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The cognitive and motivational effects of imagery on sport performance.

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THE COGNITIVE AND MOTIVATIONAL EFFECTS OF IMAGERY ON SPORT PERFORMANCE

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SUMMARY

This thesis is written as a collection of research papers through which the cognitive and motivational effects of imagery on sports performance were investigated. A number of research methodologies, ranging from a quasi-experimental design to a multiple-baseline across participants design, were employed to explore the effects of imagery. The first section of this thesis explored the cognitive effects of imagery. Specifically, study 1 examined the effects of different visual imagery perspectives and kinaesthetic imagery on the acquisition and retention of a simple gymnastics routine. External visual imagery was shown to have superior effects over internal visual imagery for this form-based task. A significant interaction was found in the retention phase; however, follow up tests failed to clarify the nature of the interaction. Study 2 and study 3 further investigated the imagery perspective issue by exploring the strength of relationship between external visual imagery and kinaesthetic imagery, and between internal visual imagery and kinaesthetic imagery. Results indicated that when the participant is the object of the image, kinaesthetic imagery has a greater association with external visual imagery than with internal visual imagery. However, because the tasks that participants imaged were essentially form-based, the results may not generalise to other types of tasks. The second section of the thesis examined the motivational effects of imagery. Study 4 employed a multiple-baseline across participants design to establish the effect of a mastery imagery intervention on sport confidence. Consistent with Paivio's (1985) proposals, the results suggested that imagery has a motivational function as the imagery intervention was found to increase confidence. Study 5 further considered the imagery confidence relationship and two factors which may moderate this relationship, that is skill level and sport-type. The results suggest that in team sport players the type of imagery associated with confidence depends on the skill level of the player.

CHAPTER 1

GENERAL INTRODUCTION

Purpose of the Research Programme

In 1992, Murphy and Jowdy contended that the limitations of previous imagery research needed to be overcome, and theoretically driven, methodologically sound experiments devised. The reason for this suggestion was not only because of the need to further explore the nature of imagery and its effects upon performance, but also to move its knowledge base forward. Thus, the primary purpose of the present research programme was to explore the cognitive and motivational effects of imagery upon sport performance through a series of methodologically sound studies; a possible consequence of this process would be the progression of the imagery research base. The secondary purpose of this research programme was to use it as a vehicle to provide training in the research process. That is, from the development and examination of a research question, through to the communication of the research findings as an empirical research paper.

Introduction to the Findings of Imagery Research within Sport Psychology

The use of imagery exists throughout the sports domain. Specifically, a very high proportion of elite athletes report using imagery as a basic psychological skill to: enhance learning and performance (Orlick & Partington, 1988), increase self-confidence (Hemery, 1986), improve concentration (Jones & Hardy, 1990), reduce anxiety (Hall, Rogers, & Barr, 1990), increase motivation (Salmon, Hall, & Haslam, 1994), analyse past performance (Syer & Connally, 1998), and for sports rehabilitation (e.g., Ievleva & Orlick, 1991). Furthermore, the significance of imagery to sports performers is highlighted by Olympic athletes who rate imagery as having an important effect on their performance (e.g., Greenleaf, Gould, & Dieffenbach, under review). However, when imagery is used for these different functions depends on whether the performer is in training or competition, what type of sport they are participating in (White & Hardy, 1998), and the point at which the performer is at in the season (Munro, Hall, Simms, & Weinberg, 1998).

Numerous studies have explored the efficacy of imagery, focusing mainly on its effects on the acquisition and performance of motor skills (e.g., Blair, Hall, & Leyshon, 1993; Mackay, 1981; Start & Richardson, 1964; Smyth, 1975; White & Hardy, 1995). Despite the wealth of information in this area (see Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983; Jones & Stuth, 1997 for reviews), the research base, in the past, has been criticised because it lacks empirically tested theory (e.g., Hardy, Jones, & Gould, 1996), it fails to take account of mediating variables (e.g., Murphy, 1990) and its research design is often flawed (e.g., Goginsky & Collins, 1996). As Murphy and Jowdy (1992) have pointed out, these factors have led to equivocal research findings (e.g., Wollman, 1986; Moran, 1993) and misinterpretations of the research literature. Specifically, some studies have found large effect sizes for imagery (Clarke, 1960; Oxendine, 1969; Vandell, Davis, & Clugston, 1943), and some small effect sizes (Smyth, 1975; Shick, 1970; Wrisberg & Ragsdale, 1979).

To clarify the results of imagery research Feltz and Landers (1983) and Driskell et al., (1994) conducted meta-analyses of the imagery research literature. These researchers found effect sizes of 0.48 and 0.26 respectively, indicating that imagery can have a small to moderate effect on performance. Despite these somewhat equivocal findings, the received view (e.g., Hardy, 1997; Vealey, 1994) is that imagery enhances the acquisition and performance of motor skills. However, Murphy and Jowdy (1992) contend that the imagery knowledge base needs to be moved forward by overcoming the limitations of previous imagery research, and devising theoretically driven, methodologically sound experiments. But, what limitations need to be overcome and what research issues addressed to move the knowledge base forward? These two questions will be addressed briefly.

Limitations of Previous Imagery Research Design

Murphy (1994) contended imagery research has been limited because it has followed a medical model of treatment research. This medical model attempts to answer the question "Does imagery work?" by applying a treatment (imagery), and then comparing the effects of this treatment, to no treatment, to an effective treatment (physical practice), or to a placebo. However, in the present author's opinion, the limitations of the imagery research have occurred not because of this. Rather, they have occurred because imagery research adopted laboratory based experiments from motor learning research (Landers, 1995) via its parent discipline of psychology. This research design lends itself to the study of the question, "Does imagery improve the acquisition and performance of motor skills?" The limited use of different research designs provides one reason why imagery research has been slow in developing our understanding of how and why imagery works.

Researchers are also still asking the question "Does imagery work?" because flawed research designs have caused equivocal results. In particular, imagery research has failed to produce systematically designed studies related to the previous literature.

Specifically, the methodological components of imagery studies have varied greatly, with differences in imagery instructions, distribution and duration of imagery practice, and control conditions being attributed as the cause of contradictory results (Gogisnky & Collins, 1996; Moran, 1993). Moreover, failure to take into account mediating variables such as imagery perspective, ability, outcome, and task type (Murphy & Jowdy, 1992) has meant that it has not been possible to establish if these mediating variables are actually causing differential effects, rather than the results being equivocal.

How to Overcome Some of the Limitations of Previous Imagery Research Design and Move the Knowledge Base Forward

Researchers (e.g., Goginsky & Collins 1996, Wollman, 1986; Moran, 1993; Murphy 1990, 1994; Murphy & Jowdy, 1992) have identified a number of suggestions for improving the designs of imagery research. Many of these suggestions overlap, only those relevant to the thesis will be presented here.

Imagery Perspectives

Murphy (1994) suggested that imagery perspective may mediate the effectiveness of imagery. By manipulating imagery perspective, it may be possible to sift out which components of imagery result in what effects. Mahoney and Avener (1977) described internal imagery as "requiring an approximation of the real life phenomenology such that the person actually images being inside his/her body and experiencing those sensations which might be expected in the actual situation" and external imagery as "when a person views himself from the perspective of an external observer much like in the home movies" (p. 137). These researchers found that gymnasts who were successful in qualifying for the U.S. Olympic team used internal imagery more than did gymnasts who were unsuccessful. Meyers, Cooke, Cullen, and Liles (1979), however, found no significant differences in imagery use between more and less successful racquetball players. Furthermore, Ungerleider and Golding (1991) suggested that successful U.S. track and field trialists for the Seoul Olympics used external imagery more than internal imagery and had stronger physical sensations accompanying their imagery than their unsuccessful fellow trialists. There are at least two possible explanations for these equivocal findings. Firstly, researchers have confounded internal visual imagery with kinaesthetic imagery (that is, imagery of what a movement feels like). Specifically, Mahoney and Avener (1977) appear to assess gymnasts' use of internal imagery by asking them whether they experience what the image would feel like in their muscles. Such a question clearly assesses the kinaesthetic rather than the internal visual component of the performer's image (White & Hardy, 1995). Secondly, certain types of imagery may be more effective for some types of tasks than for others. Indeed, when manipulating visual imagery perspectives White and Hardy (1995) found that external visual imagery had superior effects on the acquisition and retention of a task which required form of movement for its successful execution. However, internal visual imagery produced a more accurate performance and external visual imagery a faster performance for a task which depended on perception of environmental information to initiate key movements for its successful execution. Furthermore, these researchers found, through participants' responses to a post-experimental questionnaire, that there was no difference in the amount of kinaesthetic imagery used with internal and external visual imagery, but the researchers did not manipulate kinaesthetic imagery in the experimental treatment. Thus, there is a need to further examine the differential effects of internal and external visual imagery in conjunction with kinaesthetic imagery. This research issue forms the basis for the first three studies of the thesis. Specifically, the first study (chapter 2) explored the differential effects of kinaesthetic imagery with different visual perspectives on the learning and performance of a form-based task; studies 2 and 3 (chapter 3) examined the strength of the relationship between kinaesthetic imagery ability and the ability to use different visual imagery perspectives.

General Design Issues

Murphy and Jowdy (1992) provided two useful proposals for improving research design. Specifically, they contend future research should provide detailed descriptions of what participants were instructed to image. This would allow for comparisons across studies. Furthermore, they argued that manipulation checks should be included in imagery interventions to ensure that the imagery experience of the participant is the same as that described by the experimenter. These two proposals have been adhered to, where appropriate, through the thesis.

Wollman (1986) proposed the use of single-subject designs to further our knowledge of imagery because these designs use repeated data collections over time, thus allowing individual variability to be studied and the true effects of imagery on a participant to be evaluated (for discussion see Hrycakio & Martin, 1996). The fourth study in this thesis used a single-subject multiple-baseline design to explore a research issue introduced in the next two sections.

Focus of Previous Imagery Research

Within the field of psychology, research into Paivio's (1971, 1975) dual coding model has provided evidence indicating that psychological activity is regulated by two coding systems, the imagery system and the verbal system, and that each of these systems has specific structural and functional properties. It was proposed that the imagery system is linked to perceptual experiences brought into play when the individual needs to process information with a figural content, for example, forming visual images. Whereas, the verbal system is linked to language exposure and experience and is used for linguistic processing. Despite challenges to this model by a propositional framework of imagery (e.g., Pylyshyn, 1973) and a mixed model approach (e.g., Kosslyn, 1973) the focus of most imagery research has been on Paivio's model and consequently on the use of visual imagery. Considering the experimental roots of sport psychology it is not surprising to find, therefore, that its research has focused primarily on visual imagery. However, what is surprising is that imagery research within sport psychology has not developed to explore the many other facets of imagery. Indeed, in a discipline whose medium is movement it is startling that there is such a lack of research on kinaesthetic imagery. Further to this, the focus of imagery on different imagery perspectives as first defined by Mahoney and Avener (1977) has narrowed the focus even further by ignoring other possible types of imagery (e.g., Martin, Moritz, & Hall, 1999). Similarly, because of its experimental history, imagery research has focused on the effect of imagery on acquisition and learning of skill rather than the other potential effects that have been reported anecdotally. Indeed, despite elite performers reporting imagery to have a motivational effect (e.g., Orlick & Partington, 1988; White & Hardy, 1998), Murphy

(1994) stated that research into the motivational function of imagery was in fact limited.

How to Diversify the Research Focus and Move the Knowledge Base Forward

In 1985, Paivio proposed an analytic framework for imagery, (see Figure 1). This framework considered imagery to have both a motivational and a cognitive role in mediating behaviour, and each of these roles to operate at either a specific or a general level.

	IMAGERY FUNCTION	
	MOTIVATION	COGNITION
GENERAL LEVEL	Arousal and Affect	Strategies
SPECIFIC LEVEL	Goal-oriented Responses	Skills

Figure 1. Analytic framework for imagery effects (Paivio, 1985).

This framework provides a very useful conceptual model to diversify the imagery research focus. Based on Paivio's model, Hall, Mack, Paivio, and Hausenblas (1998) developed a taxonomy for classifying the different types of imagery used by athletes. The imagery types classified are as follows: Motivational General-Mastery (MG-M; e.g., imaging staying focused when confronted by problems); Motivational General-Arousal (MG-A; e.g., imaging the emotions that accompany major competitions); Motivational Specific (MS; e.g., imaging specific performance goals being achieved); Cognitive General (CG; e.g., imaging performance plans being executed successfully); Cognitive Specific (CS; e.g., imaging specific skills being executed perfectly). This taxonomy was verified in a series of empirical studies and provides a classifying system of imagery used by performers that goes beyond that of imagery perspectives. In addition to categorising sport imagery, Hall et al. (1998) developed the Sport Imagery Questionnaire to measure the extent to which the five imagery types identified were used.

Hall et al's (1998) taxonomy and questionnaire has the potential to diversify imagery usage research in terms of these different types of imagery and the potential effects they may have. However, the majority of the recent research developing from Paivio's framework and Hall et al's (1998) taxonomy has either been descriptive (e.g., Salmon et al., 1994; Munro et al., 1998) or correlational (e.g., Moritz, Hall, Martin, & Vadocz, 1996; Vadocz, Hall, & Moritz, 1997), so that causality cannot be implied. For example, Moritz et al. (1996) found Motivational General-Mastery (MG-M) imagery predicted state sport confidence in roller skaters. However, because the study was correlational in nature it cannot be established if using Motivational General-Mastery imagery causes an increase in confidence, or having high sport confidence causes performers to use Motivational General-Mastery imagery, or, alternatively, some other variable causes both. It is important to examine the causal direction of this relationship for two reasons. Theoretically, as Murphy (1994) contends, researchers should be moving away from questions about, "Does imagery work?" towards questions about, "How and why does imagery work?" (p. 491). If it can be established that (MG-M) imagery enhances sport confidence, then this would suggest that imagery may effect performance via a motivation-enhancing mechanism. From an applied perspective, if it is established that MG-M imagery enhances confidence then, because confidence plays a vital role in sports performance (Hardy et al., 1996), this form of imagery could become a valuable psychological skill for performers to develop and use. The causality of the sport confidence/Motivational General-Mastery imagery relationship was addressed in the fourth study (chapter 4) of the thesis.

Lack of Theoretical Base

The lack of research on a broad range of imagery uses has been blamed on the narrow focus of existing sport imagery theories (Murphy, 1990). However, the focus on such a constricted range of imagery uses, with the employment of often flawed research design, has led to a difficulty in assembling facts from existing empirical data, and subsequently developing theories about how imagery exerts its influence upon behaviour. Without facts that researchers can agree upon theoretical statements are seriously compromised (Hall & Linsey, 1995). The magnitude of the problem is further exasperated by the large number of potential effects that imagery has; that is, it would be very difficult to develop an all encompassing theory to explain all of potential effects which imagery might have. This current state of affairs within sport psychology imagery research is highlighted by the lack of empirically tested and robust theoretical explanations of imagery effects.

Theoretical Explanations for Imagery Effects

Psychoneuromuscular Theory and Symbolic Learning Theory

Previously, the psychoneuromuscular theory was used to explain how imagery works at a lower level of peripheral control, and the symbolic learning theory to explain how it works at a higher level of central processing (e.g., Hale, 1982; Ryan & Simons, 1981). However, it is now widely acknowledged that these theories have severe limitations both in terms of the research that provides support for them, and as parsimonious explanations of how and why imagery exerts its potential effects (e.g., Hecker & Kaczor, 1988; Murphy & Jowdy, 1992).

Recently, three theories have been used to focus research, improve experimental procedures, and provide possible explanations for imagery effects. These are, Ahsen's triple code model for imagery and psychophysiology (1984), Lang's bio-informational theory of emotional imagery (1977, 1979, 1988), and Bandura's self-efficacy theory (1977, 1986, 1997).

Ahsen's Triple Code Model (1984)

Ahsen's triple code model (1984) deals specifically with interconnections between the image (I), the psychophysiological response (S) and the meaning of the image (M). The I, S, and M factors may combine in various orders (e.g., ISM; IMS; SIM), each order serves various operations. The most natural and useful order of the triple code model is the ISM (Ahsen, 1994). That is, the evocation of a visual image (or another sensory image) is followed by a somatic response, and then by a meaning. The image serves as the central mode from which a somatic response is emancipated, and a significance or meaning imparted. The model overcomes the failure of Paivio's (1971) dual code theory to acknowledge the somatic response, and the general failure of imagery researchers to recognise the importance of the meaning of an image to performers.

Despite the intuitive appeal of the model, it does not explain the underlying processes and mechanisms of how and why imagery may alter behaviour. Furthermore, the ISM model is based on clinical examples rather than empirically tested research. In addition, it is this author's opinion, that Ahsen's model was superseded by Lang's bio-informational theory (1988) when that theory was developed and modified to included meaning.

Lang's Bio-informational Processing Theory

In 1977, Lang proposed his bio-informational theory of emotional imagery, in 1988 the theory was modified to provide a more general framework of understanding affective behaviour. The 1988 theory assumes an image to be a functionally organised, finite set of propositions (statements) stored by the brain. To this end, an image can contain three main types of propositions: stimulus propositions, response propositions, and meaning propositions. Stimulus propositions are statements which describe the content of the image; response propositions describe the imager's overt and covert response to the image; and meaning propositions are analytical in nature and interpret the image. Response propositions are hypothesised to be double coded in that their deep structure is linked to the motor command system which generates efferent output. The complete set of propositions is organised into an associative network, and the associated motor programme contains instructions for how the imager is to respond.

Lang (1979) has demonstrated that imagery is accompanied by an efferent outflow appropriate to the content of the image. Further, more vivid images produce a greater magnitude of physiological response, and greater changes in accompanying behaviour (Lang, Melamed, & Hart, 1970). Thus, modifying or creating a vivid image will result in changing the overt behaviour of the imager and visa versa. Lang's theory provides a possible explanation of how and why imagery may work.

This explanation requires empirical verification in the field of sport psychology; however, recent research evidence with regard to stimulus and response propositions has produced tentative support for Lang's theory in a sport setting. Bakker, Boscher, and Chung (1996) found that participants who had received a response proposition imagery script had greater EMG activity during the imagery of a biceps curl, than participants who had received a stimulus imagery script, suggesting that Lang's model is applicable to emotionally neutral movement imagery.

Interestingly, Lang's theory may have a parallel in research reviewed by Jeannerod (1994). This research suggested that visual images and motor (kinaesthetic) images are encoded in the brain using different neural networks, and that these neural networks are activated in the same way as they are activated when actually performing the imaged act. This has a neat corollary with Lang in that the neural network may provide the physiological substrate for the propostitional network, with the connections between neurons providing the substrate for the links between propositions.

Bandura's Self-Efficacy Theory (1977)

As previously mentioned it would be very difficult to develop a theory which explained all of the possible effects on imagery. Thus, it could be that different theories may be needed to explain different imagery effects. Bandura's self-efficacy theory (1977, 1986, 1997) could be used to explain the motivational effects of imagery. Bandura (1997) states that four sources of information can serve to increase an individuals self-efficacy; that is, enactive mastery, vicarious experience, verbal persuasion, and emotional and affective state. Techniques which provide the performer with mastery or vicarious experience such as video feedback and modeling (watching someone else successfully perform a skill) have been shown to increase self-efficacy in sport settings (Gould & Weiss, 1981; McAuley, 1985; Feltz, 1982). Since imagery can provide both mastery and vicarious information (depending upon the degree of identification with the image), imagery has been suggested as a strategy to enhance the self-efficacy of sports performers because imagery could serve to increase efficacy expectations via these two sources of information.

How to Move the Theoretical Base Forward

The present author shares Murphy and Jowdy's (1992) contention that, researchers should utilise some version of information processing models of imagery to explain the effects of imagery. Furthermore, the meaning of an image should be acknowledged in terms of its possible influence on the efficacy of imagery via the cognitive, affective, and behavioural reactions to an image. Based on this sort of approach, Martin et al. (1999) developed an Applied Model of Mental Imagery Use. These researchers utilised concepts from both Ahsen's (1984) triple code model and Lang's (1977, 1979) bio-informational theory. Although not a theory, Martin et al's (1999) model will be discussed here as it provides a clear theoretical background for designing imagery use experiments, and for guiding the selection of variables to be included and measured in experiments. Furthermore, the model provides the theoretical framework for the fifth study (chapter 5) of the thesis.

An Applied Model of Mental Imagery

Martin et al's (1999) Applied Model centres on the type of imagery used by athletes (as defined by Hall et al., 1998). The model is based upon four imagery related variables; namely, the sport situation, the type of imagery used, imagery ability, and outcomes associated with imagery use (see Figure 2). In addition, the model reflects the notion that different images are associated with different cognitive, affective, and behavioural reactions and that images may have different meanings for athletes. Via a review of the research literature and subsequent model development, Martin et al. (1999) developed 15 specific and testable hypotheses that related to sport situation, type of imagery used, and the predicted effects/outcomes. Furthermore, these authors acknowledged that variables such as skill level and sport type may moderate the type of imagery used. With the desire to examine the possible role of moderating variables, the fifth study of the thesis explored these two possible moderating variables. Specifically, the types of imagery associated with sport confidence were explored in relation to performers of varying skill levels. Furthermore, whereas previous research has explored the imagery usage of performers from individual sports, (e.g., Moritz et al., 1996; White & Hardy, 1998), study 5 explored the imagery usage of participants from a team sport.

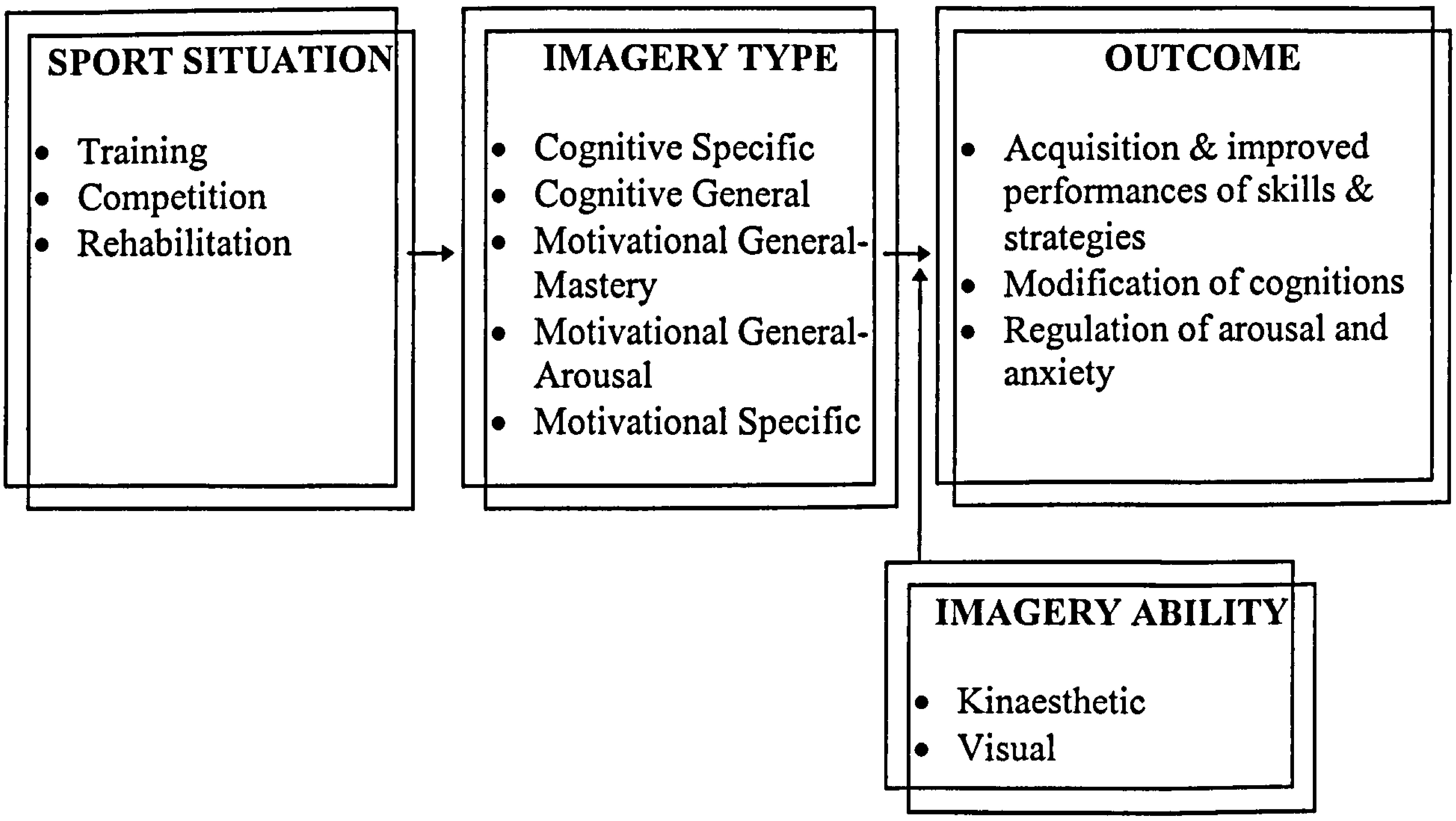

Figure 2. An Applied Model of Mental Imagery use in sport (Martin, et al. 1999, with permission from first author).

Overview of Thesis

Through a series of five studies this thesis explores the cognitive and motivational effects of imagery upon sport performance. The studies stand in their own right as a total of four papers. Studies 1, 4, and 5 have been presented at international conferences. Study 1 forms part of a published paper. Study 4 is in press, study 3 has been provisionally accepted for publication., and studies 2 and 3 are ready to be submitted as a combined paper. Despite their independence these studies are linked together in the thesis by the present introduction and a general discussion. The general introduction served to provide the reader with a brief overview of the thesis and an outline of the research related to imagery effects on sport performance, the limitations of previous imagery research in terms of design, focus, and theory, and the specific research issues that are relevant to, and examined within, the thesis. The general discussion serves to draw the studies together in terms of their collective findings and implications, and provides directions for future research. As the studies are independent but linked, at times there is a necessary overlap between chapters.

The Research Programme

The first part of the thesis (chapters 2 and 3) reports the results of three studies on the cognitive effects of imagery. Chapter 2 presents a study which uses a quasi-experimental design to explore the main and interactive effects of internal visual imagery, external visual imagery, and kinaesthetic imagery on the acquisition and retention of a simple gymnastics floor routine. The findings of the experiment are discussed in terms of the cognitive processes that may underlie imagery effects and suggest that kinaesthetic imagery can be used with external visual imagery as well as internal visual imagery. Two findings from this study steered the future direction of the thesis. Firstly, although study 1 indicated that external visual imagery was superior to internal visual imagery, and that external visual imagery and kinaesthetic imagery could be used together, many applied sport psychology researchers (e.g., Hale, 1998) still advocate the use of internal visual imagery in preference to external visual imagery for performance enhancement. The assumption underlying this advice lies in internal imagery's supposed greater association with kinaesthetic sensation/imagery (Jowdy, Murphy, & Durtschi, 1989). Thus, chapter 3 reports the results of two conceptual studies which further explore the imagery perspective issue, via the strength of the relationship between a performer's ability to image internally or externally with kinaesthetic imagery. These results are discussed in terms of who is the object of the image, the delivery of appropriate imagery exercises to sport performers, and the use of particular psychometric methods to develop our understanding of the processes underlying the imagery of movement.

The second part of the thesis (chapters 4 and 5) reports two studies on the motivational effects of imagery. The thesis changes direction to explore motivational effects for two reasons. In the first study of the thesis (chapter 2), one treatment group reported significantly greater confidence than other treatment groups, thereby indicating that imagery may have both a motivational and cognitive effect. Secondly, as Murphy (1994) argued, research into the motivational effects of imagery has been limited. Thus, chapter 3 reports on a study which used a multiple-baseline across participants design to explore the causal direction of the confidence/imagery relationship. The results suggested that mastery forms of imagery increase sport confidence, thus providing evidence to support the hypothesis proposed by Martin, et al. (1999) that mastery imagery increases the confidence of athletes. The facilitative effects of the mastery imagery are discussed in terms of the meaning that the image may have for the performer (Lang, 1988), and the possibility that the information provided by the image may serve to increase the performer's efficacy expectations (Bandura, 1997).

The final study (chapter 5) extends the findings of previous studies in line with Martin et al's (1999) Applied Model of Imagery. Specifically, using two validated questionnaires, the types of imagery associated with sport confidence were explored in relation to varying skill levels of performers. However, as opposed to using participants from individual sports, as with the research of Moritz et al. (1996) and White and Hardy (1998), team games players were used as participants. The results suggested that more confident athletes of different skill levels use different types of imagery; thus revealing that skill level and sport-type are variables worthy of future research to establish if they should be included in prospective versions of the Applied Imagery Model.

Summary

The thesis addressed the following four research issues.

1. Does the combination of different visual imagery perspectives and kinaesthetic imagery produce differential effects on performance?
2. What is the relationship between internal/external visual imagery and kinaesthetic imagery?
3. What is the causal relationship between imagery and confidence?
4. What types of imagery are associated with confidence in team sport players of differing skill levels?

CHAPTER 2

THE INTERACTIVE EFFECTS OF KINAESTHETIC IMAGERY WITH DIFFERENT VISUAL IMAGERY PERSPECTIVES UPON THE PERFORMANCE OF A GYMNASTICS ROUTINE[1]

Abstract

The purpose of the present study was to examine the effect of different imagery perspectives, on form of movement, of a gymnastics routine. Forty participants were randomly assigned to one of the following four treatment groups: external visual imagery and kinaesthetic imagery; external visual imagery only; internal visual imagery and kinaesthetic imagery; and internal visual imagery only. The results showed a significant main effect for visual imagery perspectives upon the acquisition of the skill. Analysis of the retention data revealed a significant interaction between visual imagery perspectives and kinaesthetic imagery during the retention of the task. However, follow up tests failed to find a significant difference between groups. These results are discussed in relation to information processing, social learning, and neuropsychological theories. The implications for applied work are also highlighted.

[1] This research was presented at the British Association of Sport and Exercise Sciences conference in 1996 and forms part of the paper: Hardy, L. & Callow, N. (1999). Efficacy of external and internal visual imagery perspectives for the enhancement of performance on tasks in which form is important. *Journal of Sport & Exercise Psychology*, 21, 95-112.

Introduction

The findings of previous research investigating the effects of different imagery perspectives on motor performance and learning have been somewhat equivocal. For example, Mahoney and Avener (1977) reported that gymnasts who were successful in qualifying for the US Olympic team used internal imagery more than gymnasts who were unsuccessful. However, Meyers, Cooke, Cullen, and Liles (1979) found no significant differences in imagery usage between more and less successful racquetball players. Furthermore, Ungerleider and Golding (1991) suggested that successful, US track and field Seoul Olympic trialists use external imagery more than internal imagery, and had stronger physical sensations accompanying their imagery than their non-successful trialist colleagues.

One possible explanation for some of these equivocal findings is that researchers have confounded internal visual imagery with kinaesthetic imagery in the definitions that they have provided for athletes (Hardy, 1997; White & Hardy, 1995). Mahoney and Avener (1977) described internal imagery as "requiring an approximation of the real life phenomenology such that the person actually images being inside his/her body and experiencing those sensations which might be expected in the actual situation". In line with this, Mahoney and Avener (1977) appeared to assess gymnasts' use of internal imagery by asking them whether they experienced what the image would feel like in their muscles. As White and Hardy (1995) have indicated, such a question clearly assesses the kinaesthetic, rather than the internal visual, component of the performer's image. It is possible, therefore, to view Ungerleider and Golding's (1991) findings as a confirmation of the importance of kinaesthetic imagery, rather than a contradiction of the superiority of internal visual imagery.

A second possible explanation of some of the differences reported above is that certain types of imagery are more effective for some tasks than others. Meyers, et al. (1979), and Highlen and Bennett (1979) examined the imagery use of participants in racquetball and wrestling, both of which sports rely heavily on open skills. However, Mahoney and Avener (1977) examined imagery use in gymnastics, a sport which relies almost exclusively on closed skills. Furthermore, Highlen and Bennett (1979) argued that it may be easier to use imagery in closed skills because performers can image in their own time and without the external distraction of an opponent. Consequently, the absence of imagery differences reported by Meyers et al. (1979), and Highlen and Bennett (1979), could be due to task differences. Similar arguments that certain types of imagery may be more effective for some tasks than others were presented by Paivio (1985) and, more recently, empirical research by Hall and associates has shown that athletes from different sports use imagery in different ways (e.g., Hall, Mack, Paivio, & Hausenblas, 1998; Munroe, Hall, Simms, & Weinberg, 1998).

White and Hardy (1995) took the task difference argument presented above a stage further. They proposed that external visual imagery would have superior effects on the acquisition and performance of skills which depended heavily on form for their successful execution, but internal visual imagery would be superior for the acquisition and performance of open skills which depend heavily on perception for their successful execution. A theoretical explanation of these predictions was offered by Hardy (1997): Imagery should exert a beneficial effect upon the acquisition and performance of a motor skill only to the extent that the images generated supplement the useful information that would otherwise be available to the performer. Thus, in tasks which depend upon form for their successful execution, external visual imagery may enable the performer to "see" the precise positions and movements that are required for successful performance. This information may not normally be available to the performer and would not normally be provided by an internal visual image of the movements (imagine the internal visual field of a gymnast performing a handstand or a cartwheel). Consequently, external visual imagery provides additional information which is beneficial to performance on such tasks.

Conversely, in open skills which depend heavily on perception for their successful execution, internal visual imagery allows the performer to mentally rehearse the precise spatial locations, environmental conditions, and timings at which key movements must be initiated (imagine canoe slalom or a tackle at football). In this sort of task, the actual movements are typically not as complex and do not depend upon technical form to such a great extent, so that external visual imagery may provide less useful information. Hardy (1997) also argued that kinaesthetic imagery should enhance performance over and above gains from either visual imagery perspective because it should enable the performer to match the timing and feel of movements to the visual images used (cf. Jeannerod, 1994).

White and Hardy (1995) examined the use of internal and external visual imagery in the acquisition of two skills, one depending heavily upon form for successful completion, and the other depending more upon perceptual information. In the first task, participants were required to learn and precisely replicate a sequence of arm and club positions using rhythmic gymnastics clubs. External visual imagery proved superior to internal visual imagery in both acquisition and retention trials on this task. In the second task, the same participants were required to negotiate a series of obstacles resembling a canoe slalom course, but on dry land in a wheelchair. On this task, the results were not quite so clear. After initial practice on the acquisition course, participants who used internal visual imagery made significantly fewer mistakes on a transfer trial round a new course than participants who used external visual imagery. However, participants who used external visual imagery performed significantly faster than participants using internal visual imagery on both the acquisition and transfer trials. White and Hardy (1995) suggested that this speed-accuracy trade off might have been due to external visual imagery enhancing the competitive drive of the participants. White and Hardy (1995) did not manipulate kinaesthetic imagery, but did assess its use via a post-experimental questionnaire. There was no significant difference in the extent to which participants reported using kinaesthetic images, regardless of the visual imagery perspective used. It is intuitively appealing to suggest that combining kinaesthetic imagery with the appropriate visual imagery perspective may maximally enhance the efficacy of the imagery. However, this area has not been empirically examined. Empirically, it is important to determine if combining a visual imagery perspective with kinaesthetic imagery does in fact have a more beneficial influence on performance than just a visual imagery perspective. Furthermore, the appropriate combination of visual imagery perspective and kinaesthetic imagery needs to be established in relation to the task (or type of performance) that the imagery is targeting. Therefore, the purpose of the present study was to examine the following two hypotheses.

1. External visual imagery will enhance the performance of a gymnastics task, which requires the form of movement, to a greater extent than internal visual imagery.

2. The combination of external visual imagery and kinaesthetic imagery will enhance performance to a greater extent, than the combination of internal visual imagery and kinaesthetic imagery.

Method

Participants

Participants were recruited from students in the first year of the Sport, Health, and Physical Education degree course at the University of Wales, Bangor. Seventy-six students on the Elite Performers module of the degree course received a three hour imagery training workshop. At the end of the workshop participants completed the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986, see Appendix A for questionnaire) and the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983, see Appendix B for questionnaire). The MIQ has a test-retest reliability of .83 (Hall, Pongrac, & Buckolz, 1985) and the VMIQ a test-retest reliability of .76 (Atienza, Balaguer, & Garcia-Merita, 1994) with acceptable convergent validity Isaac et al. (1986). The MIQ has good internal consistency, .83 for the visual subscale and .91 for the kinaesthetic subscale on the MIQ (Atienza et al., 1994). Both questionnaires take the form of a likert scale. The VMIQ measures imagery ability on a 5 point Likert scale, anchored by 1 (*perfectly clear images*) to 5 (*no images at all*); while the MIQ measures imagery ability on a 7 point Likert scale, anchored by 1 (*very easy to picture/feel*) to 7 (*very hard to picture/feel*). To ensure that participants could image proficiently, only those participants who gained a score of 144 and below on the VMIQ (that is they found their images to be at least *moderately clear and vivid*) and 72 or below on the MIQ (that is they found their images at least *not too hard or easy to picture/feel*) were recruited on to the study on a voluntary basis. Participants could gain course credit for performing the experiment if they wished. A total of 40 participants (20 males and 20 females) were recruited for the experimental phase of the study. Their ages ranged from 18 to 35 years (age $M = 22.08$, $SD = 3.74$ years).

Experimental Task

Participants were asked to complete a basic gymnastics sequence. The sequence consisted of the following elements, with novel positioning of the arms for the lunge and arabesque elements.

1. Standing position: With bent arms in front of the body, body upright, heels together, feet at the "ten to two" position, step forward with the left leg into a lunge.
2. Lunge: With right leg back straight; body upright; right arm horizontal in front of the body, palm facing downwards and left arm held out at 45° in front of the body palm facing down, move into an arabesque.
3. Arabesque: Stand on right leg, left leg behind, horizontal and straight, toes pointed. Circle right arm back until straight behind the body. Holding left arm horizontal and straight in front of the body move into a headstand.
4. Headstand: From a tucked position, straight legs. After holding return to tuck and return to standing.
5. Standing position: Stand with bent arms, body upright, heels together, feet at "ten to two". Participants were told that the form of the elements would be judged and that they should therefore reproduce the form as accurately as they could.

Scoring

Participants were scored according to a form analysis, on each element, by two trained gymnastics judges. The judges had not taken part in the workshop nor the experiment and were also blind to the experimental group of the participants. Judging was according to the Federation International de Gymnastique (FIG) Code of Points. Judges analyzed the first trial in each of the six blocks. A total of 10 marks were available for the sequence. Nine marks were given for the analysis of the five elements, and one mark was given for overall impression. Marks were deducted for errors in form. A 0.05 deduction was made for a minor error (e.g., small misalignment of limb during an element) .10 for clear errors (e.g., incorrect alignment of limb during an element), and .30 for serious errors, (e.g., missing part of an element). The mean of the two judges' scores was used as an overall performance score. Interjudge reliability, over the six blocks of trials showed adequate to good reliability $r = .59$ ($SD = .06$).

Design and Procedure

Participants were randomly assigned to one of the following four treatment groups: External visual imagery with kinaesthetic imagery (EVI/KIN); External visual imagery only (EVI); Internal visual imagery with kinaesthetic imagery (IVI/KIN); Internal visual imagery only (IVI). Participants were shown a video recording of a gymnast completing the gymnastics sequence, either from an internal or external visual imagery perspective. To construct the video, for the internal visual perspective, a video camera was placed on a gymnast's shoulder, with the camera lens level with the gymnast's eyes, while she was performing the routine. The external visual perspective video was constructed by placing the camera 7 meters away from the gymnast, the gymnast was filmed while doing the routine.

All participants initially saw one video replay of the gymnast performing the routine from an external perspective in order to give them the general form of the routine. Those in the external visual perspective groups then viewed the video shot from an external visual perspective another three times. Those in the internal visual perspective treatment groups viewed the video shot from an internal visual perspective a further three times. In addition to the video, imagery scripts were read to the participants prior to the start of both the acquisition and the retention parts of the study. The imagery scripts corresponded with the treatment groups that participants were in; that is, the scripts were written from either an external or an internal visual perspective, and either with or without kinaesthetic imagery. In line with Lang, Kozak, Miller, Levin, and McLeans' (1980) recommendations, the scripts were weighted with response, rather than stimulus propositions; that is to say, emphasis was placed on the physiological, emotional, and movement concomitants of images, not simply a description of the situation that participants were asked to image. Lang, et al. (1980) indicate that imagery scripts weighted with response propositions are more likely to produce vivid images than those weighted with stimulus propositions, consequently the scripts were written in accordance with this recommendation (see Appendix C for imagery scripts).

Participants were tested individually in the experimental phase. This itself had two phases, an acquisition phase and a retention phase. For the acquisition phase, participants performed six blocks of three trials with a 2 minute rest interval between each block. During the rest interval they were asked not to use imagery. Following each interval and immediately prior to each trial, participants were asked to image the task once, in accordance with the experimental condition to which they had been assigned. No time constraints were placed on completing the task. After the final trial of each block, feedback was given to participants in the form of a performance score by the two gymnastic judges. After completing the acquisition phase of the experiment participants were asked to fill in a post-experimental questionnaire. This questionnaire examined: the extent of adherence to and perceived suitability of the imagery perspective for the gymnastics task; the experience of kinaesthetic feelings during imagery; the use of other strategies to aid performance; feelings of self-confidence in relation to completion of the task with good form. Each item, except the uses of other strategies, was scored on a Likert scale with 1 being the lowest score (*not at all*) and 10 being the highest (*greatly*), see Appendix D for questionnaire. Four weeks after learning the sequence, the participants returned to complete the retention phase. This consisted of one further block of three trials of the sequence.

Results

Six participants whose performance data showed evidence of ceiling effects (defined as a starting score of 9.2 or above with an improvement of 0.2 or less during the remainder of the 18 acquisition trials) were removed from the data set. This resulted in the main analyses being performed on the remaining 34 participants. A three factor (visual imagery perspective x kinaesthetic imagery x block) analysis of variance, with repeated measures on the block factor, was used to analyze the acquisition data. A three factor (visual imagery perspective x kinaesthetic imagery x trial) analysis of variance, with repeated measures on the trial factor, was used to analyze the retention data of 33 participants. One participant was unable to perform the retention test. The Box M test for homogeneity of dispersion matrices was significant for both the acquisition and retention phase. Data transformations, including $\log_e x$, $\log_e x^2$, $1/x$, $1/(10\text{-}x)$, $\log_{10} x$, and $\log_{10} x^2$, failed to rectify this problem. However, Stevens (1996) states that if the Box M test is significant with approximately equal numbers of participants in each group, Type 1 error rate will only be slightly affected, whilst power will be weakened. Thus, it is relatively safe to interpret highly significant effects because they have been robust enough to appear despite the low power of the tests performed. Consequently, the results from the three factor analysis of variance on the *raw* data are reported here.

Acquisition Data

The three factor analysis of variance showed a significant main effect for visual imagery perspective, $F(1, 30) = 8.03, p < .01, \eta^2 = .21$. Examination of the cell means showed that this was due to external visual imagery being superior to internal visual imagery. (See Table 1 for descriptive statistics.)

BLOCK	EVI+KIN	EVI	IVI+KIN	IVI
1	8.25	8.08	6.84	7.90
	(0.78)	(0.86)	(1.05)	(0.84)
2	8.55	8.44	7.60	8.13
	(0.35)	(037)	(1.11)	(0.87)
3	8.70	8.58	7.56	8.38
	(0.18)	(0.51)	(1.28)	(0.67)
4	8.84	8.68	7.59	8.30
	(0.20)	(0.41)	(1.42)	(0.73)
5	8.85	8.60	7.69	8.41
	(0.30)	(0.51)	(1.37)	(0.73)
6	8.89	8.45	7.77	8.45
	(0.31)	(0.69)	(1.10)	(0.69)
Mean	8.68	8.47	7.51	8.26
	(0.35)	(0.56)	(1.23)	(1.23)

Table 1. Mean and standard deviation performance scores for the acquisition phase.

There was also a significant main effect for block, $F(5, 150) = 12.04, p < .001, \eta^2 = .29$. Follow up Tukey's tests showed a significant increase in performance between blocks one and two. However, subsequent increases in performance were not significant. No other effects were significant.

Retention Data

The three factor analysis of variance with repeated measures on trial showed no significant main effects for either visual imagery perspective or kinaesthetic imagery. The interaction between visual imagery perspectives and kinaesthetic imagery was significant $F(1, 29) = 4.37, p < .05, \eta^2 = .13$. However, despite the fact that the external visual imagery plus kinaesthetic imagery group performed better than the internal visual imagery plus kinaesthetic imagery group, Tukey's tests failed to find any significant differences between the groups. There were no significant main effects or interactions involving trial. See Table 2 for descriptive statistics.

TRIAL	EVI+KIN	EVI	IVI+KIN	IVI
1	8.50	7.75	7.55	8.14
	(0.77)	(0.84)	(1.20)	(0.88)
2	8.58	7.71	7.92	8.52
	(0.71)	(0.93)	(1.08)	(0.84)
3	8.56	8.28	7.89	8.40
	(0.72)	(0.71)	(1.00)	(0.96)
Mean	8.50	7.91	7.79	8.30
	(0.73)	(0.83)	(1.09)	(0.89)

Table 2. Mean and standard deviation performance scores for the retention phase.

Post-experimental data

The post-experimental questionnaire data indicated that participants were generally able to adhere to the imagery treatments prescribed (mean score = 6.8, *SD* = 1.4). Two factor (visual imagery perspective x kinaesthetic imagery) analysis of variance revealed significant main effects for kinaesthetic imagery with regard to how appropriate participants felt their imagery treatment was for the task $F(1, 30) = 8.01$, $p < .01$, $\eta^2 = .20$, and how confident they were of performing the task with good form, $F(1, 30) = 7.03$, $p < .05$, $\eta^2 = .19$). Inspection of the cell means indicated that these main effects were because participants who performed kinaesthetic imagery felt their imagery treatment was both more appropriate for the task, and gave them greater confidence to perform the task with good form.

Discussion

The results for the acquisition data clearly offer further support for the first hypothesis that external visual imagery is superior to internal visual imagery on form based tasks. The findings for the retention data are rather less clear. Participants who learnt the gymnastics sequence using external visual imagery continued to perform better than participants who learnt the sequence using internal visual imagery, but this difference was no longer significant. Furthermore, although the significant interaction which was obtained could be taken as offering support for the combined use of external visual imagery with kinaesthetic imagery, Tukey's follow-up tests failed to confirm this interpretation. Consequently, in light of Stevens' (1996) recommendations and the very modest size of this effect, the interaction could be due to a Type 1 error.

The enhanced performance scores for the external visual imagery groups support White and Hardy's (1995) findings and contention that external visual imagery may provide a model for performance. In accordance with the social cognitive perspective, information extracted from such a model may be transformed into symbolic codes to be stored for some template of action, and mental rehearsal of the model may enhance such memory representations (Carroll & Bandura, 1985). Thus, following the observation of a model, external visual imagery should provide the learner with the opportunity to visually rehearse the key visual parameters extracted from the model and plan appropriate motor responses. Therefore, it is reasonable to expect that external visual imagery will be superior to internal visual imagery, during the acquisition of a form based task because external visual imagery provides additional information about the movement, which may not available to the learner during physical practice or via internal visual imagery (cf. Hardy, 1997). Consequently, from an applied perspective, performers, coaches, and sport psychologists must match the appropriate imagery perspective to the task, so that the imagery perspective will maximally enhance the performance of the task.

Kinaesthetic imagery did not have a significant effect on the form of movement during the acquisition period. However, the mean performance scores show that external visual imagery/kinaesthetic imagery group had the highest performance score, whereas the internal visual imagery/kinaesthetic imagery group had the lowest performance scores. The absence of any significant effect for kinaesthetic imagery upon performance was rather surprising, particularly in light of the fact that participants reported that they found imagery involving kinaesthetic imagery to be more appropriate than imagery which did not involve it, and also that they felt more confident when they used this perspective. It is possible that this apparent paradox is due to the relative inexperience of the participants on the task. Cognitive theories of learning generally argue that performers rely largely upon visual and verbal cues during the early stages of learning (Fitts, 1964), and only make use of kinaesthetic cues later in learning (Fleishman & Rich, 1963). The participants in this experiment were either Sports Science, or Sport, Health, and Physical Education students. Consequently, it is entirely plausible that they recognized the potential value of using kinaesthetic imagery, but were unable to make effective use of it on the criterion task because of a lack of familiarity with the task.

The divergent mean performance scores (external visual imagery/Kin group with the highest performance score and internal visual imagery/Kin with the lowest performance scores) did result in a significant interaction during the retention period, which *suggests* that kinaesthetic imagery may be more effective when used in conjunction with external visual imagery than with internal visual imagery. This finding ought not to be at all controversial. Unfortunately, some researchers continue to suggest that the notion of combining external visual imagery with kinaesthetic imagery reflects confused conceptualization (Collins & Hale, 1997).

From a theoretical perspective, Hardy's (1997) proposed explanation of the above effects based on the additional information provided by imagery offers one means of understanding them. This explanation links to the motor control and learning literature in a number of ways. First, Whiting and den Brinker's (1981) notion of the image of the act and the image of achievement may provide an explanation of how the additional information, provided by kinaesthetic imagery might be used by performers. Image of the act refers to the performer's understanding of the general shape or form of the movement; while image of achievement refers to a template of the precise muscular forces, that need to be produced, in order to perform the movement accurately. Thus, with criterion tasks which require form for their successful completion external visual imagery could provide the participant with information about the gross movement patterns of the gymnastic sequence (image of the act); and when the performer becomes skilled, kinaesthetic imagery could provide information about muscular forces required to produce these movements (image of achievement). Consequently, the addition of kinaesthetic imagery to external visual imagery, could enable performers to operationalize the image of an act into an image of achievement. However, internal visual imagery may not have assisted performers to create an appropriate image of the act, because it excluded such information as, for example, leg positioning, due to this not being in the field of view for the internal visual imagery. Thus, participants in this group may not have been able to operationalize the image of the act into an appropriate image of achievement using kinaesthetic imagery, or the image of achievement created may have been an adequate translation of an inappropriate image of the act. As a consequent of these two possiblilties, a lower performance score for internal visual imagery/kinaesthetic imagery was produced in comparison to both external visual imagery/kinaesthetic imagery and internal visual imagery groups. Similar arguments could, of course, be presented regarding the use of internal visual imagery in criterion tasks which are essentially "open" in nature.

A related notion has been proposed by Jeannerod (1994), who reviewed evidence which suggested that visual images and motor (kinaesthetic) images are encoded in the brain using different neural networks, and that these neural pathways are activated by imagery in the same way as they are activated when actually performing the imagined act. Indeed, Williams, Rippon, Stone, and Annett (1995) using EEG Brain Electrical Activity Mapping (BEAM), found involvement of both motor systems and visuospatial mechanisms, at specific locations of the cortex, during visual and movement imagery. Thus, it could be that the addition of kinaesthetic imagery to external visual imagery provides a more vivid image than when it is added to internal visual imagery because it provides the closest functional equivalent to the task, with the same neural correlates being activated as would be activated if one were actually performing the task. In fact, the only difference between the imagery process and actually performing the task may be that the coupling of the imagery process to a (lower level) motor system is removed or reduced (Heuer, 1989). However, the latter comment should be viewed with caution as EEG does not take into account the subcortical and spinal systems which are involved in the motor system (Brooks, 1986). In summary, the combination of visual and motor imagery would be expected to be maximally effective for enhancing performance because it would activate both neural pathways. Having said this, it should perhaps be noted that Jeannerod (1994) uses Mahoney and Avener's (1977) original definition of internal imagery which confounds internal visual imagery with kinaesthetic imagery. Nevertheless, Jeannerod (1994) argues that what he calls motor imagery is *largely* kinaesthetic.

The finding from the post-experimental questionnaire that participants who used kinaesthetic imagery felt more confident about their ability to perform the task with good form is interesting. Other research on the motivational function of imagery has generally examined the *content* of imagery to identify what sorts of image are related to self-confidence (e.g., Moritz, Hall, Martin, & Vadocz, 1996). The present finding suggests that the use of kinaesthetic imagery may also influence self-confidence, but does not offer any evidence in support of the notion that internal visual images enhance self-confidence more than external visual images because the performer can identify more closely with the image (cf., Bandura, 1986; Hardy, 1997).

There appear a number of applied implications arising from the present findings. First, consideration of task differences may be more important than has previously been realized when making recommendations regarding the most effective form of imagery to use for performance enhancement purposes. Second, performers are able to utilize kinaesthetic imagery with external visual imagery. Third, the combination of external visual imagery with kinaesthetic imagery appears to be particularly effective for tasks which depend on form for their successful execution. Fourth, it may be that this recommendation does not generalize to performers who have a strong preference for internal visual imagery, since all participants in the present studies were skilled at using both internal and external visual perspectives. Fifth, sometimes a single task may combine a requirement for form with a perceptual requirement to respond to changes in the environment at different moments in time. For example, a double straight back somersault in gymnastics has an obvious requirement for form whilst taking off and rotating, but adjustments to perceptual information about environmental changes may be the dominant factor in landing (Lee, Young, & Rewt, 1992). This may require performers to switch between imagery perspectives when rehearsing such moves (cf., Jowdy, Murphy, & Durtschi, 1989; Orlick & Partington, 1988; White & Hardy, 1998). Finally, the possible role of kinaesthetic imagery in the enhancement of self-confidence is worthy of consideration by applied sport psychologists, as well as further investigation by research sport psychologists.

A number of limitations, and at least one strength can be identified with the present study. Perhaps the most obvious limitation is the small sample size that was used. The main reason for this was the rather labour intensive nature of the learning paradigm employed. However, the effect size was moderate in magnitude. A second limitation of the experiment was that it used subjective judging scores as the dependent variable. Perhaps there is a certain inevitability about this when examining performance on sports tasks that depend heavily upon form for their successful completion. However, the use of kinematic motion analysis to objectively calculate limb positions and movements would be an obvious possibility for future researchers in this area to consider. Finally, the use of post experiment interviews and questionnaires to perform manipulation checks and thereby gain greater experimental control was recommended by Murphy (1990). In the present study, data from six participants were excluded from both the acquisition and retention analyses. These exclusions were made because participants showed ceiling effects during the early stages of learning the gymnastics routine. In the authors' opinions, this constitutes a strength of the designs used.

In conclusion, the experiment suggests that external visual imagery enhances the performance of a task (that requires form of movement) to a greater extent than internal visual imagery. Also, there is some evidence, here, to suggest that kinaesthetic imagery (in conjunction with external visual imagery) may enhance the performance of a task with individuals who have experience of that task. Future research should focus on the effectiveness of the combination of external visual imagery and kinaesthetic imagery with performers who have knowledge of a task in comparison to those who do not. Furthermore, ecologically valid research should be used to explore the influence of different visual perspectives and kinaesthetic imagery on tasks that have a perceptual requirement to respond to changes in the environment at different moments in time (that is "open" skills).

CHAPTER 3

THE RELATIONSHIP BETWEEN KINAESTHETIC IMAGERY AND DIFFERENT VISUAL IMAGERY PERSPECTIVES[2]

Abstract

Two studies (studies 2 and 3 of the present thesis) examined the strength of relationship between internal and external visual imagery with kinaesthetic imagery. In study 2, 56 participants completed the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) and the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983). Pearson's product-moment correlations, failed to find significant correlations between either internal visual imagery and kinaesthetic imagery, or external visual imagery and kinaesthetic imagery. In study 3, the instructional set of the VMIQ was changed to make *the participant* the "object" of the external visual perspective images rather than *somebody else*. Sixty-four participants completed the 2 questionnaires. Results indicated a significant correlation between external visual imagery and kinaesthetic imagery, $r = .60$ $p < .001$, but not between internal visual imagery and kinaesthetic imagery. The results are discussed in relation to: who is the object of the image; the processes that may underlie kinaesthetic imagery, and the appropriateness of imagery exercises for sport performers.

[2] This chapter is in preparation as a paper: Callow, N. & Hardy, L. (in preparation). The relationship between kinaesthetic imagery and different visual imagery perspectives. *British Journal of Psychology*.

Introduction

Recent research evidence (e.g., Hardy & Callow, 1999; White & Hardy, 1995) and academic discussion (e.g., Hall, 1997; Hardy, 1997) suggests that the advocacy of internal visual imagery over external visual imagery (to enhance performance) may be a myth. Despite this, some researchers still advise the use of the internal perspective over the external perspective for performance benefits. For example, Hale (1998) states

> Using an internal perspective, the image would be much more vivid *than an external perspective* [*italics added*]. Not only would you see everything happen...you would also feel your hands on the club,... your body rotate and the solid contact on impact as you swing. (p.6)

The reasoning behind Hale's advice does make intuitive sense. Suinn (1984) suggests that multimodal imagery (imagery involving all the sensory modalities) can provide a holistic retrieval of the experience which is being imaged - that is, a vivid image. Vivid imagery has been associated with higher performance acquisition (e.g., Goss, Hall, Buckolz, & Fishbourne, 1986). Thus, the combination of a visual perspective with another sensory modality (e.g., kinaesthetic imagery) may have a more beneficial effect on performance, because the use of two modalities can provide a more vivid image than using just one modality.

In relation to the use of two imagery modalities, researchers have proposed that internal visual imagery should be used with kinaesthetic imagery rather than external visual imagery because "internal imagery can lead to more emotional involvement than *external imagery* [*italics added*] and an increased ability to rehearse kinaesthetically" (Jowdy, Murphy, & Durtschi, 1989, p. 14). However, the assumption that internal imagery can lead to a greater ability to use kinaesthetic imagery is based upon implied evidence rather than a demonstrated causal relationship between internal visual imagery and kinaesthetic imagery.

The advocacy of internal visual imagery over external visual imagery (because of its supposed greater association with kinaesthetic sensations/imagery) originates from research examining the neuromuscular basis of imagery. Hale (1982) measured EMG activity in weight lifters, while they imaged lifting a dumbbell from an internal or an external perspective. A main effect for perspective was found with the mean data indicating internal imagery produced greater EMG activity than external imagery. Harris and Robinson (1986) measured EMG activity in karatika students whilst they imaged internally and externally doing five right lateral armed raises. Internal imagery produced the highest local muscular efference in the right deltiod.

The imagery instructions from these two studies included two perspectives: internal, directing the participant to experience feelings and sensations associated with executing the task; and external, directing the participant to see him/herself executing the task. The instruction provided for the internal perspective does, in fact, confound internal visual imagery with kinaesthetic imagery (c.f. Hardy, 1997; Hardy & Callow, 1999; White & Hardy, 1995), this is because the internal instructions do not actually refer to visual information but to kinaesthetic information. It is therefore understandable that internal imagery produced muscular responses whereas external imagery did not, because the external instructions did not ask participants to experience the feelings and sensations associated with executing the task. If the participant was asked to use external visual imagery and to experience the feelings and sensations associated with executing the task simultaneously, then the external perspectives may also have produced physiological responses. Additionally, empirical evidence has recently questioned the findings of EMG activity during imagery. Thill, Bryche, Poumarat, and Rigoulet (1997) measured EMG activity in the biceps of male physical education students while they imaged themselves doing a bicep curl (visual perspective was not defined). These researchers also used a force sensor and an oscilloscope to detect if any mechanical action occurred (despite the mechanical action being prohibited) during imagery. Interestingly, when mechanical action occurred EMG activity was present; however, when mechanical action did not occur EMG activity was not present. This study not only brings into question the findings of imagery research based on EMG activity, but the validity of the psychoneuromuscular hypothesis. Proponents of the psychoneuromuscular hypothesis (e.g., Corbin, 1972; Richardson, 1967; Schmidt, 1987) suggest that imagery causes innervations of the muscles involved in the skill being imagined, and that this innervation provides feedback which can strengthen or adjust existing motor programs. However, the research by Thrill and associates suggests these innervations might correspond to actual muscular contraction rather than to imagery.

Contrary to the assumption that internal imagery should only be used with kinaesthetic imagery, White & Hardy (1995) indicated that kinaesthetic imagery can be used with both visual perspectives. Lang's (1988) bio-informational theory offers an explanation of this finding. Bio-informational theory assumes an image to be a propositional structure which contains three classes of coded information: stimulus propositions (e.g., physical details of an object e.g., what it looks like), response propositions (e.g., muscle tension), and meaning propositions (e.g., the interpretation of the image). The theory assumes propositions are not stored in isolation, but are organised as coded conceptual links in a network. Thus, the retrieval of a stimulus proposition may, for example, prompt the retrieval of a response proposition or a meaning proposition. Because of the possible coded links between propositions, the present authors argue that it would be difficult (but not impossible) to separate visual images of movement (stimulus propositions) from kinaesthetic images (response propositions) irrespective of visual perspective, especially as response propositions can be doubly encoded at a "deeper" level to include a motor program (Lang, 1979, p. 501).

Some researchers seem to have difficulty with the notion of performers using kinaesthetic imagery with external visual imagery. For example, Collins and Hale (1997) state "the use of terms such as *external kinaesthetic* imagery (cf. White & Hardy, 1995) is a confound of Mahoney and Avener's (1977) original operational definition of internal and external imagery." (p. 209). However, White and Hardy do *not* refer to external kinaesthetic imagery, they refer to the use of external visual imagery with kinaesthetic imagery. That is, visualizing yourself from a third person perspective and imaging what it feels like for you to do the movements; or visualizing somebody else from a third person perspective and what it feels like for you to do the moves. For example, imaging somebody from behind doing a parallel turn whilst skiing (external visual imagery) and *you* feeling the contraction of *your* hamstrings (kinaesthetic imagery) as they do the turn. Kinaesthetic imagery and external imagery would not, in the case of the previous example, be imaging what it feels like for the person in your image to contract their legs.

The question of whether one visual perspective is easier to use with kinaesthetic imagery than the other has both theoretical and applied implications. Theoretically, an answer to this question may provide clues as to the nature of kinaesthetic imagery. Kinaesthetic imagery, within sport psychology research, is still loosely defined as the feel of the movement (e.g., Kim, Singer, & Tennant, 1998). In a discipline where movement is the most common medium, it is surprising that a detailed understanding of the processes and mechanics underlying kinaesthetic imagery is not known. If internal visual imagery or external visual imagery had a greater association with kinaesthetic imagery, this may indicate that specific visual and/or spatial information (gained from the respective visual image) is needed to help to create kinaesthetic imagery. Indeed, Smyth and Waller (1998) contend that Jeannerod's (1994) emphasis on motor imagery, as the generator of forces and effort, may obscure spatial and visual components that are possibly required when imaging action. From an applied perspective, if it can be established that a particular visual perspective has greater association with kinaesthetic imagery then using this particular combination may be more effective for performers than the other.

A possible way to examine whether one visual perspective is more highly associated with kinaesthetic imagery than the other, would be to measure the strength of the relationship between a performer's ability to image both internal visual imagery and external visual imagery with kinaesthetic imagery. If, for example, a stronger positive relationship was found between internal visual imagery and kinaesthetic imagery than between external visual imagery and kinaesthetic imagery, then this may suggest that a higher number of common processes exist between the internal visual perspective and kinaesthetic imagery than the external visual perspective and kinaesthetic imagery.

Within the motor domain the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983) and the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986), are the most commonly used self-report measures of imagery ability (Hall, 1998). The MIQ measures vividness of *visual imagery* (external or internal is not specified) and *kinaesthetic imagery.* The VMIQ measures the vividness of movement imagery from an external visual *watching somebody else* and internal (visual) *doing it yourself* perspective. Thus, if performers were able to image kinaesthetic imagery more easily with internal (visual) imagery than external visual imagery, then their scores for internal (visual) imagery on the VMIQ should correlate more strongly with kinaesthetic imagery on the MIQ than the external visual imagery on the VMIQ.

Therefore, the purpose of the present study was to examine if there are any differences between the correlation of the internal visual imagery scores on the VMIQ and kinaesthetic imagery scores on the MIQ and the correlation between external visual imagery scores on the VMIQ and kinaesthetic imagery scores on the MIQ.

Study 2

Method

Participants

Participants were recruited from School of Sport, Health, and Exercise Sciences at the University of Wales, Bangor. A total of 56 participants were recruited (28 females and 28 males). Their ages ranged from 19-35 years (age $M = 22.8$, $SD = 3.2$ years). All participants had received a three hour imagery training workshop, as part of a module of their degree course, and were recruited at the end of the workshop for the study.

Measures

Participants' imagery ability was measured using the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983) and the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986). The MIQ is comprised of 18 items, 9 related to visual and 9 related to kinaesthetic imagery. The scoring procedure for the questionnaire is summative, with the items for the visual and kinaesthetic scales being added to give an imagery ability score for the respective scales. Participants are required to perform the move to be imaged first, then image it, either visually or kinaesthetically, and then to rate the ease/difficulty with which they imagined the movement on a seven point Likert scale, ranging from 1 (*very easy to picture/feel*) to 7 (*very hard to picture/feel*). An example item follows:

> Make a fist with your dominant hand (the hand you write with) and then place this hand on the same shoulder (e.g., right hand on right shoulder) such that your elbow is pointing directly in front of you. Extend your elbow so that your hand that was on your shoulder is straight in front of you parallel to the floor. Keep your hand in a fist. Make this movement slowly.

Hall, Pongrac, and Buckolz, (1985) report adequate psychometric properties for the questionnaire. They found the questionnaire to have a test-retest reliability of $r = .83$ for a 1 week interval and good internal consistency ($r = .87$ for the visual scale and r

= .91 for the kinaesthetic scale). Atienza, Balaquer, and Garcia-Merita (1994) reported similar internal consistencies ($r = .89$ for the visual scale and $r = .88$ for the kinaesthetic scale). These authors also provide support for the bifactorial structure of the questionnaire.

The VMIQ contains 24 items relevant to general movement imagery (e.g., jumping sidewards). The items are divided into six categories of four items. Participants are asked to image each of the 24 items twice, from two perspectives. That is, *watching somebody else* (external visual imagery) and *doing it yourself* (internal visual imagery). Once the participants have imaged each item they are asked to rate the vividness of the image using a five point Likert scale. The scale ranges from 1 (*perfectly clear image*) to 5 (*no image at all*). The scoring procedure for the questionnaire is summative, with the 24 items being added to give a score for the internal, doing it yourself, and external, watching somebody else, perspective. A lower score indicates greater vividness. The reliability of the questionnaire using the test-retest method (over a 3 week period) has been found to be acceptable $r = .76$ (Isaac et al., 1986). The validity of the questionnaire was established by using Pearson's product-moment correlation, a correlation of $r = .81$ was found between the VMIQ and the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973).

Design and Procedure

Once the participants had completed the three hour imagery workshop they completed the two imagery questionnaires. To control for any sequencing effects the order of administration of the questionnaires was counterbalanced; that is, half the sample received the MIQ first and half received the VMIQ first. Participants completed the questionnaires in groups of between 10-15 in a large enclosed room away from any distractions. Gymnastics mats were provided so that participants could perform some of the moves specified in the MIQ (e.g., a forward roll). Participants were not allowed to confer with each other.

Results

Three sets of statistical analysis were performed on the data. Firstly, the reliability of the questionnaires was explored by calculating Cronbach's alpha for each of the scales. Secondly, to assess any differences in imagery ability between males and females, means and standard deviations were calculated for each of the questionnaires scales and totals. Independent t-tests with Bonferonni correction (Stevens 1996) were employed to determine any significant differences between means. Thirdly, Pearson's product-moment correlations, were employed to assess the strength of relationship between the scales of the VMIQ and MIQ. Meng, Rosenthal, and Rubin's (1992) equation for correlated coefficients was used to identify differences between the correlations obtained from the different scales.

Reliability Analysis

An alpha coefficient of .70 is the generally accepted standard for internal consistency (Nunnally, 1978). With specific reference to imagery questionnaires, this co-efficient level has been supported by Mckelvie (1994) "as the lowest desirable level" (p. 122). The coefficients for the MIQ visual and kinaesthetic scales were $r = .86$ and $r = .88$ respectively, and for the VMIQ external visual and internal visual scales $r = .88$ and $r = .95$ respectively.

Gender Difference Analysis

Entire sample, and both male and female, mean and standard deviation scores were calculated for the MIQ and VMIQ scales and totals. See tables 3 and 4 for results. Independent sample t-tests with Bonferroni correction to control for Type 1 error (Stevens, 1996) failed to find any significant differences in imagery ability between males and females on any of the MIQ or VMIQ totals and scales. Thus, the data were collapsed across gender for the correlational analysis.

Participants	Kinaesthetic	Visual	MIQ
Males	25.55	23.86	49.41
	(10.71)	(11.81)	(20.67)
Females	25.86	23.74	49.62
	(8.55)	(8.86)	(16.03)
Total sample	25.73	23.79	49.53
	(9.51)	(10.22)	(18.13)

Table 3. Means and (standard deviations) for the Movement Imagery Questionnaire (MIQ) scales and total.

Participants	External visual imagery	Internal visual imagery	VMIQ
Males	56.57	49.29	105.86
	(16.79)	(13.30)	(25.04)
Females	59.50	47.29	106.79
	(17.87)	(18.64)	(24.34)
Total sample	58.04	48.29	106.32
	(17.24)	(16.08)	(24.47)

Table 4. Means and (standard deviations) for the Vividness of Movement Imagery Questionnaire (VMIQ) scales and total.

Correlational Analysis

Two tailed Pearson's product-moment correlations were calculated on the data. When conducting multiple order correlations, an adjustment should be made to the critical *r*. This adjustment is based on the total number of significant tests to be performed and the degrees of freedom. Consequently, in the present study, with four tests, 54 degrees of freedom, and $p < .01$, the adjusted critical *r* for a significant correlation is $r = .44$ (Schutz & Gessaroli, 1993; Shavelson, 1988).

The results of the Pearson's product-moment correlation analysis indicated that the correlation between internal visual imagery and kinaesthetic imagery ($r = .41$) approached, but did not reach, significance at the $p < .01$ level. External visual imagery did not correlate significantly with kinaesthetic imagery ($r = .15$). Interestingly, external visual imagery (as measured by the VMIQ) did not correlate with visual imagery (as measured by the MIQ; $r = .004$) but internal visual imagery did ($r = .56$).

Using Meng et al's (1992) adjusted z scores equation for correlated co-efficients, the correlations of internal visual imagery with kinaesthetic imagery and external visual imagery with kinaesthetic imagery were compared. This analysis revealed no significant difference between these two correlations $z = 1.51, p > .05$.

Discussion

Internal imagery has often been advocated in preference to external visual imagery because the internal perspective is assumed to have a greater association with kinaesthetic sensations/imagery (Jowdy et al., 1989). The present study attempted to explore this assumption by examining the strength of relationship between participants' ability to image internally and externally with their ability to image kinaesthetically by correlating scores on the VMIQ and MIQ questionnaires.

No significant difference was found between the correlations of kinaesthetic imagery and external visual imagery, and kinaesthetic imagery and internal visual imagery. Furthermore, neither of these two correlations was significantly different from zero, which might be taken as evidence suggesting that neither external visual imagery nor internal visual imagery can be rehearsed with kinaesthetic imagery. This conclusion is counter to previous research (White & Hardy, 1995) and theoretical reasoning (Hardy, 1997) which has suggested that kinaesthetic imagery can be rehearsed with either visual perspectives. However, further exploration of the MIQ and the VMIQ does provide a possible explanation for these equivocal findings.

All of the items on the MIQ require the participant to perform movements which depend heavily on "form" of movement for their execution. For example, one of the items from the MIQ requires the participant to image the following movement,

> make a fist with your dominant hand and then place this hand on the same shoulder such that your elbow is pointing directly in front of you. Extend your elbow so that your hand leaves your shoulder and is straight in front of you parallel to the floor. Keep your hand in a fist.

Hardy and Callow (1999) and White and Hardy (1995) have found external visual imagery to be superior to internal visual imagery in the acquisition and performance of skills that depend heavily on form for their successful execution. Hardy (1997) has argued that these effects were obtained because external visual imagery can provide the performer with precise information about the movements and positions required for performance. However, when a participant uses internal visual imagery, the image may not provide information about the desired shapes to be formed "because the required body shapes cannot be seen in such an image, or if they can be seen the image is inadequate" (Hardy, 1997, p. 289). Consequently, there may be little matching of the kinaesthetic image with the internal visual perspective, leading to the lack of correlation between internal visual imagery and kinaesthetic imagery. A theoretical rationale for this reasoning can be made. Lang (1979) proposes that an imagery prototype may be activated as a unit by sensory input which matches that in the propositional network of coded information. However, Lang suggests a critical number of propositions must be matched for the entire conceptual network and associated motor program to be activated. Thus, if the internal visual imagery is not providing sufficient information for the entire conceptual network to be activated, the links to certain response propositions (e.g., kinaesthetic images) may not be activated.

The above line of reasoning may explain why internal visual imagery was not correlated with kinaesthetic imagery, but it does not explain why external visual imagery was not correlated with kinaesthetic imagery. However, further examination of the results may again provide a possible explanation of this finding. Internal visual imagery (from the VMIQ) was found to correlate with visual imagery (from the MIQ), whereas external visual imagery (from the VMIQ) was found not to correlate with visual imagery. The VMIQ asks performers to create images of actions and moves in two ways: firstly, as if they were *actually doing it themselves*, that is, internal visual imagery; and secondly, by watching somebody else carry out the actions and moves that is, external visual imagery of *somebody else*. As internal visual imagery, but not external visual imagery was correlated with visual imagery, it could be that different cognitive processes are involved in visually imaging somebody else as opposed to oneself. Therefore, the reason for the lack of correlation between kinaesthetic imagery and external visual imagery may not have been due to the difficulty of using external visual imagery with kinaesthetic imagery, but the fact that participants could not identify with the image because they were asked to perform external visual imagery of *somebody else.*

In order to remove "identification" as a possible confound, a further study was devised. The procedure for the third study was exactly the same as for study 2; however, the instruction for the external perspective on the VMIQ was changed from *watching somebody else* to *watching yourself.* As with study 2 the purpose of study 3 was to examine if there are any differences between the correlation of the internal visual imagery scores on the VMIQ and kinaesthetic imagery scores on the MIQ and the correlation between external visual imagery scores on the VMIQ and kinaesthetic imagery scores on the MIQ.

Study 3

Method

Participants

Participants were recruited from the School of Sport, Health, and Exercise Sciences at the University of Wales, Bangor. A total of 64 participants were recruited (29 females and 35 males). Their ages ranged from 18-35 years (age $M = 21.02$, $SD =$ 4.3 years). All participants had received a three hour imagery training workshop, as part of a module of their degree course, and were recruited at the end of the workshop for the study. The participants were different from those used in study 2.

Measures

Participants' imagery ability was measured using the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986) and the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983). However, the instruction for the external perspective on the VMIQ was changed from *watching somebody else* to *watching yourself.* Thus, the question is still from an external visual perspective (see Appendix E for questionnaire).

Design and Procedure

After participants had completed the imagery workshop they completed the two imagery questionnaires. To control for any sequencing effects the order of administration of the two questionnaires was again counterbalanced. Participants completed the questionnaire in groups of between 10-15, in a large enclosed room away from any distractions. Gymnastics mats were provided so that participants could perform some of the moves of the MIQ (e.g., a forward roll). Participants were not allowed to confer with each other.

Results

The analyses performed were the same as for study 2.

Reliability Analysis

Cronbach's alpha for the MIQ visual and kinaesthetic scales were r =.92 and r =.92, respectively, and for the VMIQ external visual imagery and internal visual imagery scales were, r = .97 and r = .96 respectively.

Gender Analysis

Independent sample t-tests with Bonferroni correction again failed to find a significant difference in imagery ability between males and females on any of the MIQ or the VMIQ scales and totals. All data was again collapsed across gender for the correlational analysis, see tables 5 and 6 for results.

Participants	Kinaesthetic	Visual	MIQ
Males	22.86	24.5	47.36
	(7.85)	(8.24)	(15.29)
Females	20.07	23.29	43.36
	(6.43)	(9.42)	(14.78)
Total sample	21.46	23.89	45.36
	(7.25)	(8.79)	(15.03)

Table 5. Means and (standard deviations) for the MIQ scales and total.

Participants	External visual imagery	Internal visual imagery	VMIQ
Males	57.97	49.21	105.31
	(21.07)	(20.12)	(32.07)
Females	60.34	54.22	114.57
	(18.53)	(19.55)	(32.39)
Total sample	59.27	51.95	110.37
	(19.57)	(19.67)	(32.58)

Table 6. Means and (standard deviations) for changed VMIQ scales and total.

Correlational Analysis

Based on Shavelson's (1988) recommendations, at 62 degrees of freedom and $p <$ .01, the critical r for study 3 was $r = .43$. Using this criterion external visual imagery (as measured by the VMIQ) correlated significantly with visual imagery (as measured by the MIQ $r = .60$). The correlation between internal visual imagery and visual imagery was not significant ($p < .007$). External visual imagery correlated significantly with kinaesthetic imagery ($r = .47$), internal visual imagery did not correlate significantly with kinaesthetic imagery ($r = .23$).

Difference between Correlations in Study 2 and 3

Snedecor and Cochran's (1967) method for calculating z scores for uncorrelated co-efficients was employed to explore the imagery scale correlations between study 2 and study 3. A significant difference was found between external visual imagery and kinaesthetic correlations in study 2 and study 3, $z = 1.93, p < .05$. External visual imagery and kinaesthetic imagery had a stronger relationship in study 3 than in study 2. However, there was no significant difference in the correlation between internal visual imagery and kinaesthetic imagery in study 2 and study 3, $z = 1.09, p < .05$.

Discussion

The results of study 3 support the previous explanation that the lack of a significant correlation in study 2 between kinaesthetic imagery and external visual imagery may have been due to the fact that participants were asked to externally image somebody else performing the movement rather than themselves.

Changing the instructions on the VMIQ questionnaire from imagine watching somebody else to imaging watching yourself had a strong effect on the results. External visual imagery was correlated with kinaesthetic imagery, whereas internal visual imagery was (again) uncorrelated with kinaesthetic imagery. There is a possible explanation for the change in result for external visual imagery. As Denis, Engelkamp, and Mohr (1991) contend, the representational properties of overt enactment and self-imagination differ from those involved in the imagination of another person. Specifically, Denis and associates suggest that imaging oneself in action may involve some visual representation but these representations are likely to be enriched by the evocation of motor programs and the elicitation of kinaesthetic sensations which would not occur if one were visualising someone else. Thus, because participants in study 3 were imaging themselves they could perhaps access kinaesthetic information. Similarly, in line with Lang's (1979) bio-informational theory, because the participant is imaging "as if" the image was happening to them, a critical number of propositions may be matched and a response prototype may be activated, thus providing the correlation between visual and kinaesthetic imagery.

General Discussion

Taken together, the results of the two studies provide tentative evidence to suggest kinaesthetic imagery can be used with external visual imagery when the *imager is the object* of the image. At the very least this implies that internal imagery does not necessarily have a greater association with kinaesthetic imagery than does external visual imagery.

The results have important theoretical and applied implications. Lang (1988) contends that an imagery script which directs the imager to image "as if" the image was actually happening to them is critical to the semantic content and the accessing of the relevant prototype from long-term memory. If a performer is using external visual imagery of *somebody else* it may be more difficult for them to perceive, access and/or develop kinaesthetic and proprioceptive information to create kinaesthetic imagery than if they were using external visual imagery and *imaging themselves.* Miller, Galanter, and Pribram (1960) contend that the stimuli which provide adequate cues for one person may be different for another, and, in fact, relevant stimuli may be idiosyncratic. In the case of imaging somebody else, the imager, would not necessarily have a motor program for what the other person was doing. Secondly, it might be difficult to translate the visual information of somebody else into kinaesthetic information for themselves. Furthermore, if the visual information from the image was in conflict with the translated proprioceptive information for themselves, then the proprioceptive information may have been ignored (Lee & Aronson, 1974). However, this is not an argument for using internal visual imagery in preference to external visual imagery. This is because, as was shown in study 3, if a performer images themselves from an external visual imagery perspective, then a relationship does occur between external visual imagery and kinaesthetic imagery, suggesting that the kinaesthetic information was not only be available to them, but the visual and kinaesthetic information were not in conflict.

The fact that external visual imagery and kinaesthetic imagery were correlated suggests that they have common processes. This finding provides tentative support for Smyth and Wallers' (1998) contention that Jeannerod's (1994) view of motor imagery, as just force and effort, may be an oversimplification, and that motor imagery might have visual and/or spatial components. This view does make intuitive sense. The tasks on the MIQ questionnaire required participants to perform movements which depend heavily on "form" of movement for their execution, specifically, for example, the positioning of limbs in space (e.g., extend your elbow so that your hand leaves your shoulder and is straight in front of you parallel to the floor). To develop an accurate feeling of this movement, information about the spatial positioning of the movement, and visual referencing of its location may be needed. It is only when the imager is the object of the image, that they would get this precise spatial and visual information, thus possibly leading to the correlation in study 3 between external visual imagery and kinaesthetic imagery and indicating that kinaesthetic imagery may have spatial and/or visual components.

From an applied perspective, coaches and sport psychologists must provide athletes with learning experiences to develop external visual imagery because the results suggest here that external visual imagery can be associated with kinaesthetic imagery. Secondly, coaches and sport psychologists should pay special attention to the imagery exercises that they give to performers. For example, when athlete's are having difficulty achieving a physical technique or outcome goal they often try to image themselves achieving these targets (Orlick, 1990). However, some individuals have difficulty imaging themselves achieving something they can not actually do yet (Orlick, 1986). A common way to overcome this difficulty (especially with junior performers) is to watch a video of a role model from their sport achieving the target that the perfomers are working towards. Once the athlete is able to image the role model achieving the target they then work towards translating themselves into the object of the image (adapted from Orlick, 1986). However, the results presented here suggest that, if this technique is to be used, athletes must be directed towards paying attention to their own kinaesthetic sensations because the development of kinaesthetic images may not occur automatically when they image somebody else.

One implication for future research is highlighted by the studies. Changing the instructional set for the VMIQ in study 3 had an impact on the results and may suggest the VMIQ to be an inaccurate indicator of an athletes' imagery ability because it currently measures the ability to image somebody else. This emphasizes that care and consideration needs to be taken when using imagery questionnaires as research tools, not only when measure imagery ability but the processes underlying imagery.

CHAPTER 4

THE EFFECTS OF A MOTIVATIONAL GENERAL-MASTERY IMAGERY INTERVENTION ON THE SPORT CONFIDENCE OF HIGH LEVEL BADMINTON PLAYERS[3]

Abstract

A multiple-baseline across participants design was employed to examine the effect of a Motivational General-Mastery imagery intervention on the sport confidence of 4 high level, junior badminton players. Sport confidence data were collected once a week for 21 weeks prior to international and county matches. The imagery intervention consisted of 6 imagery sessions (2 per week for 3 weeks) and was administered using a multiple-baseline design with interventions commencing at weeks 5, 7, 9, and 11 for participants 1, 2, 3, and 4 respectively. Results of visual inspection and Binomial tests suggested significant increases in sport confidence for participants 1 and 2, a significant decrease in sport confidence for Participant 3, and a delayed increase in sport confidence for Participant 4. The results are discussed in terms of the implications of using mastery imagery and the usefulness of multiple-baseline designs for furthering imagery research.

[3] This research was presented at the Association for the Advancement of Applied Sport Psychology conference in 1998 and has been provisionally accepted as a paper for publication: Callow, N. Hardy, L. & Hall, C. R. (provisionally accepted). The effects of a motivational general-mastery imagery intervention of the sport confidence of high level badminton players. *Research Quarterly of Exercise and Sport.*

Introduction

The use of imagery within sport psychology has generated a large body of research (e.g., Jones & Stuth, 1997). However, the majority of this research has examined imagery effects on performance and learning at the expense of motivational and self-confidence effects (Murphy, 1994). Anecdotally, motivational effects of imagery have been reported by elite performers. For example, a highly successful Olympian springboard diver stated, "I got to the point where I could see myself doing a perfect dive and the crowd yelling at the Olympics" (Orlick & Partington, 1988, p. 114). Similarly, a successful international slalom canoeist stated, "If you're unsure about a move, the more times you go over it in your head the more confident you feel" (White & Hardy, 1998, p. 397).

The potential for imagery to have a motivational function has been discussed by several authors. Paivio (1985) proposed a functional model of imagery, stating imagery could have both a cognitive (e.g., imaging skills) and a motivational (e.g., imaging arousal and affect) function. Despite the anecdotal evidence and conceptual proposal indicating imagery may have a motivational function, empirical research has been slow to explore this possibility. Salmon, Hall, and Haslam (1994) investigated the motivational and cognitive use of imagery by soccer players of various skill levels. These researchers found footballers used imagery more for its motivational function than its cognitive function. Moritz, Hall, Martin, and Vadocz (1996) explored Paivio's model using the Sport Imagery Questionnaire (SIQ; Hall, Mack, Paivio, & Hausenblas, 1998). The SIQ measures athletes' utilization of the following five types of imagery: Cognitive General (CG; e.g., imaging performance plans being executed successfully); Cognitive Specific (CS; e.g., imaging specific skills being executed perfectly); Motivational General-Mastery (MG-M; e.g., imaging staying focused when confronted by problems); Motivational General-Arousal (MG-A; e.g., imaging the emotions that accompany major competitions); and Motivational Specific (MS; imaging specific performance goals being achieved, e.g., imaging receiving a medal). Moritz et al. (1996) found highly confident elite roller skaters were more likely to image mastery and emotions associated with competition (i.e., MG-M and MG-A) than their less sport-confident counterparts.

The research cited above suggests a link between motivational imagery and confidence. However, the studies by Moritz et al. (1996) and Salmon et al. (1994) are correlational in nature. Consequently, direction of causality cannot be established (Heyman, 1982). That is, it cannot be established if using Motivational General-Mastery imagery causes an increase in confidence, or having high self-confidence causes performers to use Motivational General-Mastery imagery, or, alternatively, some other variable causes both.

It is important to examine the causal direction of the imagery/self-confidence relationship for two reasons. Theoretically, as Murphy (1994) contends, researchers should be moving away from questions about, "Does imagery work? towards questions about, How and why does imagery work?" (p. 491). If it can be established that imagery enhances self-confidence, then this would suggest one of the mechanisms by which imagery affects performance is via a motivation-enhancing mechanism. From an applied perspective, if it is established that Motivational General-Mastery imagery enhances confidence then, because confidence plays a vital role in sports performance (Hardy, Jones, & Gould, 1996), this form of imagery could become a valuable psychological skill for performers to develop and use.

There are two main conceptualizations of self-confidence in sport: sport confidence and self-efficacy. Sport confidence (Vealey, 1986) refers to the degree of certainty an athlete possesses about his or her ability to be successful in sport (trait sport confidence) and in specific competitions (state sport confidence). Self-efficacy (Bandura, 1986) refers to an individual's belief that he or she can be successful in specific tasks, skills, or under specific conditions, and has been operationalized as magnitude, strength, and generalization. As state sport confidence measures how confident a performer feels in executing those skills which are necessary in order to be successful, state sport confidence can be regarded as a useful construct for the measurement of self-efficacy in specific sport situations.

Theoretically, it is understandable that using MG-M imagery may enhance self-confidence. Bandura (1997) contends self-efficacy beliefs are constructed from four principle sources of information; enactive mastery, vicarious experience, verbal persuasion, and physiological and affective states. Bandura (1997) states, "Enactive mastery experiences are the most influential sources of efficacy information because they provide the most authentic evidence of whether one can muster whatever it takes to succeed" (p. 80). Enactive mastery is based on *personal mastery* experiences (rather than seeing *others* have mastery experiences, as in vicarious experience). Lang (1979) has argued that the meaning which imagers place upon their imagery has a profound influence upon their psychophysiological responses and the subsequent impact of the imagery upon their behaviour. Thus, in the present context, the authors would argue that by "identifying" with their mastery images, performers may gain enactive mastery experiences rather than vicarious experiences. Of course, even if performers do not "identify" with their mastery images they will still obtain vicarious experiences from it.

Typically research investigating the effects of imagery on sports performance has used nomothetic designs (i.e., the exploration of group averages), which have been the preferred methodology of applied sport psychology research (Smith, 1988). However, the use of this method within imagery research has been criticized. For example, Wollman (1986) stated, in imagery research, single-subject (i.e., ideographic) designs should be used as well as nomothetic designs because single-subject designs eradicate the problem of group averages and lack of statistical significance obscuring improvements in individual performances. However, this is not an adequate justification for the use of single-subject design research. Often such problems occur in nomothetic designs because the experiment fails to consider the appropriate individual difference variables. The true advantages of single-subject design research over nomothetic research are: large sample sizes are not a necessity to draw statistical inferences; and design complexity can be reduced. Furthermore, because single-subject design research can involve repeated observation or data collection over time, individual variability can be studied and the true effects of an intervention on a participant evaluated. Additionally, there is no need to withhold the treatment from a control group. (For a discussion, see Hrycaiko & Martin, 1996.)

Single-subject designs do have their own limitations; for example, factors such as history and maturation being plausible explanations for results of an intervention, or having to reverse a behavior back to the baseline. Such limitations can be overcome by choosing an appropriate design variant. One such variant is the multiple-baseline design. With this design, intervention effects are demonstrated by introducing the intervention to different baselines (e.g., behaviours or participants) at different points in time. If each baseline changes when the intervention is introduced, the effects can be attributed to the intervention. Consequently, there is more precision in ruling out alternative hypotheses and arriving at causal interpretations of the data than if just one baseline were used (Kazdin, 1982).

The present study had two purposes. The first purpose of the study was to investigate the causal direction of the imagery/self-confidence relationship. This causality was investigated by exploring the effects of a Motivational General-Mastery imagery intervention on state sport confidence. It was hypothesized that MG-M imagery would increase state sport confidence. The second purpose of the study was to address one of the methodological criticisms leveled at imagery research, namely the predominant use of nomothetic designs. To address this criticism an ideographic design was used. Specifically, a multiple-baseline across participants design was employed to examine the effects of the imagery intervention on the sport confidence of four high level, junior badminton players.

Method

Participants and Experimental Design

Four junior badminton players, under 18 years of age, participated in the study (age *M*=15.00, *SD*=1.00 years). Three of the players were male and one was female. All four participants had at least six years of competitive badminton experience, and had competed for their county in junior national championships. Two out of the four had competed internationally in junior international championships.

The study period totaled twenty-four weeks, with participants involved in weekly badminton matches. The imagery ability of the participants was measured prior to the study, and their use of imagery assessed before and during the study. Sport confidence data were measured prior to each match, and the imagery intervention implemented in a multiple-baseline across participants design.

Measures

Imagery Ability. Prior to the start of the study, the imagery ability of the four participants was measured using the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997). The results from the MIQ-R were used to individualize part of the imagery intervention for each participant. The MIQ-R is a shortened version of the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983). The MIQ-R measures visual and kinaesthetic imagery ability using eight items on a 7-point Likert scale, anchored by 1 (*very hard to see/feel*) and 7 (*very easy to see/feel*). Participants are provided with descriptions of specific actions which they first perform, then image, and then rate the ease/difficulty of imaging the action. A sample item from the MIQ-R follows:

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.

The factorial integrity of the MIQ has been supported by Atienza, Balaguer, and Garcia-Merita (1994). The MIQ-R has shown correlations with the MIQ for both the visual ($r = -.77$) and kinaesthetic ($r = -.77$) subscales (Hall & Martin, 1997). The negative correlations reflect the fact that the MIQ-R is scored in the opposite direction to the MIQ. These high correlations indicate convergent validity between the already validated MIQ and the MIQ-R, thus suggesting that the MIQ-R does in fact measure the constructs of visual and kinaesthetic imagery (cf. Spector, 1992).

State Sport Confidence. Prior to each competition, participants completed the State Sport Confidence Inventory (SSCI; Vealey, 1986, see Appendix F for questionnaire) to measure their confidence of success in the match. The SSCI has 13 items, each item is measured on a 9 point Likert scale ranging from 1 (*low*) to 9 (*high*). An example item from the SSCI is: "Compare the confidence you feel right now in your ability to execute the skills necessary to be successful to the most confident athlete you know." To score the SSCI, the athlete's responses to the 13 items are summed. The SSCI has demonstrated an internal consistency of .95 and adequate construct validity (Vealey, 1986).

Imagery usage. At the beginning and midpoints of the study, participants completed the Sport Imagery Questionnaire (SIQ; Hall et al., 1998, see Appendix G for questionnaire) to assess their use of imagery. The SIQ asks athletes to rate how often they use five different functions of imagery. Each function of imagery is measured by six items, thus giving a total of 30 items for the questionnaire. The items are scaled from 1 (*rarely*) to 7 (*often*). Examples of the imagery functions items include: "I make up new plans/strategies in my head" (Cognitive General); "I can easily change an image of a skill" (Cognitive Specific); "I imagine the stress and anxiety associated with competing" (Motivational General-Arousal); "I imagine myself being in control in difficult situations" (Motivational General-Mastery); and "I image myself winning a medal" (Motivation Specific). Principle components factor analysis has demonstrated the SIQ to have adequate structural validity (Hall et al., 1998) with items loading onto their respective imagery scales (functions) above the criterion level of .35 (Tabachnick & Fidell, 1989). All of the scales have acceptable internal consistencies, with alpha coefficients ranging from .70 to .88. Furthermore, the predictive validity of the SIQ has been supported because greater imagery usage predicts successful sport performance (Hall et al., 1998).

The purpose of administering this questionnaire was to serve as a manipulation check. Murphy (1990) states manipulation checks during imagery interventions are essential because of the subjective nature of a person's response to imagery interventions. Administering the SIQ before and during the intervention meant that the scores on the MG-M questions could be compared to see if participants were using that function and if its usage had increased through the intervention period. If the MG-M imagery usage had not changed, the intervention would have been adjusted and the SIQ administered at the end of the intervention to see if there were any changes in imagery usage at that point.

Post-experimental interview. To gain information about the athletes' views on the imagery intervention, a structured interview was conducted by one of the authors (an experienced researcher trained in conducting qualitative interviews). The interview schedule was constructed using a deductive approach (Patton, 1990) to create a predetermined set of themes and categories about the intervention. These themes and categories were used to organize questions for the interview in the following categories: adherence to the intervention, perceived effects of the intervention, aspects of the intervention which were easy/hard/useful, and time spent practicing. (See Appendix H for interview protocol.) The interviews were conducted, for each participant, two weeks after their final match, and were recorded and transcribed verbatim.

Procedure

Six high-level badminton players were identified as potential participants by the regional badminton development officer. While these players were at a coaching session one of the study's authors met with them and outlined the study. The players were not told the true purpose of the study. Rather, they were told the study was designed to explore different ways of delivering imagery training to badminton players. Furthermore, they were told it was important to be honest about what they thought and reported because the study was exploratory and their input could help with future imagery interventions. Four of the badminton players volunteered to take part in the study.

The study period totaled 24 weeks and was divided into three phases: baseline, intervention, and post-intervention. Sport confidence data were collected using the State Sport Confidence Inventory (SSCI; Vealey, 1986) once a week prior to competitive matches during the baseline and post intervention phase, but not during the intervention phase. The intervention lasted for three weeks and was introduced to the participants using a multiple-baseline procedure. That is, each participant began the intervention at different points during the study. (Participant 1 after 5 matches, Participant 2 after 7 matches, Participant 3 after 9 matches, and Participant 4 after 11 matches.)

Because sport confidence data were not collected during the intervention phase, each participant yielded 21 data points (24 weeks minus the 3 weeks of the intervention period). The matches and tournaments used to collect data from were of a similar standard, that is, either county or international matches. Participants were randomly assigned to the different baseline conditions.

Intervention

The intervention was administered by one of the study's authors, a British Association of Sport and Exercise Sciences accredited sport psychologist. To avoid the possible occurrence of experimenter effects during the intervention, the exact instructions for the intervention were written down and scrutinized to ensure they themselves did not have biasing effects. These instructions were adhered to throughout the intervention. The process of automating the intervention (by writing down the instructions) provides standardization and reduces possible experimenter effects (Christensen, 1988).

The first imagery intervention session consisted of two parts, individualized general imagery training and standardized Motivational General-Mastery training, for each participant the first session lasted from between 1 to 1.5 hours. In the first part of the session participants were: introduced to four different types of imagery (internal visual, external visual, kinaesthetic, and motivational-general mastery), given examples of how imagery could be used in badminton, and provided with imagery training to improve their imagery ability.

Imagery ability mediates the efficacy of imagery interventions; that is, the greater performer's imagery ability, the more effective are imagery interventions (Goss, Hall, Buckloz, & Fishbourne, 1986; Ryan & Simons, 1981). However, the research literature has not identified an imagery ability level at which imagery interventions become effective. It was the authors' opinion for the imagery intervention used in this study to be effective, the participants would have to be able to image both visually and kinaesthetically before the intervention started (cf. Hall, 1985). Consequently, it was decided that participants should score at least a mean of 16 for both the visual and kinaesthetic scales of the MIQ-R (Hall & Martin, 1997). This mean score was decided upon because it meant each participant was scoring an average of at least "not easy nor hard" for the task they imaged on the MIQ-R. Participants' scores on the MIQ-R were examined and those scoring below the criterion score were provided with training to improve their imagery ability. Exercises from Hardy and Fazey's (1990) Mental Rehearsal Program were utilised for imagery training. Examples of one basic and one more advanced exercise used in the imagery training follow. If a participant had a low visual ability score then a basic exercise used was imaging two equilateral triangles (one on its base, one on its tip) moving together to create a star. A more advanced exercise used (to enhance visual or kinaesthetic imagery) was to physically practise a technique, taking note of visual and kinaesthetic information and then image the technique while trying to emulate (as vividly as possible) the visual and/or kinaesthetic information which was perceived while physically performing the technique.

The second part of this session was standardized. Each participant was taken through the Motivational General-Mastery imagery scripts that they were subsequently asked to practise before the next session. At the end of the first session, participants were given a choice of one or both of an audiotape containing training imagery instructions or a booklet with imagery scripts for their own imagery practices. Participants were also given a diary in which to record any imagery practice they carried out. In accordance with Smith (1988), it was suggested to all participants that they would maximize the effect of their imagery training if they spent five minutes a day practising the imagery routines. Bull (1991) suggested one method for encouraging adherence to training was the individualization of psychological skills training. Consequently, participants were encouraged to individualize their imagery scripts rather than relying on the audiotapes and/or booklets. The first session for each participant lasted for between 1 to 1.5 hours.

After this first session participants had five more imagery sessions over a three week period. During each of these sessions, the imagery training was reinforced, new scripts with different badminton situations were administered, and the participants were given opportunities to ask questions and discuss any problems (see Appendix I for an outline of imagery sessions and scripts). These sessions ranged from 15 to 30 minutes depending on the questions and problems that arose.

Imagery Scripts

The imagery scripts were created around MG-M situations in accordance with Paivio's (1985) model. Lang, Kozak, Miller, Levin, and McLean (1980) suggest imagery scripts weighted with response propositions which evoke physiological/emotional/movement reactions (e.g., imagine being in control of the situation) are more likely to produce vivid images than those weighted with stimulus propositions, which describe the content of the scenario (e.g., imagine the physical details of an object). Consequently, scripts were written with both response and stimulus propositions, but with emphasis placed on response propositions.

In order to be realistic and create imagery situations that "challenged" the performer, the imagery scripts also contained advanced technical detail. Two national coaches helped to provide this detail for the scripts. An example, of a section, of one of the imagery scripts is given below:

> In the first few minutes of the first game you find your opponent hard to stretch... Pause. Imagine yourself staying focused during any challenging situation... Pause. You begin to realize that your player has difficulty doing straight smashes instead they play them cross court... Pause. Imagine yourself taking advantage of the cross court shot... Pause. Imagine what

your return shot would be... Pause. Imagine yourself being in control of the situation.

Data Analysis

The traditional method for analyzing single-case design research is visual inspection. This method involves visually examining the graphed data and reaching a judgment about whether the intervention has produced a reliable change in the data. This judgment is related to the magnitude of these changes (mean and level) and the rate of these changes (trend and latency). However, Kazdin (1982) contends visual inspection is an unrefined and insensitive method for assessing change because there are no concrete rules pertaining to what a reliable change is. Thus, the judgment can be subjective, open to bias, inconsistent, and overlook weak but reliable effects. In view of these short-comings of visual inspection, a number of statistical analyses have been proposed which allow inferences to be made about the reliability or consistency of changes. Thus, the present study departed from the traditional method for analyzing single-subject design data by using statistical analyses as well as visual inspection of the data. Trend lines were calculated to provide a descriptive aid for visual inspection and to allow for level and slope measurements to be calculated. Mean sport-confidence scores and standard deviations were also calculated for each phase.

The use of conventional t and F tests may be inappropriate for single-case data, because the independence of error assumption required for parametric tests is often violated (Kazdin, 1982). This violation can occur because adjacent data points are often correlated over time. When the data is correlated in this way it is called serially dependent (Jones, Weinrott, & Vaught, 1978). To assess the existence of serial dependency in the present data, autocorrelations were computed on the baseline and post-intervention phase sport-confidence data (see Kazdin, 1982); that is, for each participant, the sport confidence data for matches 1 and 2, matches 2 and 3, matches 3 and 4, etc., were correlated. The autocorrelations for Participants 1 and 4 were significant at $p < 0.001$. Thus, serial dependence existed in the data of Participant 1 and 4. Furthermore, the variance of Participant 3's baseline data, was more than double the variance of his/her post-intervention phase data. Thus, the homogeneity of variance assumption was also violated (Stevens, 1996). Consequently, the only data which could be statistically analyzed, using parametric tests, was that of Participant 2. In light of this, it was decided to use non-parametric tests to analyze the data in the same way for all participants.

Kazdin (1982) proposed a number of non-parametric tests that can be used on data which exhibits serial dependency. One such analysis is the split-middle technique (White, 1974). The split-middle technique determines trend lines; in the present study, one for the baseline phase and one for the post-intervention phase. These trend lines can then be used for visual inspection of the data (see Figure 3). To contribute to inferences drawn using visual inspection, White (1974) proposed the level and slope of the lines be calculated. To demonstrate these calculations, the data from Participant 2 will be used. Level refers to the last data point during the baseline and the first data point during the intervention. The levels of the lines on the last day of the baseline (81.50) and the first day of the post-intervention line (93.75) are noted. To calculate the change in level, the larger of the two values is divided by the

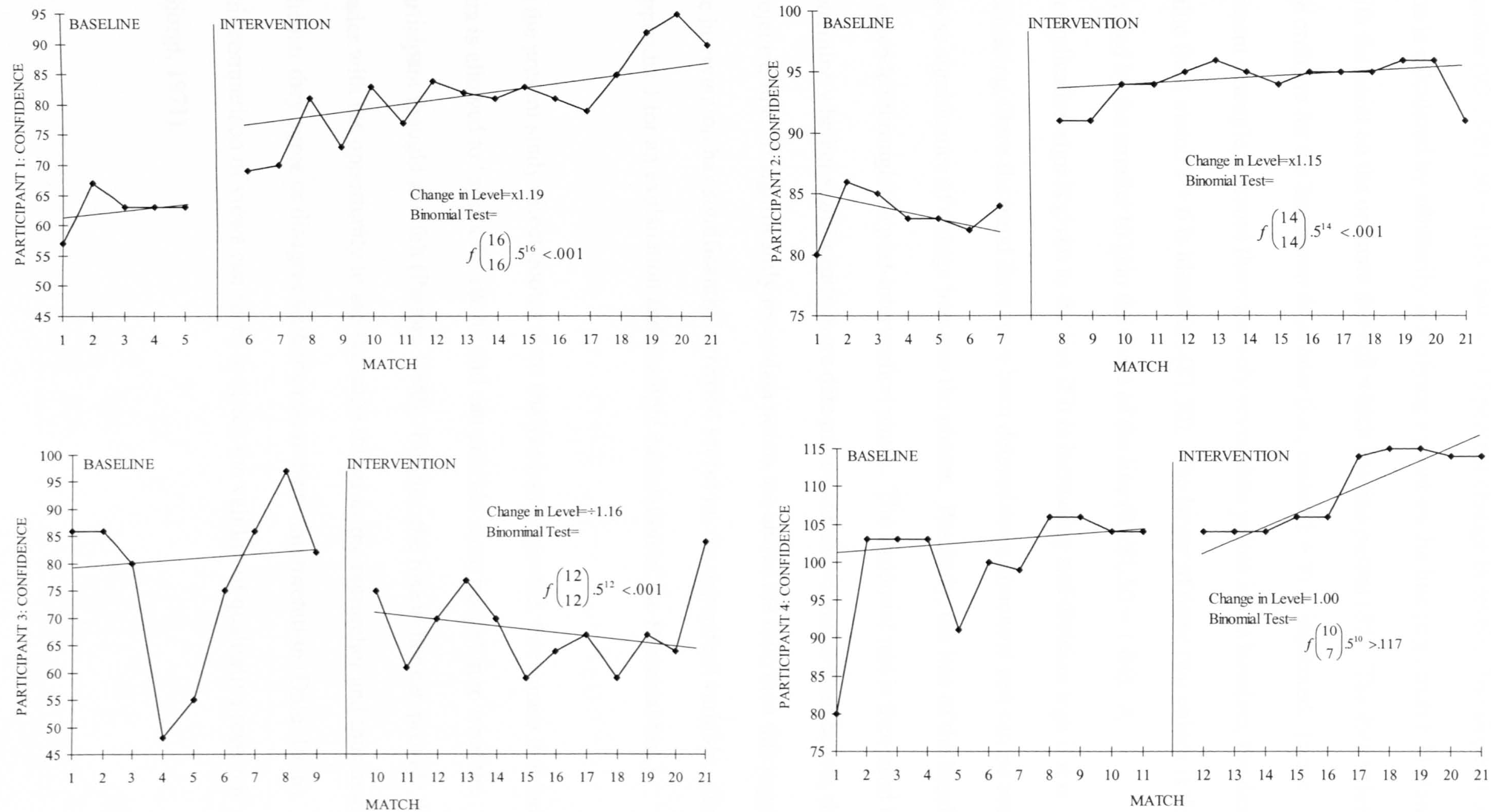

Figure 3. Graphed sport confidence data. The vertical line, on each graph, indicates when the intervention was implemented for each participant.

smaller (93.75/81.50 = 1.15, that is a 15 percent change in level). The slope of the line is calculated by arbitrarily identifying a point on the line (e.g., match 1) along with the point on the ordinate through which the line passes (85). The data value on the ordinate for the line seven days later (i.e., match 1 + 7) is identified. In the present example, because there are only seven data points in the baseline, the data value from match 1 + 6 is identified (81.50). The larger of these two values is then divided by the smaller to gain the slope of the line (85/81.50 = 1.04). A multiplication sign is given to the line if it is increasing and division sign if it is decreasing. Once the trend lines have been determined a Binomial test can be used to assess significance of change between the phases. Precisely, the line of the baseline is extended through the post-intervention phase. The Binomial test is then used to determine whether significantly more data points are above, rather than below, the projected line. If significantly more data points are above the line, then this suggests the intervention has significantly increased scores on the dependent variable. (See Appendix J for an explanation and example calculation of the Binomial test.)

In the present study direct quotes were analysed and reported, this means that the data is allowed to "speak for itself" and can provide more insight in to what the participant thought and felt (Patton, 1990). Further, the researcher can provide the reader with the opportunity to see the same things as the researcher and thus assess whether they agree or disagree with the researchers' interpretation (Dale, 1996). This comparison of views can serve to check the validity of qualitative research (Giorgi, 1971).

Results

All participants reached the criterion imagery ability level of 16 on the MIQ-R questionnaire (Hall & Martin, 1997), except Participant 4 who failed to reach the criterion level for the visual scale. One week after the first imagery session (part of which was designed to improve imagery ability) Participant 4 was re-administered the MIQ-R, this time they reached the criterion level on both scales. The SIQ questionnaire scores (Hall et al., 1998) indicated that the participants' usage of MG-M did increase from a pre-intervention usage score of $M = 12.75$, $SD = 8.30$, to a mid-intervention usage score of $M = 29.25$, $SD = 3.10$.

Sport Confidence Data

Participant 1's mean sport confidence increased from 62.60 in the baseline phase to 81.56 in the post-intervention phase. The baseline level of 64 increased to 76 at the start of the post-intervention phase, thus there was a 19% increase in level. Furthermore, the baseline slope of x1.03 increased to x1.05. The Binomial test indicated a significant increase in sport confidence when comparing the post-intervention data with projected sport confidence, $p < .001$. Taken together, these results suggest a significant increase in self-confidence. In particular, the 19% increase in level suggests an immediate influence of the imagery training. (Table 7 and 8 for a summary of the results.)

	Baseline		Intervention	
Participant	*M*	*SD*	*M*	*SD*
1	62.60	3.60	81.56	7.20
2	83.28	2.00	94.14	1.80
3	77.22	15.80	68.08	7.60
4	99.90	7.80	109.60	5.10

Table 7. Mean and standard deviation sport confidence scores, for each participant, for the baseline and intervention phase.

	Baseline	Intervention		Baseline	Intervention
Participant	Level	Level	Change in level	Slope	Slope
1	64.00	76.00	x1.19	x1.03	x1.05
2	81.50	93.75	x1.15	÷1.04	x1.01
3	81.08	71.00	x1.16	x1.03	÷1.05
4	104.00	104.00	1.00	x1.02	x1.16

Table 8. Split middle results, for each participant, for the baseline and intervention phase.

Participant 2's mean sport confidence increased from 83.28 in the baseline phase to 94.14 in the post-intervention phase. The baseline level of 81.50 increased to 93.75 at the start of the post-intervention phase, thus there was a 15% increase in level across the intervention. Furthermore, the baseline slope of ÷1.04 increased to x1.01. The Binomial test indicated a significant increase in sport confidence when comparing the post-intervention data with projected sport confidence, $p < .001$. The statistically significant Binomial test, the increase in mean sport confidence, and the 15% increase in level suggests a notable improvement in sport confidence after the imagery training.

Participant 3 had unstable baseline data that can interfere with drawing conclusions about an intervention (Kazdin, 1982). Participant 3's mean sport confidence decreased from 77.22 in the baseline phase, to 68.08 for the post-intervention phase. The baseline intervention produced a level of 81.08 which decreased to 71 in the post-intervention phase, thus there was a 16% decrease in level across the intervention. From baseline to post-intervention, the slope decreased from x1.03 to

÷1.05. The Binomial test on the data indicated a significant decrease in sport confidence when comparing the post-intervention data with projected sport confidence ($p < .001$). Taken together, these results suggest a decrease in sport confidence after the imagery training.

Participant 4's mean sport confidence increased from 99.90 in the baseline phase, to 109.60 for the post-intervention phase. The baseline level of 104 remained constant at the start of the post-intervention. Visual inspection of the post-intervention phase suggests a delay in the effect of the imagery training upon sport confidence. The level of the line increased sharply at match 17, 6 weeks into the intervention phase. This is highlighted by the increase in slope from x1.02 to x1.16. The Binomial test did not reach significance when comparing the post-intervention data with projected sport confidence, $p > 0.117$. However, care must be taken when interpreting the result from this Binomial test because there were only 10 data points in the post-intervention phase. With only 10 data points there is a high chance of committing a type II error with the Binomial test because at least 8 out of the 10 points would have to be above the projected line before a significant effect could be detected at $p =. 05$. Although the Binomial test did not indicate a significant increase in sport confidence, the graphed data and associated statistics suggest a delayed increase in sport confidence as a result of the intervention.

Post-Experimental Interview Data

The data reported here reflect responses to questions which focus on participants' effectiveness of the imagery intervention. All participants indicated the perception that the MG-M imagery intervention enhanced their confidence, and three participants (1, 2, and 4) attributed this increase to the intervention. For example, when Participant 1 was asked why their confidence increased over the intervention period they stated,

> I think that when I image it.. and it goes right.. it proves to myself that I *can* [*italics added*] do it and that I can do it right and well. Before I just like didn't have any confidence. It would go wrong once and I think its going to go wrong again. But at least then I can image myself doing it right, and I think *I could do that* [*italics added*].

In contrast to the sport confidence data for participants 1, 2, and 4, Participant 3 demonstrated a reduction over the course of the study. When asked if the imagery helped their confidence Participant 3 described their confidence in a manner consistent with the numerical data,

> Yeah...by keeping my confidence the same which has helped because maybe before it was not too consistent. I would be confident for one match and then maybe not the other. I am steady more cons*istent* [*italics added*] the same confidence all the way through.

Furthermore, when asked why he/she thought their confidence decreased during the study Participant 3 provided information which indicated the decrease in confidence was due to a factor outside of the intervention, they stated, "It could be that I am playing better players." Thus indicating competing against higher level players possibly decrease their confidence.

Discussion

Imagery research within sport psychology has had a predominantly narrow focus centering on the use of imagery for learning and performance. However, anecdotal evidence indicates athletes use imagery for a wide variety of other reasons; for example, to enhance their self-confidence. Many issues need to be explored to extend the breadth of our knowledge with regard to imagery. Two of these issues have been examined in the present study. Firstly, the causal direction of the imagery/sport confidence relationship and, secondly, the use of experimental designs other than traditional nomothetic designs. In the present study, a multiple-baseline across participants design was employed to evaluate the effect of a Motivational General-Mastery imagery intervention on the sport confidence of four high-level badminton players. The results of the study suggest a facilitative effect for the imagery intervention on the sport confidence of three out of the four participants. These findings are discussed in relation to Bandura's self-efficacy theory (1977, 1997), and their research and applied implications.

Visual inspection of the graphed sport confidence data suggested participants 1, 2, and 4 increased in sport confidence, across the phases, whereas Participant 3 decreased in sport confidence. This was partially confirmed by the Binomial test, which showed a significant increase in sport confidence across the phases for participants 1, 2, and a significant decrease in sport confidence across the phases for Participant 3, but no significant effect for Participant 4.

Inspection of each of the participants' results, together with their responses from the post-experimental interview, help to glean more information about the efficacy of the intervention. The intervention seemed most effective for participants 1 and 2. Their data showed large increases in level, 19% and 15% respectively. The interviews indicated that participants 1 and 2 perceived the imagery intervention to have enhanced their confidence.

Participant 4 had a consistent level from the pre to immediately post-intervention phase, however there was an increase in the slope. At match 17 (five weeks into the post-intervention phase) there was a sharp rise in Participant 4's sport confidence. There are three plausible explanations for these findings. Firstly, despite the rise in sport confidence the Binomial test was not significant, thus the intervention may not have been effective. However, previous researchers (e.g., Shambrook & Bull, 1996) have discussed the notion that psychological interventions can show a temporal lag. In line with this research, a second possible explanation for the results could be that the imagery intervention was effective but only after a period of time, evident in the rise in confidence at match 17. As there were only 10 data points in the post-intervention phase there may not have been enough data points to detect the significance of this delayed increase in confidence and, as explained in the results section, a type II error may have occurred. A third reason for the results could have been due to the motivational orientation of the participant, that is Participant 4 appeared to be motivated by winning. Thus, the impact of the intervention may only have been realized when the participant started to win more frequently. This was alluded to during the post-experimental interview. When asked why his/her confidence had increased Participant 4 stated, "I feel more confident and I am winning more now." This finding can be linked to self-efficacy theory. The strongest source of self-efficacy is enactive mastery (Bandura, 1997). Therefore, winning may have provided

Participant 4 with a source of enactive mastery which might have increased the performer's efficacy expectations. Consequently, the effect of the intervention could have been mediated by the performer winning.

It could be argued that the increase in confidence of participant 1, 2, and 4 should be attributed to them winning more often rather that the imagery intervention. However, this begs the question of why the participants started to win more often during the post-intervention phase, to which, in our opinion, the most parsimonious explanation has to be because of the intervention (cf. Kazdin, 1982). Thus, the increase in sport confidence is still due to imagery, it is just that this is mediated by changes in performance.

The Binomial test for Participant 3 showed a significant decrease in sport confidence indicating a negative effect for the imagery training. An explanation for this effect can be gleaned through an examination of the post-experimental questionnaire. When asked why the participant thought his/her sport confidence scores had decreased he/she stated, "It could be that I am playing better people." Due to the participant being placed highly and winning specific tournaments at the beginning of the season, he/she had gained enough points to be promoted from the standard to the premier division. This occurred at match 9, the week before the intervention started. The competition is harder in the premier division than the standard division. Thus, the reduction in sport confidence may not have been due to the imagery intervention, but due to the fact that the participant was playing against stronger opponents, and therefore winning less often or less convincingly (Bandura, 1977).

Further visual inspection of Participant 3's data indicates the variability of the sport confidence scores was reduced after the intervention. This was confirmed by a reduction in the standard deviation of his/her sport confidence scores from 15.8 for the pre-intervention phase to 7.6 for the post-intervention phase. Bandura (1977) states efficacy expectations can vary in strength and, "weak expectations are extinguishable by disconfirming experiences, whereas individuals who possess strong expectations of mastery will persevere in their coping efforts despite disconfirming experiences." (p. 194). Thus, even though the participant's confidence was lower after the intervention (due to playing against more able opponents), the participant's sport confidence may be regarded as being more "resilient" (Bandura, 1997, p. 80) because it had less variation. Indeed, Participant 3 stated that the imagery helped,

> by keeping my confidence the same which has helped because maybe before it was not too consistent. I would be confident for one match and then maybe not the other. I am steady more cons*istent* [*italics added*] the same confidence all the way through.

Three methodological weaknesses can be identified in the present study. Firstly, the individual administering the intervention was one of the investigators of the study. This is an inherent weakness because *experimenter expectancies* (Rosenthal, 1976) may have influenced the research outcome. Experimenter expectancies refer to the fact that the investigator may have a biasing effect on the results by behaving unintentionally in ways that may influence the results in the desired direction. However, as previously discussed, steps were taken in the present study to minimise any bias that may have contaminated the results. The second methodological weakness lies in the fact that objective win/loss data was not collected. Thus, it could be argued that winning experiences can not be ruled out as an alternative hypothesis. Future researchers should attempted to collect win/loss data and correlate it, at different lag intervals, with the dependent variable. The third methodological weakness of the study was that there were only 10 data points in the post-intervention phase for Participant 4. In retrospect, for each participant, the number of data points in the post-intervention phase should have been the same rather than the total number of data points (21). This would have allowed 16 data points in the post-intervention phase for Participant 4.

A number of research directions are implicated by the present study. Goginsky and Collins (1996) contend that the replication of similar methodological components of studies (if not the entire research designs) could help to develop a clear and coherent picture of imagery effects. The multiple-baseline design is a simple methodology which allows for the replication of intervention studies. An important and valuable area of research would be to use multiple-baseline designs to explore the effect of interventions which focus upon each of the five imagery functions defined by Hall et al. (1998) on cognitive and motivational factors. This, together with well-designed nomothetic studies, could help to build a picture of which imagery is the most effective for particular dependent variables (e.g., confidence, cognitive anxiety, goal orientations). Furthermore, in a discipline where the use of elite performers for research raises serious ethical considerations (Hardy, et al., 1996) but is necessary in order to identify the true effects of interventions on their target population (Greenspan & Feltz, 1989), the multiple-baseline across participants design is invaluable because large samples are unnecessary and the intervention is not withheld or withdrawn from any participants.

Recent research by Munroe, Hall, Simms, and Weinberg (1998) indicates athletes use Motivational General-Mastery imagery to help themselves get through tough practices early on in the season, whereas, later on the season, they use Motivational Specific imagery to see themselves competing successfully. This raises important applied issues concerning the most effective time to use the different functions of imagery, and also selecting teachable moments to introduce performers to the different functions. Research exploring the appropriate timing of specific imagery interventions would be very valuable.

The results of the present study also have two applied implications. They suggest Motivational General-Mastery imagery would be a valuable psychological tool for performers to use for two reasons: firstly, to increase the performer's confidence during the competitive season; and secondly, to increase the resilience of the performer's confidence, so as to reduce the fluctuations in confidence which may occur prior to a competition.

CHAPTER 5

TYPES OF IMAGERY ASSOCIATED WITH SPORT CONFIDENCE IN NETBALL PLAYERS OF VARYING SKILL LEVELS[4]

Abstract

Martin, Moritz, and Hall's (1999) Applied Mental Imagery Model was developed to provide an organisational framework to guide future imagery usage research and application. The present study explores 2 aspects of the applied model: the relationship between imagery type and confidence and; 2 possible moderating variables, skill level of the athlete and sport-type.

One hundred and twenty-three female county netball players participated in the study; 55 from a low standard county and 68 from a high standard county. Participants were administered the Sport Imagery Questionnaire (SIQ). One week later, at a county netball match, the State Sport Confidence Inventory (SSCI) was administered.

Hierarchical multiple regression analyses showed that in the lower standard sample, mastery imagery and imagery related to strategies of the game accounted for a significant proportion of the variance in sport confidence. In addition, imagery related to the emotions of playing predicted confidence negatively. With the higher standard sample, goal achievement oriented imagery was the only significant predictor of variance in confidence. The results are discussed in relation to the pertinence of, and function that, different imagery types have for performers.

[4] Data from sample 1 of this study was presented at the International Society of Sport Psychology conference in 1997. The full paper has been accepted for publication. Callow, N. & Hardy, L. (accepted). Types of imagery associated with sport confidence in netball players of different skill levels. *Journal of Applied Sport Psychology*.

Introduction

Previous mental imagery research has generally examined the influence of imaging specific skills upon performance (e.g., Denis, 1985; Hall, Buckolz, & Fishburne, 1992), together with the cognitive mechanisms which may underlie such effects (e.g., Murphy, 1990). However, in 1985 Paivio suggested that mental imagery may influence motor behaviour via both cognitive (e.g., performance enhancement) and motivational (e.g., confidence enhancement) mechanisms. Although, at an applied level, the use of imagery for motivational purposes has been frequently reported (e.g., Orlick, 1990), it was not until 1994 that Salmon, Hall, and Haslam empirically examined the motivational role that imagery might have for performers. Using a survey approach, they found that soccer players utilised imagery more for motivational purposes than for cognitive purposes. More recently, some of the imagery usage research has focused more specifically on imagery and its relationship with confidence (e.g., Callow, Hardy, & Hall, provisionally accepted; Moritz, Hall, Martin, & Vadocz, 1996).

There are two main approaches to the study and measurement of self-confidence in sport, sport confidence and self-efficacy. Sport confidence (Vealey, 1986) refers to the belief that an athlete possesses about his or her ability to be successful in sport in general (trait sport confidence) and in specific sport competitions (state sport confidence). Self-efficacy (Bandura, 1986) refers to an individual's belief in their capabilities to be successful in executing specific tasks and skills in specific situations, and is measured in terms of the strength, level, and generality of self-efficacy. The use of self-efficacy per se to measure confidence in the unique sport context has been questioned (e.g., McAuley & Gill, 1983; Vealey, Hayashi, Garner-

Holman, & Giacobbi, 1998). However, because state sport confidence reflects generalised self-efficacy across the range of situations that are found in sport competitions (cf. Hardy, Jones, & Gould, 1996), state sport confidence can provide a useful method to assess generalised self-efficacy.

Theoretically, a connection between imagery and confidence has been proposed (e.g., Feltz, 1984; Martin & Hall, 1995). Specifically, based on Bandura's self-efficacy theory (1977), it was proposed that a successful image may provide an individual with vicarious information which could serve to enhance self-efficacy, and therefore sport confidence. Establishing if imagery has a facilitative effect on confidence is important because confidence plays a vital role in sports performance (e.g., Burton, 1988; Jones, Swain, & Hardy, 1993; Martens, Burton, Vealey, Bump, & Smith, 1990).

Recent empirical research does report a relationship between imagery and confidence. Moritz et al. (1996) explored the relationship between imagery and confidence using the Sport Imagery Questionnaire (SIQ; Hall, Mack, Paivio, & Hausenblas, 1998). The SIQ measures athletes' utilisation of the following five types of imagery: Cognitive General (CG; e.g., I imagine executing entire plays/programs/sections just the way I want them to happen in an event/game); Cognitive Specific (CS; e.g., I can easily change an image of a skill); Motivational General-Mastery (MG-M; e.g., I imagine myself working successfully through tough situations); Motivational General-Arousal (MG-A; e.g., I imagine the excitement associated with competing); and Motivational Specific (MS; e.g., I imagine myself winning a medal).

Moritz et al. (1996) found highly confident elite roller skaters to be more likely to image mastery and emotions associated with sports competition (i.e.; MG-M and MG-A imagery) than their less sport confident counterparts. This study was correlational in nature and therefore causality could not be implied (Heyman, 1982). Despite the limitation of not being able to imply causality, this type of exploratory study is desirable because it starts to identify which imagery types should be explored with specific dependent variables. Causal experimental designs can then be used to establish the direction of any relationships identified. For example, based on Moritz et al's (1996) finding that MG-M was used by more confident roller skaters, Callow, et al. (provisionally accepted) used a multiple-baseline across participants design to examine the effect of a MG-M imagery intervention on the sport confidence of four high level badminton players. The results showed a facilitative effect of MG-M imagery on sport confidence, thereby providing initial confirmation that this type of imagery can enhance confidence.

To facilitate the organisation and development of imagery usage research and application, and to help to guide imagery research towards developing a theoretical explanation of imagery effects, Martin, Moritz, and Hall (1999) have constructed a model that encompasses the many uses of mental imagery in sport. The model is centred on the types of images used by athletes (that is the five imagery types defined by the Sport Imagery Questionnaire), and includes variables which influence the use of imagery (sport situation and imagery ability) together with the subsequent predicted effects/outcomes of using specific types of imagery (e.g., facilitating the learning and performance of skills, increasing self-confidence). If this model is related to the current findings on imagery usage and confidence some interesting questions are developed.

Martins et al. (1999) state that one of the limitations of their model is that it does not specify individual differences that could influence the relationships among imagery usage and effects/outcome. An individual difference of particular relevance within the imagery use literature is skill level. Research evidence indicates that skill level has a differential effect on the type of imagery used by athletes. In the early stages of skill acquisition, novices attend to cognitive cues regarding the skill to be learnt (Fitz, 1962). Therefore, novices may use imagery primarily for its cognitive function to assist in the organisation of information (about the skill or strategy to be learnt) at the central processing level (Murphy & Jowdy, 1992). In the autonomous stage of learning when athletes have mastered their skills, they may be trying to gain peak performances in competitive situations. At this stage, athletes report using imagery for its motivational function (e.g., Hall et al., 1998). Specifically, Salmon et al. (1994) found that elite footballers used more motivational general imagery than local level footballers. Furthermore (although not comparing athletes of different skill levels), White and Hardy (1998) found that high level canoeists and gymnasts used more Motivational Specific (MS) imagery during competition than in training.

Theoretically, a link can be made between MS imagery and confidence. It has been suggested that imaging goals may enhance performers' confidence because they see themselves achieving their outcome goal (Bandura, 1977). Thus, although the previous sport psychology research has indicated that MG-M imagery can enhance confidence, other types of imagery may also enhance confidence. The imagery type that most effectively enhances confidence may depend on the athletes' skill levels and at what point they are in their competitive cycle.

It is important to find out which imagery types are effective for athletes of specific skill levels, so that appropriate imagery interventions can be administered to athletes. Thus, the first purpose of the present study was to explore the types of imagery that highly confident athletes, of different skill levels, use.

Although sport-type (e.g., team verses individual) was not included in the applied model of imagery, it was identified as a variable that may have differential effects on the usage of imagery. The present authors believe that sport-type is an important variable to examine, especially in relation to Cognitive General imagery. As Martins et al. (1999) state, the research on CG imagery is limited. However, so far, a relationship has not been found between CG imagery and confidence. In the case of Moritz and associates' (1996) study, CG did not account for variance in sport confidence. Furthermore, when White and Hardy (1998) interviewed high level performers, the performers did not report using imagery about strategies to enhance their confidence. This lack of relationship between CG and confidence is understandable due to the samples that this previous research has used. Moritz et al. (1996) and White and Hardy (1998) both used participants from individual sports - roller skating, slalom canoeing, and gymnastics. These individual sports perhaps require less interactive strategy than particular team sports such as football, basketball, or netball (Carron & Chelladurai, 1981). Consequently, CG imagery (e.g., I image each section of an event/game; offence vs defence, fast vs slow) may be used more in team sports because it provides the individual with the opportunity to work out, and/or through interactive strategies with both team mates and opposition present in the image.

Theoretically, it is understandable that CG may be linked to confidence with team sport athletes. Bandura (1997) states that self-efficacy beliefs are constructed from four principle sources of information; enactive mastery, vicarious experience, verbal persuasion, and physiological and affective states. With regard to vicarious experience, when applying CG to a team sport, the performer could image his or her team mates successfully executing strategies. Consequently, the imager would gain vicarious experience, about the task and therefore self-confidence about his/her team's ability to perform. Research has shown that vicarious experience can enhance self-efficacy (e.g., McAuley, 1985) and that it has a greater influence if the person observed is similar to the observer in skill and other relevant characteristics (Bandura, Blanchard, & Ritter, 1969). This could be the case if performer's images involve team mates as part of the situational context of the image. The second purpose of the present study was therefore to explore the relationship between imagery usage and high levels of confidence in netball players.

To summarise, in the present study, two questions were explored. Firstly, do more confident athletes, of different skill levels, use different types of imagery? Secondly, is the use of CG imagery related to sport confidence in team players? More specifically, it was hypothesised that MG-M, MG-A, CG, and MS imagery would predict sport confidence, with MG-M predicting the greatest variance in the sport confidence of lower skill level netballers, and MS predicting the greatest variance in the sport confidence of the higher skilled netballers. The hypothesis was formulated as such for three reasons. Firstly, MG-M and MS have been theoretically linked with confidence (e.g., Bandura 1977; Feltz, 1984; Vealey, 1986). Secondly, MG-M has been empirically linked with confidence (Moritz et al., 1996; Callow et al, provisionally accepted) and MS with use by high level/elite performers (Hall, et al , 1998; White & Hardy, 1998). Finally, depending on the skill level of the athlete these two types of imagery may have differential salience for increasing confidence. Specifically, athletes of a low skill level may come across many situations in a competitive match which they find particularly challenging, thus the use of MG-M to see themselves succeeding in these situations may be of particular pertinence in enhancing their confidence. This is not to say that higher skill level athletes do not experience challenging situations, but they would perhaps know they had the skill level to master these challenges, thus MG-M may not be of such pertinence in increasing their confidence. Rather, with higher level athletes, motivational specific imagery may be of particular pertinence in enhancing their confidence because they see themselves succeeding at their peak performance goals.

Method

Participants

One hundred and twenty-three female county netball players (from four different counties) participated in the study. For the purpose of the present study the four counties used for the sample were ordered based on the results of county rankings. The two counties with the lowest rank (those with the lower skill level) were placed in sample 1 and consisted of 56 players ($M = 14.02$; $SD = 1.23$). Whereas, the two counties with the highest rank (those with the highest skill level) were placed in sample 2 and consisted of 68 players ($M = 16.6$; $SD = 4.6$). All participants had at least two years of county netball experience.

Explanation of the Game of and Organisational Structure of Netball in the UK

Netball is a game that involves fourteen players (7 on each team, plus a maximum of 5 reserves for each team). The game is played on a 30.5m by 15.25m court, two netball posts of 3.05m high are situated at either end of the court. The idea of the game is to pass the ball from one team member to another, so that a goal may be scored, from within the shooting circle, by throwing the ball through the ring of the netball post. The game is very similar to basketball; however, the ball may only be bounced once. In the UK, netball is played at school, club, county, and national level. Each level has its own administrative network, and these networks liase to promote and develop performers up through the levels.

To be eligible to play at county level, potential county netballers are put forward by either their school or club for county trials (at county level netballers play in the following age groups, under 14s, 16s, 18s, and seniors). The netballers are put through a series of trials to show their netball skills and team play. During these trials the best players (usually ten per age group) are selected to play for the county. The netballer must trial each year for a place in the county squad. Through the same process the top county squad members are then selected to represent their respective international squads.

Measures

Sport Imagery Questionnaire. To assess imagery use the Sport Imagery

Questionnaire (SIQ; Hall et al., 1998) was administered. This inventory asks athletes to rate, how often they use five different types of imagery on a 7 point Likert scale, ranging from 1 (*rarely*) to 7 (*often*). The imagery types are as follows: Cognitive General (CG); Cognitive Specific (CS); Motivational General-Arousal (MG-A); Motivational General-Mastery (MG-M) and Motivation Specific (MS). All scales have been shown to have acceptable internal consistencies, with alpha coefficients ranging from .70 to .88; additionally interscale correlation's ranged from -.31 to .22 indicating that the scales represent different constructs (Hall, et al., 1998).

Sport Confidence Questionnaire. Sport confidence was assessed using Vealey's (1986) State Sport Confidence Inventory (SSCI). The inventory is administered prior to a game in order to assess the athletes' degree of confidence that they would be successful in that game. Each item is measured on a 9 point Likert scale, from 1 (*low*) to 9 (*high*). The SSCI has demonstrated good internal consistency $r = .95$ and adequate concurrent validity $r = .64$ (Vealey, 1986).

Procedure

Permission to use the county squad players, for the study, was gained via their respective county committees. So that the participants from the four counties were at a similar point in their competitive season the following procedure was utilised, for each county, within a three week period. At a county training session netballers were asked to volunteer for the experiment. Those who volunteered were administered the SIQ at the training session. One week after the training session, the SSCI was administered at a county match. At county matches each of the age groups (teams) are scheduled to play at different times during the day, consequently each of the teams were gathered, in the changing room, one hour prior to the start of their specific county match to fill in the inventory. All participants were asked to fill in the inventory without conferring with other team members. A total of 123 netballers (15 teams plus reserves) volunteered for the study.

Results

Out of 123 participants who completed the SIQ, 10 did not compete in the county match the following week and, therefore, did not complete the SSCI; a further 3 participants did not complete the SSCI fully. Thus, the raw data from 110 participants was used in the analysis, 50 participants from sample 1 (the low skill level) and 60 participants from sample 2 (the high skill level).

Descriptive Statistics of Samples

Levene's homogeneity of variance test revealed that the two samples had significantly different variances. To control for a Type 1 error (Stevens, 1996) unequal variance t-tests were employed. The first t-test revealed that there was a significant difference in age between the two samples t (68.91) = -4.08 $p < .001$. Visual inspection of the means indicated that participants in sample 2 were older than sample 1. The second t-test indicated a significant difference in state sport confidence between the two samples t (75.96) $p < .001$. Visual inspection of the means showed that sample 1 (lower skill level) had higher state sport confidence than sample 2 (higher skill level).

Interpretation of Sample Descriptive Statistics

Before hierarchical regression analysis of the sport confidence data could proceed the difference in chronological age and direction of confidence, between the two samples, needed to be explored. This exploration was carried out in order to establish if these factors could confound imagery usage.

As yet, imagery usage research in sport psychology has not examined whether imagery usage varies as a function of age. However, research in main stream psychology has investigated various components of imagery ability in relation to age. This research indicates that by the age of 14 individuals have developed most aspects of visual imagery, and that this does not greatly change into (early) adulthood (Isaac & Marks, 1994; Kosslyn, Margolis, Barrett, Goldknopf, & Daly, 1990). Thus, as the majority of the participants in the present study were older than 14 years of age, it was assumed that the two samples would not differ greatly in relation to imagery use.

Previous research has indicated a positive relationship between confidence and performance (e.g., Burton, 1988; Jones, et al., 1993; Martens et al., 1990). However, the results of the present study were contrary to this, with the higher skill level netballers having *lower* confidence than the lower skilled netballers. An explanation for this apparent contradiction may lie in the participants reports of their own self-confidence. Research has demonstrated that young adults are typically over confident in a wide variety of tasks (see Keren, 1991 for a review). In particular, research has shown novice participants are more over-confident than expert participants (Keren, 1987) and, also, that the more difficult a task the more over-confident participants are (Lichtenstein & Fischoff, 1977). In the present study, the two samples of netballers could have perceived the difficulty of the tasks that they were carrying out in different ways. That is, the lower skilled netballers could have perceived the tasks to be harder than the higher skilled performers perceived them. If this line of reasoning is followed, the combination of the lower skill level and perception of difficulty of the task may have led the participants in sample 1 to report over-confident scores in comparison to the higher skill performers in sample 2. Considering this line of reasoning, we assumed that the higher confidence levels of sample 1 was due to an overestimation of their confidence rather than the sample being from a negatively skewed distribution. Thus, we proceeded with the hierarchical analysis.

Descriptive Statistics of SIQ and SSCI Data

Using Cronbach's alphas the internal consistency of items measuring each of the Sport Imagery Questionnaire scales, and those measuring the State Sport Confident Inventory, were calculated, for both samples. All of the SIQ scales and the SSCI showed acceptable internal consistency, with alpha coefficients ranging from .71 to .97 (Nunnally, 1978).

Sport Confidence Analysis

Hierarchical regression analyses were employed on each of the samples to establish if the SIQ variables predicted sport confidence. The five SIQ variables were entered into the regression equation in the following order: MG-M; MG-A; MS; CG; CS. The rationale for this model was that MG-M and MG-A have been theoretically (e.g., Feltz, 1984; Vealey, 1986) and empirically (Moritz et al., 1996) linked with sport confidence. MG-M was entered first as this has been shown to be the strongest predictor of sport confidence in previous research. Because both MS and CG have a theoretical explanation as to why they might account for variance in sport confidence, it was difficult to decide which should be entered into the equation next. However, MS was put into the equation next because research (e.g., Salmon, et al., 1994) found that higher standard athletes used more motivational imagery than cognitive imagery and the participants from both samples played netball to a high standard. Furthermore, if CG did predict a significant amount of variance after all the motivational imagery types had been entered into the model then this would suggest that CG was a very strong predictor of sport confidence. CS was entered into the equation as the final variable.

Sport Confidence Analysis for Sample 1

The correlation coefficient matrix indicates high correlations between the imagery scales (refer to table 9); Belsley, Kuh, & Welsch, (1980) state that high correlations between independent variables has often been assumed to indicate multicollinearity.

	SSCI	MG-M	CG	MG-A	CS	MS
SSCI	1.00	0.45*	0.54*	0.16	0.41*	0.40*
MG-M		1.00	0.85*	0.77*	0.80*	0.81*
CG			1.00	0.69*	0.83*	0.71*
MG-A				1.00	0.68*	0.69*
CS					1.00	0.73*
MS						1.00

Table 9. Correlation coefficient matrix for sport confidence (sample 1) **p* <.001 (two tailed).

However, Belsley et al. (1980) contend that this use of the correlation matrix to calculate multicollinearity is flawed because the correlation matrix is incapable of diagnosing specific collinear relationships. For example, a high pairwise correlation between X_1, X_2, X_3, and X_4 could be due to a single near dependency involving all four variates; or to two separate near dependencies one between X_1 and X_2 and one between X_3 and X_4 The correlation matrix cannot identify where the collinearity lies between the four variates. Belsley and associates recommend the combined use of two methods to detect collinearity; variance decomposition proportions and the condition index. Variance decomposition provides an indicator of how much an independent variable contributes (as a proportion) to the total variance for that particular regression coefficient. Serious collinearity problems are indicated when an independent variable contributes more than 50% of the variance of two or more regression coefficients in a single regression equation. The condition index provides a number to show the extent of near singularity of independent variables. Condition indices around 10 indicate weak dependencies. Condition indices of 30 to 100 indicate moderate to strong dependencies and indices larger than 100 indicate serious collinearity problems. Belsley et al. recommend that any independent variable that has a condition index of above 30 and contributes more than 50% of the variance to two or more regression coefficients should be excluded from that regression model. This is because scores of this level, on the two diagnostic measures, indicate that the independent variable (in question) is having the greatest influence on the collinearity problem. When collinearity diagnostics were carried out on the present data, all imagery scales were below the recommended diagnostic threshold and were, therefore, included in the regression model. (See table 10 for collinearity diagnostics.)

		Condition Index	Variance Proportions					
Model	Dimension		(Constant)	MG-M	MG-A	MS	CG	CS
1	1	1.000	.02	.02				
	2	7.38	.98	.98				
2	1	1.00	.01	.00	.00			
	2	8.23	.99	.10	.13			
	3	13.26	.00	.90	.87			
3	1	1.00	.00	.00	.00	.00		
	2	8.07	.67	.01	.00	.21		
	3	12.27	.27	.00	.68	.42		
	4	17.09	.06	.99	.32	.37		
4	1	1.00	.00	.00	.00	.00	.00	
	2	9.01	.67	.01	.00	.19	.00	
	3	13.63	.32	.01	.38	.59	.06	
	4	14.44	.01	.03	.53	.07	.42	
	5	23.20	.00	.96	.09	.14	.52	
5	1	1.00	.00	.00	.00	.00	.00	.00
	2	9.86	.66	.00	.00	.17	.00	.00
	3	14.57	.21	.00	.02	.50	.17	.12
	4	15.07	.13	.00	.84	.17	.01	.03
	5	20.61	.00	.23	.05	.01	.18	.73
	6	26.03	.00	.76	.08	.16	.63	.11

Table 10. Collinearity diagnostics for the hierarchical regression analysis (sample 1).

The hierarchical regression analysis indicated that the five SIQ variables predicted a significant proportion of the variance in SSCI scores $R^2 = 0.41$, $F\,(5{,}44) = 6.1\ p <$ .001. MG-M accounted for the greatest proportion of the variance ($R^2_{\text{cha}} = .21\ p <$ .01); followed by CG ($R^2_{\text{cha}} =.10\ p < .01$) and then MG-A ($R^2_{\text{cha}} = .9$ p < .01). However, MG-A showed a significant negative relationship with sport confidence (beta -.54 $p < .01$). MS and CS did not account for a significant proportion of the variance in sport confidence (See table 11 for the hierarchical regression analysis results.)

Step	R^2	R^2_{cha}	F_{Cha}	Sig_{Cha}	Beta	Sig p
MG-M	0.21	0.21	12.44	0.00	0.27	0.00
MG-A	0.30	0.09	6.10	0.02	-0.54	0.01
MS	0.31	0.01	0.70	0.41	0.15	0.46
CG	0.41	0.10	7.61	0.01	0.64	0.01
CS	0.41	0.00	0.14	0.71	-0.08	0.71

Table 11. Results of the hierarchical regression analysis (sample 1).

Sport Confidence Analysis for Sample 2

Table 12 shows the correlation coefficient matrix for sport confidence.

	SC	MG-M	CG	MG-A	CS	MS
SC	1.00	0.16	0.05	0.06	0.12	0.35*
MG-M		1.00	0.65*	0.84*	0.67*	0.53*
CG			1.00	0.58*	0.79*	0.42*
MG-A				1.00	0.69*	0.52*
CS					1.00	0.48*
MS						1.00

Table 12. Correlation coefficient matrix for sport confidence (sample 2).

*p <.001 (two tailed).

The matrix shows high correlation between the SIQ subscales. When collinearity diagnostics were carried out on the data, the diagnostics indicated a moderate collinearity problem, with the final principle component (CS) having the greatest impact on the collinearity problem (condition index = 32.34, the variance decomposition proportions indication that CS contributed heavily, 82% and 78%, to the coefficients of MG-M and MG-A respectively, see table 13). Thus, in line with Belsley et al's (1980) recommendations the CS scale was removed from the regression equation. Collinearity diagnostics were carried out again and all of the imagery subscales were below the threshold for a collinearity problem.

		Condition Index	Variance Proportions					
Model	Dimension		(Constant)	MG-M	MG-A	MS	CG	CS
1	1	1.00	.01	.01				
	2	10.47	.99	.99				
2	1	1.00	.00	.00	.00			
	2	11.03	.95	.05	.12			
	3	21.79	.04	.95	.88			
3	1	1.00	.00	.00	.00	.00		
	2	8.97	.15	.01	.01	.91		
	3	12.97	.81	.06	.15	.09		
	4	25.05	.04	.93	.84	.00		
4	1	1.00	.00	.00	.00	.00	.00	
	2	9.82	.07	.00	.00	.94	.05	
	3	12.40	.48	.00	.00	.00	.62	
	4	15.29	.42	.07	.24	.06	.27	
	5	28.49	.04	.92	.76	.00	.05	
5	1	1.00	.00	.00	.00	.00	.00	.00
	2	10.58	.02	.00	.00	.92	.04	.01
	3	12.73	.50	.01	.01	.01	.18	.06
	4	16.75	.42	.07	.21	.06	.15	.00
	5	22.10	.02	.10	.00	.00	.47	.80
	6	32.34	.03	.82	.78	.00	.16	.12

Table 13. Collinearity diagnostics for hierarchical regression analysis (sample 2).

The SIQ variables were entered into the regression equation in the same order as for sample 1, but without CS that is: MG-M; MG-A; MS; CG. The four subscales of the SIQ predicted a significant proportion of the variance in SSCI scores $R^2 = .17$, $F(4, 55) = 2.88$, $p < .03$. However, MS was the only imagery scale that accounted for a significant proportion of the variance ($R^2_{cha} = .12$, $p < .01$). Table 14 indicates the results from the hierarchical regression analysis.

STEP	R^2	R^2_{cha}	F_{Cha}	Sig_{Cha}	Beta	Sig p
MG-M	0.03	0.03	1.59	0.21	0.31	0.20
MG-A	0.04	0.02	1.06	0.31	-0.34	0.15
MS	0.16	0.12	7.88	0.01	0.42	0.01
CG	0.17	0.01	0.72	0.40	-0.14	0.40

Table 14. Results of the hierarchical regression equation (sample 2).

Discussion

Taken together, the results of the present study indicate that netballers of different skill and confidence level use different types of imagery, and that CG imagery is related to confidence in lower skilled netballers. Specifically, lower skilled netballers who had high levels of confidence used more imagery about dealing with challenging situations (MG-M), and strategies of the game (CG), but less imagery about emotions (MG-A) than their less confident counterparts. Whereas, the higher skilled netballers, who were more confident used more goal achievement oriented imagery (MS) than their less confident counterparts. The results confirmed MG-M to predict the greatest proportion of variance in lower skilled netballers and MS to predict the greatest proportion of variance in higher skilled netballers.

As proposed in the introduction, the reason that different types of imagery may predict confidence in each of the samples, could be due to different types of imagery having a particular *pertinence* to the performer. Specifically, the use of MG-M may be particularly pertinent for the lower skilled netballers, because it allows them to see themselves mastering challenging situations. By doing this, they may be able to gain performance accomplishment information, which can enhance their efficacy expectations (Bandura, 1997). Conversely, because the participants in sample 2 were highly skilled (indeed, 11 out of the 60 netballers were actually international players) a more effective way to enhance their confidence may be through the use of goal-orientated imagery (MS); that is, using more specific images such as I image myself winning a championship (an outcome goal) or I image the atmosphere of winning a championship (the response to achieving an outcome goal). The SIQ items that measure MS imagery are related to outcome goals rather than performance or process goals (cf. Hardy 1997, 1998 for an explanation of the three types of goals). Imaging outcome goals may be of great motivational value for performers, through difficulties or long training periods (Hardy, 1997, 1998). Indeed, at a high skill level, imagery of outcome goals may enhance performers' confidence because they see themselves achieving their ultimate outcome goal (Bandura, 1977).

In the low skill sample, strategy rehearsal (CG) was associated with high sport confidence. This association was not found by Moritz et al. (1996). Again as proposed in the introduction, the reason for this conflicting result could be due to a team sport being used for the participant population as opposed to an individual sport as was used by Moritz et al. Netball is a game that relies heavily on general and team interactive strategy, whereas roller skating, may require less interactive strategy

(Carron & Chelladurai, 1981). Consequently, it is reasonable to assume that a netball player would utilise CG imagery to enhance their confidence, to a greater extent than a roller skater. Furthermore, as with the use of MG-M imagery, the use of CG imagery may be particularly pertinent to lower skill performers, as they can work on and run through strategies that they have not yet quite mastered.

Although MG-A predicted sport confidence in the low skill sample, the beta coefficients indicated a negative relationship; that is, more sport confident players used less MG-A than less confident players. This is counter to Moritz et al. (1996), who found a positive beta coefficient with their sample. The conflicting results may be due to the *function* that the imagery had for the performer. Bandura (1977) proposed that the effects of arousal upon performance are the results of efficacy expectations derived from the performer's cognitive appraisal of perceived arousal levels. Higher levels of confidence have been shown to be associated with more positive perceptions of physiological arousal (Jones & Swain, 1995). Thus, when a performer uses MG-A imagery (I imagine the stress and anxiety associated with competing) and these emotions are perceived positively, then the performer's efficacy expectations could increase. The roller skaters from Moritz et al's study could have used the MG-A imagery in a positive way while the netballers from sample 1 may have used it in a more negative way. To be more specific, participants from sample 1 may have imaged the emotional correlates of their doubts, whereas the roller skaters may have used emotional imagery more positively for the function of psyching themselves up. It follows from this, that it may not be *what* is imaged that influences self-confidence, but the *function* of what is being imaged. Of course, this argument is speculative, and precisely why the two samples may have differed with respect to the function of their imagery remains unclear.

The present study may have important theoretical and applied implications. Theoretically, the results provide some support for the view that skill level and sport-type may influence the use of imagery. Future research should further examine this finding in order to establish if these two variables should be included in future versions of the Applied Mental Imagery Model, Martins et al. (1999). Further, differentiation must be made between the type of imagery a performer uses and the function which it may have. This is because two performers may use the same type of imagery, but it may have a very different function for each of them. That is, one netballer may image strategies of play (CG) for the cognitive function of improving strategy, whereas another may image strategies of play for the motivational function of psyching themselves up to use the strategy. By understanding these differential effects we may gain a greater understanding regarding the efficacy of imagery. From an applied perspective, coaches must be aware of the pertinence (to their performers) of each type of imagery, so that the types of imagery recommended are of the greatest use to the performer. Furthermore, it is vital for coaches to emphasise general, team, and individual strategies in practices so that players have the opportunity to develop clear and accurate images of their strategical responsibilities.

CHAPTER 6

GENERAL DISCUSSION

Summary

The purpose of this research programme was to explore the cognitive and motivational effects of imagery on sport performance. The first section of this thesis explored the cognitive effects of imagery. Specifically, in the first study (chapter 2) the direct effects of different visual imagery perspectives and kinaesthetic imagery on the acquisition and retention of a simple gymnastics routine were explored. The results indicated that external visual imagery had superior effects over internal visual imagery on the acquisition of the routine. A significant interaction was found during the retention phase, offering support for the combined use of external visual imagery with kinaesthetic imagery, however, Tukey's follow-up tests failed to clarify the precise nature of this interpretation.

The relationship between visual imagery perspectives and kinaesthetic imagery was further explored in studies 2 and 3 (chapter 3) by correlating the visual imagery scales on the VMIQ (Isaac, Marks, & Russell, 1986) with the visual and kinaesthetic scales on the MIQ (Hall & Pongrac, 1983). Taken together, the results from these two studies provide tentative evidence that, when the imager is the object of the image, kinaesthetic imagery has a stronger association with external visual imagery than with internal visual imagery. However, because the tasks that performers are asked to image on the MIQ are essentially tasks that require form of movement, the results and subsequent interpretation from studies 2 and 3, may not generalise to other types of tasks.

The second section of the thesis explored the motivational effects of imagery. In the fourth study (chapter 4) a multiple-baseline design was used to explore the relationship between imagery and confidence. Specifically, the effects of a Motivational General-Mastery imagery intervention on the sport confidence of four high level badminton players were examined. The results indicated that the imagery intervention had a facilitative effect on confidence. A theoretical rationale was provided based on Bandura's (1977, 1997) self-efficacy theory. Specifically, the mastery imagery provided the performer with information which served to increase their efficacy expectations. The fifth study (chapter 5) of this thesis further explored the imagery/confidence relationship using Martin, Moritz, and Hall's (1999) Applied Mental Imagery Model, together with two further factors that may moderate the imagery/confidence relationship. These factors were sport-type and skill level. The results showed that with netballers of a lower skill level, higher sport confidence was associated with mastery imagery and imagery related to strategies of the game. Conversely, with netballers of a higher skill level, higher sport confidence was related to goal achievement oriented imagery. The results were interpreted in terms of the pertinence and function that different types of imagery may have for performers.

The specific implications of these studies have already been presented in their respective chapters. This final chapter draws together the central theoretical and applied issues raised by the chapters in an attempt to draw meaningful conclusions from the whole thesis. In addition, methodological and measurement issues are discussed together with the strengths and weaknesses of the thesis. Finally, future research directions are suggested.

Theoretical implications

Cognitive effects

The first section of this thesis examined the cognitive effects of imagery by exploring the effects of imagery perspectives on learning and performance. External visual imagery produced superior learning and performance gains in comparison to internal visual imagery on a form-based task. However, kinaesthetic imagery did not produce significant learning and performance effects, despite participants reporting that using kinaesthetic imagery was significantly more useful than not using kinaesthetic imagery. A theoretical explanation for these findings can be provided through Whiting and den Brinker's (1981) notion of the image of the act and image of achievement. In tasks which require form for their successful completion, external visual imagery might help the performer acquire the general framework (image of the act) for performance, because it provides the performer with additional information about the movement which they may not be able to gain from internal visual imagery. However, if performers are inexperienced at a task (as with the participants in this thesis) they may not know how the movement feels, thus they can not acquire a detailed "feel" for the required movements (image of achievement). Indeed, further support for this theoretical reasoning comes from another study reported in Hardy and Callow (1999). Expert performers were used as participants to examine the separate and interactive effects of internal and external visual imagery when used in conjunction with kinaesthetic imagery or without it during the acquisition and retention of rock-climbing problems. External visual imagery proved to be superior to internal visual imagery and kinaesthetic imagery was superior to no kinaesthetic imagery. Thus, when performers become more skilled, they may be able to fully utilise kinaesthetic imagery because they can acquire a more detailed "feel" for the required movements (image of achievement).

Not only is it important for a performer to be able to utilise kinaesthetic imagery, but they must also be able to identify with the kinaesthetic component of an image. Support for this contention is implicated from findings within studies 2 and 3. Specifically, only when participants became the object of the image was there a significant correlation between external visual imagery and kinaesthetic imagery. Denis, Englkamp, and Mohr (1991) contend that the representational properties of overt enactment and self-imagination differ from those involved in the imagination of another person. Specifically, these researchers suggest that imaging oneself in action may involve the evocation of motor programmes and the elicitation of kinaesthetic sensations which would not occur when visualising someone else. Thus, even if they were not the object of the image, performers may still be able to acquire an image of the act because they can gain knowledge about the general framework through imaging somebody else (in line with observational learning, cf. Wrisberg & Ragsdale, 1979; Minas, 1980; Isaac & Marks, 1992). However, they may not be able to gain a detailed understanding about the feel of the movement, thus they may not be able to operationalise an image of an act into an image of achievement.

From a theoretical perspective it seems that the effects of imagery may depend not only on the information that the image provides, but also on the resources that the performer has to create the image from. This then raises an interesting question, what are the resources and processes that underlie imagery effects? The processes underlying imagery may be very different depending on the demands of the task and what performance gains are required. For example, when imagining a gymnastics routine one could be imaging posture, configuration, or stability. On the other hand, one could be imaging location, force, and time (c.f. Smyth & Waller, 1998). Thus, if we are going to truly understand the effects of imagery we need to explore the resources and processes underlying imagery, in particular those pertaining to kinaesthetic imagery. Indeed, many of the major cognitive imagery theorists within mainstream psychology (e.g., Pylyshyn, 1973; Kosslyn, 1973; Paivio, 1979) have been criticised for not addressing the issue of somatic experiences during imagery (Ahsen, 1984). By exploring the processes underlying imagery effects perhaps we (as sport psychology researchers) may gain an understanding of the image-body relationship which we can then contribute to our parent discipline.

Motivational Effects

In study 1, those participants who experienced kinaesthetic imagery had greater self-confidence in achieving the task, than those who did not experience kinaesthetic imagery. Thus, consistent with the original framework proposed by Paivio (1985), this result provides further support that imagery has both a cognitive and motivational function.

Evidence for the motivational effects of imagery were explored and presented in studies 4 and 5. Specifically, the results of study 4 indicate that a mastery form of imagery can facilitate confidence. Bandura's self-efficacy theory (1997) and Lang's bio-informational theory (1988) can provide a theoretical rationale for this finding. Bandura (1997) contends that self-efficacy beliefs are constructed from four principle sources of information; enactive mastery, vicarious experience, verbal persuasion, and physiological and affective states. Bandura (1997) states, "Enactive mastery experiences are the most influential sources of efficacy information because they provide the most authentic evidence of whether one can muster whatever it takes to succeed" (p. 80). Enactive mastery is based on *personal mastery* experiences (rather than seeing *others* have mastery experiences, as in vicarious experience). Lang (1979) has argued that the meaning which imagers place upon their imagery has a profound influence upon their psychophysiological responses and the subsequent impact of the imagery upon their behaviour. Thus, in the present context, the author would argue that by "identifying" with their mastery images, performers may gain enactive mastery experiences. Furthermore, the results of study 5 were interpreted along these lines. That is, when a particular type of imagery (e.g., MG-M) has a particular pertinence to mastery, for a performer, then this type of imagery may be associated with confidence. Thus, if we are to gain a detailed understanding of the motivational effects of imagery we must take into account the meaning that an image has for a performer.

Of particular theoretical interest was the finding from study 5 of a negative beta relationship between arousal imagery and confidence in sample 1 (the low skilled group). In the discussion of study 5, this negative relationship was compared to the positive relationship found between arousal imagery and confidence by Moritz, Hall, Martin, and Vadocz (1996), and was discussed in terms of the function that images may have for performers. Function relates to the purpose that an image may have for a performer. For example, a footballer might image taking a penalty kick in football for the function of learning how to do the kick (cognitive function) or for the function of psyching themselves up (motivational function). In the present author's opinion, another important concept should be discussed here, that is the interpretation of an image. Although linked to function, interpretation is essentially different. For example, a footballer may image taking a penalty kick for the function of improving skill, but the image may be interpreted as being a challenge or a threat. Indeed, Hale and Whitehouse (1998) found that if participants had the situation they were imagining manipulated to be a pressure situation, then they had less confidence than those who had the same situation manipulated to be a challenge. With particular relevance to study 5, when using MG-A imagery (I imagine the stress and anxiety associated with competing) participants from sample 1 may have imaged the emotional correlates of their doubts and thus interpreted the image negatively. Conversely, the roller skaters (from Mortiz and associates' study, 1996) may have used the emotional imagery proactively to psych themselves up and interpreted the image positively. Thus, it may not be what is imaged that influences self-confidence, but the function and interpretation of what is being imaged. However, the explanation of the results, for sample 1, based on the negative interpretation of the emotional imagery, has an apparent contradiction because the participants in sample 1 reported high confidence levels. This poses the question how could they have these negative interpretations and also report being highly confident? There is a possible answer to this question. It could be that the participants from sample 1 (the low skilled sample) over-estimated their confidence (Keren, 1987; Lichtenstein & Fischoff, 1977) and that they did not, in fact, have the resources available to meet the demands of the task, thus leading to a negative interpretation of their emotional imagery. The present author does acknowledge that this discussion based on function and interpretation is highly speculative. However, it may be that if we are to fully understand the effects of imagery researchers should consider not only the function that an image has for an individual, but also their interpretation of that image.

Applied Implications

Cognitive Effects

The results of this thesis prove consistent with White and Hardy's (1995) that, task differences must be considered when proposing recommendations with regard to the most effective form of imagery to use for performance enhancing purposes. These considerations must take into account the requirements of the task to be imaged. It is recommended, based on the results in this thesis, the findings of White and Hardy (1995), and the findings of the other studies reported in Hardy and Callow (1999), that for tasks which require form of movement external visual imagery should be prescribed because this form of imagery seems to have superior learning and performance effects. The results on which to base recommendations with regard to kinaesthetic imagery are less clear cut. However, a further explanation can allow for greater clarification. Theoretical reasoning (e.g., Fitz & Posner, 1967; Whiting & den Brinker, 1981) and results presented in Hardy and Callow (1999) seem to indicate that, when performers are experienced at a task, kinaesthetic imagery can produce additional performance benefits. The implication for this is that when a performer is perfecting a skill, kinaesthetic imagery should be prescribed to help the performer with the fine detail of the skill. Thus, performers should be directed towards how a movement feels so that they can use this information to develop vivid kinaesthetic images and thus create an image of achievement (Whiting & den Brinker, 1981).

Although cognitive theorists do contend that kinaesthetic cues are used in the later stages of learning, some researchers (e.g., Phillips, 1941; Phillips & Summers, 1954) have found kinaesthetic cues to be related to early, but not the later, stages of learning. Furthermore, Graydon and Townsend (1984) found that participants who were asked to maximise attention to the feel of a move produced better performances when learning a trampolining forward summersault, a task which requires form of movement, than those who were given visuo-spatial information. However, the reverse was true for learning a badminton serve, a task which is performed in accordance with an external reference point. Thus, depending on the type of task, it seems that kinaesthetic cues can be used even in the early stages of learning. If this is the case then there is no reason why kinaesthetic imagery cannot be used during this stage of learning, and its use may in fact lead to performance benefits. However, coaches may have to direct the performers attention towards their kinaesthetic sensations so that vivid kinaesthetic images can be developed, this may be particularly important with junior performers. This is because, as Zaporozehets (1961) reported, children are usually more concerned with the end results of their actions, than with the means by which they achieve them, and that directing attention to movement enables them to learn a skill more easily.

Further support for directing the performer's attention towards their own sensations can be found from this thesis. In particular, for there to be a significant relationship between external visual imagery and kinaesthetic imagery, it was found that the participant needs to be the object of the image. Thus, if, as researchers (e.g., Hale & Whitehouse, 1998) suggest, performers should use video analysis to enhance their images, they must be given advice not only to pay attention to how the move would feel for them, but also on how to translate themselves into the image so that they can fully develop their kinaesthetic images.

These recommendations must be viewed with caution because the findings on which they are based do not take into account imagery perspective preference. That is, some performers may have a preference for kinaesthetic imagery and may not even be able to image from an external visual perspective, thus affecting the potential that the external visual perspective may have. Coaches and applied sport psychology practitioners would be well-advised to measure the imagery ability of performers prior to administering any imagery intervention, as the performers may need some specific imagery training to improve a particular perspective if they are going to get the maximum benefits from the imagery intervention. Ensuring that performers can image from both visual perspectives would enable them to switch between imagery perspectives. Switching between perspectives may be required for certain skills. For example, a double straight-back somersault in gymnastics has an obvious requirement for form while taking off and rotating, but adjustments to perceptual information about environmental changes might be the dominant factor in landing (Lee, Young, & Rewt, 1992). Similar arguments can be made for sports of an "open" nature. For example, in canoe slalom, (where performers have to manoeuvre in their canoe through a series of "gates" positioned along a stretch of fast moving water) requirements for form are needed when manoeuvring around and through a gate, whereas adjustments to perceptual information about the environment are required when moving from gate to gate. Thus, it may be necessary to use both external visual imagery and internal visual imagery in relation to these two requirements to gain maximum performance benefits.

Motivational Effects

The results presented in the second section of this thesis have important applied implications in terms of the effects that imagery can have on self-confidence; and can, specifically, provide a possible answer to a question recently posed by Gould, Guinan, Greenleaf, Medbery, and Peterson (1999). The results from study 4 indicate mastery imagery to have a motivational function by facilitating confidence. Thus, this function of imagery could be used as a possible psychological strategy to enhance self-confidence. Furthermore, these results suggest that mastery imagery may help to develop a "resilience" (Bandura, 1997, p. 80) in confidence. This resilience may protect against disconfirming experiences that an athlete may encounter and thus stabilise the performer's confidence. Gould, et al. (1999) report that the confidence levels of Olympic Games athletes can be atypically "fragile" and more easily shaken. These researchers subsequently ask the question "What can be done to sturdy one's confidence, particularly in an environment that is different from all other competitions and occurs only once every four years" (p. 391). The results from study 4 not only suggest a strategy to develop the performer's resilience with respect to self-confidence, but provides a way to recreate the Olympic experience as often as the performer desires. Indeed, a common strategy to help athletes to prepare for major competition is through "what if" scenarios (e.g., Miller, 1997). This is where athletes identify possible problems that they may encounter prior to and during the event. They then work out solutions to deal with and overcome these problems. The impact of this strategy could perhaps be enhanced by the athlete actually imaging themselves mastering these identified problems. Olympians could then provide themselves with a way of developing a resilience to their confidence when faced with disconfirming experiences. Care needs to be taken with these recommendations for two reasons. Firstly, future research is needed to confirm that mastery imagery can develop the resilience of performer's self-confidence. Secondly, the participants in study 4 were high level performers not Olympians so that, due to the individual nature of imagery, the findings may not generalise to Olympic athletes (cf. Murphy & Jowdy, 1992).

It must be noted that the interpretation of the results of study 5 suggests that the facilitative effects of imagery may depend on the pertinence, function, and/or interpretation that the image has for the performer. Thus, coaches and applied sport psychologists must be aware of: what performers are working on in terms of their skills and strategies; what motivates them; and the meaning they attach to their images. In particular, research has shown that negative images can have a detrimental effect on performance (Ungerleider, 1985) and that the same image can be cognitively appraised as being both facilitative and debilitative (Hale & Whitehouse, 1998). This must be kept in mind when delivering imagery through the medium of a workshop, with large numbers of athletes, where it maybe difficult to assess if the imagery proposed is actually having a positive effect.

Methodological Issues

Clearly, for a coherent picture of imagery effects to be established, imagery studies need not only to be linked with the previous research literature, but also connected in terms of their methodological components (cf. Goginsky & Collins, 1996). It is only through a systematic process of replication and extension that possible confounds can be identified and imagery effects explained and attributed. The present research program highlights the importance of this systematic process. By replicating and extending White and Hardy's (1995) study, it was confirmed that external visual imagery does have superior effects over internal visual imagery for form-based tasks. Theoretical reasoning provided a possible explanation for the results based on cognitive theory and the level of expertise of the participants in the study. Subsequently, a further study reported in Hardy and Callow (1999) confirmed that level of expertise may have moderated the effectiveness of kinaesthetic imagery. Studies 2 and 3 then provided confirmation for a further finding of study 1, that external visual imagery and kinaesthetic imagery can be used together. In a similar way, studies 4 and 5 were linked with the previous research. Study 4 explored the direction of causality of the MG-M imagery and confidence relationship highlighted by Mortiz et al. (1996), and study 5 identified factors which may moderate this type of relationship. If future imagery research is to overcome previous limitations it is imperative that systematic research is conducted so that a reliable and valid knowledge base can be developed from which appropriate conclusions can be drawn and theories evolve. However, as this thesis demonstrates this does not mean using only one particular methodology. Rather, it means the replication of certain methodological components to further clarify previous findings, and the use of appropriate (and, if required, new) methodologies to examine the research hypothesis in question.

In the present author's opinion, imagery research has been limited because it has used, in the past, predominantly nomothetic research methodologies, such as the pre-test post-test design in a laboratory or field-setting. Using this type of methodology has allowed for high internal validity with the ability to control and manipulate independent variables and a focus on the cognitive effects of imagery. However, this methodology can place artificial restrictions on the study of behaviour and hence reduce the generalizability of research findings (Martens, 1987; Locke, 1989). This is especially true when studying imagery effects, due to the individuality of imagery experiences (Ashen, 1984). Wollman (1986) proposed that imagery research would benefit by complementing traditional group design research with single-subject design research. This thesis provides one example to support Wollman's proposition. In fact, particular variations of the single-subject design (e.g., the multiple-baseline design) with appropriate statistical analysis not only complement traditional designs but can be used in their own right to answer causal research questions and produce research findings which have greater ecological validity (Locke, 1989; Seidentop, 1989). Further to this, in a discipline which has been criticised because it has used predominantly male college students as its participant population (Greenspan & Feltz, 1989), single-subject designs provide a methodology which can overcome certain ethical problems encountered with elite performers (Hardy, Jones, & Gould, 1996) when carrying out nomothetic research. Indeed, the exploration of individual imagery effects through idiographic designs allows for an insight into imagery effects which may be unique to high level/elite performers. However, idiographic designs do have their limitations. It is acknowledged that although causal relationships can be identified they are unique to the participant involved, and the generalizability of the results must be viewed with caution. It could also be argued that idiographic designs do not in fact take account of individual differences, because they remove them from the equation by considering only a particular individual. However, if one assumes that behaviour is lawful, then identifying sources of variability in one participant should give at least some information about sources of variability in other similar participants (Kazdin, 1982).

Indeed, when testing strong hypotheses, if a multiple-baseline across participant design is employed then individual differences between the participants can possibly be identified.

Measurement Issues

When exploring imagery effects it is important to know if the participant can in fact image because as Hall (1985) states, "If performers are asked to use an imagery strategy and they are low imagers, it is likely that no effect or only a small effect for the condition will be shown." (p. 18). This then raises the issue of how to measure imagery. It is acknowledged, in this thesis, that despite self-report measures being the most practical way to measure imagery ability, they can be subject to social desirability and acquiescence effects (that is applying the same rating to each vividness scale) Moran (1993).

The results of studies 2 and 3 should be viewed with caution because the Vividness of Movement Imagery Questionnaire has not been validated for the specific use it was employed for in these studies. The VMIQ was originally designed to measure movement imagery relevant to: visual imagery of movement itself, and the imagery of kinaesthetic sensations. Participants are directed to create images of someone else performing a particular movement, and to image themselves performing the movement (Isaac et al., 1986). However, as the participants are directed to create the images with respect to someone else and then themselves, one could assume this would involve the visual perspectives of external visual imagery and internal visual imagery respectively. Although the VMIQ and MIQ are valid and reliable questionnaires their relevance for specific sporting situations has been recently questioned. Specifically, it has been proposed that the current versions of these questionnaires are general in nature and that in many research settings it would be applicable to have more specific instruments (Hall, 1998).

The fact that changing the instructional set in study 3 had an impact on the results highlights that care and consideration needs to be taken when using imagery questionnaires as research tools. Specifically, researchers not only need to fully understand the questionnaires they are using, they also need to ensure that the questionnaires actually measure the desired construct. Furthermore, Nunnally (1978) is sceptical about the method that questionnaires use for measuring magnitude of dimensions (e.g., vividness of imagery). In particular, Nunnally questions whether a participant can accurately partition the dimension being measured into uniform segments (e.g., the 5 point Likert scale of the VMIQ). This suggested inaccuracy can lead to the researcher having no definitive evidence on the consistency and precision of the participants' responses. Magnitude estimation scaling (Stevens, 1975) could be used to overcome this limitation. Relating this method to the measurement of vividness of imagery, participants would be asked to create an image and to assign any number to the vividness of that image. This number acts as the participants standard, they then rate the vividness of subsequent successive images in relation to the first assigned number to provide a scale of vividness. An extension of this method is cross-modality matching (cf. Stevens, 1975). Here the magnitude of two or more types of stimuli across modalities are estimated, and then the relative magnitude of the stimuli compared. Thus, for example, a particular image may produce an external visual imagery vividness of five, this may correspond to a kinaesthetic imagery vividness of six, and an internal imagery vividness of two.

Direct comparison between the visual imagery perspectives and kinaesthetic imagery can possibly be made, in the present example comparison of the vividness magnitudes indicates that external visual imagery may be associated with a greater vividness of kinaesthetic imagery, than internal visual imagery with kinaesthetic imagery.

If researchers are going to answer questions about the processes and mechanisms underlying imagery, then they must have a greater awareness regarding what the cognitive processes are that the current imagery questionnaires actually measure. The VMIQ requires participants to construct a visual image of movement by, for example, recalling the image of swinging on a rope or slipping on ice from long term memory. On the other hand, the MIQ requires participants to perform a movement and then form an image of it. Thus, participants are using short-term motor memory and imagery generation. The two questionnaires therefore require very different processes to create the images requested. It is difficult to gain an understanding of the underlying processes and mechanisms of imagery from introspection based on questionnaire data. However, the use of multidimensional scaling could possibly aid our understanding in this area. Multidimensional scaling is a statistical technique that allows the dimensions of constructs to be delivered from empirically obtained data. It does this by representing similarities or dissimilarities between constructs as distances on a spatial map. Constructs that are judged to be experimentally similar to one another are represented as points close to each other in a resultant spatial map. Constructs judged to be dissimilar are represented as points distant from one another. If constructs "group" together then this indicates an underlying dimension. As multidimensional scaling is not based on the assumption of linear relationships between the variables, which can be a severe assumption with regard to perceptual data (Schiffman, Reynolds, & Young, 1981), it is a suitable technique to measure vividness of imagery. Specifically, the method could be used to measure the similarities (or dissimilarities) between internal visual imagery, external visual imagery, and kinaesthetic imagery based on some of the processes of imagery that are explored in main stream psychology that is: imagery generation, maintenance, inspection, and transformation (Dror & Kosslyn, 1994). Indeed, Murphy (1990) proposed the use of magnitude estimation scaling and multidimensional scaling as two psychometric methods to improve future imagery research. The present author reiterates this recommendation.

Another note of caution relates to the Sports Imagery Questionnaire (Hall, Mack, Paivio, & Hausenblas, 1998). This questionnaire measures imagery use rather than ability. With reference to the present research program, it is not known if the participants actually had the ability to image the different types of imagery. Thus, it is difficult to establish if a particular imagery type is not used because it lacks pertinence to the performer or because they did not have the ability to image it.

Strengths of the Research Programme

The present research programme has a number of strengths which distinguish it. As already discussed within this chapter, the research programme is tied to previous imagery research and provides five methodologically sound studies which help to move the imagery knowledge base forward. The combined use of nomothetic and idiographic research designs is a considerable strength. In particular, although the use of idiographic research is growing within the sport psychology literature (e.g., Swain & Jones, 1995; Jackson, Dover, & Mayocchi, 1998; Gould, Eklund, &

Jackson, 1992; Scanlan, Stein, & Ravizza, 1991) to date only two notable studies have used this methodology to examine imagery effects/usage (Shambrook & Bull, 1996; White & Hardy, 1998), study 3 now adds to this body of research.

An additional strength of the research programme was the amount of control exerted over the treatment conditions in the experimental studies. For example, with the first study any participants who could not image adequately (as defined by gaining a score of 144 on the VMIQ and 72 or below on the MIQ) were not used as a participants in the study. A further six participants were excluded from the data set for showing ceiling effects with the gymnastics routine. Establishing control over the experimental condition was important as exploring imagery effects in participants who could not image or who were imaging the wrong perspective or type of imagery would clearly confound results. The use of manipulation checks, in the form of interviews and questionnaires, further facilitated the process of control (cf., Wollman, 1986; Murphy, 1990) by ensuring that participants could comply with the experimental treatment (study 1) and were in fact using the appropriate type of imagery (study 4).

Throughout this thesis statistical rigour was firmly maintained. In study 1, the Box M test for homogeneity of dispersion matrices was significant for both the acquisition and retention phase. Data transformations were performed on the data but failed to rectify the problem. However, in line with Stevens (1996), it was assumed that Type 1 error rate would only be slightly affected, whilst power would be weakened. Thus, it would have been relatively safe to interpret highly significant effects because they were robust enough to appear despite the low power of the tests performed. With this in mind, when the results showed a significant interaction between visual imagery and kinaesthetic imagery $F(1, 29) = 4.37, p < .05$ but Tukey's tests failed to find any significant differences between groups, because the F value was low, the significant interaction was interpreted as being due to a Type 1 error. Effect sizes were also reported for this study as Thomas (1983) contends that this calculation provides qualification and quantification of statements of significance.

In studies 2 and 3 because multiple t-tests and correlations were conducted on the same set of data, appropriate adjustments were made to the statistical tests employed to guard against inflated Type 1 error (Stevens, 1996). These adjustments included the use of Bonferroni corrections with multiple t-tests, adjustment of the critical r for multiple correlations (Schutz & Gessaroli, 1993), and the use of adjusted equations when comparing correlated co-efficients (Meng, Rosenthal, & Rubin, 1992).

Within the recent sport psychology literature the use of single-subject design research has increased; however, the majority of published studies have used visual inspection of graphed data, lines, slopes, and mean data to draw conclusions about interventions (e.g., Galvan & Ward, 1998; Lerner, Ostrow, Yura, & Etzel, 1996; Swain & Jones, 1995; Wanlin, Hrycaiko, Martin, & Mahon, 1997). Certain researchers (e.g., Gottman & Glass, 1978) have been sceptical about the validity of the conclusions drawn from this type of analysis. Perhaps their scepticism is understandable because judges, even when experts in the field, often disagree about a particular conclusion when it is drawn from visual inspection and mean data (e.g., DeProspero & Cohen, 1979). However, the use of non-parametric statistical tests can strengthen the reliability of conclusions drawn from single-subject design research (Kazdin, 1982). Unfortunately, recent proponents of this design (e.g., Hrycaiko & Martin, 1996; Reboussin & Morgan, 1996) have failed to recommend the use of statistical tests with single-subject designs. The present author recognises that there are arguments against the use of statistics with this design. For example, a focus on statistics might divert researchers' attention from further developing interventions (cf. Baer, 1977). Similarly, there is no empirical evidence that the adoption of statistical inference procedures actually improves the judgements of researchers as to whether their treatments are responsible for changes in the performance of participants (cf. Michael, 1974). However, in the present author's opinion these arguments are perhaps short-sighted. Firstly, it is unlikely that an enquiring and conscientious researcher using a single-subject design would stop the development of their methodology due to the use of statistics. Secondly, one of the reasons for using statistics is not to improve the researchers judgements, but to give confidence to their judgements. It is vital that proponents of single-subject designs do support the use of statistics because the use of statistics can increase the confidence placed on the interpretation of the research findings. Further, in a research climate (within sport psychology) which has a preference for quantitative methodology and the use of the .05 probability level (cf. Hrycaiko & Martin, 1996), the use of statistics would perhaps provide the methodology with greater acceptance to the research community.

With reference to study 5, when using multiple regression analysis to analyse if any of the SIQ imagery types (Hall et al., 1998) predicted sport confidence, the covariance matrix suggested that the data might be exhibiting multicollinearity.

However, on further investigation, the author found research literature to indicate that the common use of the covariance matrix within sport psychology research to assess multicollinearity (e.g., Renger, 1993) is in fact flawed (Belsley, Kuh, & Welsch, 1980). Thus, as advised by Belsley, et al. (1980), variance decomposition proportions and the condition index were used to detect collinearity problems. The use of these two analyses, in study 5, detected a serious collinarity problem with the second sample, subsequently the dependent variable causing the collinearity was removed from the regression equation.

Weaknesses of the Research Programme

Although experimental control by selecting participants based on their ability to image in study 1 was identified as a strength, it must also be acknowledged as a weakness. Attempts to maintain control reduced the statistical power of the study, and therefore the probability of committing a Type II error increased (Cohen, 1992; Schutz & Gessoroli, 1993). The balance between experimental control and Cohen's estimations of participant numbers required to establish good statistical power is a serious issue for imagery researchers to examine. In study 1, because the focus of the research program was the study of imagery effects, it was decided that establishing control over the experimental conditions was most important. Using participants who could not image would not facilitate this process.

A second weakness of the research programme was the lack of traditional and/or multiple control groups used in study 1, and a control participant in study 4. This is especially the case as researchers (e.g., Wollman, 1986) have proposed the use of multiple control groups to better isolate the factors that are necessary for performance improvements within imagery research. However, there are a number of problems associated with control groups within imagery literature. Firstly, the pragmatics of using multiple control groups are difficult, and as Wollman points out, sometimes not feasible. Secondly, with the use of traditional control groups, it is difficult to ensure that the participants will do nothing, and also to predict exactly what they will do. With distraction groups, it is difficult to establish if differences between the control group and the treatment group have been caused by the interference effects of the control group, rather than enhanced performance of the treatment group. With study 4, the use of a control participant was not required. This is because a multiple-baseline design across participants design was employed and, if each baseline changes when the intervention is introduced then the effects can be attributed to the intervention thus the design allows for its own control. However, as previously discussed one of the limitations of idiographic research is the lack of external validity. One of the findings and subsequent interpretation in study 4 is particularly limited with respect to external validity. Participant 3, in study 4, had a large variance in their sport confidence scores, in the baseline phase. Immediately prior to the intervention they moved up a level in league. After the intervention, their confidence scores decreased but the variance in confidence reduced. This finding was interpreted as the intervention providing a 'resilience' to the performers confidence. As a single-subject design was used and there was only one example of this result, external validity (generalizability) is weak. If a group design had been employed this effect might have been masked. However, leading from this finding a group design is now needed to explore the possible stabilising effect of imagery. Hence, the importance of using a diverse number of research methodologies is highlighted.

The above discussion does raise an interesting but difficult question: is it the imagery per se or the participants' expectation that the imagery will work which causes improvements in performance and confidence? From a purely applied perspective an answer to this question may not be relevant, if the strategy works, then use it. However, the question does raise issues with regard to presentation of psychological strategies to performers. On the other hand, from a theoretical position it is important to know the answer to this question. Clearly, the current thesis does not address this question and, this should, perhaps, be acknowledged as a weakness of the research program. However, the theoretical implications derived from the thesis point to a possible research direction which could be used to explore if it is the imagery that causes the effects. That is, by researching the processes underlying imagery effects, for example, at a neurophysiological level (e.g., Mellet, Petit, Mazoyer, Denis, & Tzourio, 1998), we may gain an understanding of how imagery exerts its effects.

Future Research Directions

A number of research directions are implicated from this research program. The results presented in study 1, by Hardy and Callow (1999), and by White and Hardy (1995) provide strong evidence to suggest that external visual imagery enhances the performance of tasks which require form of movement, and a theoretical rationale for why internal visual imagery should enhance the performance of a task which required changes to be made in response to environmental cues. However, to date, only White and Hardy (1995) have examined the effect of imagery perspectives on a task of this nature, a wheel chair slalom task. Thus, there is a need to replicate and confirm these findings, possibly with a more ecologically valid task.

As discussed in the applied implications section of this chapter some tasks may require both form of movement and adjustments to be made in response to perceptual information about environmental changes. One way to explore if performers use kinaesthetic imagery with visual imagery perspectives would be to examine performers' use of these types of imagery in a sport which uses both form of movement and adjustments to perceptual information about environmental changes. For example, three day event riders in the dressage event have to produce form-based movements with the horse, in accordance to a technical model. In the cross country event, the rider and horse have to proceed over a course of jumps (without missing any) as quickly as possible, thus the rider uses perceptual information to make decisions about movement in relationship to environmental changes, for example, how close they are to the jump before the rider "asks" the horse to jump. Examining a sport of this nature not only has the advantage of including skills that require both form and perceptual information, but the participants could serve as their own controls.

The results of the present research programme suggest that kinaesthetic imagery alone may not produce performance benefits. However, theoretical reasoning and other results reported in Hardy and Callow (1999) suggest that, if the performer is experienced at the task, kinaesthetic imagery can produce performance gains. Very little is known about kinaesthetic imagery, for example, what exactly is kinaesthetic imagery and what are the processes underlying it? Smyth and Waller (1998) have proposed that motor imagery (which by their definition is a kinaesthetic phenomenal experience) may be more than just how a movement feels, that is force and effort.

They propose that it may include configurational and spatial components. Thus, research into the possible components of kinaesthetic imagery and their interaction with visual imagery perspectives would not only extend our knowledge about imagery effects, but also, perhaps, the processes underlying them.

Furthermore, the results in study 1 indicating that kinaesthetic imagery enhanced participants' confidence to perform a task are worthy of further examination. Of particular interest would be research into this area from an applied perspective. For example, Evans (1999) reported that self-confidence seems to play a very important role in adherence to rehabilitation programmes and re-entry into sport following serious injury. Thus, examining the effect of kinaesthetic imagery not only on the performer's confidence that the injury was healing, but also the subsequent effect that this may have on adherence to rehabilitation and on performance when returning to sport, would be exciting and relevant. The single-subject design employed in study 4 would provide an excellent way of examining the possible effects that the imagery may have on rehabilitation, (as long as the baseline phase was kept to a minimum).

The motivational effects of imagery are clearly complex in nature. Imagery researchers examining such effects of imagery need to be aware not only of the pertinence of imagery to the performer, but the function that the image serves for the performer, and the interpretation that the performer places on the image. Through exploring the pertinence, function, and interpretation that imagery has for different performers, a greater understanding regarding the motivational effect of imagery may possibly be gained.

In recent years, imagery research has explored the effect of imagery on individual sports (e.g., Moritz et al., 1996: White & Hardy, 1998). Group dynamics research has been criticised for its lack of research into intervention strategies which may enhance factors such as group cohesion or collective efficacy (Widmeyer, Brawley, & Carron, 1992). Perhaps imagery could provide a possible strategy to enhance collective efficacy. Specifically, study 3 indicated cognitive general imagery (e.g., imaging strategies of play) to be associated with sport confidence. As vicarious experience (seeing others succeed) has been shown to predict collective efficacy (Chase, Feltz, Tully, & Lirgg, 1994), it would make intuitive sense that cognitive general imagery may also predict collective efficacy.

To summarise, this thesis had two purposes firstly, to explore the cognitive and motivational effects of imagery upon sport performance through a series of methodologically sound studies. Secondly, to provide a vehicle for research training. In the present author's opinion, the thesis has successfully achieved these two purposes. It has provided research papers that have contributed to, and extended our knowledge of, the effects of imagery, and has provided a number of future directions for imagery research. Furthermore, the training I have gained through this thesis has given me a firm foundation in research, which I hope to be able to continually develop and pass on to future researchers.

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APPENDIX A

VIVIDNESS OF MOVEMENT IMAGERY QUESTIONNAIRE[5]

TOTAL SCORES

(a) other =
(b) self =
(c) total (a)+(b) =

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 somebody else 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 somebody else 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 somebody else	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

[5] With permission from first author

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

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

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9. Falling forwards		
10. Running up stairs		
11. Jumping sideways		
12. Slipping over backwards		

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

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

	Watching somebody else	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		

---

17. Running downhill		
18. Climbing over a high wall		
19. Sliding on ice		
20. Riding a bike		

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
Think of each of the following acts, classify the images according to the degree of

clearness and vividness as shown on the RATING SCALE.

21. Jumping into water		
22. Swinging on a rope		
23. Balancing on one leg		
24. Jumping off a high wall		

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

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

APPENDIX B

MOVEMENT IMAGERY QUESTIONNAIRE[6]

INSTRUCTIONS

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 the formation of a mental (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 describe 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 mental image as possible of the movement just performed, or 2) attempt to positively 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 any number of movements "imaged" or "felt" and it is not necessary to utilize the entire length of the scale.

RATING SCALES

Visual Imagery Scale

1	2	3	4	5	6	7
Very Easy to picture	Easy to picture	Somewhat easy to picture	Neutral (Not Easy nor Hard)	Somewhat hard to picture	Hard to Picture	Very hard Picture

Kinesthetic Imagery Scale

1	2	3	4	5	6	7
Very Easy to feel	Easy to feel	Somewhat easy to feel	Neutral (Not Easy nor Hard)	Somewhat hard to feel	Hard to feel	Very hard feel

[6] With permission from first author

1. STARTING POSITION:	Make a fist with your dominant hand (the hand you write with)and then place this hand on the same shoulder (e.g., right hand on right shoulder) such that your elbow is pointing directly in front of you.
ACTION: Be sure to read the entire action before attempted it	Extend your elbow so that your hand leaves your shoulder and is straight in front of you parallel to the floor. Keep your hand in a fist. Make this movement slowly.
MENTAL TASK:	Assume the starting position (exactly as described above). Form as clear and vivid a mental image as possible of the movement just performed. DO NOT PERFORM THE MOVEMENT. Now rate the ease/difficulty with which you were able to do this mental task.
	Rating
2. 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 you are once 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
3. 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 side
MENTAL TASK:	Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. 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 at your side.
ACTION:	Jump upwards and rotate your entire body to the left such that you land in the same position in which you started. That is rotate to the left in a complete (360°) circle.
MENTAL TASK:	Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficult with which you were able to do this mental task.

Rating

5. 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. Form as clear and vivid a mental image as possible of the movement just performed. 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 left leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your support (right) leg straight. Now lower you left leg so you are once 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

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 your hands). Now return to the starting position, standing erect with your arms extended above your head.
MENTAL TASK:	Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

8. STARTING POSITION:	Make a fist with your nondominant hand. Extend your arm above your head keeping you hand in a fist. Keep you other arm at your side.
ACTION:	Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your hand clenched.
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

9. STARTING POSITION: Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.

ACTION: Perform a front somersault (roll) on the mat and finish in a standing position.

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

10. STARTING POSITION: Make a fist with your dominant hand (the hand you write with) and then place this hand on the same shoulder (e.g. right hand on right shoulder) such that your elbow is pointing directly in front of you.

ACTION: Extend your elbow so that your hand that was your shoulder and is straight in front of you parallel to the floor. Keep your hand in a fist. Make this 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

11. 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 you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

12. 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 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

13. STARTING POSITION: Stand with your feet slightly apart and your arms at your sides.

ACTION: Jump upwards and rotate your entire body to the left such that you land in the same position in which you started. That is, rotate to the left in a complete 360 circle.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

14. 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

15. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your left; leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your upper (right) leg straight. Now lower your left leg so you are once again standing on two feet Perform these to actions slowly.

MENTAL TASK: Assume the staring position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

16. 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 your 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

17. STARTING POSITION: Make a fist with your nondominant hand. Extend your arm above

	your head keeping you hand in a fist. Keep your other arm at your side.
ACTION:	Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your hand clenched.
MENTAL TASK:	Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.
	Rating
18. STARTING POSITION:	Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.
ACTION:	Perform a front somersault (roll) on the mat and finish in a standing position.
MENTAL TASK:	Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.
	Rating

APPENDIX C

IMAGERY SCRIPTS

External Visual Imagery and Kinesthetic Imagery

Sit down in a place where you will not be disturbed....Uncross your legs and arms....Concentrate on your breathing and relax.....*Feel the tension release from your body*.....You are going to imagine yourself doing the gymnastics routine as if you are on the outside watching yourself. That is from an external perspective. Imagine the room that you are in......How high is the ceiling?..... What sort of lighting is there?..... What sounds are there?.....See and sense as much detail as possible. See yourself standing ready to start the gymnastics routine. Your head is facing forwards. *Feel the warm air going in through your nose or mouth and fill your lungs*......Imagine your arms curved just in front of you and the shape that they make.......*Feel the tension in your back holding you upright*.......imagine your heels locked together and your feet in the "ten to two" position. *Feel your leg muscles tighten* as you step forwards with your left leg into the lunge...... your knee joint is at 90 degrees and your right leg back straight......*Feel the tension in your legs supporting your body weight*......Now imagine your arms......see your right arm horizontal in front of you, palm facing downwards...... and your left arm held out straight in front of you at 45 degrees palm facing downwards. ...... See the shape that you are forming..... Hold that image in your mind......Remember you are watching yourself from the outside. Imagine yourself moving into the arabesque.....*Feel all of your body weight move onto your left leg*.....and your right leg lift behind you *feel the stretch in your right leg from your hip down to your toe*...... Imagine circling right arm back until it is straight behind and your left arm straighten in front of you.....Recall your body position ....Imagine yourself bending down into a tucked position your hands flat on the floor.....Feel yourself steady as you extend your legs upwards slowly and under control and your legs disappear from your view...... *Feel the tension through your body and your weight on your head and hands*.....Imagine holding the balance for 4 seconds.......Imagine bringing your legs back down to the ground watch them tuck in front of you...... See your feet touch the floor. Imagine yourself returning to the standing position......Your head is facing forwards......*Feel the warm air going in through your nose or mouth and fill your lungs*...... Imagine your arms curved just in front of you and the shape that they make.......*Feel the tension in your back holding you upright*.......imagine your heels together and your feet in the "ten to two" position. Stand feet together toes forward. Arms down by your side palms facing inwards. Shoulders square head facing forwards.

Internal Visual Imagery and Kinesthetic Imagery

Sit down in a place where you will not be disturbed....Uncross your legs and arms....Concentrate on your breathing and relax.....*Feel the tension release from your body*.....You are going to imagine yourself doing the gymnastics routine from the first person perspective as if you are actually doing the performance. Imagine the room that you are in......How high is the ceiling?..... What sort of lighting is there?..... What sounds are there?.....See and sense as much detail as possible. Imagine yourself standing ready to start the gymnastics routine. Your head is facing forwards.....Notice the colour of the wall and the wall bars in front of you.......Look down and see what you are wearing.......*Feel the warm air going in through your nose or mouth and fill your lungs*.......*Feel the tension in your back holding you upright*.......*Feel your leg muscles tighten* as you step forwards with your left leg into the lunge.....*Feel the tension in your legs supporting your body weight*......Your view of the wall changes... notice any marks on the wall.....you see your right arm horizontally out in front of you, palm facing downwards...... and your left arm held out straight in front of you at 45 degrees palm facing downwards. ......Notice the texture of what your wearing and the color of your hands...... Hold that image in your mind......Imagine yourself moving into the arabesque.....*Feel all of your body weight move onto your left leg*.....and your right leg lift behind you *feel the stretch in your left leg from your hip down to your toe*...... See your right arm circle behind you and your left arm straighten in front of you..... Hold that image in your mind.......Imagine yourself bending down into a tucked position your hands flat on the floor.....Your eyes follow the line of the wall down to the floor. Notice the color of the mat.....Imagine the view that you have of the floor and the wall behind you ......every thing is upside down. Imagine you hands and your legs tucked in front of you..... Feel yourself steady as you extend your legs upwards slowly and under control and your legs disappear from your view...... *Feel the tension through your body and your weight on your head and hands*.....Imagine holding the balance for 4 seconds.......Imagine bringing your legs back down to the ground watch them tuck in front of you...... See your feet touch the floor. Imagine yourself returning to the standing position....... *Feel the tension in your back holding you upright.*

External Visual Imagery

Sit down in a place where you will not be disturbed....Uncross your legs and arms....Concentrate on your breathing and relax.....You are going to imagine yourself doing the gymnastics routine as if you are on the outside watching yourself doing it. Imagine the room that you are in......How high is the ceiling?..... What sort of lighting is there?..... What sounds are there?.....See and sense as much detail as possible. Imagine yourself standing ready to start the gymnastics routine. Your head is facing forwards. Imagine your arms curved just in front of you and the shape that they make.....imagine your heels together and your feet in the "ten to two" position. Imagine stepping forwards with your left leg into the lunge...... your knee joint is at 90 degrees and your right leg back......Now imagine your arms......see your right arm horizontal in front of you, palm facing downwards...... and your left arm held out straight in front of you at 45 degrees palm facing downwards. See the shape that you are forming..... Hold that image in your mind......Imagine yourself moving into the arabesque.....Step onto your left leg.....and lift your right leg behind you...... Imagine circling right arm back until it is straight behind and your left arm straighten in front of you.....Recall your body position......Hold that image in your mind.......Remember you are watching yourself from the outside. Imagine yourself bending down into a tucked position your hands flat on the floor imagine squashing your nose on the mat...... Establish a good base while the body is still in the tuck position.....Imagine extending your legs upwards slowly and under control. Imagine holding the balance for 4 seconds....... See yourself bringing your legs back down into the tucked position and then feet to the floor. Imagine yourself returning to the standing position. Your head is facing forwards......Imagine your arms curved just in front of you and the shape that they make.......imagine your heels together and your feet in the "ten to two" position. Stand feet together toes forward. Arms down by your side palms facing inwards. Shoulders square head facing forwards

Internal Visual Imagery

Sit down in a place where you will not be disturbed....Uncross your legs and arms....Concentrate on your breathing and relax......You are going to imagine yourself doing the gymnastics routine from the first person perspective as if you are actually doing the performance. Imagine the room that you are in......How high is the ceiling?..... What sort of lighting is there?..... What sounds are there?.....See and sense as much detail as possible. imagine yourself standing ready to start the gymnastics routine. Your head is facing forwards.....Notice the color of the wall and the wall bars in front of you.......Look down and see what you are wearing.......Your view of the wall changes... notice any marks on the wall.....you see your right arm horizontal in front of you, palm facing downwards...... and your left arm held out straight in front of you at 45 degrees palm facing downwards. ......Notice the texture of what your wearing and the color of your hands...... Hold that image in your mind......Imagine yourself moving into the arabesque..... See your right arm move out of your left arm straighten in front of you..... Hold that image in your mind.......Imagine yourself bending down into a tucked position your hands flat on the floor your eyes follow the line on the wall down to the floor....Notice the color of the mat.....Imagine the view that you have of the floor and the wall behind you ......every thing is upside down. Imagine you hands and the color of the veins on your hands and your legs tucked infant of you..... Imagine your legs disappear from your view as you extend them upwards...........Imagine holding the balance for 4 seconds.......Imagine bringing your legs back down to the ground watch them tuck infant of you and your feet touching the mat. Imagine yourself returning to the standing position.

APPENDIX D

POST-EXPERIMENTAL QUESTIONNAIRE

Participant Number
Treatment Group

1. To what extent were you able to adhere to the imagery perspective you were asked to form prior to your attempts?

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

2. To what extent did you experience any kinaesthetic (feeling) during imagery?

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

3. How suitable did you feel that the perspective was for the task you had to perform?

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

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

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

5. To what extent did you feel that the imagery treatment helped your self-confidence to complete the task with good form?

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

APPENDIX E

CHANGED VIVIDNESS OF MOVEMENT IMAGERY QUESTIONNAIRE[7]

TOTAL SCORES

(a) other =
(b) self =
(c) total (a)+(b) =

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 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 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	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

[7] The external perspective has been changed from “somebody else” being the object of the image, to the imager being the object of the image.

APPENDIX F

STATE SPORT CONFIDENCE INVENTORY[8]

NAME..................................	DATE..................................
AGE....................................	MALE/FEMALE.............
SPORT..................................	LEVEL OF SPORT.............
	(e.g. school, club, county, international)

Think about how confident you feel right now about performing successfully (that is, winning) the upcoming competition.

Answer the questions below based on how confident you feel right now about competing in and winning the upcoming contest.

When responding, compare your self-confidence to the most self-confident athlete you know.

Please answer as you really feel, not how you would like to feel. Your answers will be kept completely confidential.

How confident are you right now about competing in and winning the upcoming contest? (circle number).

1. Compare the confidence you feel right now in your ability to execute successful strategy to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

2. Compare the confidence you feel right now in your ability to concentrate well enough to be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

3. Compare the confidence you feel right now in your ability to achieve your competitive goals to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

4. Compare the confidence you feel right now in your ability to be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

[8] With permission from author

5. Compare the confidence you feel right now in your ability to perform consistently enough to be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

6. Compare the confidence you feel right now in your ability to adapt to different competitive situations and still be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

7. Compare the confidence you feel right now in your ability to be successful based on your preparation for this event to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

8. Compare the confidence you feel right now in your ability to perform under pressure to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

9. Compare the confidence you feel right now in your ability to meet the challenge of competition to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

10. Compare the confidence you feel right now in your ability to bounce back from performing poorly and be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

11. Compare the confidence you feel right now in your ability to make critical decisions during competition to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

12. Compare the confidence you feel right now in your ability to think and respond successfully during competition to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

13. Compare the confidence you feel right now in your ability to execute the skills necessary to be successful to the most confident athlete you know

1	2	3	4	5	6	7	8	9
Low			Medium				High	

APPENDIX G

SPORT IMAGERY QUESTIONNAIRE[9]

This questionnaire was designed to assess the extent to which you incorporate imagery into your athletic training. Imagery involves "mentally" seeing yourself performing. The image in your mind should approximate the actual physical performance as closely as possible. Imagery may also include sensations, and/or feelings associated with the performance itself. Imagery can also be used in conjunction with mood states, attentional focus, game plans, etc. Your ratings will be made on a seven-point scale, where *one* is the rarely or never engage in that kind of imagery end of the scale and *seven* is the often engage in that kind of imagery end of the scale. Read each statement below and fill in the blank the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are practicing or competition in your sport. Remember, if you rarely or never engage in the type of imagery depicted in the statement, then a rating of 1 should be given; if you often engage in the type of imagery depicted by the statement, a rating of 7 should be given; frequencies of imagery that fall within these two extremes should be rated accordingly along the rest of the scale.
Don't be concerned about using the same numbers repeatedly if you feel they represent your true feelings. For example, the statement "imagine other athletes congratulating me on a good performance" should be rated according to how often you imagine other athletes congratulating you on a good performance. Remember, there are no right or wrong answers, so please answer as accurately as possible.

Rarely						Often
1	2	3	4	5	6	7

(1) I make up new plans/strategies in my head.

____

(2) I image the atmosphere of winning a championship (e.g., the excitement that follows winning a championship).

____

(3) I image giving 100% during an event/game.

____

(4) I can re-create in my head the emotions I feel before I compete.

____

(5) I image alternative strategies in case my event/game plan fails.

____

[9] With permission from first author

Rarely						Often
1	2	3	4	5	6	7

(6) I imagine myself handling the stress and excitement of competitions and remaining calm.

____

(7) I imagine other athletes congratulating me on a good performance.

____

(8) I can consistently control the image of a physical skill.

____

(9) I image each section of an event/game (e.g., offense vs. defense, fast vs. slow).

____

(10) I image the atmosphere of receiving a medal (e.g., the pride, the excitement, etc.).

____

(11) I can easily change an image of a skill.

____

(12) I image the audience applauding my performance.

____

(13) When imaging a particular skill, I consistently perform it perfectly in my mind. '

____

(14) I image myself winning a medal.

____

(15) I imagine the stress and anxiety associated with competing.

____

Rarely						Often
1	2	3	4	5	6	7

(16) I image myself continuing with my game/event plan, even when performing poorly.

____

(17) When I image a competition, I feel myself getting emotionally excited.

____

(18) I can mentally make corrections to physical skills.

____

(19) I imagine executing entire plays/programs/sections just the way I want them to happen in an event/game.

____

(20) Before attempting a particular skill, I imagine myself performing it perfectly.

____

(21) I imagine myself being mentally tough.

____

(22) When I image an event/game that I am to participate in, I feel anxious.

____

(23) I imagine myself appearing self-confident in front of my opponents.

____

(24) I imagine the excitement associated with competing.

____

(25) I image myself being interviewed as a champion.

____

Rarely						Often
1	2	3	4	5	6	7

(26) I image myself to be focused during a challenging situation.

____

(27) When learning a new skill, I imagine myself performing it perfectly.

____

(28) I imagine myself being in control in difficult situations.

____

(29) I imagine myself successfully following my game/event plan.

____

(30) I image myself working successfully through tough situations (e.g., a power play, sore ankle, etc.).

APPENDIX H

INTERVIEW PROTOCOL

1. What did you do during the imagery intervention in badminton training/matches that you did not do before the imagery intervention?
2. What effect did using the imagery have on you?
3. How did you find using the motivational imagery during training?
4. How did you find using the motivational imagery during competition?
5. Did you spend any time practising motivational imagery in your spare time?
6. What do you do now in badminton training/matches that you did not do before the imagery intervention?
7. Participant 1: Your confidence increased over the intervention period why do you think this was?

   Participant 2 : Your confidence increased over the intervention period. Why do you think this was?

   Participant 3: Your confidence decreased but became more stable over the intervention period. Why do you think this was?

   Participant 4: Your confidence increased over the intervention period. Why do you think this was?

APPENDIX I

OUTLINE OF IMAGERY SESSIONS AND SCRIPTS

IMAGERY SESSION 1

Standardized session

What is imagery?

1. Internal visual imagery. This is actually imaging from inside your body, looking out and seeing what's in front of you. For example, looking at the court infront of you, you can see the net and your opponent.
2. External visual imagery. This is imaging yourself as if you were watching yourself on a video. For example, imaging yourself doing a smash.
3. Kinesthetic imagery. This is the feelings associated with the movement that you are imaging. For example, the contraction in your calf muscles when you apply pressure through your feet as you go for a net shot. Or the feel of your racquet in your palm.

We are now going to do a few exercises to go through these types of imagery.

You can do the exercises standing, sitting or lying down and with or without your eyes closed. Before you do each exercise take a couple of deep breaths to relax your body.

EXERCISE 1

Pick on an object in the room

Open your eyes and focus on every detail of this object; look at the shape and color

Close your eyes and imagine you are still looking at the object-see all the detail and colors

Now open your eyes and compare your image with the real object

Close your eyes again and see the object with its color and detail

EXERCISE 2

Now imagine your house-you are standing at the front of your house-notice the color and the detail

Walk to the front door-notice how the house seems to grow larger as you get closer

Open the door and walk into your house-and walk to the doorway of your room

See the colors of the walls the furniture the curtains the floor

Notice all of the details as you look around your room

Now turn round and walk back to the front door of your house

Open the door and walk out, turn round and look back at your house

EXERCISE 3

Now see a beautiful warm summers day and you are standing on a beach

Lie down on the beach and feel the warm sand you are lying on and the penetrating warmth of the sun as you lie quietly

Hear the ocean waves as they break on the shore and feel a slightly cool breeze blow over you as you lie on the sand-you feel warm and relaxed

EXERCISE 4

Place your hand on your knees, squeeze your knees notice how your knees feel..... how your hands feel against your knees......

Stop squeezing and image those feelings......

What cues did you pick up on?

INDIVIDUAL SESSION

The individual sessions were centered around exercises from (Hardy & Fazey, 1990)

IMAGERY SESSION 2

Find a comfortable position either standing, sitting or lying down. You are going to take yourself through a guided imagery script. Read through each of the imagery situations, once you have read one, image it and then go onto the next.

RELAX BY TAKING A DEEP BREATH IN; FEEL THE TENSION RELEASE FROM YOUR BODY

- Imagine yourself walking over to your position ready to start a badminton match.......................your opponent looks strong; however, you image yourself in a strong stance ready to do a good strong return of serve.................... You imagine yourself being mentally tough so that you can cope with any difficult situations ahead of you. For example, if your opponent is producing good attacking high clears you keep counterattacking until you do a winning drop shot which passes a couple of centimeters above the tape.

- In the first few minutes of the first game you find that your opponent is hard to "stretch"...........Imagine yourself staying focused during any challenging situations...........You begin to realize that your player has difficulty doing straight smashes, instead they play them cross court................Imagine yourself taking advantage of the cross court shot.............image what your return shot would be. Image yourself being in control of the situation.
- As the game progresses you begin to find that your movements are flowing...............Imagine being in control of your shots. Being in control in these difficult situations increases your confidence............Imagine yourself being self-confident in front of your opponent.
- It is coming to the last few points of the game, the score is very close. You are having a tendency to rush your shots. Image telling yourself to be in control through this difficult situation . Image being in control in the following rally

  You are hitting high attacking clears to maneuver the player at the back of the court

  Your opponent is replying with high defensive clears

  You play a fast drop shot

  Your opponent has to "dig" to return the shot

  You play a straight smash and win the point

IMAGERY SESSION 3

Find a comfortable position either standing, sitting or lying down. You are going to take yourself through a guided imagery script. Read through each of the imagery situations, once you have read one, image it and then go onto the next.

RELAX BY TAKING A DEEP BREATH IN; FEEL THE TENSION RELEASE FROM YOUR BODY

- You are in the first few minutes of a county game............Image the situation.........What is the hall like?.............What is your opponent like? Image a series of shots that end in you doing a spinning net shot to won the point...........With the situation that you are imaging you are under alot of pressure but you stay focused and hit the shots cleanly and accurately.
- Imagine a situation where it is important that you do an accurate return........You are in a deep forehand situation and need to do a high deep clear to avoid your opponent being able to do a smash............imagine yourself staying in control ....you make a perfectly timed and accurate high deep clear.
- Image a situation where you have given 100% effort during a game, for example every time you were stretched you got to the shuttle.............at the end of the match you realize you are physically exhausted.

IMAGERY SESSION 4

Find a comfortable position either standing, sitting or lying down. You are going to take yourself through a guided imagery script. Read through each of the imagery situations, once you have read one, image it and then go onto the next.

RELAX BY TAKING A DEEP BREATH IN; FEEL THE TENSION RELEASE FROM YOUR BODY

- Image yourself in the lead in an easy game........however you become careless and have lost a number of easy point in a row..........Image yourself refocusing, making the appropriate shot selection and executing the shots accurately.

- Think back to a game where you had to work hard but you won. In the space below write out a series of play from that game. Once you have done that image the series of play that you have written.
- A lines judge has called out for your shot on a crucial point. Image yourself standing strong against your opponent waiting to receive their serve...........they make a high flick serve.........you make a dummy high clear and go for a drop shot which wins the point.

It is nearly the end of the game which could go either way. You are feeling tired, the score is very close and your opponent is putting a lot of pressure on you. Imagine yourself working successfully through that sort of tough situation.

IMAGERY SESSION 5

Find a comfortable position either standing, sitting or lying down. You are going to take yourself through a guided imagery script. Read through each of the imagery situations, once you have read one, image it and then go onto the next.

RELAX BY TAKING A DEEP BREATH IN; FEEL THE TENSION RELEASE FROM YOUR BODY

- Image yourself in total control of the play on court...........Your opponent is rushed you therefore do a flatter lift in return......they reply with an attempt on a defensive clear which you "kill" with a slice smash
- Write down any situations that you have been thinking of or imaging that have not been covered in this booklet. Image at least two of these situations.
- Imagine a difficult game that you have played in recently.........As the game progresses you begin to find that your movements are flowing...............Imagine being in control of your shots. Being in control in these difficult situations

increases your confidence............Imagine yourself being self-confident in front of your opponent.

IMAGERY SESSION 6

- Decide on whether you want to repeat some of the imagery sessions from previous weeks or create some more of your own. If you create your own write them down. Make sure you do at least 4 different situations. However, which ones you do is your choice.

APPENDIX J

WORKED EXAMPLE OF BINOMIAL TEST

The Binomial test was used to calculate if there was a significant difference in the confidence scores between the pre-intervention and post intervention phase by calculating the probability of obtaining x data points above the projected line:

$$f(x) = \binom{n}{x} p^x q^{n-x} \ or \ \binom{n}{x} p^n \ or \left(\frac{n!}{x!(n-x)!}\right) p^n$$

Thus, with Participant 2 the calculations were as follows:

n = the number of total data points in the post intervention phase = 14

x = the number of data points above (or below) the projected slope = 14

p = q = .5 by definition of the split middle slope

$$f = \left(\frac{14!}{14!(14-14)!}\right) .5^{14} = .001$$

The probability of obtaining all 14 data points above the line assuming the null hypothesis to be true is, therefore, p = .001. The null hypothesis is therefore rejected.