vivid a visual image as possible of the movement just performed, or (2) attempt to feel yourself making the movement just performed without actually doing it.

After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task. Take your rating from the following scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for each movement. You may choose the same rating for any number of movements "seen" or "felt" and it is not necessary to utilize the entire length of the scale.

RATING SCALES

Visual Imagery Scale

7	6	5	4	3	2	1
Very easy to see	Easy to see	Somewhat easy to see	Neutral (neither easy nor hard)	Somewhat hard to see	Hard to see	Very hard to see

Kinaesthetic Imagery Scale

7	6	5	4	3	2	1
Very easy to feel	Easy to feel	Somewhat easy to feel	Neutral (neither easy nor hard)	Somewhat hard to feel	Hard to feel	Very hard to feel

1. **STARTING POSITION**:	Stand with your feet and legs together and your arms at your sides.
ACTION:	Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.
MENTAL TASK:	Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
2. **STARTING POSITION**:	Stand with your feet slightly apart and your hands at your sides.
ACTION:	Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
MENTAL TASK:	Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
3. **STARTING POSITION**:	Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
ACTION:	Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
MENTAL TASK:	Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
4. **STARTING POSITION**:	Stand with your feet slightly apart and your arms fully extended above your head.
ACTION:	Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.
MENTAL TASK:	Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________

5. **STARTING POSITION**:	Stand with your feet slightly apart and your hands at your sides.
ACTION:	Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
MENTAL TASK:	Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
6. **STARTING POSITION**:	Stand with your feet and legs together and your arms at your sides.
ACTION:	Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.
MENTAL TASK:	Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
7. **STARTING POSITION**:	Stand with your feet slightly apart and your arms fully extended above your head.
ACTION:	Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.
MENTAL TASK:	Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________
8. **STARTING POSITION**:	Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
ACTION:	Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
MENTAL TASK:	Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.
	RATING: ________

APPENDIX G

Vividness of Movement Imagery Questionnaire – 2

Name: **Age:**

Gender: **Sport:**

Level at which sport is played at (e.g., Recreational, Club, University, National, International, Professional)

Years spent participating in this sport competitively:

Movement imagery refers to the ability to imagine a movement. The aim of this questionnaire is to determine the vividness of your movement imagery. The items of the questionnaire are designed to bring certain images to your mind. You are asked to rate the vividness of each item by reference to the 5-point scale. After each item, circle the appropriate number in the boxes provided. The first column is for an image obtained watching yourself performing the movement from an external point of view (External Visual Imagery), and the second column is for an image obtained from an internal point of view, as if you were looking out through your own eyes whilst performing the movement (Internal Visual Imagery). The third column is for an image obtained by feeling yourself do the movement (Kinaesthetic imagery). Try to do each item separately, independently of how you may have done other items. Complete all items from an external visual perspective and then return to the beginning of the questionnaire and complete all of the items from an internal visual perspective, and finally return to the beginning of the questionnaire and complete the items while feeling the movement. The three ratings for a given item may not in all cases be the same. For all items please have your eyes CLOSED.

Think of each of the following acts that appear on the next page, and classify the images according to the degree of clearness and vividness as shown on the RATING SCALE.

RATING SCALE. The image aroused by each item might be:

Perfectly clear and as vivid (as normal vision or feel of movement)	....	RATING 1
Clear and reasonably vivid	....	RATING 2
Moderately clear and vivid	....	RATING 3
Vague and dim	....	RATING 4
No image at all, you only “know” that you are thinking of the skill.	....	RATING 5

	Watching yourself performing the movement (External Visual Imagery)					Looking through your own eyes whilst performing the movement (Internal Visual Imagery)					Feeling yourself do the movement (Kinaesthetic Imagery)				
Item	Perfectly clear and vivid as normal vision	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the	Perfectly clear and vivid as normal vision	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the	Perfectly clear and vivid as normal feel of movement	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the
1.Walking	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2.Running	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3.Kicking a stone	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4.Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.Running up stairs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6.Jumping sideways	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7.Throwing a stone into water	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8.Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
9.Running downhill	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10.Riding a bike	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
11.Swinging on a rope	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
12.Jumping off a high wall	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

APPENDIX H

Example Manipulation/Post-Experimental Questionnaire

Name

Condition

1. To what extent were you able to adhere to the treatment condition you were asked to prior to your attempts?

1 2 3 4 5 6 7 8 9 10 11
not at all greatly

2. How suitable did you feel that the treatment group was for the task you had to perform?

1 2 3 4 5 6 7 8 9 10 11
not at all greatly

3. Did you experience any kinaesthetic imagery, that is imagery relating to the feeling of the movements, during your attempts?

1 2 3 4 5 6 7 8 9 10 11
not at all greatly

4. To what extent did you feel that the treatment group helped your self-confidence to complete the task quickly?

1 2 3 4 5 6 7 8 9 10 11
not at all greatly

5. Did you switch between imagery perspectives and use and maintain the non-required perspective?

Yes/No

6. To what extent did you switch between and use both imagery perspectives?
1 2 3 4 5 6 7 8 9 10 11
not at all greatly

7. Did you use any other strategies to aid your performance, if yes what strategies did you use?

APPENDIX I

Narcissism Personality Inventory – 40

Please read each pair of statements and then choose the one that is closer to your own feelings and beliefs. Indicate your answer by circling either the letter 'A' or 'B' to the left of each item. Please do not skip any items. Please note that there are no right or wrong answers and your responses will be treated in the strictest confidentiality.

1. A: I have a natural talent for influencing people
   B: I am not good at influencing people

2. A: Modesty doesn't become me
   B: I am essentially a modest person

3. A: I would do almost anything on a dare
   B: I tend to be a fairly cautious person

4. A: When people compliment me I sometimes get embarrassed
   B: I know that I am good because everybody keeps telling me so

5. A: The thought of ruling the world scares the hell out of me
   B: If I ruled the world it would be a much better place

6. A: I can usually talk my way out of anything
   B: I try to accept the consequences of my behaviour

7. A: I prefer to blend in with the crowd
   B: I like to be the centre of attention

8. A: I will be a success
   B: I am not too concerned about success

9. A: I am no better or no worse than most people
   B: I think I am a special person

10. A: I am not sure if I would make a good leader
    B: I see myself as a good leader

11. A: I am assertive
    B: I wish I were more assertive

12. A: I like having authority over people
    B: I don't mind following orders

13. A: I find it easy to manipulate people
    B: I don't like it when I find myself manipulating people

14. A: I insist on getting the respect that is due me
    B: I usually get the respect I deserve

15. A: I don't particularly like to show off my body
B: I like to display my body

16. A: I can read people like a book
B: People are sometimes hard to understand

17. A: If I feel competent I am willing to take responsibility for making decisions
B: I like to take responsibility for making decisions

18. A: I just want to be reasonably happy
B: I want to amount to something in the eyes of the world

19. A: My body is nothing special
B: I like to look at my body

20. A: I try not to show off
B: I am apt to show off if I get the chance

21. A: I always know what I am doing
B: Sometimes I am not sure of what I am doing

22. A: Sometimes I depend on people to get things done
B: I rarely depend on anyone else to get things done

23. A: Sometimes I tell good stories
B: Everybody likes to hear my stories

24. A: I expect a great deal from other people
B: I like to do things for other people

25. A: I will never be satisfied until I get all that I deserve
B: I take my satisfactions as they come

26. A: Compliments embarrass me
B: I like to be complimented

27. A: I have a strong will to power
B: Power for its own sake doesn't interest me

28. A: I don't very much care about new fads and fashions
B: I like to start new fads and fashions

29. A: I like to look at myself in the mirror
B: I am not particularly interested in looking at myself in the mirror

30. A: I really like to be the centre of attention
B: It makes me uncomfortable to be the centre of attention

31. A: I can live my life in any way I want to
B: People can't always live their lives in terms of what they want

32. A: Being an authority doesn't mean that much to me
B: People always seem to recognize my authority

33. A: I would prefer to be a leader
B: It makes little difference to me whether I am a leader or not

34. A: I am going to be a great person
B: I hope I am going to be successful

35. A: People sometimes believe what I tell them
B: I can make anybody believe anything I want them to

36. A: I am a born leader
B: Leadership is a quality that takes a long time to develop

37. A: I wish somebody would someday write my biography
B: I don't like people to pry into my life for any reason

38. A: I get upset when people don't notice how I look when I go out in public
B: I don't mind blending into the crowd when I go out in public

39. A: I am more capable than other people
B: There is a lot that I can learn from other people

40. A: I am much like everybody else
B: I am an extraordinary person

Thank you for you time