PREFERENCE FOR IMAGERY PERSPECTIVE, IMAGERY PERSPECTIVE TRAINING AND TASK PERFORMANCE

by

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Abstract

This thesis investigated the use, training, and performance effects of internal and external imagery. In Study 1, 41 participants aged 14 to 28 (M = 19.4 years) completed the Imagery Use Questionnaire (IUQ; Hall, Rodgers, & Barr, 1990) and then imagined performing eight common sports skills, four open skills and four closed skills, in a random order. Participants provided concurrent verbalisation (CV) during their imagery. Immediately after imagination of each skill participants completed retrospective verbalisation (RV) and rating scales (RS) of imagery perspective used. Results revealed that the IUQ gave a general imagery perspective preference and the CV, RS, and RV were equivalent measures of imagery perspective actually used. Participants experienced more internal imagery than external imagery across imagination over all eight sport skills, but reported experiencing more external imagery in imagining the closed skills than the open skills.

In Study 2, 49 participants aged between 18 and 35 years (M = 20 years) completed pre- and post-tests for imagery perspective use on the IUQ, and RS and RV of 10 imagery trials of an open skill (table tennis) and 10 imagery trials of a closed skill (darts). Based on pre-test scores on the IUQ, RS, and RV, participants were assigned to mis-matched training groups, with those lower on internal imagery use assigned to internal training and those lower on external imagery use assigned to external training. Both training groups completed four 30-minute imagery-training sessions. Results indicated that on the RV and RS the internal training group increased significantly in their use of internal imagery for both the open and closed skill. There was a trend for increased use of external imagery for the external training group. Correlations between RS and RV were very high, but were poor to moderate

with the IUQ. Before training, participants experienced more internal imagery than external imagery in imagining both skills, however, participants experienced more external imagery in imagination of the open skill (table tennis) than the closed skill (darts).

In Study 3, 30 participants aged 18 to 35 years (M = 23.37 years) completed a pre-test for imagery perspective use on the IUQ and RS of 10 imagery trials of a closed skill (darts) and 10 imagery trials of an open skill (table tennis). Participants then completed 40 pre- and post-test performance trials on the closed skill (darts) and 40 pre-and post-test performance trials on the open skill (table tennis). Based on the pre-test scores on the IUQ and RS, participants were assigned to mis-matched training groups as for Study 2. Another 10 participants were assigned to a control group. This gave three groups, an internal training group, external training group, and control group. Participants in the internal and external training groups trained in imagery perspective use across two 30-minute general sessions and two 30-minute specific sessions on each of the skills. Participants completed RS manipulation checks after the general and specific training sessions to examine the effects of perspective training. Participants in all three groups completed the imagery and performance pre-tests and the performance post-tests, as well as the manipulation checks, but the control group did not undertake any imagery training. Results indicated strong correlations between the IUQ items and the RS. Before imagery perspective training, participants experienced both skills more from an internal than an external perspective; however, there was a substantial external component, as for Studies 1 and 2. In addition, participants reported significantly greater use of external imagery in imaging the open skill than the closed skill. Following training there was a change in perspective use by the two training groups, resulting in participants using

their mis-matched perspective more than they did before training. There was no difference between the perspective training groups on performance gains; however, both training groups improved performance on the darts and table tennis skills significantly more than the control group. In addition, an analysis of actual reported use of imagery perspective, irrespective of training group, revealed that internals improved performance significantly more on the darts skill than externals, whereas for the table tennis task externals improved performance significantly more than internals. The findings of the three studies are discussed in terms of theoretical, measurement, and practical implications.

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CHAPTER ONE: INTRODUCTION

Imagery is essentially a process whereby an individual recalls and performs sensory experiences in the absence of external stimuli (Murphy, 1994). Studies have suggested that imagery is an effective performance enhancement tool (e.g., Kearns & Crossman, 1992; Rodgers, Hall, & Buckolz, 1991; Savoy & Beitel, 1996; Templin & Vernacchia, 1995; Woolfolk, Parrish, & Murphy, 1985) and is one of the psychological skills that sport psychologists and athletes use most (e.g., DeFrancesco & Burke, 1997; Gould, Tammen, Murphy, & May, 1989; Orlick & Partington, 1988). Because of its wide use and recognised potential, there is debate on how to use this valuable psychological tool most effectively in the sport setting.

An aspect of imagery that sport psychologists have claimed to act as a mediator between imagery practice and performance enhancement is the imagery perspective the individual adopts, however, the actual influence of imagery perspective is still unclear. Mahoney and Avener (1977) defined perspective in terms of whether the image is internal or external. They proposed that external imagery occurs when the person views themselves from the perspective of an external observer (much like watching oneself on TV). Mahoney and Avener considered that internal imagery involves the person imagining being inside their body and experiencing those sensations that might occur while performing in the real situation. Sport psychologists and researchers have generally considered that internal imagery is superior to external imagery for performance enhancement (e.g., Rushall, 1992; Vealey, 1986). The research on imagery perspectives, however, does not satisfactorily support this view (Hardy, 1997). Confusion over the effectiveness of imagery perspectives might be due to the failure of sport psychologists to review the research adequately, as well as their failure to consider the different requirements of different tasks and individual perspective preference.

Generally, research on imagery perspectives has been of three types: questionnaire studies, electromyography (EMG) studies, and performance task studies. The pioneering study of Mahoney and Avener (1977) has been the basis for much of the questionnaire research on imagery perspectives, with researchers typically asking elite athletes which perspective they use. The findings have been mixed, with some studies finding that elite performers, or more successful elite performers, used more internal imagery than less elite/successful athletes (e.g., Barr & Hall, 1992; Carpinter & Cratty, 1983; Doyle & Landers, 1980; Mahoney & Avener, 1977), some studies finding no difference between the use of internal and external imagery by these categories of performer (e.g., Hall, Rodgers, & Barr, 1990; Highlen & Bennett, 1979; Meyers, Cooke, Cullen, & Liles, 1979; Rotella, Gansneder, Ojala, & Billing, 1980), and still others concluding that elite athletes used more external imagery (e.g., Ungerleider & Golding, 1991). EMG studies have generally suggested that internal imagery produces greater muscular activity than external imagery (e.g., Bakker, Boschker, & Chung, 1996; Hale, 1982; Harris & Robinson, 1986; Jacobson, 1931a; Shaw, 1940). It appears that some researchers have interpreted this as meaning that internal imagery is superior for performance enhancement, however, the generation of greater muscular activity or kinaesthetic experience does not mean that the imagery will enhance performance more. Studies that have examined performance change due to imagery rehearsal or practice in different perspectives have also produced mixed findings. Most studies comparing internal and external imagery groups have found no differences between the groups on performance enhancement (e.g., Epstein, 1980; Gordon, Weinberg, & Jackson, 1994; Mumford & Hall, 1985). Some studies found that internal imagery groups had greater performance gains (e.g., Neisser, 1976), or that different types of task responded differently to the perspectives, with external imagery producing greater gains on one task and internal imagery on another (e.g., Glisky, Williams, & Kihlstrom, 1996; Hardy & Callow, 1999; White & Hardy, 1995). Thus, the research is equivocal and clearly does not support the contention that internal imagery is superior to external imagery for performance enhancement. As such the influence of perspective appears unclear.

Recently, researchers and theorists have suggested that the type of task might influence which perspective is more appropriate for the efficacious application of imagery. Several psychologists (Annett, 1995; Harris, 1986; Mclean & Richardson, 1994) have suggested that it might be that closed skills benefit more from internal imagery, whereas open skills benefit most from external imagery. Researchers have not yet conducted systematic research based on this classification of skills. Other psychologists have suggested that different elements of the task, such as form elements (White & Hardy, 1995) or spatial elements (Paivio, 1985), might influence which perspective is more efficacious for imagery practice. White and Hardy (1995) and Hardy and Callow (1999) have found that form-based tasks, such as gymnastics and rock-climbing responded better to external imagery than internal imagery. Consequently, it appears likely that the type of task does influence the imagery perspective that is most effective.

It has been suggested that preference for one perspective or another may influence perspective use (Hall, 1997), however, no studies have examined this aspect. Studies have also focussed on measuring performance change as a result of imagery training in one perspective or another. No studies have specifically examined whether participants can actually be trained to use a perspective by measuring change in actual perspective use rather than just inferring this from performance change. Consequently, there is a need for studies to address issues of task type (open versus closed skill), imagery preference, and imagery training effects on perspective use.

This thesis examined the influence of imagery perspective preference, imagery training, and task type (open versus closed skill) on perspective use during imagery and resulting performance. The main aims of the thesis were to examine whether individuals have a preferred imagery perspective; the extent to which they used their preferred perspective in imaging different tasks; whether task type influences the imagery perspective used during imagery; whether individuals can be trained to use a pre-determined imagery perspective; and whether internal or external imagery is superior for performance enhancement of open and closed skills. To address these issues the thesis adopted a three-study design. Study 1 investigated imagery perspective preference and use across imagination of a number of open and closed skills. Study 2 examined the trainability of imagery perspective by measuring imagery perspective changes as a result of training, rather than performance changes. Study 3 investigated the effect of internal and external imagery training on actual performance of an open and a closed skill.

CHAPTER TWO: REVIEW OF LITERATURE

This chapter reviews aspects of imagery related to imagery perspectives. First imagery and MP are defined and contrasted, then the concept of imagery perspectives is introduced. The chapter describes several theories on why imagery is effective in enhancing sports performance and how the theories might provide clues on imagery perspective use as well as the influence of imagery perspective on performance enhancement. The instruments that researchers and applied sport psychologists use to measure imagery are reviewed briefly, with emphasis on the assessment of imagery perspective. Having described what imagery and imagery perspectives are, why imagery might enhance sports performance, and how sport psychologists measure imagery and imagery perspectives, the review turns to research on whether imagery is effective in enhancing sports performance. This provides a basis for the review to examine the effects of imagery perspectives on performance enhancement and explanations for these effects extensively. Finally, the purpose and rationale for the present thesis are explained.

Definition of Imagery

The definition of imagery is still an issue of some debate in sport psychology because sport psychologists have used it in many different ways and interchangeably with other terms. Similarly, the definition of imagery perspective is an area of confusion. Throughout the imagery perspectives literature the definitions of internal imagery and kinaesthetic imagery appear to have been confused and, as Hardy (1997) suggested, this has lead to perpetuating 'myths' about which perspective is superior for performance enhancement in sport. These issues and more are discussed in this section on conceptualisation and definition of imagery and imagery perspectives.

Imagery and Related Concepts

Richardson (1969) has provided probably the most widely accepted definition of imagery to date. According to Richardson, the term mental imagery refers to "all those quasi-sensory and quasi-perceptual experiences of which we are self-consciously aware and which exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts" (1969, pp. 2-3). Murphy and Jowdy (1992) and Murphy (1994) suggested that this definition addressed three important issues about the nature of imagery. First, imagery experiences imitate sensory or perceptual experience. The imager "sees" an image or "feels" the movement. Second, the imager is consciously aware of the experience, which differentiates imagery from dreaming or daydreaming. Perry and Morris (1995) argued, however, that this might not adequately distinguish mental imagery from daydreaming because individuals characteristically experience daydreams in a conscious state. They suggested a better distinction might be in terms of volitional control, that is, whether or not the imager generates the experience intentionally. There are still problems with this as researchers have reported that the level of control over images can vary. The third aspect addressed, is that imagery occurs without any known stimulus antecedents. For instance, no football or opponents need be present for a footballer to imagine playing football. Other definitions of imagery consider some or all of these factors. For example, Solso (1991) suggested that mental imagery refers to "a mental representation of a non-present object or event" (p. 267), whereas Denis (1985) defined imagery as " a psychological activity which evokes the physical characteristics of an absent object" (p. 4). These definitions seem to focus on imaging objects rather than movements, and so may not be adequate in describing imagery of movement or imagery of sporting activities.

Suinn (1993) distinguished between mental practice (MP) and imagery rehearsal. MP is defined by Corbin (1972) as "the repetition of a task, without observable movement, with the specific intent of learning" (p. 94). This is a broad definition that covers a variety of covert practice techniques that could involve verbal rehearsal rather than any form of imagery. Imagery rehearsal is more specific and involves the individual intentionally rehearsing the sport skill with imagery. Grouios (1992) proposed that MP involves some kind of imagery employing various methods. These methods include reading descriptions (e.g., Jones, 1963), listening to descriptions (e.g., Wilson, 1960), verbalising the skill (e.g., Brassie, 1968), and different audio-visual techniques (e.g., Surburg, 1966). Murphy (1994) drew a distinction between the mental practice literature (using imagery to "practice skills and enhance skill acquisition and learning" (p. 486) and the psyching-up literature (using imagery to "facilitate the actual performance of a learned skill" p. 486). The term psyching-up may be misleading because optimal preparation for competition might not involve getting the athlete as "psyched" as possible. Practical questions in the area of anxiety and arousal concern whether the athlete should be as "fired up" as possible or as relaxed as possible before competition. There are various theories concerning the arousal-performance relationship. Although most of these recognise that characteristics of the person and the task influence how aroused the performer should be, few theories seem to recommend getting the athlete as psyched-up as possible before competition for most sporting tasks (Perry & Morris, 1995). Rushall and Lippman (1998) in a commentary on MP and imagery research suggested that MP and imagery are labels used to describe a variety of procedures that have been used in different methods, such as skill learning and competition preparation (such as arousal control, attention, confidence), to influence performance. They argued that a distinction is necessary between procedures aimed at skill development or learning and competition or performance preparation, due to the different procedures and elements involved with the different purpose. For example, the MP used by a child learning to serve in tennis would probably be different to that of a professional tennis player preparing for a match. The problem with these descriptions is that they do not describe what imagery is, rather, they classify its main uses in motor learning and sport.

Other terms that psychologists and researchers have used in an almost interchangeable fashion with mental practice and mental imagery include mental rehearsal, visualisation, imaginal practice, symbolic rehearsal, ideomotor training, visual motor behaviour rehearsal (VMBR), covert practice, implicit practice, mental review, conceptualizing practice, psychomotor rehearsal, cognitive rehearsal, and behaviour rehearsal. The term imagery is used in this thesis as it is the most appropriate for the concept under investigation. Mental practice is not appropriate because it could include verbal, non-imaginal thinking. Other terms listed are limited by their cognitive focus, as some imagery is about motor performance. Ideo-motor is weak because it implies a strong motor component, which may not be present in imagery, and visualisation is problematic because it emphasises visual imagery. VMBR is a specific technique to facilitate imagery rehearsal, involving two steps, relaxation training followed by imagery rehearsal. As such, it is too specific a term.

Imagery Ability – Vividness and Controllability

In imagery there are also a number of mediating variables that researchers have suggested influence the imagery-performance relationship. Several researchers have investigated imagery ability as a mediator in the imagery performance relationship (Gould & Damarjian, 1996). Psychologists have generally defined imagery ability by the level of vividness and controllability an imager has over their imagery (Murphy & Jowdy, 1992). Vividness refers to the clarity and sharpness or sensory richness of the imagery (Richardson, 1988). Controllability refers to the ease and accuracy with which an image can be transformed or manipulated in one's mind (Kosslyn, 1980). It is the degree to which an imager can guide the imagery experience. The idea that vivid, controllable images are the most effective was supported by Start and Richardson (1964), who also found that vivid uncontrollable images hindered performance most severely. Researchers probably also need to consider other factors that are likely to be associated with superior imagery, for example, the duration of the image or the ease with which it is generated (Perry & Morris, 1995). Thus, it could be that the images are vivid, but do not last long or are difficult to generate.

Another dimension of imagery is image content. This is a dimension that general psychologists have seen as important, but it is also relevant to sport psychology. There are a variety of content dimensions, but the most frequently investigated is affective tone, e.g., negative emotions, such as anxiety, depression, and hostility. An additional mediating variable might be the correctness of an athlete's imagery (Gould & Damarjian, 1996). For example, Woolfolk, Parrish, and Murphy (1985) found that participants in a negative imagery condition performed the task significantly worse than participants in a positive imagery condition or a control condition on a golf-putting task. Other research has also suggested that positive or accurate imagery produces greater learning or performance than negative or inaccurate imagery (e.g., Gregory et al., 1982; Lee, 1990; Powell, 1973).

Imagery Perspectives

Another mediating variable that sport psychologists have addressed is imagery perspective, that is, whether the imagery is internal or external. According to Mahoney and Avener (1977), internal imagery "requires an approximation of the real-life phenomenology such that the person actually imagines being inside his or her body and experiences those sensations which might be expected in the actual situation" (p.137). Mahoney and Avener suggested that in external imagery "a person views himself from the perspective of an external observer (much like in home movies)" (p.137). For example, in imaging kicking a ball from an internal perspective, the imager would see the ball at their feet and their attention would be on the ball as their foot draws back to strike it andfeel their leg move back and then forward to make contact. From an external perspective, the imager would be outside their body and would see their own movement from a third-person viewpoint.

Imagery Perspectives and Visual and Kinaesthetic Imagerx

There is some confusion and debate in the literature on the distinction between internal and external imagery, on the one hand, and visual and kinaesthetic imagery on the other. Part of this seems to be due to Mahoney and Avener's (1977) original definition of internal and external imagery. Many sport psychologists consider the kinaesthetic sense important in internal imagery, and have apparently confused internal imagery with kinaesthetic imagery (Janssen & Sheikh, 1994; Weinberg, 1982). Cox (1998) expressed this confusion when he stated that "internal imagery is considered to be primarily kinesthetic in nature, as opposed to visual" (p. 176) and that "external imagery is considered to be primarily visual in nature" (p. 176). Weinberg (1982) and Janssen and Sheikh (1994) both stated that internal imagery is sometimes called kinaesthetic imagery, but this is confusing the two terms. For example, Hardy and colleagues (Hardy & Callow, 1999; White & Hardy, 1995) and other researchers (Glisky, Williams, & Kihlstrom, 1996) have found that participants are able to form kinaesthetic images equally well with either imagery perspective. So the terms internal and kinaesthetic are not synonymous, they refer to different aspects of imagery. Imagery perspective refers to whether the athlete experiences the imagery from inside or outside of the body, not the sense modality or modalities the athlete experiences. White and Hardy (1995) argued that much of the confusion is due to researchers not clearly differentiating between internal visual imagery and kinaesthetic imagery. Purely kinaesthetic imagery involves the imager "feeling" the movement. It does not necessarily require an accompanying visual experience, but when it does, the visual imagery is to be distinguished from the kinaesthetic imagery, each referring only to the experience associated with the corresponding sense modality. To emphasise this point further, Hardy and Callow (1999) concluded that the results of their study offer some support for the claim that kinaesthetic imagery provides an additional beneficial effect regardless of perspective adopted. As stated by Denis (1985), it is not acceptable to equate the dimensions of internal and external imagery and visual and kinaesthetic imagery, and state that first-person experience has only kinaesthetic components, or that visual images are involved only in third-person experience.

Collins and Hale (1997) and Collins, Smith, and Hale (1998) have expressed a contrasting view on the distinction between internal and external imagery, and visual and kinaesthetic imagery. Collins and Hale stated there are confusions concerning the operational definitions of imagery perspectives. They cited the example of the term external kinaesthetic imagery, as used by White and Hardy (1995) and stated that

> this is a confound of Mahoney and Avener's (1977) original operational definition of *internal* and *external* imagery. Only in internal imagery does the individual "experience those sensations that might be expected in the actual situation" (Mahoney & Avener, 1977, p. 137). (Collins & Hale, 1997, p. 209)

Collins and Hale's use of the definition from Mahoney and Avener (1977) may be misleading, as Mahoney and Avener did not use the term <u>only</u> at the beginning of the quote. Mahoney and Avener's definition stated that internal imagery <u>requires</u> an approximation of the real life sensations, however, the definition does not state that these sensations <u>cannot</u> accompany external images. It is just that they are a requirement for internal imagery. The only requirement, according to this definition, which is the result of one question on a questionnaire designed to measure general mental preparation, is an external visual orientation, no mention is made of the absence of physical sensations. As such, this does not rule out the possibility that external imagery can have accompanying kinaesthetic experience.

Whether or not kinaesthetic imagery can accompany internal and external imagery is less important to the present thesis, than the understanding that kinaesthetic imagery and internal imagery are not the same thing. The interest of this thesis is to investigate how athletes use internal and external imagery and how internal and external imagery might mediate the imagery-performance relationship. In general terms, sport psychologists have believed internal imagery is superior to external imagery for performance enhancement, and this is largely due to two areas of research. The first of these areas is questionnaire research with elite athletes, who in some cases reported using internal imagery to a greater degree than novice or less elite athletes (Barr & Hall, 1992; Mahoney & Avener, 1977). The second area is studies measuring electrical activity in the muscles. These studies have found that internal imagery results in greater levels of measurable subliminal electrical muscle activity (electromyogram, EMG) in the muscles associated with the imagined actions than external imagery (Barr & Hall, 1992: Hale, 1982; Harris & Robinson, 1986: Jacobson, 1931a). Many sport psychologists have considered the kinaesthetic sense important in internal imagery. For example, Murphy (1994) stated that it is possible that the importance of kinaesthetic awareness to sports performance makes the influence of imagery perspective more important. As stated by Hardy, Jones, and Gould (1996), "a number of researchers have promoted the belief that internal imagery is superior since it closely allies the perceptual and kinaesthetic experience of performing in vivo (Corbin, 1972; Lane, 1980; Suinn, 1983; Vealey, 1986)." (p. 29). As reported in the section of this review on internal and external imagery research, studies comparing the influence of internal and external imagery on performance have produced mixed findings.

In this thesis, I use the term imagery to describe the general mental process as defined by Richardson (1969) and the term mental rehearsal to refer to the use of the imagery process to achieve a specific sport-related goal, including learning, practice, and competition preparation. The terms imagery perspective and internal and external imagery are used to refer to whether the athlete experiences the imagery from inside or outside of the body (first or third person), not the sense modality or modalities the athlete experiences.

Imagery Theories

This literature review examines research comparing internal and external imagery perspectives to lead to ideas on how athletes use internal and external imagery and how imagery perspective might mediate the imagery-performance relationship. As Hardy (1997) intimated, to understand the relationship between imagery perspectives and performance enhancement, an understanding of the theoretical basis for the effects and examination of different performance tasks are necessary. This section of the literature review addresses explanations for why imagery enhances sports performance. Theorists have postulated numerous explanations in the literature. It is impractical, and unnecessary, to review every explanation here, so this review only addresses the major theories that sport psychologists have considered or those theories that might have implications for research on imagery perspectives. Early theories of mental practice (MP) that sport psychologists have used to explain the effects of imagery are examined first. These theories have not been adequate explanations for the effects of imagery as it is used in applied sport psychology (Martin, Moritz, & Hall, 1999; Murphy, 1990; Murphy & Jowdy, 1994). Consequently, sport psychologists have turned to general psychology for alternative conceptualisations for how imagery might enhance sports performance. The problem, however, is that so far, there has been little direct research of these explanations in sport. Several of these explanations, divided into theories with a cognitive basis, such as Bioinformational Theory, Triple Code Theory, and Gross Framework or Insight Theory, and theories with an emphasis on psychological states, such as motivation, self-confidence/self-efficacy, and arousal-attention set explanations are reviewed next. Finally a possible explanation, that is based largely on neurophysiological evidence is reviewed, that motor imagery and motor preparation are functionally equivalent. This explanation has possible implications for imagery perspective research in sport. For each explanation the review contains a description of the main elements of the theory. There is a very brief review of research, with an emphasis on studies in the context of sport, along with critical assessment of the theory as an explanation of the performance-enhancing effects of imagery. Finally, the status of imagery theory is discussed.

Early Theories of Mental Practice

The literature in psychology generated two major theoretical explanations for the effects of mental practice (MP) - psychoneuromuscular explanations (Corbin, 1972; Jacobson, 1931a; Richardson, 1967a, 1967b; Schmidt, 1991) and the symbolic learning theory (Sackett, 1934). These two major theories have been examined for almost 70 years without resolving the issue of what is occurring during imagery to enhance performance (e.g., Harris & Robinson, 1986; Morrisett, 1956; Shaw, 1938). Murphy (1990) suggested that this is because these early theories were both developed to explain why MP might work, and this makes them part of a model of MP, and not mental imagery.

Psychoneuromuscular Theory

The psychoneuromuscular theory evolved largely out of the ideomotor principle. The ideomotor principle suggests that during imagery localised muscular activity occurs that is weaker in magnitude, but identical in pattern to muscle activation during actual physical performance of the task. The theory is based on Carpenter's (1894) "idea-motor principle" that he originally proposed as far back as 1855. The ideo-motor principle proposed that continued concentration on a certain idea gives it "dominant" power in the mind, that then determines "involuntary instruments of the Will" (movement in the muscles). That is, if the idea reaches a certain level of intensity, then the content of that idea will produce muscular efferent outflow.

Start and Richardson (1964) were the first to actually mention the psychoneuromuscular explanation of MP, based on early psychophysiological studies, such as those of Jacobson (1930d, 1931a), Shaw (1938, 1940) and Allers and Scheminsky (1926). Richardson (1967b) further developed the psychoneuromuscular explanation. Murphy and Jowdy (1992) stated that a number of researchers have proposed similar psychoneuromuscular explanations (Corbin, 1972; Richardson, 1967b; Schmidt, 1991), however, it has not been fully developed or stated in enough detail to truly be a 'theory'. Those who put forward the psychoneuromuscular feedback theories propose that the efficacy of imagery rehearsal of a motor task results from provision of feedback resulting from the minute muscle innervations, that are identical in pattern to actual execution, that occur when an individual imagines performing a motor skill. This feedback enables adjustment to be made to motor behavior (Corbin, 1972) or facilitates the rate at which the performer activates mental nodes representing the desired motor behavior during overt performance (MacKay, 1981).

To demonstrate the psychoneuromuscular theory, theorists need evidence of task-specific muscle activation. Evidence in support of the psychoneuromuscular hypothesis includes early studies that found electrical activation in the muscles, during imagery of a task involving those muscles (e.g., Allers & Scheminsky, 1926; Jacobson, 1930a, 1930b, 1930c, 1930d, 1931a, 1931b; 1931c; Shaw, 1940). Jacobson conducted several studies with various imaginal and actual activities, such as bending the arm, sweeping, and performing a biceps curl. Jacobson's general conclusions were that muscle activity specific to the muscles occurred during imagination, however, at a much lower level than during actual movement. Other studies have also suggested that the muscle response is localised to the specific muscles involved in the activity being imagined (e.g., Bird, 1984; Hale, 1982; Harris & Robinson, 1986; Wehner, Vogt, & Stadler, 1984), whereas others have not (e.g., Shaw, 1938). Overall, the research is not conclusive that muscle activity during actual and imaginary practice is localised to the specific muscles involved in the activity the participant is imaging. It could just be a general increase in readiness for performance or a by-product of central processes. Even if this muscle activity is localised, to provide strong evidence for the psychoneuromuscular theory, researchers must go a step further and demonstrate that it is the cause of the performance improvements by providing feedback. Researchers have not tested this to date.

Research studies (e.g., Ryan & Simons, 1981, 1983), as well as the reviews of the MP and imagery literature (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983; Feltz, Landers, & Becker, 1988), have suggested that cognitive rather than strength tasks benefit most from imagery. This indicates that cognitive processing rather than neuromuscular feedback is a more likely explanation for the efficacy of MP and imagery. Other problems with the psychoneuromuscular explanations are to do with the methodologies employed to support such theories. For example, the data measured to date has been limited to amplitude measures of EMG, not factors such as frequency and duration of EMG, which would be necessary to prove a "mirror hypothesis" (Hale, 1994).

The psychoneuromuscular theory suggests the most efficacious imagery would be vivid, controllable visual and kinaesthetic imagery, to produce strong levels of identical muscle innervation in order to produce kinaesthetic feedback. An inference from psychoneuromuscular theory is that internal imagery should be a more effective facilitator of performance than external imagery because muscle innervation and kinaesthetic feedback should be greater when using internal imagery (Budney et al., 1994). Some research (e.g., Hale, 1982, Harris & Robinson, 1986) has suggested that internal imagery produces greater localised muscle efference than external imagery. As discussed in more detail in the imagery perspectives section of this review, the inclusion of more kinaesthetic description in the internal imagery instructions than in the external imagery instructions might be more important than the perspective adopted in determining level of efference. Again, this suggestion that internal imagery should be more effective than external imagery is due to the confounding of the definitions of perspective and sensory modality.

Symbolic Learning Theory

The symbolic learning theory is an alternative attempt to explain how imagery works to facilitate performance. Sackett (1934) suggested that imagery of a task allows the imager to rehearse the sequence of movements as symbolic components of the task. That is, movement patterns are symbolically coded in the central nervous system and imagery assists in coding movements into symbols that would make the movement easier to perform. Repetitive practice of the skill in the mind could focus attention onto important cues within the skill. This would reinforce these cues and allow building of subconscious perceptual-motor plans or schemas in the pre-motor cortex. Consequently, according to this theory, imagery or MP facilitates only the cognitive aspects of a skill, such as timing, sequencing, and planning of movement. Sackett proposed that skills that are cognitive in nature are more easily coded than strength or motor tasks and so should respond better to imagery. To support this theory, research should demonstrate that imagery is more effective with primarily cognitive tasks and less effective with primarily motor tasks. In addition, motor learning theories (e.g., Fitts & Posner, 1967) have suggested that early stages of learning are primarily cognitive. Consequently, if the benefits of imagery are primarily cognitive, imagery should benefit performers in early stages of learning more than performers in later stages of learning.

Sackett (1934) demonstrated that mental rehearsal improved performance on a finger maze, a largely cognitive task. Other research (e.g., Minas, 1978; Morrisett, 1956; Ryan & Simons, 1981, 1983; Wrisberg & Ragsdale, 1979) has supported symbolic learning theory by showing that mental rehearsal facilitated performance more on cognitive than motor tasks. Meta-analyses of the MP literature have concluded that the data seem to support the symbolic learning theory, largely because of the stronger effects of MP on cognitive as opposed to strength tasks (Driskell et al., 1994; Feltz & Landers, 1983, Feltz et al., 1988). Other supporting evidence for the symbolic learning theory has come from studies by Kohl and Roenker (1980, 1983), who showed that bilateral transfer occurred even when participants performed the training task, with the contralateral limb, using imagery.

In comparing imagery effects at different stages of learning, athletes at various skill levels have reported using imagery (Hall, Rodgers, & Barr, 1990) and the literature has not clearly demonstrated that performers at different levels have differential benefit from using imagery. It does, however, appear that individuals at different levels do respond favorably to imagery or MP (Driskell et al., 1994; Feltz & Landers, 1983).

There are problems with the symbolic learning theory, and questions that it fails to answer. For example, the theory does not predict that imagery should enhance performance of motor and strength tasks. Reviews such as the meta-analysis of Driskell et al. (1994), however, have found an effect for physical tasks, although this was smaller than for more cognitive tasks. Also, a number of studies have found that imagery facilitated performance in experienced performers who already have a well-established movement pattern, a difficult result for symbolic learning theory to explain (Hecker & Kaczor, 1988). Hale (1994) stated that researchers have not tested the symbolic learning theory in a single study comparing tasks at both ends of the cognitive-motor continuum. Hale further suggested that a potential biasing could have occurred in that participants might be more familiar with practicing in a cognitive rather than a motor or kinaesthetic mode. In addition, the research that suggests a greater performance enhancing effect for imagery on cognitive rather than motor tasks, does not specifically support symbolic learning theory. It only supports a theory with a major cognitive component.

Savoyant (1988) considered that the symbolic learning theory and psychoneuromuscular theory might complement one another. Savoyant suggested that MP could be effective in planning and organising the motor sequence and motor programming and control of motor program execution. It could be that cognitive symbolic imagery may be more effective in early stages of learning in the construction and planning of the action and neuromuscular feedback more effective in later stages of learning when the motor program is automatic and generalised and learning requires knowledge of results. Hale (1994) proposed that, if this conception is applied to imagery perspectives, external imagery might be most applicable to cognitive-symbolic effects because external imagery emphasises the visual gestalt of the task, whereas internal imagery might be most applicable to neuromuscular feedback because kinaesthetic imagery is a major focus in its processing. Again, this seems to be a confounding between the definitions of imagery perspectives and sensory modality experienced.

The two early explanations, the psychoneuromuscular hypothesis and symbolic learning theory, have not been able to explain how imagery influences performance adequately. As stated earlier, Murphy (1994) claimed that this is because sport psychologists latched on to the psychoneuromuscular and symbolic learning theories specifically to explain skill learning and MP effects. These theories have concentrated on explaining why MP might work and this makes them part of the MP model. Sport psychologists use imagery in a much wider range of applications today. In fact, Murphy and Jowdy (1992) stated that although there is substantial research on MP in sport, researchers have much work to do in the area of theory development. They suggested that the psychoneuromuscular and symbolic learning "theories" of MP are not much more than explanations of a limited subset of MP findings. For example, the psychoneuromuscular theory provides a credible explanation for muscle innervation during MP, but does not explain the cause of imagery effects on performance. The symbolic learning theory provides an explanation for why tasks with greater cognitive demands benefit more than tasks with fewer cognitive demands, however, it does not provide an explanation for the form of the conceptual representations in imagery. To explain how imagery influences performance, Murphy and Murphy and Jowdy, suggested looking beyond the field of sport psychology and maybe towards cognitive science which would investigate the nature of imagery.

Cognitive Theories of Imagery Applied to Sport

Cognitive psychologists have put forward a number of explanations for the effects of imagery, however, they are only gradually being investigated by sport psychologists. The problem with such an approach is that these theories were developed to explain imagery in learning cognitive tasks not on learning physical skills, so may not be directly transferable to explaining the effects of imagery in sport. For example, the theories tend to focus on explaining the effects of visual imagery. This review, therefore, based on the suggestion of Murphy (1990), focuses on cognitive theories that have been applied to sport and go beyond considering just visual imagery, such as Lang's (1977) bioinformational theory, and Ahsen's (1984) triple code theory.

Cognitive psychologists have proposed various models of imagery experience. The most popular approach that cognitive psychologists take to understanding mental processes such as imagery is an information-processing approach. People use memory to produce imagery, so how they process and store information is important in understanding how imagery works from a cognitive perspective. Paivio (1971, 1975, 1986) proposed that people store information both verbally and visually in a complementary fashion and this is the basis of dual-code theory. The form of representation people use depends on both how the information is presented, verbally or non-verbally, and the imagery value of the information to be remembered. Although there is some evidence that people store some memories separately as images or words, many theorists suggest that much of our memory is based on a network of abstract representations tied to meanings, rather than sensory or verbal information (Dworetzky, 1988). Storing information by its meaning requires it to be stored as a proposition, rather than in its raw form. Consequently, cognitive theories of memory mainly adopt what is called a propositional (or associative network) model of memory (e.g., Anderson, 1983, 1990; Anderson & Bower, 1973; Clark, 1974; Frederickson, 1975; Norman & Rumelhart, 1975; Oden, 1987). An example of this approach is Lang's bioinformational theory (1977). A proposition refers to "the smallest unit about which it makes sense to make the judgement true or false" (Anderson, 1980, p. 102). Propositional theories argue that if we want to recall how something looked or was stated we must first recall its meaning and then reconstruct the actual sensory or verbal representation.

Dual Code Theory

Paivio (1975, 1986) suggested that the reason that images are effective in learning is that an image provides two independent memory codes, either of which can result in recall. This theory is termed dual-code theory. For example, if we store both the word ball and an image of a ball we can remember the ball if we retrieve it from memory as either an image or a word. Evidence suggests that the two memory codes are independent, in that we can forget one code without forgetting the other (Paivio, 1975). Thus, having two memory codes gives us a better chance of remembering an item.

A major criticism of dual-code theory is that it only functions in situations where people focus on relational information (Marschark & Hunt, 1989). If this is correct then the range of application of dual-code theory is restricted even in general psychology. Even so, the restricted uses are still large since many learning activities require us to learn associations between items. Researchers and theorists investigating information-processing explanations, such as Paivio (1975) and Kosslyn (1981), have focused on visual imagery. This is a very narrow conception of imagery, especially in applying imagery to sport (Murphy & Jowdy, 1992). Ahsen (1984) strongly criticised the absence of any idea of body experience in imagery in the views of Pylshyn (1973, 1981), Kosslyn, and Paivio.

Bioinformational Theory

Bioinformational theory is a cognitive theory that uses an information-processing model of imagery stored as propositions, but considers the psychophysiology of imagery. Lang (1977) originally developed this theory to increase the understanding of research into phobias and anxiety disorders. The theory is aimed at analysing fear and emotional imagery and so may not be readily applicable to sport. Lang suggested that the units abstracted and interpreted during perception are stored in long term memory (LTM) in abstract form and need to be processed to generate an experience of an image. So, an image is thought to be one kind of network, composed of a specific set of organised propositions in the brain that are able to access information on behavior prototypes stored in LTM. Applying this to sport, the set of abstract propositions that represents an image contains a motor program that possesses instructions about how to make the specific movement. The image proposition network is therefore a model for overt responses. The theory holds that wherever processing of a network of propositions occurs, physiological responses or efferent flow always occurs. Consequently, this theory considers responses and efference rather than just image content, and as such predicts the muscular activity observed by psychoneuromuscular theory.

According to Lang, images contain three main classes of propositions: stimulus, response, and meaning. Stimulus propositions are statements that describe the content of the scene the individual is to imagine. Stimulus propositions describe specific features of stimuli, for example, "a heavy wooden baseball bat". Response propositions are statements that describe the response to the scene. They are modality specific assertions about behavior, such as verbal responses, overt motor acts, and physiological responses, for example, "tensing my biceps". Meaning propositions function to analyse and interpret the significance of input and output events, the probabilities of stimulus occurrence, and the consequences of action. For example, "I am anxious before the game and my heart starts pounding". Learning and performance involve the linking of appropriate stimulus and response propositions and imagery is a process that allows strengthening of these links. Response propositions include the emotional and physiological responses associated with performance. Thus, quality imagery should include feelings, such as fear, anxiety, anger and, elation, as well as physical symptoms, such as fatigue, perspiration, and tension, because these physiological and emotional reactions are generally included in actual performance. The individual gains more control and hence improves performance by modifying responses to given situations through imagery. For example, in Lang's work with fear and the techniques of desensitisation and flooding, the more realistic and frightening the scene and the more fear that is produced in the imagery, the better the individual coped with the real fearful situation (e.g., Lang, Melamad, & Hart, 1970).

Support for the bioinformational theory comes from a number of sources. Several non-sport studies (e.g., Carroll, Mazilier, & Merian, 1982; Lang, 1979; Lang, Kozak, Miller, Levin, & McLean, 1980; Lang, Levin, Miller, & Kozak, 1983; Mermecz, & Melamed, 1984; Miller, Levin, Kozak, Cook, McLean, Carroll, & Lang, 1981) and a review (Cuthbert, Vrana, & Bradley, 1991) have reported that scripts that emphasise response propositions elicit greater efferent activity than scripts that emphasise stimulus propositions. Moreover, Lang has demonstrated with phobic patients that the greater the physiological responses in imagery the greater the change in behavior (e.g., Lang, Melamad, & Hart, 1970), however, no sport studies have tested this.

In the sport psychology literature, support comes directly and indirectly from several studies. Studies by Hale (1982), Hecker and Kaczor (1988) and Bakker, Boschker, and Chung (1996) have suggested that there is a greater efferent flow to scripts weighted in response rather than stimulus propositions. A weakness of these studies is that the researchers did not link the physiological data to performance. Research that links the demonstration of muscle activity during imagery with response propositions, to performance improvements would support the application of Lang's theory in sport. Indirect support for Lang's predictions comes from the internal and external perspective and muscle innervation studies. Researchers (e.g., Budney et al., 1994; Hale, 1982, 1994; Janssen, & Sheikh, 1994) have suggested that stimulus and response propositions may be functionally similar to internal and external imagery perspectives. The suggestion is that internal imagery enhances response proposition processing, because the imagery is of actually performing the skill, rather than watching the skill. According to this conception, internal imagery would contain many response propositions because the imager is experiencing the imagery from a first person perspective, as if the imager was there and performing the movement, emphasising kinesthetic and muscular sensations. External imagery would consist mainly of stimulus propositions, "because the sense modality is constrained to a third person visual perspective during processing" (Hale, 1994, p. 89). This issue is addressed in detail in the discussion on imagery perspectives later in this literature review, however, it must be stressed that internal imagery is not the same as response propositions and external imagery is not the same as stimulus propositions. A non-sport study looking at imagery of fearful and neutral situations by Bauer and Craighead (1979) supported this. Bauer and Craighead compared manipulation of stimulus or response propositions and manipulations of imagery perspective (first or third person). They found differences only as a result of changing response and stimulus processing, with response propositions producing greater activation of heart rate and skin conductance.

Lang's theory has not been extensively researched in terms of sport and motor skills. The theory has some research support from the general psychology literature, and from EMG studies on motor skills (e.g., Bakker et al., 1996; Hale, 1982). The idea of stimulus and response propositions provides a useful framework for understanding of efferent outcome from imagery of motor activity, and important factors to consider when creating imagery scripts. For the theory to be really credible in the movement domain, more research in sport, especially the applied sport setting, is required, as well as studies that link the theory to actual performance outcome and not just efferent activity. In the applied sport setting, one of the main concerns with bioinformational theory is that the focus has been on investigating differences between the effects of stimulus and response propositions on muscular activity. What is needed are studies in sport that demonstrate that scripts weighted in response propositions elicit greater efferent activity and this is accompanied by larger performance improvements than scripts weighted in stimulus propositions. In addition, Lang, working in a clinical context, was trying to understand emotional reactions, such as anxiety and fear, so the application to movement may be tenuous. Lang's model might be difficult to apply to performance, but may be more applicable to sport when imagery is used to reduce anxiety or enhance self-confidence.

Ahsen's Triple Code Theory (ISM)

Ahsen's (1984) triple code (ISM) theory is a model that sets out three components of imagery important to understanding how imagery affects performance. The first component is the image itself (I). Ahsen viewed an image as being a centrally aroused sensation that is internally generated but possesses all the attributes of a sensation. The second component is the somatic response (S). Ahsen suggested that imagery causes psychophysiological changes in the body. The third component is the meaning of the image (M). This is an aspect ignored by most models of imagery. Ahsen proposed that the individual brings their own background and history with them into imagery and so even if people receive the same imagery instructions, the imagery experience will be different for each individual. Ahsen suggested that researchers need to take into account the meaning of the imagery to the outcome. Other important aspects to come out of Ahsen's theory are that research reports need to describe the imagery script, and the researcher needs to consider the imagery experience of the individual participant. Also, because there are psychophysiological changes, researchers should consider psychophysiological measures and assess the meaning of the image to the individual to evaluate whether the image evokes other thoughts that may detract from optimal imagery. For instance, researchers have found negative imagery to produce performance decrements or a belief of poor performance (Gregory et al., 1982; Lee, 1990; Powell, 1973; Woolfolk, Parrish, & Murphy, 1985). Ahsen's theory provides a useful framework for investigating imagery, however, it does not provide an explanation for cognitive effects of imagery or of imagery perspectives.

Gross Framework or Insight Theory

Grouios (1992) and Hale (1994) have identified two related approaches to the question of how imagery works, gross framework theory and insight theory. These efforts to explain how imagery enhances performance are both based on Gestalt psychology, a predecessor of cognitive psychology. Lawther (1968) advocated the "gross framework" theory as necessary for optimal motor learning to occur. The learner must be able to conceptualise the entirety or "gestalt" (total picture) of the task in order to improve skill performance. Imagery rehearsal or MP could help the learner direct attention onto the general impression or gross framework of the skill, rather than the details of the movement. Theorists and researchers have often used this theory to explain why previous experience (vicarious or actual) seems to benefit the positive effects of MP. In terms of "insight" theory, gestalt theories suggest a need for insight in successful problem solving. In this conception performance improvements do not necessarily come in direct proportion to the length of time spent in practice. Rather, learning comes about with changes in behaviour over time resulting from insight. Prior to and during the improvement of performance through imagery, imagery is necessary possibly to provide the opportunity for behavioural changes resulting from insight. Imagery would not ensure learning, but provide for a new perceptual organisation through insight. This theory does not specifically address imagery perspectives, but it could be argued that internal or external imagery, or their combination, enhances the person's experience of the whole or allows more opportunity for insight. For example, Hardy (1997) suggested that imagery's beneficial effect on performance depends on the extent that the images add to the useful information that would otherwise be available. External imagery might assist the imager to see precise positions of players relative to themself in a team game, for instance, and movements required for successful performance (e.g., gymnastics, rock climbing, team ball sports). Alternatively, internal imagery might allow the performer to practice the spatial locations, environmental conditions, and timings of movements (e.g., slalom type tasks, dart throwing). Perhaps if both are used at different times during imagery, greater insight or a more holistic experience of the task might result. This needs to be investigated, especially in the sport context.

Psychological State Explanations

The cognitive theories provide possible explanations of how imagery might work to enhance performance in sport, however, sport psychologists have not sufficiently researched or developed them for sport. Other potential explanations that sport psychologists have put forward consider how imagery affects the athlete's psychological state, which in turn influences performance. For example, imagery of winning an Olympic medal in front of a large crowd, or even just performing a skill correctly, can affect the athlete's motivation, self-confidence, or arousal, and this change in psychological state leads to an increased performance level. These explanations might provide clues on how imagery perspective mediates the imagery-performance relationship.

Attention-Arousal Set Theory

According to attention-arousal set theory, imagery functions as a preparatory set that assists the performer in achieving an optimal arousal level. This optimal level of arousal allows the athlete to achieve peak performance. Optimal arousal helps to enhance performance by focussing attention onto task-relevant cues and screening out task-irrelevant or distracting cues. The attention-arousal set theory has not received any direct empirical support (Hecker & Kaczor, 1988; Murphy, Woolfolk, & Budney, 1988), but there is some research to support such a theory. Researchers (e.g., Hale, 1982; Harris & Robinson, 1986; Jacobson, 1931a; Ryan, Blakeslee, & Furst, 1986; Shaw, 1940) have found low level muscle innervations associated with imagery. Schmidt (1982) proposed that it could be that these innervations are indications of the performer "preparing for the action, setting the arousal level, and generally getting prepared for good performance" (p. 520). Feltz and Landers (1983) suggested that this minimal tension helps prime the muscles and lower the sensory threshold to assist in producing focussed attention. Wilkes and Summers (1984) found a post-hoc relationship between self-reports of attentional focus and strength performance following imagery, providing indirect support for an attention-arousal set theory. In opposition to these findings, Lee (1990) found that task-relevant imagery produced greater improvement on an endurance task than irrelevant imagery, but that imagery effects were not a result of affective mood states. The evidence does not provide adequate support for an attention-arousal explanation of imagery effects. In addition, this sort of explanation does not adequately explain the facilitative effects found for imagery training programs that do not use imagery just as a pre-performance readiness tool, but as a part of daily training programs (e.g., Blair et al., 1993; Shambrook & Bull, 1996).

Self-Efficacy and Self-Confidence Theories

Self-confidence or, more frequently, self-efficacy theory (Bandura, 1977) has been proposed to explain imagery's effect on performance (Budney et al., 1994; Grouios, 1992; Morris, 1997). Self-confidence for sport is probably the more widely understood concept, referring to a person's perception of their overall capability in a sport context. Self-efficacy is task specific, being defined as a person's belief in their ability to perform that precise task. The proposition developed from self-efficacy theory is that imagery increases the performer's success expectations and this leads to successful overt performance. Most of the research into the relationship between self-efficacy and performance is based on Bandura's (1969, 1971, 1977) social learning theory, which suggests that expectations of success are based on past performance success, vicarious experience (modelling), verbal reinforcement, and emotional arousal. Modelling is a process in which observers copy or reproduce behaviors or actions demonstrated by others. The idea is that imaging oneself performing a task successfully is similar to observing someone else perform the skill (modelling), or overtly performing the skill (past performance success), and therefore provides reinforcement and expectations of success are increased.

There is a considerable amount of literature that suggests that increased self-efficacy leads to enhanced performance in sport (e.g., Feltz, 1982; Feltz & Mugno, 1983; McAuley, 1985). Several recent studies have investigated self-efficacy and imagery in sport tasks or motor skills and may help resolve whether self-efficacy theories have some merit in explaining the effects of imagery on sporting performance. Some studies have found that imagery programs increased self-efficacy (e.g., Callery & Morris, 1993; McKenzie & Howe, 1997; Martin & Hall, 1995), or self-efficacy and performance (e.g., Callery & Morris, 1997c; Feltz & Riessinger, 1990; Garza & Feltz, 1998; She & Morris, 1997). Hale and Whitehouse (1998) found that imagery can positively and negatively affect self-confidence of athletes. Page, Sime, and Nordell (1999) found that a single imagery session modified the perceptions of anxiety in athletes. Interestingly, other studies concluded that imagery had little impact on self-efficacy or self-confidence (e.g., Callow & Hardy, 1997; Moritz, Hall, Martin, & Vadocz, 1996). Unfortunately, in these studies the researchers did not attempt to test the causal links between imagery, self-efficacy, and performance. In a field-experiment, Callery and Morris (1997a) found that a 10-session imagery rehearsal program improved goal-kicking performance and self-efficacy of elite Australian Rules footballers, compared to a control group. Callery and Morris (1997b) used structural equation modelling (SEM) to consider the links between performance, imagery, and self-efficacy, using the data from the field-experiment on goal-kicking. The SEM analysis showed a causal link between imagery and performance, as well as one between imagery and self-efficacy. No significant causal link between self-efficacy and performance was found at post-test, suggesting that although imagery affected both performance and self-efficacy, self-efficacy was not a mediator between imagery and performance. The authors suggested exercising some caution in interpreting the results, because the goodness of fit statistics indicated that the data did not fit the model at desirable levels.

Self-efficacy and self-confidence theories do not explain the effects on cognitive skills as opposed to strength or motor tasks (e.g., Feltz & Landers, 1983), or the fine grain muscle innervation that has been found in some studies (e.g., Hale, 1982; Harris & Robinson 1986; Jacobson, 1931a). It seems more likely that increased self-efficacy of a sport task is an outcome of imagery, which occurs when the imagery that is experienced (as opposed to that which is scripted or instructed) includes imagining successful performance. This would explain why increased self-efficacy sometimes occurs during imagery that has been devised for another purpose and why increases in self-efficacy are more likely outcomes of scripts that emphasise or focus on success. Epstein (1980) and Smith (1987) both suggested that a possible benefit of internal imagery over external imagery is that external imagery might be associated with self-consciousness and nervousness, because external imagery requires the imager to assume the role of a critical evaluative observer. This idea is supported by an unpublished study of anxiety in high school female track athletes by Epstein and Mahoney (1979). Epstein and Mahoney found that external imagery was significantly related to difficulty concentrating, shaky self-confidence, worrying about mistakes, and remembering failures, whereas internal imagery was not. Alternatively, Gould and Damarjian (1996) stated that the mixed findings from studies of internal and external imagery might relate to the purpose of the intervention. For example, they suggested that internal imagery might help to strengthen skill learning through kinaesthetic feedback. Conversely, external imagery might enhance self-confidence, through the athlete seeing him or herself performing successfully.

Motivational Explanations

The possibility exists that performance differences between imagery or MP and control groups are due to different motivation levels of these groups. Verbal instructions, demonstrations, and introductory educational statements about imagery and sessions of imagery can lead the participant to become interested or motivated to perform, or create expectancy of superior performance in the participant following imagery. Also, in imagery programs there is often an introductory session that aims to ensure that athletes believe the facilitative effects of imagery. In investigating this as a possible explanation for imagery effects, studies are needed that compare high and low motivation groups on performance effects from an imagery-training program. The Driskell et al. (1994) meta-analysis of the MP literature suggested that the effects of MP were not due to a Hawthorne Effect. The suggestion of a Hawthorne Effect is due to the condition in MP studies where a control group (NP) gets nothing and the MP group gets something.

Paivio (1985) proposed another motivational explanation of imagery that provides a framework for evaluating imagery. Paivio emphasised the need to consider the task and function of memory and verbal mechanisms in imagery rehearsal. Paivio's framework is essentially a 2 x 2 factor model, in which imagery has the potential to play a motivational role and a cognitive role at a general or specific level. Motivation General (MG) refers to level of physiological arousal and the affect or emotion that goes with it, that is, negative or positive emotions can be experienced in imagery, which can serve as general incentives to performance. For example, imagining the emotion of winning or having the crowd cheer and imagining the increased heart rate and emotion. Motivation Specific (MS) refers to goal-oriented aspects, that is, participants can imagine goals, goal attainment strategies, and attainment or non-attainment of these goals. For example, the athlete can imagine the attainment of winning a medal, as well as the practice to get it. On the cognitive aspect, analyses of effects attributable to cognitive aspects are considered. General cognitive aspects refer to universal behavioral strategies and specific cognitive elements of imagery refer to particular responses involved in motor skills.

Research on Paivio's model has been presented recently by Hall and colleagues, who designed the Sport Imagery Questionnaire (SIQ) to measure the 2 x 2 factors. These studies suggest that athletes use imagery most for Motivation-General (MG) functions (e.g., Callow & Hardy, 1997; Hall, Mack, Paivio, & Hausenblas, 1998; Salmon, Hall, & Haslam, 1994). White and Hardy (1998) used a qualitative interview approach to explore imagery use by three high level slalom canoeists and three high level artistic gymnasts and found that one of the uses of imagery by participants was to influence anxiety levels, motivation, and self-confidence.

Paivio's theory has promise because it incorporates a cognitive theory, which seems to have more research support than psychoneuromuscular theories (e.g., Feltz & Landers, 1983), along with motivational explanations. There needs to be more research on this as a possible framework for analysing imagery effects. It is possible, however, as with self-confidence, that the motivational effects are by-products. The studies by Callery and Morris (1993, 1997c) throw some light on this indirectly. The elite football players in those studies were highly motivated to perform at their best in the games, where performance was measured. Despite high motivation (and high initial skill levels), their performance improved and their self-efficacy was enhanced. This suggests that motivation alone cannot explain all imagery effects. It could be that internal and external imagery can be used for different motivational purposes, but this has not been investigated. For example, Hardy (1997) suggested that different perspectives might have qualitatively different motivational effects. For example, external imagery could enhance competitive drive, and internal imagery could enhance self-efficacy because it allows identification with the model (cf., Bandura, 1986).

The theories that have considered affective states, such as motivation and self-efficacy, have been advanced to explain the effects of imagery in sport. A model developed by Martin, Moritz, and Hall (1999) provides a framework for how imagery can be used to produce a range of cognitive, affective, and behavioural changes. The Martin et al. applied model of imagery for sport was based on research examining imagery use by athletes. The applied model proposes that the sport situation, the type of imagery used, and imagery ability are factors that influence the effects of imagery. Imagery effects in the model are divided into three categories: skill and strategy learning and performance, cognitive modification, and arousal and anxiety regulation. This model has promise as it considers the alternative uses of imagery and the likelihood that these will produce different outcomes. The main limitations are that it is a model of imagery use in sport, rather than a theory as it does not attempt to explain the underlying processes for the effects of imagery and no predictions are made about the use of more than one type of imagery at a time, e.g., learning a skill and increasing confidence at the same time.

Functional Equivalence and Neurophysiological Research

With the advent of newer and more sophisticated neurophysiological measures (such as positron emission tomography and regional cerebral blood flow) researchers in psychology have gained a greater understanding of the relationship between imagery and movement. In fact, recent research seems to suggest that imagery and movement are very similar, and some researchers have gone so far as to suggest that motor imagery and motor preparation are functionally equivalent (e.g., Decety, 1996a, 1996b; Jeannerod, 1994, 1995). A brief description of functional equivalence and the major findings of research are provided here as a potential explanation of how imagery enhances performance in sport. The hypothesis of functional equivalence is that imagery and perception or imagery and movement recruit common structures and/or processes (Finke, 1980, 1985; Finke & Shephard, 1986). In essence, imagery enhances performance because imagery and performance are the same in their preparation, but during imagery execution is blocked. So, imagery practice is just like actual physical practice, but does not involve the final execution of the motor commands, although the commands are generated centrally in the brain. The implication is that movement and imagery have functional outcomes that are similar. Researchers have addressed two forms of equivalence in the literature, that is, the functional equivalence of visual imagery and visual perception and the functional equivalence of motor imagery and motor preparation.

Support for functional equivalence of visual imagery and visual perception comes from behavioral, case, and neurophysiological studies. Behavioral studies have generally suggested a functional equivalence of visual imagery based on similarity judgements (e.g., Bryant, 1991; Gordon & Hayward, 1973) and interference between imagery and perception (e.g., Brooks, 1968). Neurophysiological studies have found similar activation of occipital and inferior temporal regions during performance of visual perception and visual imagery tasks (e.g., Farah, 1989a , 1989b; Farah, Peronnet, Gonon, & Giard, 1988; Goldenberg, Podreka, Steiner, Wilmes, Suess, & Deecke, 1989; Kosslyn, Alpert, Thompson, Maljkovic, Weise, Chabris, Hamilton, Rauch, & Buonanno, 1993; Peronnet & Farah, 1989; Roland & Friberg, 1985; Rosler, Heil, & Glowalla, 1993; Stuss, Sarazin, Leech, & Picton, 1983; Wijers, Otten, Feenstra, Mulder, & Mulder, 1989). Tasks requiring motor imagery or non-imaginal thinking did not activate the same areas (e.g., Marks & Isaac, 1995; Morris & Gale, 1974; Williams, Rippon, Stone, & Annett, 1995). Recent reviews have concluded that cortical activation patterns measured with a variety of central measures (e.g., positron emission tomography [PET scan], regional cerebral blood flow [rCBf], electroencephalogram [EEG], functional magnetic resonance imaging [fMRI]), and during visual imagery, seem to match patterns during visual perception, and that this provides strong support for a functional equivalence between visual imagery and visual perception (e.g., Annett, 1986; Berthoz, 1996; Decety, 1996a, 1996b; Jeannerod, 1994).

Jeannerod (1994), in a substantial review of neurophysiological research on imagery, proposed that the similar neural substrate for visual imagery and visual perception could be translated to motor physiology. Jeannerod (1995) hypothesised that motor images have the same properties as the corresponding motor representations, and therefore, have the same functional relationship to the imagined movement and the same causal role in the generation of movement. The benefits of motor imagery on motor execution through this central explanation would be due to increased traffic in neural circuits responsible for improving synaptic efficacy in critical parts of the system such as the cerebellum and basal ganglia. This, Jeannerod suggested, could result in increased capacity to tune motor neuronal activity or sharpened coordination between agonist and antagonist muscle groups. In this hypothesis, the peripheral EMG activity observed during imagery would be more of an effect rather than a cause of the learning process. This central explanation, thus, suggests that because the neurophysiological substrate would be the same for both, learning by performing would not be substantially different from learning through mental imagery.

There is considerable evidence in support of Jeannerod's suggestion of a functional equivalence between motor imagery and motor preparation and planning. Research reviews (e.g., Annett, 1996; Berthoz, 1996; Decety, 1996a, b; Jeannerod, 1994) have concluded that psychophysiological measures support a common neural substrate for motor imagery and motor preparation. Evidence in support of the functional equivalence of motor imagery and motor preparation comes from studies that utilised central measures and found that cortical activation during motor imagery occurs in areas related to motor control and that the activity follows a specific pattern that closely resembles action execution (e.g., Beisteiner, Hollinger, Lindiner, Lang, & Berthoz, 1995; Decety, Perani, Jeannerod, Bettinardi, Tadary, Woods, Mazziotta, & Fazio, 1994; Deecke, 1996; Deiber, Passingham, Colebatch, Friston, Nixon, & Frackowiak, 1991; Fox, Pardo, Peterson, & Raichle, 1987; Hallett, Fieldman, Cohen, Sadato, & Pascual-Leone, 1994; Ingvar & Philipsson, 1977; Naito & Matsumura, 1994; Roland, Skinhoj, Lassen, & Larsen, 1980; Stephan, Fink, Frith, & Frackoviak, 1993). Additionally, peripheral cardiac, respiratory, and muscular measures suggest activation of motor pathways (e.g., Beyer, Weiss, Hansen, Wolf, & Seidel, 1990; Decety, Jeannerod, Durozard, & Baverel, 1993; Decety, Jeannerod, Germain, & Pastene, 1991; Decety, Sjoholm, Ryding, Stenberg, & Ingvar, 1990; Hale, 1982; Jacobson, 1931a; Wang & Morgan, 1992; Wehner et al., 1984; Yue & Cole, 1992).

Perhaps the strongest evidence in support of the functional equivalence of motor imagery and motor preparation is the demonstration of the involvement of the supplemental motor cortex in motor imagery. Regional cerebral blood flow studies suggest that the supplemental motor cortex is involved in assembling an established motor pattern (e.g., Roland, Larsen, Lassen, & Shinhoj, 1980). Several studies have found that the supplemental motor cortex is also activated in the imagination of movement (e.g., Cunnington, Iansek, Bradshaw, & Phillips, 1996; Decety et al., 1990; Roland, Shinhoj, Lassen, & Larsen, 1980; Ryding, Decety, Sjoholm, Stenberg, & Ingvar, 1993; Stephan, Fink, Passingham, Silbersweig, Ceballous-Bauman, Frith, & Frackowiak, 1995). Several studies have now gone further, suggesting that even the primary motor cortex may be active in imagery (Hallett et al., 1994; Lang, Cheyne-Hollinger, Gerschlager, & Lindinger, 1996). Studies that have found timing of simulated movements is similar to actual movement also support functional equivalence theories (e.g., Decety, Jeannerod, & Prablanc, 1989; Decety & Lindgren, 1991; Georgopoulos & Massey, 1987; Vogt, 1995), as do interference studies that suggest that actual and imagined movements have similar biasing effects on recall (e.g., Johnson, 1982; Hall, Bernoites, & Schmidt, 1995; Orliaguet & Coello, 1998; Vogt, 1995; Engelkamp & Cohen, 1991).

An issue that this literature review addresses later in the review of psychophysiological studies on internal and external imagery is the definition of motor imagery used in these studies and reviews. Motor imagery in the reviews (Decety & Ingvar, 1990; Decety, 1996a, 1996b; Berthoz, 1996; Jeannerod, 1994, 1995) as well as most of the studies (e.g., Decety et al., 1990) is defined as a dynamic state in which a participant mentally simulates a given action. According to Decety, this implies that participants feel themselves performing. "It corresponds to the so-called internal imagery (or first person perspective) of sport psychologists" (Decety, 1996a, p. 45). Jeannerod (1995), supported this by claiming that motor images are quite similar to visual images but the two types of imagery can be distinguished from each other by determining their subjective distance between the self and its own imaginal experience. Jeannerod proposed that motor imagery predominantly encompasses internal imagery. Decety (1996a) noted that no neurophysiological or neuroimaging studies have investigated this distinction. The problem with Decety's and other research into motor imagery for interpretation in relation to internal and external imagery perspective is that in these motor imagery tasks "the subjects are instructed to imagine themselves moving without actually moving" (Decety, 1996a, p. 49). Thus, there are no reported instructions as to perspectives or sensory modalities, and it is possible that the participant is using visual rather than motor imagery. Additionally, very few studies report using a manipulation check, so there is no way of knowing what kind of imagery the participants are using other than interpreting the neurophysiological measure. If the functional equivalence theory of imagery is accepted, it would lend support to the idea that internal imagery would be more effective for performance enhancement because internal imagery is experienced in more similar ways to actual execution. That is, perception occurs from a first-person perspective.

The functional equivalence of motor imagery and motor performance appears to be a potentially fruitful explanation of how imagery works to enhance motor skills, including sports performance. Because most of the research does not relate to sport, or even to movement, sport psychology researchers need to apply the psychophysiological approach to real sport skills. The research suggests that imagining a motor act is similar to performing a motor act, however, researchers are yet to produce studies that compare imagery of a complex movement or sporting performance with actual performance of a complex movement or sport skill.

Current Status of Theories and Future Directions

It is evident that none of the theories discussed in this chapter has sufficient research support at present for acceptance as a definitive theory of imagery functioning in sport. In addition, theories do not seem to provide many clues on a theoretical basis for imagery perspective as a mediator in the imagery-performance relationship. Janssen and Sheikh (1994) suggested that "It appears that while all theories have a kernel of truth, none of them, in its present state, is sufficiently developed or detailed with respect to sport psychology" (p. 6). Perhaps the functioning of imagery combines several of these ideas. After all, in overt practice performers get feedback from the muscles, cognitively plan what they are going to do, gain confidence from viewing successful performance or actually performing the skill successfully, and are motivated by performance success, as well as the belief that a technique like imagery will work. This kind of approach is used in a model of imagery by Martin, Moritz, and Hall (1999) who suggested the importance of using different types of images to achieve different outcomes. It is possible that all of these factors could occur in imagery or MP. What the athlete gains from each imagery session may be determined by a range of factors. These could include what the imager intended the session to achieve, the emphasis of the imagery script, the preferences of the person, and the nature of the task. For example, imagery aimed at cognitively planning a performance may help with cognitive plans, whereas imagery aimed at confidence enhancement may enhance confidence. There is also the possibility of incidental benefits. For example, an imagery script might emphasise imaging performance success to enhance the performance of the skill, i.e., correct performance, but because the imagery involves success, the imagery enhances self-efficacy incidentally. In addition, in line with Ahsen's theory, the effect of the imagery may depend upon the actual meaning of the image to the athlete. One promising approach is the idea of some form of functional equivalence between imagery and performance.

When considering the implications from the theories for internal and external imagery perspectives, the theories do not seem to provide much information. Perhaps whether internal or external imagery is more effective is determined by what information the athlete needs for performing the task and which perspective provides more information for that task. For example, in imagining an open skill, like rugby or soccer, the athlete might use more spatial information, such as where teammates and opponents are located, so an external perspective from above might be more effective for imagery practice. Alternatively, for a closed skill, such as archery or free throw shooting, an athlete requires environmental targeting information from their own viewpoint and so an internal perspective might be more beneficial.

Measurement of Imagery

There is widespread interest in research and practical aspects of imagery, not only in the area of sport psychology, but also in general psychology. To conduct research on imagery, it is necessary to measure it. In addition, in order to apply imagery effectively sport psychologists must be able to assess and monitor it. Consequently, measurement is an important issue. Psychologists have measured a range of aspects of imagery, such as vividness, control, and sensory modality. Few measures have been designed specifically to assess internal and external imagery perspectives, but several measures are discussed as the basis for monitoring internal and external imagery. This section will briefly review the different measurement approaches, with more attention focused on those that relate to internal and external imagery.

Issues of Measurement

As discussed in the definition section, the conceptualisation of imagery is still not universally agreed. The definitions describe imagery in terms of a wide range of experiences and, consequently, measurement of imagery has been complicated. In addition, psychologists have identified a range of parameters of imagery, which has lead to the development of tests of different aspects of imagery. Another difficulty in measuring imagery is that imagery is a mental process and, therefore, it is not directly observable. In spite of this, psychologists have developed a number of measures. The reason for the development of tests in terms of research is to enable researchers to compare behaviour or performance with the imagery dimensions and abilities discussed here. In applied sport psychology, it is important to determine imagery strengths and weaknesses, so that intervention programs can address these. It is also important to identify those aspects of imagery that facilitate its use in performance enhancement.

Measurement Approaches

In general terms, there are four types of imagery measurement techniques. These are objective, performance tests; subjective, self-reports; psychophysiological assessment; and verbal or narrative reports. In sport psychology, by far the most common method utilised is the self-report test of which there are many, aimed at assessing different aspects of imagery. It is not possible here to review all the measurement techniques comprehensively, especially the self-report measures, so this section provides only a summary description of each type of measurement. The main tests that psychologists have applied to researching imagery in terms of motor skills and sport and those that seem most applicable to the measurement of internal and external imagery will be discussed in detail.

Objective/Performance Tests

The types of performance tasks used to assess imagery intuitively require imagery, or instruct the participants to use imagery, to solve problems. The researcher interprets differences in performance as reflecting different imagery abilities. This type of test is often divided into spatial reasoning tasks or memory tests. Spatial reasoning tests usually require mental or imaginary rotation of geometric forms. Examples of these tests are the Space Relations from the Differential Aptitudes Test (Bennett, Seashore, & Wesman, 1947), the Minnesota Paper Form Board (Likert & Quasha, 1941), Flags (Thurstone & Jeffrey, 1956) and the Group Test of Mental Rotations (GTMR, Vandenberg & Kruse, 1978). The GTMR had good internal consistency, $r = 0.90$, (Moran 1993), test-retest reliability, $r = 0.83$, (Vandenberg & Kruse, 1978), and Kuder-Richardson reliability, $r = 0.88$, (Vandenberg & Kruse, 1978). Memory tests of imagery ability generally examine either memory for verbal or visual materials. Studies using such techniques have suggested that this type of test is not a useful objective measure of imagery ability and is weakly related to performance measures (Danaher & Thoresen, 1972; Rehm, 1973; Rimm & Bottrell, 1969).

The advantages of objective test instruments are that they represent a more objective measure of imagery ability than self-report measures and avoid some problems associated with self-report approaches, such as response biases or response sets (Anderson, 1981). The problem with objective tests of imagery is that psychologists have based their design on intuition rather than any theoretical approach (Kosslyn, Brunn, Cave, & Wallach, 1984; Moran, 1993; Poltrock & Brown, 1984). In addition, in sport psychology this type of test seems less applicable because what researchers generally wish to test is the ability to image motor or sports skills. The imagery measurement instruments in this thesis need to measure imagery perspective. None of the objective tests provides a measure of perspective adopted during imagery, or seems likely to be a potential means of measuring imagery perspective. An approach that sport psychologists have favoured in measuring imagery is the self-report.

Self-Report/Subjective Tests

Self-report tests can generally be classified as subjective rating tests or questionnaires (Anderson, 1981). For the purposes of this thesis and ease of understanding, since nearly all of the tests have the term questionnaire in their title, they will be termed rating scale questionnaires, or rating scales, and simple answer questionnaires. Subjective rating scales ask participants to rate their imagery on anchored or Likert scales. Examples of this type of test are the Betts Questionnaire on Mental Imagery (QMI; Betts, 1909), the Shortened Questionnaire on Mental Imagery (SQMI; Sheehan, 1967), the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986), the Movement Imagery Questionnaire (MIQ; Hall, & Pongrac, 1983), Martens' Sport Imagery Questionnaire (SIQ; 1982), the Imagery Use Questionnaire (IUQ; Hall, et al, 1990), and Hall's Sport Imagery Questionnaire (SIQ; Hall et al., 1998). The QMI, SQMI, VVIQ, VMIQ, and MIQ were designed to measure imagery ability, whereas the IUQ and SIQ purport to measure imagery use. Simple answer, self-report questionnaires are those that ask participants to respond to questions either with yes/no, true/false, or to more open-ended questions. Examples of this type of test are the Gordon Test of Imagery Control (GTIC; Gordon, 1949), the Imaginal Processes Inventory (IPI; Singer, & Antrobus, 1972), and Paivio's Individual Differences Questionnaire (IDQ; Paivio, 1971). The GTIC, IPI, and IDQ were all designed to measure imagery ability. Only those measures that report, or purport to measure aspects of imagery related to internal and external imagery are reviewed here.

Moran (1993) stated that the tests assessed in his review (QMI, SQMI, GTIC, IDQ, VVIQ, GMRT, MIQ, and VMIQ) appeared to have satisfactory internal consistency and test-retest reliability, but none has acceptable validity. Because of this lack of validity, there is no evidence that the construct the questionnaires measure is imagery, or whether it is vividness or controllability of imagery that is assessed. The main methodological flaw in imagery self-report assessment is that participants might have difficulty making judgements about their imagery experience, such as how vivid the image is (Moran, 1993). For example, the questionnaires are susceptible to response biases or response sets, such as social desirability, or acquiescence. DiVesta, Ingersoll, and Sunshine (1971), in a factor analytic study of imagery ability measures, found that QMI scores appeared on the same factor as scores on the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1964). Reviews have concluded that response sets, especially for males, influence QMI ratings to some extent (Ernest, 1977; White, Sheehan, & Ashton, 1977). Another difficulty with rating scales is to do with inconsistencies of ratings because ratings reflect judgements compared to the participants' own previous imagery experiences.

Self-reports of imagery ability in sport and movement. This section will focus on questionnaires developed for use measuring imagery ability in movement and sport. Two imagery questionnaires that sport researchers have found useful because they attempt to measure the ability to imagine movements are the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983) and the Vividness of

Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986). Isaac et al. designed the VMIQ to assess movement imagery: visual imagery of movement itself and imagery of kinaesthetic sensations. The VMIQ contains 24 items. Participants rate the vividness of imagery for an item while imaging watching someone else and while imaging performing the movement themselves. Items cover basic body movements to movements requiring control and precision in upright, unbalanced, and aerial situations, for example: "riding a bike" and "kicking a ball in the air". Participants respond to each item using a 5-point ordinal scale from 1 (perfectly clear and as vivid as normal vision) to 5 (no image at all). The VMIQ seems a reliable test with high test-retest reliability (r = .76, Isaac et al., 1986). Convergent validity of the VMIQ was supported by Isaac et al. (1986), by a significant correlation with the VVIQ, r = .81. A high correlation between the VVIQ and VMIQ might not support the contention that the test is measuring what it claims. This is because there is nothing to suggest that people who have high vividness of visual imagery should also have high vividness of movement imagery. The VMIQ does involve a substantial visual component, however. This might be the basis for a high correlation, but it might also lead to questioning of the nature of the VMIQ. It is also possible that the high correlation between the VVIQ and VMIQ arose because their question and answer formats are very similar, so respondents react in similar ways to them both. Isaac (1992), in a study with trampolinists, suggested that the VMIQ is a useful measure of imagery ability. Isaac classified participants as high or low imagery ability based on VMIQ scores, and found that high ability imagers improved performance significantly more than low ability imagers did.

Hall and Pongrac (1983) developed the Movement Imagery Questionnaire (MIQ) to assess visual and kinaesthetic imagery of movement. The MIQ consists of

18 items, nine visual and nine kinaesthetic. Each item involves a short movement sequence such as an arm, leg, or whole body movement. Participants rate the ease/difficulty with which imagery was achieved on a 7-point Likert scale where 1 (very easy to picture/feel) and 7 (very difficult to picture/feel). The visual scores and kinaesthetic scores reflect independent factors of visual and kinaesthetic imagery. Moran (1993) stated that researchers have not validated the MIQ adequately, but have used it in research (Jowdy & Harris, 1990). Hall, Pongrac, and Buckolz (1985) found a test-re test reliability co-efficient of, $r = .83$, for a one week interval. Hall et al. also found internal consistency co-efficients of, $r = .87$, for the visual subscale and, $r = .91$, for the kinaesthetic subscale. Atienza, Balaguer, and Garcia-Merita (1994) found similar internal consistencies, $r = .89$, for the visual and, $r = .89$, for the kinaesthetic subscales and that the visual items factor and kinaesthetic items loaded separate factors, supporting the bifactorial structure of the MIQ. Some studies provide support for the MIQ as a useful measure of imagery ability in sport (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; Lovell & Collins, 1998).

Hall and Martin (1997) revised the MIQ to produce the MIQ-R. The length of the MIQ-R was reduced by removing items that participants did not always answer and eliminating some redundant items (e.g., if two items used only arm movements, one was deleted). As well as this, Hall and Martin reversed the rating scales so that 1 = (very hard to see/feel) and 7 = (very easy to see/feel) and reworded some items for clarity. Thus, the MIQ-R consists of 8 items, 4 visual and 4 kinaesthetic. Hall and Martin suggested that it is an acceptable revision because the corresponding subscales of the original and revised MIQ questionnaires are correlated, $r = .77$, for both visual and kinaesthetic. Additionally, Hall and Martin (1997) compared the MIQ and VMIQ. They found a correlation of, $r = .65$, between the visual subscale of the MIQ and the VMIQ, and a correlation of, r = .49, between the kinaesthetic subscale of the MIQ and VMIQ. Hall (1998) reported that this is expected because the VMIQ measures vividness, whereas the MIQ measures ease\difficulty of imagining a movement.

An imagery test that applied sport psychologists often use but sport psychologists have not used in the research on imagery, because it has not been subjected to psychometric analysis is Martens' (1982) Sport Imagery Questionnaire (M-SIQ). The M-SIQ describes four common sport experiences including practising alone, practising with others, watching a teammate, and playing in a contest. Participants image each of the scenes for a minute and then rate the imagery on three sense modalities (vision, hearing, and kinaesthesis) and an item referring to the emotion on 5-point Likert scales from 1 (no image) to 5 (clear, vivid image). Vealey and Walter (1993) added controllability to these, by using a 5-point Likert scale from 1 (no control) to 5 (complete control). Vealey and Walter also added an imagery perspective question after each scene. This refers to whether the imager could see imagery from inside the body with a "yes/no" response. It is interesting to note that this is the only questionnaire discussed that is specifically designed for sport, and has been used widely in applied sport psychology, yet there has been no attempt to validate it or test for reliability. Vealey and Greenleaf (1998) have further modified the M-SIQ and changed its name to Sport Imagery Evaluation (SIE). The SIE now has seven questions after each imagery scene, all 5-point Likert scales. The scales probe vision, hearing, feeling of movement, feeling of emotions, ability to see from inside the body, ability to see from outside the body, and controllability. This questionnaire seems to be a promising measure, but needs psychometric evaluation.

Self-reports of imagery use in sport and movement. Questionnaires have examined the use of imagery by athletes. Questionnaires have either been general in nature, asking about a number of psychological skills including imagery, or aimed specifically at imagery use. Mahoney and Avener (1977) surveyed elite athletes using a general questionnaire, which included material on imagery use. This lead to several replication studies, such as those of Meyers, Cooke, Cullen, and Liles (1979), Highlen and Bennett (1979), Rotella, Gansneder, Ojala, and Billing (1980), and Doyle and Landers (1980), that have been the basis for much of the research into imagery perspectives. The Mahoney and Avener (1977) questionnaire was a general instrument that inquired about aspects of personality, self-concept, and training and competition strategies. The questionnaire contained 53 items, most of which used an 11-point Likert type scale. Participants rated such things as the frequency and type of dreams they had, their anxiety leading up to performance, attention given to various factors, their frequency of self-talk, their attributions for success and failure, and their imagery on the scales. The four imagery items probed frequency of imagery use in training and competition, difficulty in controlling imagery, imagery clarity, and perspective use. Mahoney and Avener did not provide any psychometrics of the questionnaire.

One other general approach, again by Mahoney, is the Psychological Skills Inventory for Sports (PSIS; Mahoney, Gabriel, & Perkins, 1987). Mahoney et al. aimed at identifying skills that differentiate elite and non-elite athletes. The original PSIS measured five psychological skills (anxiety, concentration, self-confidence, team emphasis and mental preparation). It consisted of 51 true/false items and five of the mental preparation items concerned mental imagery. Mahoney (1989) later modified the PSIS and it became known as the PSIS R-5. It consisted of 45 Likert scale items from 0 (strongly disagree) to 4 (strongly agree) measuring six psychological areas (anxiety control, concentration, confidence, motivation, team focus, and mental preparation). Researchers have used the PSIS R-5 in some studies (e.g., Mahoney, 1989; White, 1993), but authors have questioned its use (e.g., Chartrand, Jowdy, & Danish, 1992). Mahoney (1989) reported internal consistency (co-efficient alpha), r = .64, and split-half reliability, r = .57, for the whole scale, which are quite low values in psychometric terms. The validity was also a problem, because non-elite athletes sometimes scored higher than elite athletes. Chartrand et al. administered the PSIS R-5 to 340 intercollegiate athletes in different sports to assess its psychometric properties. They found that the internal consistency for each scale was low and that the mental preparation scale, including imagery, was well below an acceptable level, with a co-efficient alpha of, r = -.34. Chartrand et al. also concluded that the mental preparation scale is conceptually ambiguous, because some of the items correlated negatively with each other. In addition, a confirmatory factor analysis showed that the data did not fit the predicted six factors.

The Imagery Use Questionnaire (IUQ; Hall, Rodgers, & Barr, 1990) is a questionnaire designed specifically to investigate the use of imagery by athletes. The IUQ and its variations have been used in several studies by Hall and his colleagues (e.g., Barr & Hall, 1992; Hall et al., 1990; Rodgers, Hall, & Buckolz, 1991). The IUQ consists of 35 7-point Likert scale items ranging from 1 (never or very difficult) to 7 (always or very easy). There are two yes/no responses. Hall (1998) reported that the IUQ has had no psychometric evaluation. Sport specific versions of the IUQ have been developed and used in research. These are the IUQ for Rowing (Barr & Hall, 1992) and the IUQ for Figure Skating (Rodgers et al., 1991) and a major modification, the IUQ for Soccer Players (IUQ-SP, Salmon et al., 1994). Barr and

Hall (1992) reported that they formulated questions on the IUQ in part, based on previous imagery use questions asked of high performance athletes (Mahoney & Avener, 1977; Rotella et al., 1980). The IUQ for rowing and IUQ for figure skating both seem to be reliable tests of imagery use with test-retest values reported to range from r = .65 to r = .95 (Hall, 1998). The main imagery findings of the studies with the IUQ and specific versions of the IUQ are reported in the section on internal and external imagery questionnaire studies.

Salmon et al. (1994) developed the IUQ for Soccer Players (IUQ-SP) to investigate the motivational function of imagery and the actual use of imagery by soccer players. The IUQ-SP has four sections covering demographic details, general imagery use, the motivational function of imagery based on Paivio (1985), and auditory imagery. The motivational section classifies four types of imagery based on image content: cognitive general (CG), cognitive specific (CS), motivational general (MG), and motivational specific (MS). Salmon et al. reported internal consistency, assessed by alpha co-efficients, of .75 for CG, .85 for CS, .82 for MS, and .76 for MG, and using a corrected-item total correlation (CIT) minimum of .4, only two of 34 co-efficients failed. Additionally, the data fitted the model using a principal-components, exploratory factor analysis, assuming four factors and using varimax rotation. The IUQ-SP was soccer specific, so Hall, Mack, and Paivio (1995) developed the Sport Imagery Questionnaire (SIQ) as a more general instrument to examine the cognitive and motivational functions of imagery. The result is an instrument with five subscales, which are CS, CG, MS, and two MG scales, MG-arousal (MG-A) and MG-mastery (MG-M). Hall et al. (1998) reported internal consistencies for each subscale were acceptable, with alpha co-efficients greater than .7 for all subscales, and all items loaded on their appropriate factor (criterion level

.40). Munroe, Hall, Simms, and Weinberg (1998) confirmed the structure of the SIQ, finding adequate internal consistency (Cronbach's alpha coefficients ranged from .68 to .87) and interscale correlations ranging between .28 and .73.

Glisky et al. (1996) reported using the Imagery Assessment Questionnaire (IAQ; Vigus & Williams, 1985). The IAQ assesses imagery use, imagers' natural and preferred imagery perspective, as well as clarity of imagery. Imagery perspective, visual imagery clarity and kinaesthetic imagery clarity are assessed on 11 point Likert scales, where low scores represent an internal perspective or low clarity and where high scores indicate an external perspective or high clarity. Glisky et al. did not describe any psychometric properties of the IAQ.

Although the self-report instruments are not perfect measures of imagery use, they are by far the most popular approach in sport psychology. The self-report measures have largely been devoted to measuring imagery ability and imagery use, or imagery use as part of a range of psychological skills. Of the measures reviewed only the IAQ (Vigus & Williams, 1985), SIE (Vealey & Greenleaf, 1998), and IUQ (Hall et al., 1990) purport to measure internal and external imagery use. Some of the self-report measures assess visual or kinaesthetic imagery, but as discussed in the definitions section, this is not the same as internal and external imagery. The MIQ (Hall, & Pongrac, 1983) aims to measure visual and kinaesthetic imagery. The VVIQ (Marks, 1973) measures visual imagery. Some researchers used the VMIQ (Isaac et al., 1986), to measure imagery perspective by adapting the questions that ask participants to image watching someone else perform and then imagine performing themselves (e.g., Hardy & Callow, 1999; Williams et al., 1995). This, however, is not a validated measure of external and internal imagery.

Psychophysiological Assessment of Imagery

Psychophysiological assessment of imagery involves monitoring of psychophysiological activity during imagery to try to identify patterns that appear to be related to imagery. With the increase in interest in cognitive investigations of human behaviour, especially in sport psychology, researchers have increasingly become interested in recording psychophysiological (e.g., heart rate, EMG, EEG) and behavioural (movements, actions) activity. These, like verbal data, only provide clues as to the internal structure of cognitive processes that produce them (Ericsson & Simon, 1980). Generally the physiological responses that sport psychology researchers have measured are the peripheral physiological responses, such as skin conductance, heart rate, respiration rate, EOG (electrooculograph), and EMG (e.g. Jacobson, 1930d, 1931a; Shaw, 1938, 1940; Hale, 1982). Central processes, such as EEG and regional cerebral blood flow, have been measured (e.g., Davidson & Schwartz, 1977; Farah, 1989a), however, the peripheral measures have been used with much more frequency in imagery research. Several researchers have demonstrated that imagery of different situations or activities results in measurable activation of the peripheral nervous system (e.g., Grossberg & Wilson, 1968; Hale, 1982; Jacobson, 1930d, 1931a; Shaw, 1938, 1940; Wilson, 1960). Thus, these responses are part of imagery and are indicators of imagery activity. Researchers in psychology use the presence, quality, and correspondence of the physiological response to assess the extent to which the imagery approximates the overt activity the imager is imagining.

Sport psychologists have used the psychophysiological approach to investigate imagery perspectives (e.g., Hale, 1982; Harris & Robinson, 1986), however, these studies were examining psychophysiological responses to imagery scripts. This thesis focuses on measuring the perspective adopted during imagery. Using a psychophysiological measure would provide little information on this. It might provide information on the level of kinaesthetic or visual imagery, but as stated in the definitions section, this is not the same as imagery perspective. For example, having greater levels of EMG activity during imagery might demonstrate that the participant experienced more kinaesthetic imagery, but would not demonstrate that the participant was using an internal or external perspective during imagery. There does seem to be a need to use different indicators to check the validity of the measures or to understand fully what is happening in imagery. For example, using a self-report measure with a psychophysiological or narrative report measure.

Narrative Reports

The assessment of imagery by narrative report, or rather content analysis of narrative report, has been applied to investigate imagery of fear, phobic events, and assertive events (e.g., Anderson & Berkovec, 1980; Kazdin, 1975, 1976). Ericsson and Simon (1980) described different types of verbal reports that researchers can use as data. Concurrent verbalisation (CV) occurs when participants verbalise information as they are attending to the information. It is often called "thinking aloud" and, in the present context, involves describing imagery as it occurs. Retrospective verbalisation (RV) is when a researcher asks participants about cognitive processes that occurred earlier. Psychologists have also used CV techniques to investigate other mental activities, such as problem solving (e.g., Newell & Simon, 1972), cue-probability learning (Brehmer, 1974), concept learning (Bower & King, 1967), performance on intelligence tests (Merz, 1969) and mental multiplication problems (Dansereau & Gregg, 1966). Klos and Singer (1981) monitored ongoing thoughts following simulated parental confrontations with a verbalisation protocol. Schomer (1986) investigated the relationship between associative and dissociative mental strategies and the perception of training intensity in a study that suggested that a verbalisation protocol might be used in investigating sport skills. Schomer recorded verbalisations during training runs of marathon runners. The content analysis results achieved 97.338% concordance among independent coders, across ten categories comprising associative and dissociative strategies. The results revealed a relationship between associative strategy and perception of effort. Schomer reported that the runners did not perceive a discrepancy between the speed thoughts occur and the verbalisation of these thoughts as a problem in describing their thoughts. Research that has used a RV protocol includes studies on concept learning (Hendrix, 1947; Phelan, 1965), learned generalisations (Sowder, 1974), and concept formation (Rommetveit, 1960, 1965; Rommetveit & Kvale, 1965a, 1965b). These studies suggested that CV and RV can be used by psychologists to study mental activities. Sport psychologists, however, have not applied them to investigate imagery of movement or sports skills.

In discussing whether a verbalisation protocol is applicable to the investigation of imagery of sport skills, and imagery perspectives in particular, a consideration of the theoretical basis for its application and review of studies that have used verbalisation in investigating imagery is warranted. One important issue in cognitive views of imagery, as reported in the Theories section, is how knowledge is stored or represented. The argument is whether information that one is aware of while imaging is stored in an imaginal form, such as quasi-sensory and verbal codes, or in a propositional format. Anderson (1981) and Lang (1977) stated that images of different quality generated by propositional networks would differ in the amount of information or descriptive detail contained in them. So one method of assessing the quality of imagery would be to use the relative amount of detail that participants can report from their imagery as an index of the quality of the underlying representation. Anderson concluded that this approach might provide a more direct means of assessing ability than rating scales and questionnaires.

Ericsson and Simon (1980) wrote a review advocating that verbal reports are data. They provided a discussion of different processes underlying verbalisation from a cognitive information processing approach. Ericsson and Simon suggested that when instructed to think aloud, participants verbalise information to which they are attending in short-term memory (STM). Ericsson and Simon stated that CV is the most accurate verbal account of mental activity. Based on a serial model of thinking they suggested that participants are able to describe only information that is in STM. Retrospective reports produce less accurate information about imagery because working memory during processing is very brief. Therefore, producing retrospective reports relies on inferences based on implicit causal theories of behaviour. Ericsson and Simon differentiated between three levels of verbalisation: level 1 or direct verbalisation occurs when the participants reproduce the information in the form in which they process it; level 2 occurs when the internal representation is not in the verbal code and therefore the participants have to translate it; and level 3 involves instructions for verbalisations of only a selected type of information (filtering) or of aspects that the participants would not normally attend to (interference). The most general type of RV requires the participant to report everything they can remember about the imagery. If the researcher asks the participant immediately after imagery, it will aid information retrieval because some information will still be in the STM. Ericsson and Simon claimed that when participants are asked to think aloud about information that is already available to them, then verbalisation will not change the course or structure of the cognitive process, or slow down the process. If the information the participant is processing is not verbal or propositional the performance might slow down, or be incomplete, but the course and structure of the task will not change. Level 3 type of information might change the cognitive process, however.

Studies on imaginal activity, such as dreaming and imagery, have suggested that researchers can use a verbalisation protocol to investigate imagery and the contents and quality of imagery (e.g., Antrobus, Fein, Jordan, Ellman, & Arkin, 1978; Bertini, Lewis, & Witkin, 1969; Klinger, 1978). In addition to these studies, a variety of studies have provided support for the assumption of a relationship between descriptive detail and quality of imagery and describing the imagery scene aloud as a technique for improving imagery quality (e.g., Hurley, 1976; Phillips, 1973; Wolpe, 1973). Kazdin (1975, 1976, 1979) conducted a series of studies using CV to investigate imagery. They provide strong support for using a verbalisation technique to assess imagery as it is occurring, and possibly using such a technique to ascertain information such as imagery perspective adopted during imagery.

Kazdin (1975) investigated covert modelling and developed a CV technique to assess imagery during treatment. Covert modelling is a procedure in which the clients imagine, rather than observe, a model engage in behaviours they wish to develop (Cautela, 1976). In Kazdin's studies (1975, 1976, 1979), this tended to be an assertive model. Kazdin proposed that using CV was necessary because it is difficult to assess imagery due to its private nature. Kazdin stated that although a researcher might instruct a participant to imagine specific material, it is almost impossible to ensure that that is specifically what the participant is imaging. Obviously the content of the imagery is essential for behaviour change and if the participant is not consistently imaging the specific content then the treatment is not really being adequately assessed. An imagery treatment that fails to effect behaviour change could result from deviations from the presented conditions. Informal reports in some studies have shown that imagery can sometimes differ from the presented material (e.g., Davison & Wilson, 1973; Weitzman, 1967). This has also been the case in sporting studies (e.g., Woolfolk, Murphy, Gottesfeld, & Aitken, 1985) and internal and external imagery studies (e.g., Gordon, Weinberg, & Jackson, 1994; Collins et al., 1998).

Kazdin (1975) assessed imagery during treatment with CV and evaluated compliance with specific imagery conditions. Kazdin instructed 54 participants, 24 females and 30 males, aged 18 to 61 years (Mdn = 21 years), to verbalise aloud the scene they were imaging. Kazdin recorded the verbalisations on audiotape. Participants held each scene for 35 seconds beginning when the participant signalled that the imagery was clear. Participants imagined each scene twice each session. At the end of each session participants completed a questionnaire with ratings for clarity of imagery, anxiety experienced, how successfully they imaged the scene, and various features of the model (e.g., age, sex). Kazdin assessed each scene for three main factors: scene components, whether the verbalisations were consistent with the presented scene; elaboration of scene, whether participants introduced additional material; and completed scene, whether the participants could complete the scene in the allocated time. Two judges evaluated verbalisations. Kazdin assessed inter-observer agreement across 200 scenes of 10 randomly selected participants by comparing agreements and disagreements. Reliabilities were calculated by dividing agreements by agreements plus disagreements and multiplying by 100 to give a percentage. Reliabilities were 83% for completion of scene, 93.2% for description of assertion, 88.6% for description of consequences, and 83.6% for elaboration of scenes. Kazdin reported that the verbalisations were useful in determining adherence to imagery conditions and in revealing divergence from the presented scenes. Participants generally adhered to the assigned conditions, however, verbalisations revealed some divergences. The results of the modelling indicated that it changed behaviour.

Kazdin (1976) again investigated the effect of imagery during covert modelling in training assertive behaviour. To evaluate the effects of the verbalisation procedure on therapy outcome, Kazdin compared covert modelling groups with and without the verbalisation procedure. This was necessary because, although the verbalisation procedure might be useful in assessing imagery, it could also influence its effects. In investigations into covert modelling of the modelled response sequence researchers have reported that verbalisation enhanced the modelling effects, and verbalisations of imagery could have the same impact (e.g., Bandura, Grusec, & Menlove, 1966; Bandura & Jeffrey, 1973; Gerst, 1971). Verbalisation of imagery could also have the opposite effect if it were to reduce development of clear imagery. Thus, Kazdin investigated whether verbalisation of imagery alters the effects of imagery. Thirty-nine participants, 25 females and 14 males, aged 19 to 59 years (Mdn = 24) participated in the study. Kazdin randomly assigned them to one of four treatment conditions: covert modelling, covert modelling plus verbalisation, no-assertive model plus verbalisation (only received a portion of the scenes), and delayed treatment control. Verbalisation protocols were similar to those used in Kazdin's (1975) study and judges scored for scene components and elaboration. Inter-observer agreement between two observers for eight participants across 180 scenes ranged from 94.3% to 81.2%. Results revealed that both covert-modelling conditions increased assertiveness. Therefore, verbalisation of imagery did not affect the efficacy of imagery during covert modelling. Additionally, the verbalisations indicated that participants did tend to follow the experimental conditions, however, some participants did diverge slightly. For example, some no-assertive-model participants did imagine an assertive model. Although this was infrequent, it could impinge upon results of a treatment program. Thus, investigations that compare different imagery treatments or variations on treatments might fail to show differences if they do not consider deviations from instructions.

Thirty-two males and 16 females aged 19 to 43 years (M = 26.7) participated in a study by Kazdin (1979) investigating the influence of elaborations of imaged scenes on the efficacy of covert modelling, in treating non-assertive behaviour using CV. Kazdin divided participants into four groups: covert modelling alone (imagine someone similar to themselves in the treatment scenes making assertive responses); covert modelling plus elaboration (as for covert modelling, plus elaboration, i.e., could change the scene as long as the model engaged in an assertive response); covert modelling plus yoked elaborations (as for covert modelling, plus scenes that were generated in the elaboration groups were presented); scene plus elaboration (same as for covert modelling but model does not make an assertive response). The scene elaboration participants added their own details to scripts. Kazdin found that the scene elaboration group demonstrated greater improvement on self-report and role-playing tests than the other groups, and concluded that active elaborating of scenes containing basic elements was the best treatment for developing assertive behaviour.

Anderson and Berkovec (1980) conducted an experiment with speech anxious individuals using imagery, with either stimulus or stimulus and response propositional imagery scripts and a RV protocol. Anderson and Berkovec instructed participants in the imagery and RV procedures and told them to involve themselves in the scenes and to use a participant (internal) rather than an observer perspective (external) while imaging. They were encouraged to describe both stimulus and response elements in their narrative reports. Anderson and Berkovec concluded that the narrative data was useful for interpreting the results, as post hoc analysis revealed that the contents actually imaged by the majority of the participants in the two conditions did not differ on the script dimensions as clearly as the researcher had intended, with participants in both conditions tending to include response detail in their narrative reports. This finding suggests that it is possible for participants to describe stimulus and response elements, and possibly imagery perspective in verbal reports.

Annett (1986) conducted a series of exploratory studies where participants provided verbal explanations of non-verbal tasks. In the initial study, Annett asked participants to "tell me in as much detail as you can how you ..." with the two tasks being performing a forward roll and tying a bow. Verbalisations were recorded on audio or videotape and transcribed. In later studies, video recordings were also used to monitor any gestures participants made. Annett never instructed participants to form imagery during the experiment. Annett found that participants invariably reported that they could only provide a verbal explanation by tying an imaginary bow and referring to these images. Participants also often made movements or gestures, not exactly equivalent to those used tying a bow. Annett also introduced secondary interfering tasks to assess contributions of the motor, visual, and verbal systems. An auditory monitoring task did increase speech rate, but not significantly, and a tapping task did not interfere. Thus, it seems possible to describe an action even when performing another. Annett also restricted movement of the hands in one experiment and found that it did not interfere with explanations, but participants used other parts of the body, such as the head, to indicate spatial elements. Some interesting aspects to come out of the verbalisation were that "there were differences in the apparent point of view. Almost all subjects reported having imagery as if through their own eyes" (p. 193).

As Anderson (1981) suggested, "there is almost no substitute for relying on verbal reports to some extent because of the kinds of information that are available to them" (p. 167). There are problems with using verbal reports as data, however. For example, the ideal verbal report would be a perfectly full and accurate account of the content of imagery and the participant would leave nothing out and not add, or change anything. Such a report is probably unobtainable even when dealing with an external object or event. The real problem with imagery is that the investigator can never know for sure what has been changed, added, or omitted from perception/action to imagery to report of imagery. Another issue with verbal reports is in the timing of the report. Generally, a participant can give a report concurrently or retrospectively. One of the major problems with CV is that it might cause participants to dwell on a given aspect longer than they normally would. It is important to note that verbal reports are always retrospective to some degree because they are reporting what the individual was aware of just before the actual report. The length of delay between completion of imagery and the retrospective report is important. Anderson (1981) suggested that it is most effective if the participant gives the report as soon as possible after completion of the imagery to reduce any memory loss or distortion. Other methods to reduce memory loss are to let the participant know the researcher will be requesting a report, to give general instructions to report as completely as possible, and to provide training in reporting. Censoring or deliberate selective reporting could also affect verbal reports. To alleviate this, Anderson recommended a supportive atmosphere. Verbal reports might also have the problem that participants might add data, or that the reports might contain more information than the original imagery. Anderson (1981) suggested that this contamination occurs in two forms. First, participants might report more content information than was processed because it involves a "second look" at the experience, which could cause the participants to process additional information. Additional information is likely to be reported if the report occurs after the imagery and asks for specific information. One way of overcoming this is to make the original instructions as complete as possible about what types of awareness participants are to report. Secondly, comments about the content rather than the actual content could be included, such as, comments about clarity or difficulty of the imagery process. Another factor in verbal reports is the difficulty in finding words to describe some aspects of imagery. To overcome this, Anderson suggested providing participants with training programs or encouraging participants to include all that they are aware of and specifically all affective reactions and non-visual sense modalities.

Finally, a problem might occur due to individual differences in the verbal abilities of participants, such as verbal productivity. This could be a problem if the researcher is utilising word counts from verbal data. Foulkes and Rechtschaffen (1964) provided data indicating that this might not be a serious problem. They found that word counts from Thematic Apperception Test (TAT) protocols correlated, $\underline{r} = .47$, $\underline{p} = .02$, with word counts from REM dream reports, but only, $\underline{r} = .08$, with non-

REM reports. Reports from both sleep periods should have been affected if verbal productivity was a confounding factor. This was consistent with Anderson's idea that word count measures reflect qualitative differences in imagery because more vivid and detailed dreams would be expected in REM sleep.

One advantage of a CV protocol to investigate imagery would be that it allows a manipulation check of whether the participant was actually imaging according to the experimental condition, as in Kazdin's studies (1975, 1976, 1979). It is important that sport psychologists provide a careful check of self-reported MP or imagery experience, but very few studies have carried this out (Murphy, 1994). This manipulation check is critical because in many studies on imagery and MP the sport psychologist administers a program of imagery or MP and then looks at the effects of this program on performance. If the sport psychologist does not check that the imagery the participant uses follows that described in the experimental condition, they cannot be sure that the effects of imagery are due to that experimental condition. On the rare occasions that researchers have checked by asking participants whether their imagery followed the experimental condition, they have found that participants have changed the imagery script (Woolfolk, Murphy, Gottesfeld, & Aitken, 1985). CV of imagery would seem to provide a check of whether the participant is following the experimental condition, and the research just reported suggests it is more effective than asking for a retrospective report of what the participant imagined.

Sport psychologists have not used verbalisation techniques to investigate imagery perspectives, however, it seems from the review that it could be a useful approach. The studies suggest that participants can provide CV and RV of their imagery experience. In addition, imagery with verbalisation does not produce a different effect on overt behaviour from imagery without verbalisation, so verbalisation does not seem to alter the effects of imagery (e.g., Kazdin, 1976). The studies suggest that the verbalisation protocols provided a check on what participants imaged during imagery trials and that participants can provide detailed descriptions of what occurred during imagery and the content of these imagery trials (e.g., Bertini et al., 1969; Kazdin, 1975). In addition, participants are also able to describe stimulus and response elements in their narrative reports (Anderson & Berkovec, 1980). This all suggests that CV and RV might provide useful measures of imagery perspective use as it occurs within an imagery trial.

Research on Imagery

Studies have suggested that imagery is currently the most widely used Psychological Skills Training (PST) technique (e.g., DeFrancesco & Burke, 1997; Gould, Tammen, Murphy, & May, 1989; Orlick & Partington, 1988) and that higher level athletes tend to use it more than less skilled athletes (Hall et al., 1990). Imagery is a very versatile technique that athletes can use in a number of ways. Examples of the uses of imagery include skill learning, skill practice, strategy learning, strategy practice, mental warm-up, preview, review, problem solving, stress management, developing psychological skills, building confidence, improving concentration, and recovering from injury or heavy training (Murphy & Jowdy, 1992; Perry & morris, 1995; Vealey & Greenleaf, 1998; Weinberg & Gould, 1995). In the literature review I have considered what imagery is, how imagery might enhance performance, and how it might be measured. The issue addressed in this section of the literature review is research investigating whether imagery is effective in enhancing aspects of performance in sport and when it is most efficacious. It is important to clarify the imagery-performance relationship before considering how imagery perspectives might mediate between imagery and performance, because this is the basis of any relationship between imagery perspectives and performance. This section reviews studies on imagery and MP without considering perspective used, to ascertain whether imagery affects performance of motor and sport skills.

Experiential evidence from successful sports people and coaches suggests that imagery can be effective in improving sporting performance. This includes testimony from elite athletes such as Jack Nicklaus (golf), Greg Louganis (diving), and Chris Evert (tennis). Imagery used to perform a specific sport skill repetitively has often been termed MP. Research on MP suggests that MP is better than no practice (NP), physical practice (PP) is better than MP and a combination of PP and MP is better than or at least as good as PP (Feltz & Landers, 1983; Hird, Landers, Thomas, & Horan, 1991; Martens, 1982). Pre-competition imagery is the use of imagery immediately before competition, in an attempt to enhance performance. Studies suggest that positive pre-competition imagery improves performance in golf putting (Murphy & Woolfolk, 1987; Woolfolk, Parrish, & Murphy, 1985), muscular endurance tasks (Gould, Weinberg, & Jackson, 1980; Lee, 1990), and strength tasks (Shelton & Mahoney, 1978). Packaged PST programs often involve imagery used in conjunction with other intervention techniques and have been effective in their application in baseball (Kendall, Hrycaiko, Martin, & Kendall, 1990), figure skating (Wrisberg & Anshel, 1989) and gymnastics (Lee & Hewitt, 1987).

Mental Practice Studies

As stated earlier, mental practice (MP) generally involves using imagery or some other cognitive process to repetitively practice a skill. Studies by Jacobson (1931a) and Sackett (1934, 1935) have lead to a large amount of research examining the efficacy of MP. Researchers conducted most of the earlier studies with motor skills in the laboratory. Additionally, their methodology often utilised a pre- and post-test comparing MP with one, two, or all of three other conditions: physical practice (PP), no practice (NP), and a combination of mental practice and physical practice (PP/MP).

Many of the research studies supported MP producing improved performance (e.g., Clark, 1960; Eggleston, 1936; Ergstrom, 1964; Kohl & Roenker, 1980; Minas, 1978; Twining, 1949; White, Ashton, & Lewis, 1979; Wrisberg & Ragsdale, 1979), however, some studies (e.g., Burns, 1962; Derbyshire, 1987; Epstein, 1980; Gilmore & Stolurow, 1951; Rodriguez, 1967; Ryan, et al, 1986; Smyth, 1975) failed to support the relationship. Other studies have found that MP produces higher performance than NP, but PP produces higher performance than MP alone (e.g., Ergstrom, 1964; McBride & Rothstein, 1979; Mendoza & Wichman, 1978; Twining, 1949). Some studies have found that the PP group and the MP group produce higher performance than the NP group, but are not significantly different from one another (e.g., Hird et al., 1991; Kohl & Roenker, 1980; Rawlings, Rawlings, Chen, & Yilk, 1972; White et al., 1979; Wrisberg & Ragsdale, 1979). Studies that have included a PP/MP group, have found it to be as effective as PP alone (e.g., Ergstrom, 1964; Grouios, Mousikou, Hatzinikolaou, Semoglou, & Kabitsis, 1997; Oxendine, 1969; Vandell, Davis, & Clungston, 1943) or more effective than PP alone (e.g., Alves, Farinha, Jeronimo, Paulos, Ribeiro, Ribeiro, & Belga, 1997; McBride & Rothstein, 1979; Meacci & Price, 1985; White et al., 1979). This research, although there are some equivocal findings, seems to suggest that PP or a combination of PP and MP produces superior performance improvement to MP alone, which is better than NP (Grouios, 1992; Murphy & Jowdy, 1992).

There have been several major reviews of the MP literature. Feltz and Landers (1983) conducted a meta-analysis on 60 studies using MP, which produced 146 effect sizes. From these studies the overall effect size was .48. Feltz and Landers stated that these results suggested that MP of a motor skill is superior for performance enhancement than NP. Feltz et al. (1988) conducted a follow-up review examining 14 more studies that resulted in an average effect size of .43. Driskell et al. (1994) conducted a more recent meta-analytic review of the MP literature. Results tended to support the findings of the Feltz and Landers meta-analysis, suggesting that MP is effective at enhancing performance, however, it is less effective than PP. Review papers on MP by Weinberg (1982), Grouios (1992) and Murphy and Jowdy (1992) drew similar conclusions on the efficacy of MP. They suggested that PP is superior to MP, but MP combined and alternated with PP is better than either PP or MP alone.

The research on MP is not unequivocal and several authors have suggested that methodological problems may influence interpretation of the research findings (e.g., Corbin, 1972; Feltz & Landers, 1983; Grouios, 1992; Murphy & Jowdy, 1992; Weinberg, 1982). Sport psychologists need to consider the length and content of imagery interventions in designing or reviewing research on imagery. Many MP studies have used just one MP session, which involves simply mentally rehearsing the task or thinking about the task. This is very different to the type of imagery often presented in the applied sport setting, where the sport psychologist generally explains the nature of imagery, gradually introduces imagery, gives rich instructions, and provides substantial practice (Morris, 1997). Other methodological problems include MP being a broad term, so that different activities could be considered MP and it is likely that no two MP studies are examining exactly the same thing (Murphy, 1994).

The nature, timing, and type of instructions given might vary greatly from study to study (Grouios, 1992).

Design problems highlighted by Grouios (1992) included the type of design used (i.e., pre-post test only design); the number of practice sessions given and the length of each practice session; whether the post-test was immediate or delayed; the "Hawthorne Effect" when the MP group is given "something" to do while control (NP) groups are given "nothing" to do; the tendency for researchers to combine treatments as experimental conditions; and that the nature of the task and participants are not taken into account when considering the effects of MP. Other problems in MP (and imagery) research include not providing much control over the frequency, duration, and accuracy of MP or employing any manipulation checks to ensure MP groups are practicing mentally and that NP (control) groups are not using MP. When comparing PP and MP, the ratio of MP to PP, and the latency between them, are factors that influence MP effects (Hird et al., 1991; Kohl, Roenker, & Turner, 1985), yet researchers have rarely reported these. Another problem inherent in the research is in determining what participants are really practising in MP conditions. It is important that researchers check that the participants are following the script/procedure/instructions given to them and are imaging/practicing what the researcher assumes they are. This has rarely been operationalised in the MP literature. Murphy (1994) suggested that when researchers have asked participants they often find that participants have changed the imagery script that the researcher gave them.

<u>Imagery Interventions</u>

With the increasing use of imagery in sport psychology (DeFrancesco & Burke, 1997; Gould et al., 1989), it is important that researchers empirically test the efficacy of such treatments, so that the most effective techniques or strategies are used. Generally, three types of intervention study in the sport psychology literature that have investigated imagery can be differentiated: studies that employ imagery as a pre-performance strategy; studies that use imagery as part of a PST program; and studies of stand alone imagery training programs, using several sessions or more. The imagery interventions that use imagery as a pre-performance strategy generally involve the sport psychologist asking participants to follow a particular imagery strategy prior to completing a skill or task, similar to the MP studies. The sport psychologist usually asks participants to close their eyes, imagine successfully executing the skill, and then attempt the task. Studies that have investigated imagery as a pre-performance strategy have generally found imagery to be beneficial for performance enhancement (e.g., Gould et al., 1980; Woolfolk, Parrish, & Murphy, 1985). One of the problems of research in this area is that few studies have checked the imagery experience. Consequently, it is impossible to know what participants actually imagined during the pre-performance period or if they used any other strategies during this period (Murphy, 1994; Murphy & Jowdy, 1992).

Some studies have used imagery as part of a PST program, incorporating other psychological skills. These studies have also suggested that imagery is effective in enhancing performance, however, it is difficult to ascertain the relative effect of imagery because of its use as part of the combined program (e.g., Kendall et al., 1990; Lee & Hewitt, 1987; Mumford & Hall, 1983; Spittle & Morris, 1997; Wrisberg & Anshel, 1989). Other studies utilise a longer imagery intervention with numerous training sessions of imagery as a separate PST technique. These generally provide stronger evidence on imagery as a performance enhancing tool. Studies that have investigated imagery training programs of several sessions or more have indicated that this sort of program can be effective in enhancing performance of sport skills (e.g., Callery & Morris, 1993, 1997a, 1997c; Lamirand & Rainey, 1994; Rodgers et al., 1991). Recently in the literature there seems to have been a shift towards investigating intensive imagery training programs by the use of single-case study designs, which allow researchers to monitor individual athletes over a period of time, such as an entire season, involving a substantial number of training sessions. These studies also suggest that imagery can be an effective performance enhancement strategy (e.g., Callery & Morris, 1993; Kearns & Crossman, 1992; Lerner, Ostrow, Yura, & Etzel, 1996; Savoy & Beitel, 1996; Shambrook & Bull, 1996; Templin & Vernacchia, 1995; She & Morris, 1997).

Skill Level Characteristics

It is possible that characteristics of the participants or task will influence the effects of imagery. Consequently, this review next briefly addresses these issues. First issues of participant age and experience are reviewed, and then aspects of the task, such as cognitive or motor elements and open and closed skills are considered.

There have been two opposing views in the literature on whether imagery is more beneficial for the novice or skilled performer. Athletes at all skill levels have reported using imagery (Hall et al., 1990) and the literature has not clearly demonstrated that novices or experienced performers benefit more from using imagery. It does, however, appear that novices and experienced performers respond favourably to imagery or MP.

The view that imagery should be most effective for novices or beginners is based on the idea that the initial stage of motor skill learning is largely cognitive (working out how the skill should be done) and imagery assists in practising these cognitive elements (Hall, Schmidt, Durand, & Buckolz, 1994). Some studies have found support for greater performance enhancement with performers in earlier stages of learning than performers in later stages of learning (e.g., Ziegler, 1987; Wrisberg & Ragsdale, 1979). The other view is that the performer who practices performing the skill will find imagery more effective because they have a stronger, clearer, more accurate image of correct performance of the skill (Blair et al., 1993; Woolfolk, Parrish, & Murphy, 1985). This position is supported by several studies (e.g., Clark, 1960; Corbin, 1967a, 1967b; Isaac, 1992; Noel, 1980).

Feltz and Landers (1983) calculated an effect size based on participants' experience with the task. There were no significant differences between more experienced and novice participants when averaged across tasks varying in cognitive elements. They found a slightly larger effect size for more experienced participants ($M = .77$), although the effect size for novices was also large ($M = .44$). Feltz and Landers concluded that it appears that the effects of MP occur at both the early and later stages of learning. It should be noted that skill level and experience are different, if related variables. Skill level typically increases with experience, but it is possible for one performer to have less experience and reach much higher levels of performance.

Driskell et al. (1994) found no significant difference between novice and experienced participants. The data indicated a moderate and significant effect for participants with previous experience on the performance task, as well as novice participants. Driskell et al., however, did find an experience by task type interaction. For novice participants, the results indicated a stronger effect of MP for cognitive tasks than physical tasks. For experienced participants, there was no significant difference for cognitive tasks compared with physical tasks. This, therefore, indicates that experienced participants benefit equally from MP on cognitive and physical tasks, whereas novice participants benefit more from MP on cognitive as opposed to physical tasks, which is consistent with the theoretical predictions discussed earlier in this section.

Age Characteristics

Researchers in imagery in sport have not extensively reviewed the aspect of age. From the research conducted, it appears that performers of all ages can benefit from imagery training. Feltz and Landers (1983) calculated effect sizes for elementary, high school, and college age participants and found no consistent differences between these groups. Although some studies have been conducted with each of these age groups, only one study in their review compared the three age groups in their ability to use MP (Wills, 1966). Wills did not find any consistent differences between age groups. Studies with teenage participants have suggested that imagery is effective with this age group (e.g., Rodgers et al., 1991; Spittle & Morris, 1997).

Task Type

Much of the research on the nature of the task has examined whether tasks with a larger motor component or tasks with a larger cognitive (symbolic) component produce the greatest effects from imagery practice, as reported in the discussion on symbolic learning theory. Whereas many studies have shown MP and imagery to be effective in improving performance of skills with a large motor component (Kohl & Roenker, 1980; Mendoza & Wickman, 1978; Rawlings et al., 1972; Twining, 1949), studies actually comparing MP effects on cognitive and motor tasks have generally found greater improvements for the cognitive components (Minas, 1978; Morrisett, 1956; Ryan & Simons, 1981, 1983; Smyth, 1975; Wrisberg & Ragsdale, 1979).

In their meta-analysis, Feltz and Landers (1983) found that the effect of MP on cognitive tasks was greater than on motor, and strength tasks. Feltz and Landers stated that although cognitive tasks typically have large effect sizes, other tasks labelled as motor, at times had large effect sizes. Driskell et al. (1994) also compared cognitive and physical tasks, in their meta-analysis. They found that MP was effective for both cognitive and physical tasks, but the effects of MP were significantly stronger the greater the cognitive component of the task. An issue with the meta-analyses (Feltz & Landers, 1983; Driskell et al., 1994) is that meta-analyses try to make sense of a combination of cognitive-motor tasks and samples that are individually designed, so that the tasks and the kinds of samples used with them do not follow any systematic pattern. For example, the difficulty of the strength, motor, and cognitive tasks could be very different and make comparing such a broad range of tasks that vary on many criteria very difficult. Broad classifications like those used by Feltz and Landers and Driskell et al. do not really do justice to tasks that vary on all sorts of criteria. To sort out the relationship between task type and imagery, a systematic research program that begins from a classification of tasks would be required.

The research, therefore, seems to indicate that MP produces the greatest effects on tasks that are high in cognitive components. The categorisation of tasks into cognitive, motor, and strength categories, however, is a simplified view of these tasks (Feltz & Landers, 1983; Janssen & Sheikh, 1994). What is more likely is that tasks lie on a continuum from tasks with few cognitive components to tasks that are primarily cognitive. The problem is in determining the size of the cognitive component in a task. Janssen and Sheikh also suggested that the cognitive dimensions of a task change as the performer's skill level changes. For example, a beginner may be concerned more with how to perform a skill, whereas an expert is more focussed on strategy and tactics. They proposed that rather than looking at the cognitive and motor components, an elements of skills approach to analysing task type proposed by Paivio (1985) could be utilised. Paivio suggested that an issue that has been neglected is whether the task involves a perceptual target, whether the target is moving or stationary, and what the performer is doing in relation to the target. It might be that these different tasks will determine how athletes can use imagery most effectively. What researchers need to do is determine how to use imagery according to the specific task, rather than debate whether certain types of task produce superior effects than others.

In terms of the open and closed skill classification, Feltz and Landers (1983) compared the findings for what they described as closed skill (self-paced) and open skill (reactive) tasks. The use of reactive and non-reactive skills as open and closed skills is open to criticism as this is not the true distinction of the two terms, even though most open skills probably are reactive and most closed skills are self-paced. For example, it is easy to think of several closed skills that are reactive to some extent, e.g., swimming. Feltz and Landers felt that closed skills would be easier to practice mentally because they are consistent and predictable and only one response need be learned. They found a mean effect size of .39 for self-paced tasks and .25 for reactive tasks, supporting that proposition. A study that compared mental and physical practice on the learning and retention of an open and a closed skill was conducted by McBride and Rothstein (1979). Participants were 120 high school girls who hit a solid wiffle ball with a table tennis bat at a concentric circles target with a non-dominant forehand stroke. For the closed skill, the ball was placed on a batting tee, and for the open skill the ball was dropped down a curved tube at a 45-degree angle at a rate of one every 10 seconds. Participants performed a pre-test, then were randomly assigned to a MP, PP, or PP and MP condition and practiced in these conditions for three days. Each participant practiced the skill 40 times each day, according to the condition. McBride and Rothstein recorded accuracy scores in blocks of 10 trials during acquisition and in blocks of 10 trials during testing and retention. McBride and Rothstein reported that participants performed the closed skill more accurately than the open skill, but the effects of the types of practice appeared to be similar for open and closed skills. They found that MP was not as effective as PP and that PP was not as effective as combined PP/MP.

Methodological problems with imagery studies

Many of the same methodological problems highlighted in the MP literature also occur in the imagery studies. Lack of consistency of, or description of, the timing of instruction, nature and type of instructions, the number of sessions, length of session, and timing of post-tests has made it difficult to compare the results of studies. For example, a six week, three session per week program of 30 minutes per session is likely to have different effects to one practice session on the day of testing, so these conditions need to be reported.

Murphy (1990) pointed to limited theoretical explanations of imagery effects as a problem of the imagery literature. Sport psychologists have tended to concentrate largely on the symbolic learning theory and psychoneuromuscular theory to account for imagery effects. Psychologists have proposed other explanations and theories, but have not rigorously tested them in sport. Murphy blamed much of this on what he calls the MP model. The central issue for this model is how to explain the process by which MP can mimic the effects of PP. This means that psychologists have largely ignored other factors such as the effects of imagery on emotional experience, or the process of developing an individual pattern of images. As sport psychologists use imagery for much more than just MP, it is perhaps time that researchers conducted more rigorous research of other explanations of imagery effects.

A major problem across imagery studies has been the lack of control of and assessment of imagery or MP quality. For example, psychologists have suggested that vividness and control are important factors to determine the efficacy of imagery (Feltz & Landers, 1983; Weinberg, 1982), yet they have been measured by few studies and are rarely measured as part of a study. In addition to this, to assume that control and vividness are the only important dimensions is a narrow view of imagery. Other dimensions, such as, perspective, influence on attentional focus, image content, ease, quality and duration, intensity and reality of imagery, as well as its effect on sense modalities, such as kinaesthesis, proprioception, and hearing, may be important in imagery of some tasks.

Another related problem is the lack of manipulation checks employed. The checking of imagery content or quality during experimental conditions has been far from standard, yet it has been found that participants in imagery studies can change or vary the imagery script or instructions that constituted a particular experimental condition (e.g., Harris & Robinson, 1986; Jowdy & Harris, 1990). Very few studies have measured what the participant actually reports imagining, as opposed to what the experimenter told the participant to imagine. Thus, there has been a problem with ensuring the success of independent variable manipulation in the imagery literature. What is required is for participants to give self-reports of their actual imagery experience.

A lack of description of the imagery scripts or protocols used in studies is another problem in the imagery literature. Few studies have detailed the imagery script fully and, as stated by Murphy (1990), many studies simply describe the script, such as "the subject was instructed to image". As well as this, studies often do not describe, or do not adequately describe, practice or training opportunities. Another problem highlighted by Murphy is that researchers have largely neglected differences between participants' imagery styles, due to the MP model that assumes that all participants benefit from MP. An issue that needs investigation is whether certain people benefit from imagery, whereas others benefit more from another intervention.

Some researchers have suggested that performance assessment in imagery and MP is a potential problem in considering the efficacy of such interventions (Feltz & Landers, 1983; Suinn, 1983). Performance measures of high level athletes may not be sensitive enough to small changes in performance. Nonetheless, at the elite level, such changes are incredibly important. Other measures of performance such as consistency or secondary task measures (e.g., effort) might be useful (Budney et al., 1994). Single-subject designs are useful because they might be able to pick up performance changes for an elite athlete and graph consistency over time (e.g., Callery & Morris, 1993, 1997a, 1997b; Kearns & Crossman, 1992; Kendall et al., 1990; Shambrook & Bull, 1996). In addition, they might counter "Hawthorne" or placebo effects by providing intra-participant control. The importance placed on performance effects from imagery, resulting from the MP model, has also impeded the study of imagery according to Murphy. This reliance upon performance improvement has limited study on imagery use for other purposes, such as preparing for competition, confidence enhancement, and arousal control. Consequently, sometimes researchers should assess PST and imagery effectiveness in ways that are not based solely on performance (Grove, Norton, Van Raalte, & Brewer, 1999).

Meta-analysis has overcome some of the problems of the imagery and MP literature, and has been useful, however, there are criticisms of such a technique. Budney et al. (1994) described several potential problems of meta-analysis. First, different methods of calculating the effect size can significantly influence the results; secondly, studies of variable quality are weighted equally; third, using more than one effect size from some studies can bias the results. Budney et al. further suggested that meta-analysis, by providing an overall positive effect size, can act to confirm belief in the efficacy of interventions without giving any specific evidence. The Feltz and Landers (1983) meta-analysis is widely cited to describe the efficacy of MP and imagery, as it has been in this review. It has proved useful to this end, however, it is not exempt from these criticisms. Sport psychologists need to consider other problems when viewing the results of the Feltz and Landers review. The review provides only tentative interpretations of the literature because of the large variation in MP procedures not codified and included, and because statistical evaluation of the interaction effects was not possible (Budney et al., 1994).

The research on imagery and MP, in spite of many methodological problems and inconsistencies in findings between studies, suggested that imagery and MP can enhance performance of motor and sport skills. It is important that the imagery-performance relationship is considered before examining the mediating variable of imagery perspective, because this relationship lies at the heart of any relationship between imagery perspective and performance of sport skills. The research on MP suggested that PP was superior for performance enhancement than MP, but MP was superior than NP, and a combination of MP and PP was the most efficacious training protocol (Gould & Damarjian, 1996; Grouios, 1992; Murphy & Jowdy, 1992; Weinberg, 1982). The research reviewed on imagery interventions is best summed up as overall showing that an imagery-performance relationship exists, although the methodological problems throughout might have left the question of just how effective imagery is at enhancing performance (Gould & Damarjian, 1996; Murphy & Jowdy, 1992).

Internal and External Imagery Perspectives

The review of imagery and MP research demonstrated that imagery is an important cognitive process that is widely used in sport. Research that helps us understand how imagery might be used more effectively is, thus, of value to sport psychologists. Imagery perspective is an aspect of imagery that has received attention in the literature, yet the role it plays in the influence of imagery on performance is not clear. Athletes perform imagery from one or both perspectives, therefore, perspective is always relevant. If using one perspective for a particular situation is more effective, applied sport psychologists need to know in order to direct athletes to use imagery most efficaciously. This section of the literature review considers issues related to imagery perspective. Mahoney and Avener (1977) defined perspective in terms of whether the image is internal or external. As stated earlier, there is some confusion about the distinction between internal and external imagery, on one hand, and visual and kinaesthetic imagery on the other. Internal imagery is not kinaesthetic imagery, kinaesthetic sensory experience can accompany internal imagery, as it can accompany external imagery (Denis, 1985; Glisky, Williams, & Kihlstrom, 1996; Hardy & Callow, 1999; White & Hardy, 1995). What perspective is really referring to is whether the imagery is experienced from inside or outside of the body, not the sense modality being experienced.

In general terms, psychologists have proposed that internal imagery is superior to external imagery for performance enhancement (Cox, 1998). This is largely due to two areas of research (Hardy, 1997). The first of these areas is questionnaire research with elite athletes who in some cases reported using internal imagery to a greater degree than novice or less elite athletes (Barr & Hall, 1992; Mahoney & Avener, 1977). The second area is studies measuring electrical activity in the muscles that have suggested that internal imagery results in greater subliminal electrical muscle activity (EMG) in the muscles associated with the imagined actions than external imagery (e.g., Hale, 1982; Harris & Robinson, 1986: Jacobson, 1931a). Hardy (1997) questioned the recommendation, or "myth", that performers should use internal visual imagery rather than external visual imagery. Several researchers have suggested that the type of task (open vs closed skill) might mediate the imagery perspective-performance relationship (Annett, 1995; Harris, 1986; McLean & Richardson, 1994). For example, McLean and Richardson suggested that closed skills might benefit more from an internal perspective whereas open skills might most benefit more from an external orientation.

Internal and External Imagery Research

This section of the literature review of internal and external imagery first considers the questionnaire studies. These studies have been the basis for much of the interest in perspective in imagery and for perpetuating Hardy's (1997) third myth, that performers should use internal visual rather than external visual imagery. The review of EMG studies that have further confounded the distinction between internal and external imagery is part of the psychophysiological research into internal and external imagery, which is considered in the section that follows. Also reviewed are studies that have utilised more central physiological measures, such as electroencephalogram (EEG), positron emission tomography (PET scan), regional cerebral blood flow (rCBf), and functional magnetic resonance imaging (fMRI). A review of studies comparing internal and external groups on performance tasks is then presented to investigate the influence of imagery perspective on performance. Finally, a section that reviews studies that have investigated the effect of the type of task on the efficacy of imagery perspective is presented, to examine whether task type might mediate the imagery perspective-performance relationship.

Questionnaire Studies of Successful and Unsuccessful Competitors

Numerous questionnaire studies have assessed internal and external imagery. This section reviews these studies with emphasis on Mahoney and Avener (1977) replication studies, because of the influence this research has had on the literature. Also emphasised is research by Hall and colleagues (e.g., Barr & Hall, 1992; Hall et al., 1990; Salmon et al., 1994) that has used the IUQ, because the IUQ is the most widely used measure of imagery use in research and one of the few that measures imagery perspectives.

Mahoney and Avener Replication Studies. Mahoney and Avener's (1977) study of elite gymnasts really instigated the research into imagery perspective in the sporting domain. In what was only claimed by the researchers to be an exploratory study, Mahoney and Avener found that successful performers in one, quite specific sport, Olympic level gymnastics, tended to use internal imagery more than external imagery, based on a self-report questionnaire. Subsequent studies have attempted to replicate Mahoney and Avener's findings, but have found mixed results. The Mahoney-Avener questionnaire may be part of the reason for the equivocal findings on internal and external imagery in these replication studies. This is because the Mahoney-Avener questionnaire did not have the sole aim of determining imagery perspective use. In fact, it investigated a large range of psychological factors and cognitive strategies of the 12 surveyed athletes. Only four of the 53 items relate specifically to imagery use, and only one of these addresses imagery perspective. There are no questions on imagery perspective related to the type of task or whether the athlete experiences switching of images between perspectives. Also, as mentioned previously, the use of questionnaires is retrospective, and so introduces problems with accuracy of memory. Meyers et al. (1979) administered a version of the Mahoney-Avener questionnaire, modified for racquetball, to nine collegiate racquetball champions, who their coach ranked in order of ability from 1 to 9. Less and more skilled racquetball players were not different in the frequency of imagery use or in the imagery perspective used, but there were only nine participants in this homogeneous sample. Highlen and Bennett (1979) also attempted to replicate Mahoney and Avener's findings on imagery perspective, this time in wrestling. Thirty-nine wrestlers attempting to qualify for the 1980 Canadian World Games squad responded to the questionnaire. Their responses did not correlate with final selection classification for the team. Rotella et al. (1980) investigated downhill skiing, with the Mahoney-Avener inventory and the Coping and Attentional Inventory (CAI), that they developed for the study. Rotella et al. divided participants into three ability groups based on yearly performance ratings. Imagery questions on the Mahoney-Avener inventory did not correlate highly with ranking. Imagery questions on the CAI, however, indicated that more successful skiers developed a greater proportion of internal images, whereas less successful skiers developed visual images of their entire body skiing down the course (external). Doyle and Landers (1980) also administered the revised Mahoney-Avener questionnaire to 184 pistol and rifle shooters. They found that international level (elite) performers used predominantly internal imagery, whereas state and junior level (sub-elite) shooters used a mixture of internal and external imagery. All of these studies based their findings on the response to a single question that was not validated.

Other Questionnaire Studies. Mahoney, et al. (1987) using the Psychological Skills Inventory for Sports (PSIS) conducted another general assessment of psychological skills in sport, such as anxiety, concentration, self-confidence, team emphasis, and mental preparation. Mahoney et al. aimed at identifying psychological skills that differentiate elite and non-elite athletes and found that elite athletes used internal and kinaesthetic imagery more than non-elite athletes. Suinn and Andrews (1981) conducted a survey of elite "A" and "B" members of a professional alpine ski tour. They suggested that better skiers produced more clear and vivid imagery, however, they found no trends based on internal and external perspective. Smith (1983, as cited in Smith, 1987) on a general psychological skills questionnaire administered to Olympic Gymnasts found that only 17% reported imagining from an internal perspective, 39% reported imagining from an external perspective, and the rest (44%) used a combination of internal and external imagery. This is an interesting finding, coming so soon after the Mahoney and Avener study, also with Olympic gymnasts.

Carpinter and Cratty (1983) collected interview questionnaire data on waterpolo players' mental life and dreams. Twenty-one male university waterpolo players aged 18 to 23 years filled in questionnaires. Carpinter and Cratty compared the questionnaire data with coaches' ratings of players. The coaches rated each player on two scales: the player's ability and the player's level of motivation-intensity. The questionnaire probed variables such as quantity of time devoted to thoughts of sport, the structure and planning of thoughts, imagery types, anxiety plans, altered states, and aggression. The definition of imagery type was in terms of feeling the skill and viewing "from within their own eyes" or "viewing himself from a distance". Carpinter and Cratty reported that 13 out of 21 (62%) athletes responded that for the most part they thought of themselves performing the skill in the sport from within their own eyes. In terms of altered states, most reported that they "played the game in their heads" (12 of 19) as opposed to viewing themselves from a distance in their dreams. There was no relationship between the type of dream imagery and the type of imagery reported when they were conscious. No significant relationships were found between type of skill imagery reported and coaches' ratings of ability and motivation-intensity.

Orlick and Partington (1988) conducted a study to assess psychological readiness of 235 Canadian Olympic athletes. Interviews were conducted with 75 athletes and the other 160 athletes completed a questionnaire on mental readiness for competition, which included questions on readiness, and the influence of helpfulness of others, mental imagery, and attentional focus on mental readiness for the Olympics. According to Orlick and Partington, the qualitative analysis of interview data suggested that the athletes "had developed an inside view, as if the athlete was actually doing the skill, and feeling the action" (p. 113). On the questionnaires, 99% of athletes reported using mental imagery. For male athletes, Orlick and Partington reported that the quality of imagery was related to Olympic percentile ranking. Quality of imagery was assessed as consisting of four variables: inside view, video view, feeling, and control. For female athletes the quality of imagery was not related to Olympic ranking. Jowdy, Murphy, and Durtschi (1989) in a questionnaire study of elite athletes and coaches found that 90% of athletes surveyed regularly used imagery and a majority indicated a preference for internal imagery, and that imagery perspective fluctuates.

Ungerleider and Golding (1991) conducted a survey of 1988 United States Olympic track and field trialists. The researchers sent a 16-page 240-item questionnaire to 1,200 finalists, with 633 respondents before the Olympics, and 450 respondents to the second mail out after the Olympics. This gave 373 athletes who completed both questionnaires. The questionnaire included items on demographic characteristics, and physical and mental training strategies. The MP items on perspective were essentially visual questions with participants asked if they "see" themselves from outside or inside on 10-point Likert scales from 0 (inside) to 10 (outside). Athletes reported that 34.3% saw themselves from both perspectives, 35% reported an inside view, and 30.7% reported an outside view. Ungerleider and Golding, importantly, found that the Olympians had a more external perspective in their imagery and that there was a stronger physical sensation associated with that imagery than for non-Olympians. The authors suggested that this finding indicated the possibility that among track and field athletes the imagery perspective requirements may have differed depending on the event, with athletes perhaps needing to factor in environmental concerns such as weather, crowd, noise level, and playing surface.

Imagery Use Questionnaire Studies. Hall et al. (1990) investigated the use of imagery in a number of sports using the Imagery Use Questionnaire (IUQ; Hall et al.). They administered the IUQ to 381 male and female participants from six sports: football, ice hockey, soccer, squash, gymnastics, and figure skating. Hall et al. found that athletes use imagery more frequently in competition than during training, especially just before competition. Other general findings included that athletes often saw themselves winning and receiving an award; athletes' imagery sessions were not structured or regular; and imagery use varied across sports. Hall et al. also found that the higher the competitive level, the higher the reported imagery use. They reported that athletes used an internal visual perspective and external visual perspective equally, and identified no difference between how athletes employed visual and kinaesthetic imagery. Hall et al. reported these as visual imagery, because the items in the IUQ ask the participant whether they "see" themselves from outside their body or "see" what they actually see while performing.

Barr and Hall (1992) administered the IUQ for Rowing to 348 rowers at high school, college, and national team levels. Two hundred and eleven male and 137 female rowers completed the IUQ for rowing. Their ages ranged from 15 to 54 years and skill level ranged from novice (defined by Barr and Hall as first year competing) to expert (defined by Barr and Hall as finished in top three in the world). Barr and Hall found that rowers displayed most of the general trends reported by Hall et al. (1990). Rowers reported using imagery most just prior to competition, often imagined themselves winning and receiving a medal, and did not have very structured or regular imagery sessions. Age or gender did not affect imagery use, however, elite rowers had more structure and regularity to their imagery sessions than non-elite rowers. Elite rowers also more often imagined themselves executing a pre-race routine and reported using more kinaesthetic imagery. Non-elite rowers were more likely to imagine themselves rowing incorrectly. Barr and Hall found that rowers used an internal visual perspective ($\underline{M}$ = 4.86) more than an external visual perspective ($\underline{M}$ = 4.89), although no statistical analysis of this difference was reported. Hall (1998) proposed that the participants might have used an internal perspective more readily because of the nature of the sport. Rowing is a closed skill, taking place in a relatively stable environment, and rowers do not even face the direction in which they are going. Hall suggested that, therefore, it seems most appropriate to imagine from a first person perspective. Rowers also indicated a greater use of kinaesthetic imagery than visual imagery. One difference between rowers aged under 25 and over 25 was that older rowers indicated incorporating feeling more into their imagery. Barr and Hall explained this in terms of these rowers having more experience causing them to be more sensitive to the kinaesthetic feelings of the sport. Younger rowers adopted an external visual perspective more than older rowers, Barr and Hall stated that this is probably due to not having yet refined their internal focus and/or model of the movement. Rodgers et al. (1991) conducted a training study, which is reported in full in a later section. Rodgers et al found that on the IUQ at pre-test 29 figure skaters with a mean age of 13.7 years initially had a higher rating on external visual imagery than internal kinaesthetic imagery, which was higher than the rating for internal visual imagery.

Salmon et al. (1994) investigated the motivational function of imagery and the actual use of imagery by soccer players. Salmon et al. administered the IUQ for Soccer Players (IUQ-SP) to 201 males and 160 females with an age range of 15 to 30 years, representing 90 national level soccer players, 112 provincial level players, and 161 regional level players. Imagery use trends found in previous IUQ studies (e.g., Barr & Hall, 1992; Hall et al. 1990) were confirmed. For instance, soccer players used imagery more in conjunction with competition than training, and elite could be distinguished from non-elite soccer players by imagery use. Salmon et al. reported that soccer players used imagery more for motivational rather than cognitive purposes, with the highest ratings reported for Motivation General (MG). The IUQ-SP contained several items on visual and kinaesthetic imagery use and two items on internal and external perspective use. The means for visual imagery ranged from 4.39 to 5.72 and the kinaesthetic imagery means ranged from 4.56 to 5.72 on the 7-point Likert scales, indicating high use of these two sensory modalities in imagery. For the external perspective item, the overall mean was 4.03. The mean for national level players was 4.30, for provincial level players it was 4.32, and for local players it was 3.46. The mean for local players was significantly different from both the provincial and national level players. The overall mean for the internal imagery question was 5.02. The mean for national level players was 5.28, the mean for provincial level players was 5.32, and the mean for local level players was 4.47. The mean for local players was significantly different from both the provincial and national level players. The players at all three levels scored higher on the internal imagery than external imagery questions, which Salmon et al. interpreted as perhaps indicating a preference for internal perspective. The means for both perspectives, however, were relatively high, indicating that participants used both perspectives extensively. The authors suggested that this could have been because soccer players alternate between perspectives, depending on image content, however Salmon et al. did not specify what aspects of content they meant.

The questionnaire research seems to have provided mixed information on the relationship between imagery perspectives and their use by elite athletes. Of the Mahoney and Avener studies, only Mahoney and Avener (1977) and Doyle and Landers (1980) found internal imagery to be associated with more successful performance or performers, both in one single closed skill sport. Other replication studies did not differentiate between performance level and perspective use (e.g., Meyers et al., 1979; Highlen & Bennett, 1979; Rotella et al., 1980) in two open skills and one closed skill sport. Other questionnaire studies also have provided mixed findings, with more successful athletes adopting both perspectives, and do not support the assumption that internal imagery is superior to external imagery. In fact, Ungerleider and Golding (1991) actually found that Olympians used more external imagery. The IUQ studies found no difference between internal and external imagery use (e.g., Hall et al., 1990) or a preference for internal imagery (e.g., Barr & Hall, 1992; Salmon et al., 1994). Salmon et al., however, also found high ratings on external imagery, suggesting that soccer players used both perspectives. A problem with the use of questionnaire approaches to study imagery, especially when surveying what athletes "usually do", is that this is a retrospective approach, and consequently there could be problems with accuracy of memory (Ericsson & Simon, 1980).

Psychophysiological Research on Internal and External Imagery

The idea that internal and external imagery are psychologically distinct was first supported by Jacobson (1930d, 1931a). Studies by Jacobson (1931a), Hale (1982), and Harris and Robinson (1986) suggested that there might be a difference in the physiological concomitants of internal and external imagery, although as Hardy (1997) suggested, this could be due to the nature of instructions given and the confounding of internal imagery with kinaesthetic imagery. The question of whether this increased physiological activity that appears to accompany internal imagery facilitates sport performance is even less clear. The psychophysiological research on internal and external imagery in this review is divided into a section on studies that used peripheral measures, such as muscular (EMG) and ocular (EOG) responses and a section on studies that measured brain activity during imagery with central measures such as EEG, PET scan, rCBf, and fMRI.

Peripheral Measures. Jacobson (1930a, 1930b, 1930c, 1930d, 1931a, 1931b, 1931c) conducted a series of studies that are important in the development of psychoneuromuscular theories of imagery and in research on internal and external imagery. The literature often reports that Jacobson conducted an experiment on performing a biceps curl, however he did much more than this. Jacobson did extensive research on muscular activity during imagery and found that during imagination of such activities as bending the forearm, lifting a weight (biceps curl), sweeping, and climbing a rope muscular activity was greater than muscular activity at rest. In the most important of these studies, Jacobson (1931a) found that when participants were asked to visualise performing a biceps curl, eye activity increased, and when they were asked to imagine experiencing a biceps curl localised muscle activity occurred. In a previous study, Jacobson (1930d) recorded action potentials with the instruction to "Imagine bending the right arm". Jacobson found that the participants responded differently to the two instructions "Imagine bending the right arm" and "Visually imagine bending the right arm", with the former instruction resulting in muscular activity in the right arm muscles and the latter resulting in activity in the eye muscles. This finding was the catalyst for research into motor and visual imagery as well as internal and external imagery because it found differences in psychophysiological activity based on the imagery instructions used. However, the instructions used by Jacobson are not internal and external perspective instructions, but instructions emphasising sensory modality.

In an often cited study on muscular activity during imagery, Shaw (1940) measured action potentials during imaginal and actual lifting of weights, ranging from 100 to 500 grams in 100-gram increments, of three participants. Results overall indicated that muscular activity varied with the magnitude of the weight. To the question "what kind of imagery did you engage in?" nearly all reports were kinaesthetic. This study suggested that kinaesthetic imagery leads to EMG activity, but it does not investigate the different effects of imagery perspectives.

Hale (1982) attempted to replicate Jacobson's (1931a) site-specific findings, based on Lang's (1979) predictions. Hale inferred from Lang's ideas of stimulus and response propositions that external images are "primarily composed of ocular activity response propositions and that internal images contain predominantly muscular activity propositions (as kinaesthetic imagery)" (p. 380). Hale hypothesised that internal imagery was more likely to produce muscular responses than external imagery. Participants were 48 male university students and faculty classified as experienced (n = 24) or inexperienced (n = 24) weight-lifters. In the internal condition, instructions were to "imagine what it feels like in your biceps to lift the 25 lb dumbbell". In the external condition, instructions were to "visualise what it looks like to lift the 25 lb dumbbell". The problem here, again, is that the instructions given are not internal and external imagery instructions, but kinaesthetic and visual instructions. Hale found that internal imagery produced significant more biceps activity than external imagery. There was no significant effect for EOG activity.

Harris and Robinson (1986) investigated whether muscular innervation during imagery was specific to muscles required in actual performance and if individuals of different skill levels using the two perspectives of internal and external imagery produced different levels of muscular activity. Participants were classified as either beginner or advanced, based on karate skill and experience, and randomly assigned to counterbalanced imagery perspective groups. Internal imagery instructions directed the participant to experience feelings and sensations associated with executing the task, whereas external instructions directed the participant to see him/herself executing the task (as though watching a videotape of him/herself). Harris and Robinson collected EMG data from both deltoid muscles during and between performance of imaginary arm lifts. Following collection of the EMG data, participants completed a short questionnaire on their perceptions of success at imagery. Interestingly (as also noted by Hale, 1986), in their abstract, Harris and Robinson stated that "internal imagery produces more EMG activity than external imagery" (p.105). In the results section, they reported a significant imagery perspective by side interaction with the right deltoid muscle EMG data showing more activity during internal than external imagery. In their conclusion, however, they stated that "although the internal imagery perspective produced more deltoid activity than the external imagery perspective, the difference was not significant" (p. 109) and that the "influence of internal/external perspective is unclear" (p. 109). Harris and Robinson also reported a lack of control in maintaining the desired perspective, with over 61% of participants switching perspective, according to self-report measures. Advanced students favoured internal imagery (77.8%) more than beginners (50%), whereas a larger number of advanced students (55.6%) than beginners (27.8%) reported switching from external to internal imagery during testing. Harris and Robinson suggested that the existence of a stable imagery perspective is unlikely due to the number of reports of switching (usually from external to internal). They postulated that, because the advanced students were more likely to switch from external to internal imagery, internal imagery might have been desirable.

Vigus and Williams (1987, as cited in Hale, 1994) in a replication of Hale (1982), measured EMG activity of dominant biceps, triceps, and non-dominant triceps during imagery rehearsal in both perspectives of a biceps curl. Vigus and

William found no significant differences, suggesting that imagery perspective does not influence muscle innervation, additionally prior experience of imagery or physical practice did not influence innervation in this study.

Shick (1969) investigated muscular and ocular responses as part of her paper on mental practice of volleyball skills. Shick measured anterior deltoid and tibialis anterior EMG activity in addition to EOG activity. Shick did not report the imagery instructions given to the participants, however, all participants completed a questionnaire on their imagery experience. Shick reported that, in describing the serve, most participants seemed to be "watching themselves (or another figure) in the form of a complete entity entirely separate from their own bodies" (p. 90), an external perspective. In describing the wall volley, most of the participants "mentioned the total body in the initial stance, once the action of the volleying had begun the image was quite different, in that they then described the image in terms of only what one would see if she were to actually take the wall volley test" (p.90), indicating an initial external perspective, then a shift to an internal perspective. Shick was not able to identify any EMG or EOG pattern. Shick also did not analyse response magnitude for internal versus external imagery.

Suinn (1976), in an anecdotal report of an imagery exercise with an alpine skier, described how the skier's leg muscle EMG during an internal imagery perspective "mirrored" the downhill course being imagined. Bird (1984) recorded the muscular responses of five athletes, two male and three female athletes, who were "competent" or "champion" performers in one of the following sports: equestrian, rowing, breaststroke swimming, water skiing, and basketball. Bird instructed athletes to imagine (see and feel) a sport-specific event. Results suggested an increase in EMG activity for all participants during imagery of their sporting activity. Bird reported that participants reported the ability to image internally. No explanation was given, however, of how this was tested, nor were any manipulation checks provided to test maintenance of imagery perspective in test trials. In addition, because it was not compared with external imagery, conclusions on the differences between internal and external imagery cannot be made.

Oishi, Kimura, Yasukawa, Yoneda, and Maeshima (1994) investigated motor neuron excitability and autonomic reactions of seven elite speed skaters during mental imagery of speed skate sprinting. The skaters were experienced at imagery, having participated in speed skate imagery training programs from 17 to 56 months. Oishi et al. encouraged participants to imagine internally. The autonomic effectors recorded were skin conductance response (SCR), heart rate (HR), and respiration rate (RR). To measure motor neuron excitability, Oishi et al. also measured H-reflex from the right soleus. Results indicated that the autonomic effectors were significantly active during imagery. Unexpectedly, there was a significant decrease of the H-reflex during imagery. Oishi et al. reported that in their previous experiments (Oishi, Kimura, Yasukawa, & Maeshima, 1992) they observed high levels of autonomic activity in other speed skate athlete groups, as well as no significant changes in H-reflex during imagery of the speed skate sprint. In the previous studies, the participants were not elite athletes, and Oishi et al. reported that their imagery was often external. As well as this, they were not skilled in imagery. The authors suggested that the different finding for H-reflex might be related to the vividness or perspective of imagery. Again, this suggestion is difficult to reconcile and demonstrates how myths about internal imagery producing greater efferent activity than external imagery can be perpetuated in the literature. Oishi et al. did not compare internal and external imagery and did not use manipulation checks to ascertain whether athletes were actually using internal imagery in this study.

Wang and Morgan (1992) examined the effect of internal and external imagery perspectives on psychophysiological responses to imagined dumbbell curls. The internal imagery instructions directed participants "to imagine that your arm muscles are contracting, your heart is beating, and your breathing is changing. In other words, try to recall all the physical sensations that you experienced while actually lifting the dumbbells." (p. 169). Opposed to this the external instructions directed participants to imagine the dumbbell curl as for the actual exercise. Instructions continued "can you see yourself sitting here and lifting the dumbbells?" (p. 169). No mention was made of any physical sensations, the only sense mentioned was sight. This is not different perspective instructions, but different sensation instructions. The psychophysiological measures recorded were oxygen consumption (VO2), ventilatory minute volume (VE), respiratory rate (RR), respiratory exchange ratio (RER), heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP). In comparing internal and external imagery, internal imagery produced a significant increase in VE compared with the control condition, whereas external imagery did not. VO2, RR, RER, HR, and DBP were similar for internal and external imagery. Wang and Morgan concluded that the results did not demonstrate a significant difference between internal and external imagery, however, "the psychophysiological responses to internal imagery resemble actual exercise more than external imagery." (p. 167). This seems to be a surprising conclusion to reach, since the only difference found between internal and external imagery across more than eight measures was in VE. Wang and Morgan suggested that an explanation for finding no difference between internal and external imagery might be the inability of participants to maintain the desired perspective. A self-reported estimate of the time able to perform the appropriate imagery revealed that maintenance of the correct perspective was about 75% for internal imagery, and 80% for external imagery.

Some researchers, as mentioned earlier, have suggested that Lang's (1977, 1979) stimulus and response propositions may be functionally similar to internal and external imagery perspectives (e.g., Bakker et al., 1996; Budney et al., 1994; Hale, 1982, 1994; Janssen, & Sheikh, 1994). As suggested by Hale (1994), including response information in the image is more critical than the perspective adopted in determining physiological concomitants. For example, in a non-sport study reported earlier in this review, Bauer and Craighead (1979) compared manipulation of stimulus or response imagery and manipulations of imagery perspective and found differences only as a result of changing response and stimulus processing, with response producing greater activation of heart rate and skin conductance.

Bakker et al. (1996) investigated Lang's model of stimulus and response propositions using imagery of lifting 4.5 and 9-kg weights. Participants were 22 male and 17 female students. Bakker et al. recorded EMG of both biceps brachii muscles during imagery. Results suggested that, when participants used response propositions, imagery resulted in greater muscular activity than when participants used stimulus propositions. Collins and Hale (1997), in a commentary on the paper by Bakker et al. (1996), raised concerns over aspects in that paper. A reply by Bakker and Boschker (1998) addressed these concerns. Collins and Hale indicated that internal and external imagery perspectives are not identical to stimulus and response propositions and that Bakker et al. incorrectly used this perspective-based manipulation. Bakker and Boschker replied that they agree that external images can contain response propositions, and that internal images can contain stimulus propositions. Collins and Hale criticised the lack of an adequate manipulation check to ensure that participants followed the imagery. Bakker et al. had participants complete the Imagery Rating Scale (IRS) which assesses how easy or difficult it was to imagine the movement on a 7-point Likert scale. Bakker and Boschker replied that this was acceptable because the instructions to the IRS are exactly the same as used in the MIQ (Hall & Pongrac, 1983). This misses the point made by Collins and Hale. Yes, the IRS may measure ease or difficulty of imagining lifting the dumbbell, but it does not check that the participants were following the imagery manipulation, or what the participants were actually imaging.

The peripheral measures studies appear to demonstrate greater physiological activity for internal as opposed to external imagery. The suggestion that internal imagery produces greater activity must be considered in light of the suggestion that this effect could be due to the instructions given in these studies. Researchers seem to have used more response propositions or kinaesthetic instructions in internal imagery scripts as compared to external imagery scripts. This again highlights that there has been a widespread confusing of internal and external imagery with kinaesthetic and visual imagery in the literature. Many studies have failed to use adequate manipulation checks to ensure that participants did actually use the perspective instructed. In addition, the studies have not measured performance changes, so whether this greater activity is beneficial for performance is also unclear.

Central Measures. Central measures of psychophysiological activity of the brain during imagery have a long history, however, there are no studies that have specifically investigated internal versus external imagery (Hale, 1994). Studies, however, have investigated what their authors have suggested is analogous to either internal or external imagery, but is clearly not adequately delineated, or compared with the often-confounded aspects of imagery such as visual, kinaesthetic, and motor imagery. As these measurement techniques become more sophisticated, perhaps researchers will discover a clearer picture of the relationship between perspective adopted and physiological and mental processes, but they will have to use imagery scripts that are based on the distinction between internal and external imagery.

Marks and Isaac (1995) had 60 participants complete the VVIQ and VMIQ with only the eight highest and eight lowest combined scores selected as participants for their study. In stage 1 of the study, 16 participants performed imagery in visual and kinaesthetic modalities. Marks and Isaac collected EEG data while the participant performed visual imagery of the first four items of the VVIQ. They also collected movement imagery EEG data, while the participant imaged the first four items of the VMIQ. In stage 2, EEG data was collected during performance and imagery of two motor tasks, finger touching and fist clenching for 12 participants. Marks and Isaac concluded that visual imagery was associated with alpha attenuation in the left posterior cortex with the vivid imagery group, whereas motor imagery had the opposite effect, with alpha enhancement in vivid imagers, the greatest difference occurring in the left posterior region.

Williams, Rippon, Stone, and Annett (1995) recorded EEG while participants imagined the movements of the first 12 items from the VMIQ. According to Williams et al., each item takes a first person or internal perspective ("imagine yourself") and a third person or external perspective ("imagine someone else"). This is not true imagery perspective distinction, as in the external imagery perspective the person images themself from outside their body. In addition, telling someone to "image yourself" does not constrain the imager to an internal perspective. Thus, the instructions might not be enough to manipulate the two perspectives. Williams et al found no differences in activation of motor and visuo-spatial areas of the cortex dependent on the perspective taken during imagery.

Davidson and Schwartz (1977) assessed the patterning of occipital and sensorimotor EEG activation during self-generated visual and kinaesthetic imagery. The researchers requested 20 participants to imagine, in separate trials, a flashing light (visual imagery), a tapping sensation on the right arm (kinaesthetic imagery), and both the light and tapping together. There were significant differences between the visual and kinaesthetic imagery conditions on EEG patterning, but not on overall differences in alpha activity. Davidson and Schwartz concluded that these findings suggested that imagery in different modalities elicits specific changes in the sensory regions of the brain responsible for processing information in the relevant modalities.

These central measures studies seem to suggest different activation patterns for different types of imagery, such as motor imagery versus visual imagery, and kinaesthetic imagery versus visual imagery. As expected, it appears that motor imagery activates areas involved in motor preparation and visual imagery activates visual perception areas. As suggested by Hardy (1997), it has been incorrectly assumed in the literature that internal imagery approximates motor or kinaesthetic imagery, whereas external imagery is in the visual modality. This has lead several of the papers in this literature review to equate motor imagery with internal imagery and visual imagery with external imagery, and thus provide suggestions for psychophysiological responses in internal or external imagery that may not be accurate (e.g., Decety, 1996a; 1996b; Jeannerod, 1994; 1995). What is required are studies that employ internal and external imagery protocols, rather than inferring from visual or "motor" imagery instructions.

Internal and External Imagery and Performance of Motor and Sport Skills

Internal and external imagery studies have generally compared internal and external perspective groups or internal and external imagery training programs on performance of motor skills or sport skills. The first part of this section reviews studies investigating the effects of internal and/or external imagery on performance of a skill. The second part of this section reviews studies that have used a visuo-motor behaviour rehearsal (VMBR) protocol, which is purported to utilise an internal imagery orientation. The final part of the section, on task type, reviews studies that have compared performance of different types of skills for internal and external imagery groups.

Performance Studies. Epstein (1980) investigated the effects of imagery perspective on dart-throwing performance with pre-performance imagery. Thirty-three female and 42 male undergraduates were randomly assigned to an internal imagery (n = 30), an external imagery (n = 30), or a control group (n = 15). The two treatment groups threw thirty darts to assess baseline ability, then undertook imagery training and practice (two minutes), performed thirty trials of mental rehearsal-aided throwing, underwent another one minute of rehearsal training, and threw thirty more rehearsal-aided darts. Epstein found no significant effect on dart-throwing performance based on perspective. Epstein reported that responses to the imagery perspective questions did not correlate with ability for males or females. Thirty-nine percent of reports were exclusively internal, 35.7 percent of participants reported that they switched from external to internal at a critical point, 12 percent were simultaneously internal and external, 8 percent changed perspective at non critical points, 3.7 percent were totally external, and 1.7 percent switched from internal to external at a critical point. The data suggested that perspective might not be stable, and might not only be a function of the individual, but also of the scene or activity the participant is imagining and the imagery instructions.

Neisser (1976) described a study by Nigro and Neisser that investigated MP and dart throwing. Ninety college students threw darts at a dartboard 9 feet away, with a scale from four points for a bullseye to zero for missing the board. Nigro and Neisser assigned participants to a control group and four experimental MP groups: positive field, negative field, positive observer, and negative observer. The control group performed three blocks of 24 trials, and between blocks they worked on an unrelated colour-naming task. The control group average for the first block of trials was 1.67 and 1.68 for the last block, indicating no improvement in performance. The four experimental groups were instructed to imagine themselves throwing a dart at the target 24 separate times between each of two blocks of PP. Nigro and Neisser gave each experimental group different instructions on how to imagine the skill. Without taking experimental condition into account there was a significant increase in performance for the MP groups. Instructions for the four MP groups varied across two dimensions: positive or negative, and point of view (field or observer). In the positive condition, Nigro and Neisser instructed participants to imagine successful throws, with the dart hitting the bullseye. In the negative condition, Nigro and Neisser instructed participants to imagine unsuccessful throws that missed the target by a wide margin. In the field condition, Nigro and Neisser instructed participants to imagine themselves standing at the line, looking at the dartboard, throwing the dart, and seeing it hit the dartboard in front of them. In the observer condition, Nigro and Neisser instructed participants to imagine seeing what an observer seated to one side of the throwing line would see. Results suggested that the positive and negative dimension made no difference to performance enhancement. Point of view, however, did seem to affect performance, with the field (internal) condition producing significantly greater performance improvements than the observer (external) condition.

Mumford and Hall (1985) investigated figure skating performance with 59 figure skaters. The skaters performed a figure as a pre-test measure, rated by a panel of judges on a scale of zero to six, and then were randomly assigned to one of four groups: an internal kinaesthetic imagery group, an internal visual group, an external visual imagery group, and a control training group. All groups had four training sessions. Post-test performance revealed no significant differences between the three types of imagery training, and imagery training participants did not perform significantly better than control participants. Senior skaters, however, showed greater performance improvements and superior kinaesthetic imagery even though differences did not reach significance. A possible reason for the lack of significant findings in this study might have been due in part to the task used. There may have been a ceiling effect in operation.Although the participants had not skated the figure previously, Mumford and Hall reported that they had little trouble completing the task, because only the sequence of elements was unfamiliar. In addition, the lack of a significant finding was partly due to an improvement in performance by the control group.

Rodgers et al. (1991) assigned 29 figure skaters with a mean age of 13.7 years to an imagery training group, a verbalisation-training group, or a 'no-treatment' group. All participants were pre- and post-tested for movement imagery ability on the MIQ, imagery use on the IUQ, and skating performance. Then they underwent a 16-week training period. The imagery instructions encouraged participants to "try to use kinesthetic imagery as much as possible". The imagery training group improved in visual movement imagery ability, were more likely to use imagery in practice, had more structured imagery sessions, and could more easily visualise and feel aspects of their skating performance compared to the verbalisation group. Compared to previous years and the control group, more skaters from the two training groups attempted and passed more tests than would normally be expected. The performance assessment failed to show any significant effects for group. On the IUQ, the skaters initially had a higher rating on external visual imagery than internal kinaesthetic imagery, which was higher than the rating for internal visual imagery. The skaters in the imagery training group increased in their use of internal imagery and controllability of external imagery.

Vogt (1995) conducted three experiments comparing observational practice (OP), MP, and PP of cyclical movement sequences. The task required participants to track a visually presented cyclical movement pattern and reproduce that pattern. The results of the three experiments suggested that MP produced improvements similar to PP for movement form and temporal consistency and MP was as effective as PP in the absence of visual input during the practice phase. Vogt reported that perhaps the most important finding was that observation was nearly equal to PP for reproduction and temporal consistency, indicating that generative processes are not limited to PP and MP. In a follow up study, Vogt (1996) found that the participant already forms the representational basis for motor control during model observation. This is an important study for video-modelling explanations of learning and may suggest that external imagery may be as effective as internal imagery as it is more akin to observation. Vogt, studied whether this generative process is present immediately after a single presentation, or if imaginal rehearsal following single presentation would improve it. In addition, Vogt investigated whether motor or visual imagery would have different effects. The distinction between visual and motor imagery of Jeannerod (1994) was utilised. Four groups were utilised: visual imagery, motor imagery, physical rehearsal, or counting backwards. Participants carried out these activities in the interval between presentation of the criterion pattern (a relative timing task) on an analog display and reproduction of the movement. In addition, both the motor and visual imagery were carried out either once or three times to study longer-term rehearsal effects as well as single imagery mediated and immediate imitation. The results indicated that reproduction did not benefit from imagery or physical practice in the interval between presentation and reproduction. Immediate reproduction was equivalent to any of the delayed conditions. This would seem to indicate that generative processes are involved in observation of movement.

Hale and Whitehouse (1998) used imagery-based interventions to manipulate an athlete's facilitative or debilitative appraisal of competitive anxiety and found that imagery can manipulate intensity and directional anxiety responses. Participants reported more cognitive and somatic anxiety and lack of confidence as debilitating. Imagery instructions followed videotape footage of a soccer penalty kick taken from an internal visual perspective. Imagery instructions were for participants to imagine being inside their body and to feel body sensations and experience their thoughts as if they were in the actual penalty kick situation. Hale and Whitehouse reported that they emphasised response propositions in the script. A manipulation check after each trial used an 11-point Likert scale to check whether participants used an internal or external imagery perspective. The mean score was 3.92 for the challenge situation and 3.82 for the pressure situation, indicating a predominantly internal perspective. This suggested that imagery instructions might be enough to influence perspective use and that training programs to influence perspective may be effective in producing desired perspective.

Martin and Hall (1995) assigned 39 beginner golfers to one of three conditions, performance plus outcome imagery, performance imagery, or no imagery control. Results indicated that participants in the performance imagery group spent significantly more time physically practicing the putting task than participants in the control group. Additionally, participants in both imagery conditions set higher goals for themselves, had more realistic self-expectations, and adhered to their training program more than control participants. Martin and Hall taught all imagery participants to image from internal, kinaesthetic, and external perspectives. Participants completed a manipulation check of a general questionnaire at the end of the study that suggested that they adhered to the two imagery conditions and participants in both imagery conditions imaged from an internal perspective more often than an external perspective. Ninety-two percent of the performance plus outcome group participants and 77% of the performance imagery participants indicated that they used internal imagery "always" or "often", particularly in imaging the backswing and follow-through.

Burhams, Richman, and Bergey (1988) assessed the effects of a 12-week imagery-training program on running speed performance. This was a particularly interesting study because it utilised a protocol of external imagery, whereas most studies have favoured internal imagery. Participants were 36 male and 29 female students aged 17 to 22 enrolled in a physical conditioning course. Participants were timed over a 1.5 mile run and then assigned to one of four conditions: skills imagery group, results imagery group, results/skills imagery group, and control group. Burhams et al. instructed the skills imagery group to "get outside their bodies and mentally view themselves performing perfectly all the various movements associated with running and to focus on performing these skills to achieve maximum performance in their run" (p. 29-30). They instructed the results imagery group to "get outside their bodies and to view themselves crossing the finish line ahead of all the other competitors" (p. 30). Additionally, Burhams et al. instructed them to see themselves receiving awards, newspaper interviews, and the crowd cheering them. The results/skills imagery group received both results and skills instructions. The control group received a two-minute lecture on the benefits of running. Participants had a minimum of 5 minutes before each training and test run to use their mental training technique. After four weeks, participants ran a 1.5-mile race. After another four weeks, participants completed the run again. Results indicated that none of the four groups showed greater improvement than any other group over the 12 weeks, however, the groups seemed to improve at different rates. Between trials 1 and 2, the skills imagery group showed significantly different improvement to the control group. The trend seemed to reverse between trials 2 and 3 with the control group showing the most improvement followed by the results/skills imagery group, the results imagery group, and the skills imagery group. This then resulted in equivalence between groups over the 12 weeks. Perhaps this indicates that external imagery can assist in the initial learning of the skill, reflected in the quicker learning for the skills imagery group. Alternatively, it could be that, since running is not a complex skill, imagery increased motivation and hence effort in the early trials, but this advantage was lost over time.

In a study that used the skills imagery approach of Burhams et al. (1988), Van Gyn, Wenger, and Gaul (1990) investigated imagery as a method for transferring non-specific physiological training to a specific task. Forty undergraduate students were pre-tested, and then post-tested six weeks later, on a Wingate cycle ergometer test for peak power and a 40-metre sprint. Following the pre-test the experimenters assigned participants to one of four groups: imagery training (IT), power training (PT), imagery and power training (IPT) and control (C). Participants in the training groups met with the experimenter three times a week over the six weeks and trained in small groups of three or four. The PT consisted of sessions on the cycle ergometer. The researchers instructed the imagery training participants to focus on increasing their speed over the repetitions and to relax during the sprint. The results indicated both peak power cycle training groups (PT and IPT) significantly improved their peak power output on the cycle ergometer from pre- to post-test. Only the IPT group, however, improved their 40m sprint time between pre- and post-test, indicating that imagery assisted transfer from the cycle ergometer to 40m sprint, but imagery alone (IT) did not enhance peak power or sprint performance.

Gordon et al. (1994) investigated the effectiveness of an internal versus external imagery training program on performance of cricket bowling performance. Sixty-four high school students completed the VVIQ and VMIQ as well as a pre-test of bowling performance. In addition, participants completed three questions on imagery perspective use. Participants were randomly assigned to one of three conditions, an internal imagery, external imagery, or control group after being matched on general bowling ability and vividness of imagery as assessed by the VVIQ and VMIQ. The imagery training groups received ten minutes of training before each of six physical practice sessions over a three-week period. Control group participants were shown a 5-minute video of a coach explaining the skill of bowling and 5-minutes explaining tactical, physical, and mental aspects of bowling. External imagery participants were shown the first half of the same video as the control group, but then viewed a 5-minute video of an elite bowler performing from side-on, front-on, and the rear. They were asked to improve performance by imaging performing as if on video or TV during intervals between performance trials. The internal participants were shown the same first 5-minutes, but spent the remaining five minutes studying a bowling script and an audio-tape of an elite bowler explaining the kinaesthetic aspects of bowling. They were asked to "feel" the technical aspects of the skill in imaging between trials. Again, there seems to be some confounding of internal and kinaesthetic imagery in these instructions. Results showed that the imagery groups improved performance over time, but there were no significant differences between the two imagery perspective groups. Results from the post-experimental questionnaire indicated that approximately 50 percent of participants reported switching between internal and external imagery.

The performance studies reviewed here do not provide support for recommending that an internal imagery perspective is superior for performance enhancement than an external perspective. Most of the studies that compared internal and external imagery groups (e.g., Epstein, 1980; Mumford & Hall, 1985; Gordon et al., 1994) found no difference between internal and external imagery, but suggested that they both improve performance. One factor to emerge from these studies is the extensive level of switching between perspective when participants were assigned to internal or external imagery groups (e.g., Epstein, 1980; Gordon et al.). This could suggest that preferences for a particular perspective might be important (Hall, 1997), or that switching is a necessary or perhaps desirable method for experiencing imagery (Collins et al., 1998). Alternatively, perhaps it indicates that in complex tasks certain parts are best imaged internally and others externally, or combinations thereof. Many of these studies, where participants were either trained or given instruction in internal or external imagery (e.g., Mumford & Hall, 1985; Gordon et al., 1994), assigned participants randomly to either the internal or external group. Consequently, these studies have not investigated trainability of imagery perspective versus use of reported preference. This could also explain why these studies have found switching between perspectives, because they have mismatched preferred perspective with the trained perspective, for some, but not all, participants in each group. Additionally, none of these studies have really investigated if imagery perspective is trainable, because they have not compared perspective use before training with post training perspective patterns, to investigate whether training actually increased use of the trained perspective. What they have investigated is whether training in a perspective leads to increased performance. Some studies have used retrospective reports taken some time after imagery to test whether participants actually used the experimental condition. This is preferable to no test, as has occurred in many of the studies, but, as mentioned earlier, is subject to problems with accuracy of memory.

Visuo-Motor Behaviour Rehearsal (VMBR) Studies. Suinn (1972, 1976) has proposed a cognitive training technique called visuo-motor behavior rehearsal (VMBR). VMBR combines relaxation training with visual and multi-sensory imagery training. Suinn provided anecdotal evidence for VMBR and this technique has received some empirical support (e.g., Corbin, 1972; Kolonay, 1977; Meyers, Schleser, & Okwumabua, 1982; Noel, 1980; Weinberg, Seabourne, & Jackson, 1984). The majority of the VMBR research has used an internal imagery protocol with the athlete instructed to visualise performing perfectly and successfully from their own point of view.

Studies on a closed skill, basketball foul shooting performance suggested that VMBR improves performance on this task. Hall and Erffmeyer (1983) tested the effects of VMBR on basketball foul shooting performance, with skilled collegiate basketballers. Hall and Erffmeyer randomly assigned the ten basketballers to either a VMBR (videotaped modelling) condition or a progressive relaxation and visual imagery (no modelling) condition. This is probably an incorrect use of the term VMBR, what Hall and Erffmeyer seem to have compared is VMBR (relaxation plus imagery) versus VMBR plus modelling, so what they have tested is the benefit of modelling on VMBR. Foul shooting was recorded at pre- and post-test for performance changes. At post-test a significant difference was found between the VMBR (modelling) and progressive relaxation and visual imagery (no modelling) conditions, with higher scores for the VMBR (modelling) condition. Participants in the VMBR (modelling) condition completed the IEQ (Epstein, 1980). This revealed that all VMBR (modelling) participants reported kinaesthetic sensations and a first person perspective during imagery. Onestak (1997) compared a VMBR group, a VMBR and video modelling (VM) group, and a VM group on basketball free-throw shooting performance. Participants were 48 male collegiate athletes from different sports. Onestak found no significant differences between groups, but there was a significant improvement in free-throw shooting from pre- to post-test. A problem with this study is that as the participants were not expert basketballers this could just be a practice effect, since there was no control group. Becker, Grau, Fonollosa, and Geyer Costa (1997) used a VMBR program and investigated its effects on basketball free-throw performance, EEG, and heart rate (HR) during imagery of free-throw performance. Imagery instructions emphasised multisensory imagery (visual, auditory, tactile, proprioceptive, cognitive and affective dimensions). The authors did not report on whether they emphasised either perspective. Results revealed a significant increase in performance for the VMBR groups, but not for the control group. In addition, no differences in alpha rhythm were associated with performance improvements.

Weinberg et al. (1984) compared a VMBR (imagery with relaxation) group, imagery group, relaxation group, and placebo (control) group on facilitation of karate performance and anxiety reduction. The relaxation groups learnt a meditation (relaxation response) technique, the imagery group mentally practiced the correct movements with the instruction to see yourself from your own perspective (internal imagery) rather than that of a spectator (external imagery), the VMBR group received instruction in the relaxation and imagery, and the placebo group learnt karate quotations. All groups showed a decrease in trait anxiety from pre- to post-test. There were no differences for heart rate. State anxiety for the VMBR and relaxation groups was lower than for the imagery and control groups. Performance was different only for sparring, with the VMBR group having better performance than the other groups. A manipulation check, administered daily for the VMBR and imagery groups, contained a question on perspective used. The question asked whether "During your imagery did you try to get inside your body and experience the sensations involved, or do you try to get outside your body and view yourself as a coach or spectator might? (1) Exclusively internal, (11) Exclusively external" (Weinberg et al. p. 233). The mean for the VMBR group was 6.2 indicating almost equivalent use of internal and external imagery, contrary to the instructions to use internal imagery.

The VMBR studies, which have typically instructed participants to adopt an internal perspective, suggest that internal imagery does improve performance, however, as they do not employ an external condition, no conclusion can be drawn as to whether this internal perspective is more effective than adopting an external perspective.

Imagery Perspective and Task Type

It is possible that the task will govern the best perspective for the athlete to use. Annett (1995) stated that the possibility suggested by introspective reports is that "different kinds of imagery may be more or less effective when used with different tasks" (p. 162). Harris (1986) commenting on the findings of extensive switching of perspectives in the Harris and Robinson (1986) study stated that lack of control over perspective manipulation will continue to confuse imagery research and that "research should examine the relationship of imagery perspective to task, that is, open versus closed skills, and to skill level." (p. 349). Other researchers have also suggested that there may be a relationship between perspective and type of skill: "....it seems plausible that closed skills would benefit more from an internal focus; while open skills may gain most benefit from an external orientation .... but, no systematic research has yet been published to provide any convincing evidence on the relevance of this orientation variable." (McLean & Richardson, 1994, p. 66). Kearns and Crossman (1992) also recommended that studies comparing nonreactive and reactive target tasks using mental imagery as an intervention would assist the mental imagery literature. Most of the research on imagery perspectives has focused on closed skills, where the environment is relatively constant and the activity is self-paced (e.g., gymnastics, diving, shooting). Open skills have received less research emphasis. Open skills are those where the performance occurs in a constantly changing environment, that requires athletes to react to the changing task demands. In this coneption, imagining with an external perspective should allow the imager to scan the environment more effectively and thus enhance performance of open skills more then an internal perspective. Alternatively, imaging from an internal perspective should enhance performance of closed skills more than an external perspective because the environment is relatively constant and the inidividual needs to focus on execution of the skill, rather than reacting to the environment.

Paivio (1985) suggested that an issue that has been neglected in imagery research is whether the task involves a perceptual target, whether the target is moving or stationary, and what the performer is doing in relation to the target. Paivio contended that these different elements might determine how athletes can use imagery most effectively. What researchers need to do is determine how to use imagery according to the specific task, rather than debate whether certain types of task produce superior effects than others. Examples of tasks with stationary targets and stationary performers include archery, darts, snooker, golf, and free-throws in basketball. Examples of tasks where the target is moving and the performer is stationary include baseball batting, cricket batting, and skeet shooting. Examples of tasks where the target is moving and the performer might be moving include goalkeeping in soccer and hockey, tennis, table tennis, and boxing. Examples of complex skills that do not require reaction to a specific target include diving, gymnastics, figure skating, running, shot-putting, and weight lifting. Thus, Paivio has suggested that task differences have implications for the kind of imagery rehearsal that would be most effective. These perceptual elements described by Paivio seem to be somewhat similar to the open - closed skill continuum. Open and closed skills essentially lie on a continuum from extreme closed skills, which are performed in a totally stable environment, to extreme open skills, in which a range of factors are constantly changing.

Hardy (1997) and Hardy and Callow (1999) suggested that the confounding of internal imagery and kinaesthetic imagery perspectives, the failure to consider the theoretical bases for predictions of superiority of one perspective over another adequately, and the failure to consider different demands of different tasks have contributed to the confusion and myths that have occurred in the imagery perspective literature. Hardy used a purely cognitive theoretical base, that imagery's beneficial effect on the acquisition and performance of a motor skill depends on the extent that the images add to the useful information that would otherwise be available. Hardy and Callow proposed that external imagery might assist the imager to see precise positions and movements required for successful performance in tasks dependent on form for successful execution. Hardy and Hardy and Callow suggested that this information might not normally be available to the performer but for the external perspective, and generally would not be provided by internal imagery of the same movement. For example, little additional information is provided that is beneficial to performance in imaging a handstand or cartwheel from an internal perspective. Therefore, in tasks, such as gymnastics or rock climbing, where body shape and positioning are important an external perspective allows rehearsal of the movements and positions. Hardy suggested that this is particularly effective when combined with kinaesthetic imagery, because, as well as seeing the precise shape, the imager can experience physical sensations. Internal imagery does not allow adequate vision of the required body shape and so does not provide a template for movement. Hardy and Callow argued that the converse might also apply, that internal imagery allows the performer to rehearse the precise spatial locations, environmental conditions, and timings in skills that depend heavily on perception for successful execution. For example, in a slalom type task, an internal perspective allows rehearsal of precise locations for initiations of manoeuvres. Hardy suggested that the movements in this type of task are relatively simple, well-learned, and do not have body shape requirements. As a consequence, an external perspective provides less useful information, but might enhance competitive drives which could explain the speed increases in the wheelchair slalom task found by White and Hardy (1995). Kinaesthetic imagery might be beneficial because it allows matching timing and feel of movement. These suggestions seem useful and applicable to movement activities, such as rock climbing and gymnastics, but do not seem to consider the sort of situations that occur in ball sport activities or team games, for example, a batter in cricket imaging scanning the field from an external perspective to imagine playing a shot that pierces the field, or the midfield soccer player imaging externally where the other players are, such as those behind or in their peripheral vision. Nonetheless, Hardy's principle that the perspective that provides the most useful information for performance will be the most beneficial for performance enhancement might still hold true in team games and ball sport.

The implications for applied practice from Hardy (1997) and Hardy and Callow (1999) are that caution is necessary when offering advice on which imagery perspective to adopt. Hardy suggested that an external perspective might be best for tasks requiring form or body shape elements, especially when combined with kinaesthetic imagery. Alternatively, an internal perspective with kinaesthetic imagery might be best with tasks requiring simple movements in which form is not important, but timing relative to external cues is. Hardy suggested two qualifications to these suggestions. First, they do not take into account perspective preferences of performers. Secondly, the recommendations do not take into account using imagery for motivational purposes. Hardy suggested that different perspectives might have qualitatively different motivational effects. For example, external imagery could enhance competitive drives, and internal imagery could enhance self-efficacy because it allows identification with the model (cf., Bandura, 1986). It is possible to argue the reverse, however, for example, the athlete could imagine seeing themself crossing the finishing line and the crowd cheering from an external perspective to enhance self-efficacy. Alternatively, as Murphy (1994) suggested, the different perspectives could have differential effects on identification of technical errors.

Hall's (1997) response to Hardy (1997) supported Hardy in his recognition that it is a myth that performers should use internal imagery rather than external imagery. Hall suggested that based on research with the IUQ (e.g., Barr & Hall, 1992; Hall et al., 1990) and Hardy's research (e.g., Hardy & Callow, 1999; White & Hardy, 1995), the most effective imagery perspective for an athlete to use depends on the demands of the task and the preference an athlete has for using internal or external imagery. This is based on research that elite athletes use imagery extensively (Hall et al., 1998; Salmon et al., 1994) Thus, Hall suggested they would have established perspective, or combinations of perspective, preferences. To make an athlete change their perspective may be detrimental, even if the task characteristics seem to warrant it. Hall stated that athletes should be encouraged to use both internal and external perspectives and employ the perspective that they prefer and works best for them, but there is a need for research on this issue. Hall, in line with Hardy, also recommended that there is a need for research on different motivational effects of perspectives.

Glisky et al. (1996) also indicated that imagery perspective has mistakenly become synonymous with the sensory modality involved. Glisky et al. suggested sport psychologists might best consider perspective in terms of the viewpoint (first or third person) from which they image their own performance, rather than the sense modalities involved. They proposed that the "correct" visual viewpoint might be the critical component in whether internal or external imagery will benefit task performance more. They suggested that athletes should use different imagery perspectives, depending on the type of sport or skill they are trying to enhance, and their level of experience.

The idea that closed skills may gain most from an internal perspective and open skills from an external perspective has been hypothesised (e.g., Harris, 1986; McLean & Richardson, 1994), however, no research has systematically and convincingly provided evidence to support this hypothesis. The research from questionnaire, psychophysiological, and performance studies is reviewed in detail in the following sections of this review in light of the possibility of a relationship between perspective and type of skill as suggested by several researchers (e.g., Annett, 1995; Hall, 1997; Hardy, 1997; Harris, 1986; McLean & Richardson).

Task type studies. This section reviews studies that have investigated the influence of the task on the efficacy of perspective adopted. Glisky et al. (1996) compared performance on a cognitive/visual task with performance on a motor/kinaesthetic task for natural internal or natural external imagers. Forty-two undergraduates participated in the study. Based on Imagery Assessment Questionnaire (IAQ; Vigus & Williams, 1985) scores, the researchers classified 21 participants as internal imagers and 21 participants as external imagers. The imagery perspective was assessed on an 11-point Likert-type scale. Participants who rated either six or above were classified as externals and participants who rated two or below were classified as internals. This is interesting as the midpoint was not used, suggesting that perhaps internal imagers were more extreme in their perspective preference, and the external imagers were less extreme in their perspective preference. These participants were split into internal or external imagery groups based on the classification with seven of each group randomly assigned to a control group, making three groups of 14 participants: an internal, an external, and a control group. A stabilometer task was used as the motor/kinaesthetic task, and an angles estimation task as the cognitive/visual task. Participants each performed the two tasks in a counterbalanced order in the following format: five baseline trials, then three repeats of five imagery and then five physical trials, giving a baseline and test 1 (T1), test 2 (T2), and test 3 (T3). Three 10-point Likert scales assessing perspective and clarity of visual and kinaesthetic imagery were completed after every trial. Instructions to participants emphasised imaging their best baseline performance, maintaining their particular imagery perspective, using as many sense modalities as possible and making the image as realistic as possible. Results indicated that the external imagery group improved performance more on the stabilometer task and the internal imagery group improved performance more on the angles task, in comparison to the control group. On the stabilometer task, participants in all conditions improved from baseline to T3, however, the only statistically significant difference was between the external group and the control group, indicating that the external group improved significantly more than the control group. Effect sizes calculated between means of the imagery groups and the control group revealed an external effect size of .38 and an internal effect size of .35. On the angles estimation task, the internal group's improvement was greater than the improvement in the external and control groups. One possible problem with this finding is that the mean score for the internal group at baseline was 5.10, whereas the mean score at baseline for the external group was 3.51 and the control group was 3.13. Because a lower score indicates better performance, the internal group had more room for improvement than the other two groups, so that even though all groups seemed to improve from baseline to T3 from looking at the descriptive statistics, with the external group improving to a mean of 2.77 and the control group to 3.07 at T3, only the improvement for the internal group achieved statistical significance. It would have been interesting to see if the internal group was statistically different from the external group and control group at baseline given that the difference between the means seems very large. This is of particular note given that the improvement was less than 2 points for the internal group. The effect size calculated for the external group was .22 and for the internal group the effect size was .57. Glisky et al. found a main effect for perspective, indicating higher overall clarity for internal imagery than for external imagery. Participants rated kinaesthetic imagery as less clear than visual imagery on the angles/estimation task. On the stabilometer task, where external imagery produced superior performance, participants gave equal clarity ratings of visual and kinaesthetic imagery. According to subjective ratings, participants in the two imagery groups maintained their perspectives and screening participants for imagery perspective reduced or eliminated the problem of switching.

White and Hardy (1995) conducted two studies to examine the efficacy of internal and external imagery on a slalom type task, using wheelchairs, and a gymnastics type task, using clubs. Participants were 48 students who completed the VMIQ two weeks before the study to determine preferred imagery perspective and ability to image in both perspectives. This might be a problem with this study because the VMIQ does not specifically measure imagery perspective, but the ability to image watching someone else perform and to imagine performing oneself. It is quite possible for participants to image themselves performing from an external perspective, especially after performing under instructions to image watching somebody else. Also, as noted previously, watching someone else from inside one's own body is not an external perspective. Participants who scored less than 72 on each subscale (interpreted to mean they could image in both perspectives) were randomly assigned to either an internal visual imagery group or an external visual imagery group. This gave two groups of 12 participants. White and Hardy conducted a post-experimental interview to determine whether participants had adhered to the treatments and did not experience switching between perspectives. Because of this, a further three participants from each group were excluded from the data, giving two groups of nine. The training for the internal visual imagery participants involved them watching a video of a model completing the experimental task to be performed three times, as well as a video of the same task from a first person perspective once. Before each test trial participants were asked to "form a similar internal visual perspective image of themselves completing the task" (p. 172). The external visual imagery participants were shown the video of the model from the third person perspective four times. Before each trial they were asked to "form a similar external perspective image of themselves completing the task" (p. 172). The results indicated that using internal or external imagery might enhance different aspects of motor performance. In the slalom task, internal visual imagery participants completed the transfer trials with significantly fewer errors than did external imagery participants. The external imagery group completed the trials significantly faster than the internal visual imagery group. This, the authors claimed, suggested that the two imagery groups had different speed/accuracy trade-offs, with the external visual imagery group focusing on the speed of performance and the internal visual imagery group focusing on the accuracy of performance. The results of the gymnastics task suggested that external visual imagery was more effective than internal visual imagery for both learning and retention. In addition, White and Hardy found that participants in both groups reported kinaesthetic imagery to similar levels.

White and Hardy (1998) used a qualitative interview approach to examine imagery use by three elite slalom canoeists and three elite artistic gymnasts as a follow up to White and Hardy (1995). White and Hardy used Paivio's (1985) description of cognitive and motivational functions of imagery to describe some of the differences. Gymnasts reported that they used imagery most frequently at a cognitive specific (CS) level to rehearse skills and moves in training and competition, that is, to understand the technical demands or specific details of the skills. The slalom canoeists, however, used imagery at the cognitive specific level to rehearse difficult moves, and at a general level to formulate and rehearse movement plans. White and Hardy concluded that the differences in imagery use in gymnastics and slalom canoeing indicated that sport psychologists should have an understanding of the demands of a sport when recommending imagery applications.

Hardy and Callow (1999) have studied further the finding that internal and external imagery enhance different aspects of skills. Hardy and Callow conducted three studies to investigate the effect of different imagery perspectives on task performance of largely form-based movements. These form-based movements consisted of a karate kata task, gymnastics floor routine, and rock-climbing task. In Study 1, Hardy and Callow had 25 karateists learn a new kata, called Jion, which consists of 52 separate movements. Hardy and Callow assigned participants to an external visual imagery, internal visual imagery, or control condition. The same instructor gave all three groups instruction in the kata in the same manner. In addition to this instruction, Hardy and Callow reported that they asked participants in the external visual imagery group to form an external visual image of themselves performing the kata before each physical practice, and asked the internal visual imagery group to form an internal visual image of themselves performing the kata actions before each physical practice. They asked the control group to perform a series of gentle stretches before each physical practice. Participants completed the VMIQ in order to determine visual imagery ability before commencing the experiment. Participants were required to score less than 72 on both imagery subscales, to indicate that they could at least moderately successfully image using both external and internal visual perspectives. The VMIQ does not specifically measure internal and external imagery. Consequently, there might be a problem in this study in assuming that participants were able to use both internal and external imagery effectively. As a result of scores on the VMIQ the researchers rejected four participants and assigned 21 participants to the treatments using stratified random sampling based on gender and karate ability (grade). Participants were given general and treatment specific instructions on the kata in six one-hour sessions over a two-week period. At each session, participants received a demonstration of the kata and instruction to use their assigned imagery or stretching before each physical practice. After the two weeks, five experienced judges rated participants on their performance of the kata. After this initial test, Test 1, participants underwent eight more one-hour long training sessions over three weeks and were then re-tested, Test 2. Participants also completed a retention test after another two weeks during which they did not practice the criterion kata. At the end of the study, participants completed a post-experiment manipulation check questionnaire which asked whether they had been able to adhere to the assigned condition, whether they had experienced any switching of perspectives, whether they had experienced any kinaesthetic responses during imagery, and the extent to which they felt that their experimental condition was appropriate for the criterion task. Results indicated that the external visual imagery group performed significantly better than the internal visual imagery group, which performed significantly better than the control group on the post-test (Test 2) and the retention test. On the post-experiment questionnaire, all participants reported that they were able to adhere to the assigned condition and there was no switching of perspectives in either perspective condition. The external visual imagery group felt their treatment was more appropriate to the task than the internal visual imagery group. There was no significant difference between the external visual imagery group and the internal visual imagery group in their reported level of kinaesthetic experience during imagery.

Study 2 extended Study1 by manipulating both the visual perspective (internal and external) and kinaesthetic imagery. Hardy and Callow (1999) used a gymnastic sequence as a performance task that judges scored according to form analysis. Seventy-six sport science students completed a three-hour workshop on imagery perspectives and then completed the VMIQ and MIQ; to select those who could image as required. Again, these instruments do not specifically measure imagery perspective and so might not be adequate measures for this type of study. Hardy and Callow selected only those participants who scored below 72 on both subscales of the VMIQ and below 36 on both subscales of the MIQ to continue in the experiment. Hardy and Callow randomly assigned the 40 participants to one of four treatment groups: external visual imagery with kinaesthetic imagery, external visual imagery only, internal visual imagery with kinaesthetic imagery, or internal visual imagery only. The researchers showed participants videotape of a gymnast completing the gymnastics task from either an internal visual or external visual perspective. To achieve the internal visual video Hardy and Callow placed the camera on the gymnast's shoulder while they performed the routine. The researchers showed all participants the gymnastic routine from an external perspective, before three viewings from the assigned perspective. Additionally, they read imagery scripts to the participants that emphasised either an internal or an external visual perspective, with or without kinaesthetic imagery. Hardy and Callow reported that the scripts emphasised response, rather than stimulus propositions, that is, they emphasised the physiological, emotional, and movement concomitants, rather than simply describing the situation. The participants completed an acquisition and a retention phase. In the acquisition phase, participants performed six blocks of three trials on the gymnastics task, with a 2-min rest between blocks. Hardy and Callow asked participants not to use imagery during the rest intervals but to image the task once immediately before each trial according to their assigned condition. After completing the acquisition phase, participants completed a post-experimental questionnaire. The questionnaire contained questions on extent of adherence to the imagery perspective and perceived suitability of the imagery perspective used; experience of kinaesthetic feelings during imagery; use of other strategies to aid performance; and self-confidence of successful completion of the task. Participants rated their responses for each question scored on a 10-point Likert scale from 1 (not at all) to 10 (greatly). Participants completed a retention test, consisting of one block of three trials on the gymnastics task four weeks after the acquisition test. Results suggested that the external visual imagery groups performed significantly better than the internal visual imagery groups. During the acquisition phase there was a significant main effect for visual perspective, with external visual imagery superior to internal visual imagery. There was no significant main effect for kinaesthetic imagery. The findings from the retention data were less clear. There was no significant main effect for either visual imagery perspective or kinaesthetic imagery. The interaction between visual imagery perspectives and kinaesthetic imagery was significant, with the external visual imagery with kinaesthetic imagery group performing better than the internal visual imagery with kinaesthetic imagery group. Follow-up Tukey's tests were not significant. Hardy and Callow concluded that this retention data indicated that the external visual imagery participants continued to perform better than internal visual imagery participants, but this difference was no longer significant. In addition, Hardy and Callow suggested that the significant interaction offers support for the combined use of external visual imagery and kinaesthetic imagery. Hardy and Callow reported surprise at the absence of a significant main effect for kinaesthetic imagery, especially since on the post-experiment questionnaire participants reported that they felt that visual with kinaesthetic imagery was more appropriate and that they felt more confident when using it. Hardy and Callow suggested that this contradictory finding might be due to the relative inexperience of the participants on the task. That is, participants might have been in the cognitive stage of learning when learners are more reliant upon visual and verbal cues and only make use of kinaesthetic cues later in learning. The participants in Experiment 2 were sport science and health and physical education students. Consequently, they might have recognised the potential value of kinaesthetic imagery, but were unable to use it effectively. The post-experiment questionnaire data also indicated that participants were generally able to adhere to the imagery treatments ($\underline{M}$ = 6.8). This result also suggests, however, that they did not always stick to the assigned perspective, because 6.8 is towards the middle of a 10-point Likert scale.

Study 3 replicated Study 2 but with a rock climbing (bouldering) task and experienced rock climbers. Hardy and Callow tested 20 expert rock climbers on the VMIQ and they all obtained a score of less than 72 on both the imagery subscales. The researchers matched participants according to climbing ability and then randomly assigned them to use internal visual imagery or external visual imagery. Each participant then attempted to perform two boulder problems of the same standard, one using kinaesthetic imagery and the other not using kinaesthetic imagery. Thus, this gave four experimental treatments: external visual imagery with kinaesthetic imagery, external visual imagery without kinaesthetic imagery, internal visual imagery with kinaesthetic imagery, and internal visual imagery without kinaesthetic imagery. For each boulder problem, Hardy and Callow gave participants 15 minutes to practice the moves, instructed participants in the use of their assigned imagery treatment, and then assigned them to use that imagery strategy for 2 minutes. Participants then attempted the boulder task. The boulder tasks were 10-move problems set on an artificial indoor climbing wall. Hardy and Callow described bouldering as a rock climbing training activity in which climbers try to link a sequence of very difficult moves together at heights close to the ground, so that there are not serious consequences for falling. These technically difficult moves require very precise body positioning. Performance was assessed in three ways: self assessed technical competence relative to personal norms; externally assessed technical competence by an expert who was blind to the experimental condition; and objectively as the number of moves completed before falling. Participants also completed a post-experiment interview that examined the extent of adherence to the assigned imagery perspective, the use of other strategies to aid performance, the experience of switching between perspectives in imagery, the appropriateness of the assigned perspective for the bouldering task, difficulties in not using kinaesthetic imagery when asked not to, and the appropriateness of kinaesthetic imagery for the bouldering task. Hardy and Callow reported that participants answered the first three of these questions qualitatively, and answered the last three questions on a Likert scale from 1 (not at all) to 10 (very). The post-experiment interviews revealed that three participants were unable to comply with the experimental conditions, either due to an inability to image without switching perspectives or because they formed kinaesthetic images when asked not to. The results suggested that external visual imagery was superior to internal visual imagery and kinaesthetic imagery was superior to no kinaesthetic imagery on all three assessment techniques. The post-experiment interview data suggested that external visual imagery participants rated their perspective and use of kinaesthetic imagery as more appropriate than participants who used internal visual imagery did. In discussing the findings, Hardy and Callow suggested that because the participants were more experienced they might have been able to utilise kinaesthetic imagery more than the inexperienced participants in Studies 1 and 2. Additionally, in Study 1 the researchers had suggested that the superiority of external visual imagery might have been due to the inexperience of the participants on the task and that this beneficial effect might disappear once the performers become more expert at the task. Hardy and Callow observed that the findings in Study 3 might rule out this explanation. They also pointed out that the climbers were experts, but the task confronting them was novel, so the climbers might have relied on external visual imagery to help form an image of the act, just as an inexperienced performer would.

Overall, Hardy and Callow (1999) concluded from the series of three studies that external visual imagery was superior to internal visual imagery for the acquisition and performance of tasks that depended on form for successful performance. Further to this, Hardy and Callow suggested that the results offered some support for the claim that kinaesthetic imagery provides an additional beneficial effect regardless of perspective adopted. This effect might only occur once performers have gained a certain level of expertise on the task. Hardy and Callow suggested a number of applied implications from the studies. First, consideration of task differences are important in recommending the most effective imagery application. Second, performers can experience kinaesthetic imagery with external visual imagery. Third, combining kinaesthetic imagery with external visual imagery seems to be particularly beneficial for form-based movements. Fourth, because all participants were considered by Hardy and Callow to be skilled at both internal and external visual perspectives these recommendations may not generalise to performers with a strong preference for internal visual imagery. This could be criticised because Hardy and Callow measured perspective with the VMIQ, which does not really measure perspective. Fifth, some tasks may require a switching of perspectives, for instance, if the task requires both form-based as well as perceptual processing. Finally, Hardy and Callow raised the possibility that kinaesthetic imagery has a role in confidence enhancement. Hardy and Callow described some limitations of the studies such as the small sample sizes, which was combated somewhat by the moderate effect sizes and the replication of the three studies. Another possible limitation was the use of subjective judging scores as the dependent variable, this, however, is difficult to overcome because of the nature of sports tasks that rely heavily on form for successful execution. Hardy and Callow might have reduced this methodological weakness if they had used multiple independent judges and checked inter-rater reliability rather than just using one judge. The results of these studies are perhaps even stronger than claimed, because they occurred despite problems in the operationalisation of internal and external imagery perspectives using the VMIQ. In addition, even removing a few participants who reported an inability to image without switching perspectives is a surprising finding, given the extensive switching found in other studies (e.g., Gordon et al. 1994; Harris & Robinson, 1986), especially when participants were selected because they were competent at using both perspectives.

To investigate the suggestions by White and Hardy (1995) and Hardy and Callow (1999), Collins et al. (1998), compared internal and external imagery groups' performance on a karate kata task. On the basis of imagery ability and previous kata performance, Colllins et al. assigned 81 participants to four groups: internal imagery, external imagery aided by a coping model, external imagery aided by a mastery model, and a control group who performed stretching exercises. Over 10 weeks, participants completed a weekly karate kata training session and three imagery-stretching sessions. The schedule involved a learning phase (the first six training sessions) and a practice phase (sessions 7-10). In the learning phase, participants performed the movement in a paced fashion and were assessed weekly on performance, number of errors, and a form score. In the practice phase, participants were scored for performance, errors, and a time difference between performance time and required target time. Collins et al. found that, during the learning phase, 10 participants in the internal group reported switching between internal and external imagery, that is, they used both perspectives. Collins et al. compared these participants with the other groups and found that 'switching" internals performed significantly better than the "per instruction" internals and external-mastery group. In the practice phase, five participants in the internal group, five participants in the external-mastery group, and six in the external-coping group reported switching between internal and external imagery. Analysis revealed that the "switching" groups and the "internal-only group" performed significantly better than the other groups. Collins et al. concluded that White and Hardy were not completely correct in concluding that external imagery enhances performance of form-based movements more than internal imagery, because in their study switching between perspectives appeared to enhance performance more than external only. They also reported no evidence of external-kinaesthetic imagery as was found by White and Hardy. Based on participants' self-reported experiences, Collins et al. concluded that constant switching of perspective, like watching a demonstration and then trying to move, was the method utilised by switchers. This, they concluded, suggested that external then kinaesthetic is the actual perspective sequence employed.

The research reviewed on task type seems to suggest that different tasks influence the efficacy of perspective use and that imagers can experience kinaesthetic imagery with both internal and external imagery, either simultaneously, or as part of a quick switching method. Factors such as imagery perspective preference or skill level of performers might mediate this relationship.

Summary/Integration of Internal and External Imagery Literature

Examination of the applied texts indicates that they typically advise that internal imagery is superior to external, usually without any qualification (e.g., Rushall, 1992; Vealey, 1986). This appears premature. It seems to be based on the Mahoney and Avener (1977) research, which was specific to a small group of gymnasts and which used a suspect questionnaire. The research, therefore, seems uncertain on whether internal is better than external imagery in improving sport performance. Inconsistencies in the research findings on imagery perspective make it impossible to draw a definite conclusion on the effect of internal versus external imagery. It seems reasonable to postulate that internal imagery may be superior in some circumstances, whereas external imagery is superior in others. Study of this issue is problematic because of the use of indirect measures of imagery. An alternative approach is required where the method of assessing imagery is more closely related to its execution. An important issue for the use of internal and external imagery in practice is whether these perspectives are trainable. As noted earlier, studies to date have not examined this issue adequately because of poor designs. It was suggested that the circumstances under which each perspective is most effective in enhancing performance is a more fruitful direction than trying to demonstrate that one perspective is always superior (e.g., Annett, 1995; Harris, 1986; McLean & Richardson, 1994). The nature of the task might influence this, but again designs of studies done to date have not provided a clear test of this question. In addition, many studies have failed to manipulate imagery perspective adequately, resulting in switching of imagery perspectives, or failed to provide manipulation checks to see if actual perspective use even corresponded with assigned imagery perspectives.

Inconsistencies in the imagery perspective literature may be due in part to the type of studies that have been conducted and problems with the design and methods of studies that have been used to investigate internal and external imagery. Much of the literature is based on questionnaire studies, which were usually of a general nature, not validated measures of perspective specifically. As in the general MP and imagery literature in sport, problems with the methods and design of studies and instructions in the imagery and performance, as well as the psychophysiological studies, abound. Problems with the confounding of internal and external imagery with kinaesthetic and visual imagery, the instructions used in studies, random assignment of participants without considering perspective use or preference, the use of questionable scales in the measurement of internal and external imagery, lack of manipulation checks to verify perspective adherence, absence of description of training protocols, and the large differences between imagery practice conditions, and, up until recently, the lack of consideration of aspects of the task, have all contributed to the mixed findings in the imagery perspective literature. The confounding of internal and external imagery with kinaesthetic and visual imagery abounds in the literature and, as a consequence, many studies have not actually compared internal and external imagery. This confounding is often demonstrated in the instructions that are given to participants, which emphasise visual information for external imagery and kinaesthetic information for internal imagery, rather than the perspective that they are interpreted to elicit. The random assignment of participants without considering initial perspective use or preference might be problematic in many studies, because it may be part of the reason for the levels of switching that has been reported in those few studies that have used some form of manipulation check. Many studies have not used manipulation checks to assess whether participants have been able to comply with the imagery instructions or training, consequently, we do not know if the participants in groups were actually practising internal and external imagery as designated. Researchers have also relied upon objective physical performance scores to assess training programs, rather than looking to see if imagery perspective training did train participants to use an imagery perspective. Training procedures used also present a problem in that there is great variability in the length and nature of training and instructions in studies. Some studies have used one brief session of imagery practice immediately before performance, others have used several longer sessions. For example, some studies have used one or two short sessions of less than ten minutes immediately prior to physical performance (e.g., Burhams et al., 1988; Epstein, 1980) whereas others have shown a video a number of times and told participants to image in the prescribed perspective before each physical practice trial (e.g., Gordon et al., 1994; Hale & Whitehouse, 1998; Hardy & Callow, 1999; White & Hardy, 1995). As a result, comparing studies of this nature is difficult. Also, because of the lack of manipulation checks and reporting of the nature of scripts used in studies it is difficult to determine whether imagery perspective training has been effective in training participants to use a perspective and stick to it and which approaches to perspective training are most effective, and how much training is needed. In addition, up until the recent studies by White and Hardy, Hardy and Callow, and Glisky et al., researchers have failed to recognise that the tasks being imaged and performed might mediate the relationship between imagery perspective and performance enhancement, so that one perspective is not superior in all situations.

The idea that closed skills may gain most from an internal perspective and open skills from an external perspective has been hypothesised (e.g., Harris, 1986; McLean & Richardson, 1994), however, no research has systematically and convincingly provided evidence to support this hypothesis. Hardy and Callow (1999) considered that open skills that depend heavily on perception for their successful execution might benefit more from internal imagery and that external imagery might benefit skills that rely more on form. Hardy and Callow suggested that imagery's beneficial effect on the acquisition and performance of a motor skill depends on the extent that the images add to the useful information that would otherwise be available. Several studies on closed skills (Barr & Hall, 1992; Doyle & Landers, 1980; Gordon et al., 1994; Mahoney & Avener, 1977; Rotella et al., 1980) have shown internal imagery to be more effective or to be used more by higher level performers. There are, however, also some studies that have shown no difference between internal and external imagery on closed skills (Epstein, 1980; Mumford & Hall, 1985). There are no experimental studies on open skills that have investigated differences between the effects of external and internal imagery on performance. The surveys on athletes in open skills (Highlen & Bennett, 1979; Meyers et al., 1979) and both open and closed skills (Hall et al., 1990) have found no differences in internal versus external imagery use between successful and less successful performers. Research comparing internal and external perspectives has produced mixed results, with some studies suggesting an internal perspective is superior for successful performance (Mahoney & Avener, 1977; Rotella et al., 1980) and others finding no difference between the two (Highlen & Bennett, 1979; Mumford & Hall, 1985).

Purpose of the Present Thesis

Imagery is a major psychological preparation technique used in sport. As this literature review demonstrates, much has been written about the definition of imagery, how imagery works, and how we can measure imagery. There has also been a great deal of research on whether, and under what conditions, imagery enhances sport performance. The idea of imagery perspectives being significant originated in the sport psychology literature through Mahoney and Avener's (1977) study of elite gymnasts. Imagery perspective appears to be one of the most important variables related to effective imagery use. And, although imagery perspective has been examined widely in sport, no clear principles or patterns of the influence of perspective on performance have emerged. The confounding of the definitions of perspective with sense modality, the use of inappropriate measures of imagery perspective use, the lack of consideration of imagery perspective preference and task type as mediating variables, and the absence of manipulation checks to ascertain what participants were actually doing during imagery have all contributed to this situation. Consequently, sport psychologists have erroneously adopted some "observations" in applied work (Hardy, 1997), are not sure what athletes do during imagery in terms of internal and external imagery, do not have reliable evidence on what is involved in internal and external imagery use, and don't know how internal and external imagery affect performance to a convincing level. Thus, this thesis had several related purposes. First, it was aimed to examine actual imagery perspective use during imagination of a range of open and closed skills to ascertain the effect of the task on imagery perspective use. Second, it was proposed to compare preference with actual perspective use using validated preference measures and actual use measures taken during or immediately after imagery. Third, it was intended to find out how people actually use imagery perspectives during imagery. Fourth, it was aimed to examine imagery perspective training to determine whether participants can be trained to image in a prescribed perspective. Further, it was of interest to see if the effectiveness of training in internal and external imagery perspectives varied with the type of task. Finally, it was intended to investigate how imagery perspective training and imagery perspective use affect performance on an open and a closed skill. Although the main focus is on internal and external imagery processes, attention was paid to measuring and monitoring internal and external imagery because this is crucial to understanding their use and actual perspective use has not been rigorously examined in previous research.

This thesis examined the influence of imagery perspective use, imagery training, and task type (open versus closed skill) on perspective use during imagery and resulting performance. The main aims of the thesis were to examine whether individuals have a preferred imagery perspective; the extent to which they used their preferred perspective in imaging different tasks; whether task type influences the imagery perspective used during imagery; whether individuals can be trained to use a pre-determined imagery perspective; and whether internal or external imagery is superior for performance enhancement of open and closed skills. To address these issues, the thesis adopted a three-study design. Study 1 investigated imagery perspective preference and use across imagination of a number of open and closed skills. Study 2 examined the trainability of imagery perspective by measuring imagery perspective changes as a result of training, rather than performance changes. Study 3 investigated the effect of internal and external imagery training and perspective use on actual performance of an open and a closed skill.

CHAPTER 3: INTERNAL AND EXTERNAL PREFERENCES AND USE

The aim of this study was to examine patterns of internal and external imagery perspective use during imagery of a range of skills. A range of open and closed skills were compared based on claims by other researchers (e.g., Harris & Robinson, 1986; McLean & Richardson, 1994) that this might affect perspective use. Additionally assessment of internal and external imagery use has been problematic, so several measurement methods are used and compared. The methods used included the process of concurrent verbalisation (CV), which researchers have rarely applied to imagery research.

Method

Participants

Participants were 23 males and 18 females with sporting experience aged between 14 and 28, with a mean age of 19.4 years (SD = 3.12). Participants were recruited from undergraduate classes in sport psychology and local sporting teams. Athletes reported their primary sporting activity. Eleven participants reported they played cricket, six played netball, five played basketball, three played Australian Rules Football, three were rowers, two were swimmers, and two were triathletes. There was one participant in each of the following activities: calisthenics, surfing, baseball, judo, soccer, running, recreation, 400 m running, and AFL umpiring. On the Imagery Use Questionnaire (IUQ; Hall et al. 1990), participants rated themselves as either novice, intermediate, advanced, or elite in their primary sporting activity. Participants were four novice, 16 intermediate, 16 advanced, and five elite. Additionally, participants rated their competitive level in their primary sporting activity. There were five recreational/house league level, 17 competitive level, 14 provincial competitive level, and five national / international level participants.

Design

Participants completed assessment for preference of imagery perspective on imagery of open and closed skill tasks. Initially participants completed the IUQ and additional questions employed by Gordon, Weinberg, and Jackson (1994) to assess typical preference/use of imagery perspective. After completing this initial assessment, participants were instructed to image two trials on each of four open and four closed skills. During imagery of the skills, concurrent verbalisation (CV) was recorded and this was later transcribed and classified to assess perspective use. Following imagery of each of the skills participants completed five rating scales (RS) on that skill and retrospective verbalisation (RV) was recorded for later transcription and classification of their imagery. CV, RV, and RS on each skill, and IUQ scores were compared for extent of agreement on perspective use. General patterns of preference for internal or external perspective were examined, as were patterns of internal and external perspective use for open and closed skills.

Measures

Imagery Use Questionnaire (Hall, Rodgers, & Barr, 1990). Imagery preference and use were assessed by self-report using the Imagery Use Questionnaire (IUQ) designed by Hall et al (1990). Hall et al. used the IUQ in its general form. Barr and Hall (1992) used a sport specific version, the IUQ for rowing, and Rodgers et al., (1991) used a sport specific version, the IUQ for figure skating. The questionnaire used in the present study was the IUQ for figure skating with references to figure skating replaced by general sporting expressions.

The IUQ consists of 35 7-point Likert scale items ranging from 1 = (never) or (very difficult) to 7 = (always) or (very easy). There are two yes/no responses. Hall (1998) reported that the original IUQ has had no psychometric evaluation. The IUQ for rowing and the IUQ for figure skating both seem to be reliable tests of imagery use with reliability values reported to range from r = .65 to r = .95 (Hall, 1998). A copy of the IUQ is provided in Appendix A.

The IUQ was chosen for the present study because it was considered the most appropriate published test, as it assesses internal imagery and external imagery use, as well as overall use of imagery. The IUQ has several questions aimed at internal and external imagery, as well as imagery use, something lacking in other scales reviewed. In the external imagery questions, the participants are asked to rate if they see themselves from outside of the body as if watching themselves on a video, and then how vivid the image is, and how easily that image can be changed. In the internal imagery questions the participants are required to rate whether they see what they would see as if they were actually playing or performing, then rate how vivid the image is, and how easily that image can be changed. These are all aspects of interest to the present study. In addition to assessing internal and external imagery use, the IUQ probes how athletes use imagery and how much experience they have with imagery. The IUQ examines general preferences and use and the participants completed it before actual specific imagery in this study.

Additional Imagery Questions. Participants were asked to respond to three questions, based on those used in a study of the effectiveness of an internal versus external imagery training program on performance of cricket bowling by Gordon et al. (1994). The first question probes whether, when they image themselves performing the skill, participants see themselves as if on a video/TV (external image) or through their own eyes as if performing the actual activity (internal image). The second question asks whether the perspective (external or internal) changes during imagery, and the third question asks which perspective (external or internal) is found easiest to use. A copy of the additional questions is provided in Appendix B.

The additional questions from the study by Gordon et al. were chosen because that study was aimed specifically at training imagery perspective. Using these questions provides an additional measure of imagery perspective in a format that researchers have used in imagery perspective research, but for which there is no psychometric evaluation. These questions provide an example of how researchers often assess imagery perspective in studies of imagery perspective. Gordon et al. the questions in a study that found considerable switching between perspective among participants, so comparing this method of perspective assessment with other methods was important.

Concurrent Verbalisation (CV). Concurrent verbalisation (CV) describes the process where the individual verbalises the information they are attending to and their conscious cognitive processes at the time when they are consciously attending to a process. Essentially, it is "thinking aloud". CV was used to examine the actual use of perspective during imagery of the open and closed skills. Instructions for CV, given before imagery, emphasised describing everything experienced while performing the imagery, with special emphasis on reporting whether the participants experienced the imagery from inside or outside the body. Participants completed two trials of CV. The reason for this was to provide a back-up in case something odd happened in any one trial. This was established in pilot testing of the procedure. The concurrent verbalisations were recorded on audio-tape and transcribed later. The general instructions for CV, the specific instructions for CV of each skill, and instructions for the practice run before the eight test skills are also included in Appendix C.

The reason for using a concurrent technique was to provide an account of cognitive processing at the time it occurs rather than retrospectively, as is required in nearly all other forms of assessment. Retrospective report is prone to memory lapses as well as spontaneous reconstruction of events or processes based on known outcomes (Anderson, 1981). It was felt that a CV procedure would be suitable for use with imagery because this technique involves verbalisations of information already generated by the task. CV has been used successfully in the study of other mental processes, such as problem-solving (e.g., Newell & Simon, 1972), visual and verbal coding (e.g., Schuck & Leahy, 1966), association/dissociation (e.g., Schomer, 1986), cue-probability learning (e.g., Brehmer, 1974), concept learning (e.g., Bower & King, 1967), and performance on intelligence tests (e.g., Merz, 1969). Newell and Simon (1972) utilised a "thinking aloud" protocol in an investigation in problem-solving. The thinking aloud condition produced similar problem-solving results to the other conditions. Dansereau and Gregg (1966) found no difference in the times taken by participants to do mental multiplication problems in silent and thinking aloud conditions. Studies on imaginal activity in non-sport situations have used the CV technique (e.g., Bertini, Lewis, & Witkin, 1969; Kazdin, 1975, 1976, 1979; Klinger, 1978; Klos & Singer, 1981). Kazdin (1976) found that CV did not interfere with the effectiveness of imagery. Annett (1986) in a study of non-sport motor skills looked at visual imagery of knot tying and forward rolls with CV.

Two raters scored the transcripts from CV for percentage of internal and external imagery. The raters used expressions indicating internal or external imagery, such as "external" or "internal" or "inside my body" or "outside my body" to identify when the imagery was being experienced internally or externally. The raters then divided the total amount of imagery statements into internal and external to give a percentage of internal and external imagery. If they had difficulty in assessing whether the participant was experiencing imagery internally or externally, based on the concurrent transcript, because no relevant terms were used, the rater used the answer to the retrospective question "When performing the actual skill itself were you inside or outside your body?" to categorise that section of the verbalisation. Raters rarely needed this approach in this study. Ratings of internal and external imagery content were tested for inter-rater reliability by comparing the ratings of two independent raters for 13 randomly selected participants, giving 208 trials for comparison. A Pearson product-moment correlation co-efficient between estimated proportion of internal and external imagery used in the trials by the two raters was $r = .999$.

Rating Scales (RS). Following the two imagery trials on each skill, participants completed five rating scales (RS) designed to assess aspects of perspective use during the two imagery trials. The first scale probed the relative time spent using internal and external perspectives during the imagery trials as a whole. That is, participants were asked to describe everything they imagined between starting imaging and finishing imaging, where they were, the scene, the situation they were in, the sport and so on, as well as the actual skill. The second scale probed the relative time spent using internal and external imagery during imagery of the actual sport skill. The third scale asked participants to rate the relative importance or effectiveness of the internal and external imagery used. That is, whether they felt the imagery experienced from inside or outside the body was more important to or effective for them. For the first three ratings, 10 cm analogue scales were used, anchored at each end by (100% internal / 0% external) and (100% external / 0% internal) respectively. Participants indicated their use of internal and external imagery by placing a cross at the appropriate point on each line. The other two RS probed image clarity and control. Participants made their response on 5-point Likert scales, the clarity scale ranging from (no image) to (extremely clear image) and the control scale ranging from (no control) to (complete control). This study used Likert scales to assess the clarity and control because previous studies on imagery (e.g., Mahoney & Avener, 1977), imagery perspective (e.g., Glisky et al., 1996), and questionnaires, such as the QMI (Betts, 1909), the SIQ (Vealey & Walter, 1993), the SQMI (Sheehan, 1967), the VMIQ (Isaac et al., 1986), and the VVIQ (Marks, 1973), have utilised such a format. As such, this should allow for better comparison with these studies and questionnaires. The RS are presented in Appendix D.

Retrospective Verbalisation (RV). Following the two imagery trials on each skill and completion of RS on that skill, participants retrospectively described their imagery experience in those two trials. Studies that have used a retrospective verbalisation (RV) protocol include studies on concept learning (Hendrix, 1947; Phelan, 1965), learned generalisations (Sowder, 1974), and concept formation with 12 to 13 year olds (Rommetveit, 1960, 1965; Rommetveit & Kvale, 1965a, 1965b). Participants in the present study were encouraged to retrospectively describe what and how they imaged using two undirected and two directed questions. Questions probed (a) what happened in the imagery of the sport skill, (b) what could be remembered most clearly, (c) which imagery perspective was clearer, and (d) when performing the actual skill, which perspective was used. The questions are included in Appendix E. The RV was recorded on audio-tape and later transcribed. The transcripts for RV were scored for proportion internal and external as for CV described earlier.

Final Questions/Debriefing. At the conclusion of their involvement in the study, participants were asked a series of questions concerning their experience of imagery of the sport skills. Questions were designed to probe overall impressions of the imagery, whether the participants felt they had used more internal or external imagery across all the skills, perspective use during the skills, if there was any switching of perspective, which sport skills were difficult to imagine and why, any problems with the CV technique, whether they felt the CV technique had changed or affected their imagery in any way, any other problems they had with the procedure, and any questions or comments. The final questions are presented in Appendix F.

Imagery Task

Participants were required to imagine performing eight sport skills. Four of these skills were classified as open skills and four were classified as closed skills. Instructions for imagery of these skills emphasised creating as realistic an imagery experience as possible, describing the use of different sense modalities and the experience of emotions. Care was taken not to provide instructions that would encourage the use of either imagery perspective. The scripts for imagery were developed in pilot testing, along with the procedures for CV and RV. The scripts were based on scripts from applied texts (e.g., Vealey & Greenleaf, 1998). The imagery was relatively self-paced, in that participants could begin imaging any time following instruction on imagery content. The general instructions are presented in Appendix C. The open skills imagined were hitting a tennis ball back over the net, defending against an attack in a team ball game, catching a ball thrown when not knowing to which side it would be thrown, and dodging a ball thrown at the person unexpectedly. The closed skills imagined were hitting a stationary ball with a stick or club, throwing a ball at a stationary target, performing a forward roll on a mat, and rolling a bowl across a bowling green to a jack. The specific instructions for each of the eight skills are presented in Appendix C.

Procedure

The participants for this study were volunteers, accessed from undergraduate physical education programs and local sporting teams. The research procedures were explained to the participants. The participants were then informed that they were free to withdraw at any time and that all their data would be confidential. At this point they were encouraged to ask any questions or raise any concerns. Then participants completed informed consent forms (Appendix G). Following the signing of consent forms participants completed the IUQ under supervision, along with the additional questions of Gordon et al. (1994). Participants completed instruction and practice in the use of CV. They were encouraged to ask questions to clarify the procedure. Participants then imagined the eight sport skills in random order concurrently verbalising what they were imagining. Each participant imagined each skill twice in a different random order of skills to other participants. The participants performed the second trial on each skill immediately after completion of the first trial on that skill. The imaging was relatively self-paced, as participants could begin imaging any time after they were given the instruction on what they were to image. Upon completion of the two imagery trials of each skill, participants completed the five self-report, rating scale measures of preference. Participants completed RV following the RS to assess imagery perspective use further. At the completion of all the measures for all the skills, participants were asked a series of questions aimed at gathering information about their experience of imagery of the sport skills. Finally, participants were debriefed to resolve any problems and to acquire additional information about their behaviour, thoughts, and feelings during the study. Then they were thanked for their participation.

Treatment of Data and Analyses

The information gathered from the IUQ was used to classify participants according to their primary sporting activity, skill level, and competitive level. Questions on internal and external imagery were used to assess preferred imagery perspective use. The additional questions from Gordon et al. (1994) were also used to assess preferred imagery perspective use.

The data from CVs were transcribed. The transcripts of the imagery were then rated for percentage of internal and external content. Ratings of internal and external image content were tested for inter-rater reliability by comparing ratings of two raters for 13 randomly selected participants. Ratings were used to compare open and closed skills on internal and external imagery use. RS were scored based on measuring the 10 cm analogue lines with a ruler, or by score circled for the Likert scales. RV response were transcribed and scored as for CV.

Scores on the CV, RV, IUQ, and RS were compared as methods for assessing perspective use. Then the measures were compared for each skill using One-way Repeated Measures Analysis of Variance for differences between tasks and between open and closed categories.

Results

In this section first data from the IUQ is first presented, to describe the general imagery use of participants. The IUQ questions on internal and external imagery are next examined to assess preferred imagery perspective. The additional questions from Gordon et al. (1994) are also considered to assess preferred imagery perspective use. Descriptive statistics on CV, RS and RV for internal and external imagery use during the imagery of the sport skills are then compared to assess differences between the sport skills. The section then considers scores on the concurrent and retrospective verbal reports, the IUQ, and the RS for all the imagery, using correlations to determine the consistency of these methods for assessing perspective use. To conclude the section, CV ratings, rating scale data, and RV ratings are contrasted for each skill to identify differences in use of internal and external imagery between tasks and between open and closed categories of task.

Imagery Use Questionnaire

The means and standard deviations for imagery items on the IUQ are presented in Table 3.1. The data indicates that participants in this study reported typically using imagery more in competition than in training and that imagery use was most common before an event. It also seems that imagery "sessions" were generally not structured or regular. Of interest also is that participants reported a lot of imagery before going to bed or when they were in bed. Participants primarily reported seeing themselves winning during these sessions.

Table 3.1

Imagery Use Questionnaire Item Descriptive Statistics

Item No.	Item	M	SD
1.	To what extent do you use mental imagery in your training?	3.56	1.30
2.	To what extent do you use mental imagery in competition?	4.95	1.60
3.	Do you use mental imagery:		
a)	Before a practice?	3.20	1.65
b)	During a practice?	3.27	1.30

Table 3.1 (Continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item No.	Item	M	SD
3. c)	After a practice?	2.59	1.26
d)	Before an event?	5.17	1.50
e)	During an event?	3.61	1.55
f)	After an event?	3.17	1.82
g)	During another unrelated activity (e.g., running)?	3.17	1.63
h)	During breaks in day?	3.22	1.57
i)	Before/in bed?	4.41	1.84
4. a)	When you use mental imagery, do you see yourself from outside of your body as if you are watching yourself on a video?	3.83	2.02
b)	If you do, how vivid is this image?	3.24	2.24
c)	How easily can you control that image?	3.34	2.20
5. a)	When you use mental imagery do you see what you would see as if you were actually playing or performing?	5.05	1.34
b)	If you do, how vivid is this image?	4.71	1.33
c)	How easily can you change that view?	4.27	1.30
6.	When you are imaging, how easily do you see:		
a)	isolated parts of a skill?	4.29	1.60
b)	entire skill?	5.24	1.32
c)	part of an event?	5.02	1.17
d)	entire event?	3.76	1.67

Table 3.1 (continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item No.	Item	M	SD
7.	When you are imaging, how often do you see:		
a)	someone else performing (e.g., to imitate)?	2.63	1.51
b)	yourself performing incorrectly?	3.34	1.64
c)	yourself losing an event?	2.63	1.46
d)	yourself doing a pre-event routine (e.g., warm up)?	2.76	1.58
e)	the atmosphere of the competition day?	4.66	1.96
f)	yourself winning an event?	5.51	1.23
g)	yourself receiving a first place award?	4.37	1.88
8.	When you are using mental imagery to what extent do you actually feel yourself performing?	4.83	1.28
	How easily do you feel:		
a)	Contact with equipment?	3.66	1.57
b)	Specific muscles?	3.61	1.67
c)	Body control?	4.20	1.50
10.	Are your imagery sessions structured (i.e., you know in advance what you will do and for how long)?	2.29	1.36
11.	Are your imagery sessions regular (i.e. at a specific time each day)?	2.22	1.37
13.	In preparation for your all time best performance, how much imagery did you do?	4.56	1.75

In terms of the internal and external imagery perspective questions, the mean for internal imagery use was higher than that for use of external imagery. Additionally, the mean for vividness of internal imagery was higher than the mean for vividness of external imagery and the mean for control of internal imagery was higher than the mean for control of external imagery. The item probing the feel of performance produced a relatively high mean, indicating that participants often experienced themselves performing during imagery.

Additional Questions

With respect to the additional preliminary questions on imagery perspective from Gordon et al. (1994), participants also indicated a greater preference for internal as opposed to external imagery. Question 1a probed external imagery use and 16 participants reported that they saw themselves from an external perspective as opposed to 21 who reported that they did not and four who reported sometimes experiencing an external perspective. Question 1b concerned use of internal imagery perspective and 27 participants reported that they used an internal perspective, 11 reported that they didn't use an internal perspective, and three participants reported that they used an internal perspective sometimes. Question 2 concerned switching of perspective during imagery. Twenty-three participants indicated that their perspective does change during imagery and 18 reported that they did not change perspective during imagery. Question 3 concerned which imagery perspective was easiest to use. Twenty-six participants reported that an internal perspective was easier to use and 15 participants reported that an external perspective was easier to use.

Concurrent Verbalisation (CV) Data

Inter-rater reliability. The data from concurrent verbalisation (CV) were transcribed then analysed for percentage of internal and external imagery. Expressions indicating internal or external imagery, such as "external", "internal", "inside my body", or "outside my body" were used to identify when the imagery was being experienced internally or externally. If raters had difficulty in assessing whether the participant was experiencing internally or externally based on the concurrent transcript, the answer to the retrospective question "When performing the actual skill itself were you inside or outside your body?" was used. This occurred relatively infrequently, possibly due to the emphasis placed on reporting perspective in the imagery instructions. Raters estimating the percentage of time using internal and external imagery based on the statements and descriptions made during imagery calculated the percentage of internal and external imagery. To test for reliability, ratings of amount of internal and external imagery between two raters were compared. Inter-rater reliability was assessed for 13 randomly selected participants, giving 208 trials for comparison. A Pearson Product Moment Correlation Co-efficient between ratings of trials for proportion internal was $r = .999$. It was concluded that this rating procedure was reliable.

Descriptive statistics. The amounts of internal and external imagery from CV ratings for the two trials for each skill and across all skills are summarised in Table 3.2. In terms of the CV scores, possible scores range from 0 to 100, with a low score indicating more internal imagery and a high score indicating more external imagery. The means for the two trials of each skill were relatively consistent, so an overall mean score was calculated by adding together the mean score for both trials of all eight sport skills. Results indicated that, across all the skills, participants experienced more internal imagery than external imagery. The sport skills with the lowest scores, indicating more internal imagery content, were hitting a tennis ball back over the net, defending against an attack in a team ball game, and catching a ball thrown at you when not knowing which side.

Table 3.2.

Means and Standard Deviations for Percentage of External Imagery in Ratings of Concurrent Verbalisation (CV) for Open and Closed Skills

Variable		M	SD
Hitting a tennis ball back over the net:	Trial 1.	26.71	41.47
	Trial 2.	30.98	41.93
	Mean of Trial 1 and 2	28.84	39.67
Defending against an attack in a team ball game:	Trial 1.	26.41	36.96
	Trial 2.	33.71	40.98
	Mean of Trial 1 and 2.	30.06	35.89
Catching a ball thrown when not knowing which side:	Trial 1.	32.49	40.86
	Trial 2.	32.80	41.88
	Mean of Trial 1 and 2.	32.65	39.21
Dodging a ball thrown at you by surprise:	Trial 1.	40.73	43.61
	Trial 2.	42.20	45.19
	Mean of Trial 1 and 2.	41.46	41.82
Mean for all open skills	Trial 1.	31.59	40.83
	Trial 2.	34.92	42.35
	Mean of Trial 1 and 2.	33.25	39.16

Note. High scores indicate external imagery.

Table 3.2 (continued)

Means and Standard Deviations for Percentage of External Imagery in Ratings of Concurrent Verbalisation (CV) of Open and Closed Skills

Variable		M	SD
Hitting a stationary ball with a stick or club:	Trial 1.	33.05	39.92
	Trial 2.	35.49	42.89
	Mean of Trial 1 and 2.	34.27	39.92
Throwing a ball at a stationary target:	Trial 1.	34.05	43.97
	Trial 2.	35.73	44.03
	Mean of Trial 1 and 2.	34.89	43.09
Performing a forward roll on a mat:	Trial 1.	47.93	47.32
	Trial 2.	46.02	46.39
	Mean of Trial 1 and 2.	46.98	45.28
Rolling a bowl across a bowling green to a target:	Trial 1.	34.46	40.37
	Trial 2.	34.27	41.99
	Mean of Trial 1 and 2.	34.37	40.73
Mean for all closed skills.	Trial 1.	37.37	43.04
	Trial 2.	37.88	43.71
	Mean of Trial 1 and 2.	37.63	42.27
Mean of all 8 skills.	Trial 1	34.48	27.62
	Trial 2.	36.40	30.04
	Trial 1 and 2.	35.44	28.44

Note. High scores indicate external imagery.

The sports skills with the highest means, indicating a relatively larger amount of external imagery content, were performing a forward roll on a mat, and dodging a ball thrown at you by surprise. It is interesting to note that even these two skills had means below 50, indicating that participants experienced all skills at least as much from an internal perspective as an external perspective, across the whole sample. Also of note are the relatively high standard deviations for all skills. This indicates variability between the responses of different participants for the same skill, probably due to participants indicating either high internal or high external imagery content, with few rating moderate amounts of internal and external imagery for each skill.

In analysing open versus closed skills, the mean for the open skills was lower than that for the closed skills suggesting that the participants used a slightly higher percentage of external imagery in the closed skills than the open skills. The means for both open and closed skills were below 50, indicating that participants experienced more internal imagery in both skill types.

Rating Scale (RS) Data

Rating scales (RS) were scored based on measuring the 10 cm analogue lines with a ruler (items 1 - 3), or by score circled for the Likert scales (items 4 and 5).

Internal/External Items. Rating scale items 1, 2, and 3 probed amount of internal and external imagery use in the various skills. The means and standard deviations of these scales are summarised in Table 3.3. The possible rating scale scores range from 0 to 100, with a low score indicating more internal imagery and a high score indicating more external imagery.

Table 3.3

Means and Standard Deviations for Internal/External Rating Scale Items 1, 2, and 3 on Open and Closed Skills

Variable		M	SD
Hitting a tennis ball back over the net:	Item 1	31.35	36.90
	Item 2	22.16	33.27
	Item 3	34.28	35.59
Defending against an attack in a team ball game:	Item 1	32.49	36.58
	Item 2	33.61	38.25
	Item 3	34.99	36.81
Catching a ball when not knowing which side:	Item 1	27.52	31.05
	Item 2	25.82	31.34
	Item 3	27.30	31.74
Dodging a ball thrown at you by surprise:	Item 1	43.48	39.73
	Item 2	38.57	40.03
	Item 3	39.59	37.97
Mean for all open skills:	Item 1	33.71	36.36
	Item 2	30.04	36.15
	Item 3	34.04	35.55

Note. Higher scores indicate relatively higher external imagery. Item 1 asked participants to rate the relative time they imaged from inside versus outside their body during the imagery period. Item 2 asked participants to rate the relative time spent imaging inside versus outside your body during just the actual execution of the skill. Item 3 asked participants to rate the relative importance or effectiveness of the imagery types for them.

Table 3.3 (continued).

Means and Standard Deviations for Internal/External Rating Scale Items 1, 2, and 3 on Open and Closed Skills

Variable		M	SD
Hitting a stationary ball with a stick or club:	Item 1	34.55	37.49
	Item 2	27.56	36.30
	Item 3	32.28	34.77
Throwing a ball at a stationary target:	Item 1	37.65	41.19
	Item 2	31.88	38.01
	Item 3	33.60	38.54
Performing a forward roll on a mat:	Item 1	42.52	38.34
	Item 2	40.38	38.63
	Item 3	38.21	36.27
Rolling a bowl across a bowling green to a target:	Item 1	31.85	34.66
	Item 2	25.09	35.14
	Item 3	34.74	35.91
Mean for all closed skills:	Item 1	36.64	37.85
	Item 2	31.23	37.16
	Item 3	34.71	36.13
Mean of Item 1 for 8 skills		35.18	25.33
Mean of Item 2 for 8 skills		30.63	24.09
Mean of Item 3 for 8 skills		34.37	23.06

Note. Higher scores indicate relatively higher external imagery. Descriptions of Items 1, 2, and 3 are provided in the note to first section of this table.

In line with the concurrent data, the results suggest that across all skills and on all three scales participants rated experiencing more internal imagery than external imagery. Additionally, the skill with the highest internal imagery content was catching a ball thrown to you when not knowing which side. Other skills with means in the low 30's (indicating more internal imagery), included hitting a stationary ball, throwing a ball at a stationary target, hitting a tennis ball back over the net, bowling, and defending against an attack in a team ball game. The sport skills with the highest external rating were performing a forward roll on a mat and dodging a ball thrown at you by surprise. A comparison of the means for open and closed skills shows that for all three items the closed skills scored fractionally higher on external imagery, as was found for the concurrent data. This indicates more use of external than internal imagery for closed skills than open skills.

Clarity and control items. Rating scale item 4 probed how clear the image was and item 5 probed controllability during imagery of the skill. Participants made their ratings on 7-point scales. The results for these scales are provided in Table 3.4. In general, participants rated clarity and control as relatively high. All individual skills had ratings over 5.0 with the highest ratings on defending against an attack in a team ball game for clarity and for control, and the lowest ratings on dodging a ball thrown at you by surprise for clarity and for control. The means for open and closed skills are very similar for both clarity and control.

Table 3.4

Means and Standard Deviations for Clarity and Control Rating Scale Items

Variable		M	SD
Hitting a tennis ball back over the net:	Clarity	5.44	1.25
	Controllability	5.51	1.49
Defending against an attack in a team ball game:	Clarity	5.51	1.49
	Controllability	5.78	1.11
Catching a ball when not knowing which side:	Clarity	5.20	1.25
	Controllability	5.24	1.50
Dodging a ball thrown at you by surprise:	Clarity	5.07	1.39
	Controllability	5.12	1.36
Hitting a stationary ball with a stick or club:	Clarity	5.17	1.20
	Controllability	5.12	1.19
Throwing a ball at a stationary target:	Clarity	5.54	1.16
	Controllability	5.41	1.41
Performing a forward roll on a mat:	Clarity	5.24	1.39
	Controllability	5.20	1.49
Rolling a bowl across a bowling green to a target:	Clarity	5.12	1.40
	Controllability	5.34	1.37
Mean of all 8 skills:	Clarity	5.29	.89
Mean of all 8 skills:	Controllability	5.34	.93
Mean for open skills:	Clarity	5.30	1.34
	Controllability	5.41	1.38
Mean for closed skills:	Clarity	5.27	1.29
	Controllability	5.27	1.36

Retrospective Verbalisation (RV) Data

Retrospective verbalisation (RV) responses were transcribed and scored as for CV. The data from retrospective reports of internal and external imagery used during imagery of the sports skills is summarised in Table 3.5.

Table 3.5

Means and Standard Deviations for Retrospective Verbalisation (RV) Data

Variable	M	SD
Hitting a tennis ball back over the net	22.68	41.17
Defending against an attack in a team ball game	31.59	41.52
Catching a ball when not knowing which side	26.61	41.94
Dodging a ball thrown at you by surprise	45.17	48.34
Hitting a stationary ball with a stick or club	32.93	41.80
Throwing a ball at a stationary target	34.56	45.56
Performing a forward roll on a mat	46.90	47.53
Rolling a bowl across a bowling green to a target	38.05	45.95
Mean of open skills	31.51	43.78
Mean of closed skills	38.11	45.16
Mean of all 8 skills	34.81	28.17

Note. High Scores Indicate External Imagery.

The data indicated that participants experienced more of the imagery from an internal perspective across all skills. This was in agreement with the CV and rating scale data. In addition, in line with the concurrent data, the skill with the lowest mean was hitting a tennis ball back over the net, indicating the most internal imagery. Catching a ball when not knowing which side also had a low mean. The skills with the highest means, that is, the most external, were also the same as for CV with performing a forward roll on a mat and dodging a ball thrown at you by surprise having the highest proportion of external imagery use. In analysing the RV data according to the open and closed skill classification, the mean for closed skills was higher than that for open skills, as for the CV and rating scale data. This suggests that participants used more external imagery in imagining closed skills than open skills.

Skills

The means of each measurement technique for each skill are displayed in Table 3.6.

Table 3.6

Summary of Skills by Measurement Technique

	Concurrent (CV)		Retrospective (RV)		Rating Scale 1	
	M	SD	M	SD	M	SD
Tennis	28.84	39.67	22.68	41.17	31.35	36.90
Defending	30.06	35.89	31.59	41.52	32.49	36.58
Catching	32.65	39.21	26.61	41.94	27.52	31.05
Dodging	41.46	41.82	45.17	48.34	43.48	39.73
Throwing	34.89	43.09	32.93	41.80	37.65	41.19
Hitting	34.27	39.92	34.56	45.56	34.55	37. 49
Forward Roll	46.98	45.28	46.90	47.53	42.52	38.34
Bowling	34.37	40.73	38.05	45.95	31.85	34.66

Note. The mean presented for concurrent verbalisation (CV) is the mean for both trials of each skill. The rating scale score is the mean for rating scale item 1.

This confirmed that across measurement techniques the tennis and catching skills had the lowest means, indicating more internal imagery. The sport skills with the highest means across the three measurement techniques were dodging and the forward roll. On examination of Table 3.6, it an be seen that none of the skills according to any of the measurement techniques had scores above 50, which indicated a greater reliance on internal imagery than external imagery in the present sample.

Correlational Analyses

Relationships between measurement techniques. Pearson Product Moment Correlation Co-efficients were calculated among the internal and external imagery measurement devices: IUQ questions 4a and 5a, CV, RS, and RV. Table 3.7 indicates very close correspondence between the measures, especially between the CV, RV, and RS data. The correlations between the IUQ perspective items and the CV, RV, and rating scale data were moderate and in the appropriate direction with the external items (4a and b) showing positive correlations and the internal items (5a and b) showing negative correlations. Of the correlations only the correlation between IUQ 4a and the RV and IUQ 4a and the rating scale mean failed to reach significance at $p = .05$. The correlations between the CV, RV, and rating scale items were all above .9, indicating a very high level of agreement between the measurement techniques. The difference between the very high correlations of more than .9 between the CV and RV and rating scale techniques and the moderate correlations of around .3 and .4 for the IUQ items was noteworthy. This seems to make sense because the IUQ items refer to general preferences, whereas the other assessment measures report imagery specific to the occasion.

Table 3.7

Pearson Product Moment Correlation Co-efficient Comparison of Various Measurement Techniques

	Concurrent (CV)	Retrospective (RV)	Rating Scale (RS)
IUQ 4 a	.3336	.3027	.3308
	p = .033	p = .054	p = .035
IUQ 5a	-.4574	-.4515	-.5189
	p = .003	p = .003	p = .001
Concurrent Mean		.9141	.9348
		p = .000	p = .000
Retrospective Mean			.9015
			p = .000

Note. The mean of concurrent represents the mean of both trials for each skill. IUQ 4a refers to the external imagery item on the IUQ, and IUQ 5a refers to the internal imagery item on the IUQ. The rating scale score is the mean for RS item 1, "Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period".

Analysis of Variance

IUQ Perspective Items. The IUQ internal and external perspective items were compared using One-way Repeated Measures ANOVA. The main effect for item 4a compared with item 5a was significant, $F(5, 35) = 2.85$, $p < .05$, with the mean for the internal imagery item greater than that for the external imagery item. The IUQ items on clarity of internal (5b) and external imagery (4b) were not significantly different, $F(5, 35) = 1.2$, $p > .05$, nor were the items on controllability of internal (5c) and external (4c) imagery, $F(5, 35) = .3121$, $p > .05$.

Open and Closed Skills. One-way Repeated Measures ANOVA's were conducted on the various measurement techniques (CV, RV, and RS) comparing the open and closed skills. The CV data showed significant differences between open and closed skills for Trial 1, $F(17, 146) = 2.8289$, $p < .001$, Trial 2, $F(17, 146) = 2.3145$, $p < .01$, and for the mean of both trials, $F(30, 133) = 1.9394$, $p < .01$, with the mean for closed skills higher than that for open skills. The means for the RV were also significantly different between open and closed skills, $F(10, 153) = 2.6259$, $p < .01$, with the mean for closed skills higher than that for open skills. The rating scale data also showed some statistically significant differences between the open and closed skills. For item 1, in which participants were asked to "Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period", there was a significant difference between open and closed skills, $F(59, 104) = 2.0369$, $p < .001$, with the mean for closed skills higher than that for open skills. In item 2 participants were asked to "Rate the relative time spent imaging inside (internal imagery) versus outside your body (external imagery) during just the actual execution of the skill". For this item, internal and external imagery were not significantly different between open and closed skills, $F(58, 105) = 1.3081$, $p > .05$. Item 3 probed the relative importance or effectiveness of the imagery types for the participant, and was statistically significant, $F(62, 101) = 1.94$, $p < .002$, with the mean for closed skills higher than that for open skills. Rating scale item 4 probed clarity of imagery and once again was statistically different between open and closed skills, $F(5, 158) = 4.8154$, $p < .001$, with open skills having a higher mean than closed skills. There was also a statistically significant difference between open and closed skills on rating scale item 5, which dealt with controllability of imagery, $F(5,158) = 9.3727$, $p < .0001$, with open skills having a higher mean than closed skills.

Switching

Because previous studies on internal and external imagery perspectives (e.g., Epstein, 1980; Gordon et al., 1994; Harris & Robinson, 1986; Mumford & Hall, 1985) have reported extensive switching between perspectives, an analysis on whether participants changed perspective during imagery was warranted. To assess switching within trials the CV and RV data was analysed for the number of trials in which ratings for internal and external imagery were not 0% or 100%, which indicated total reliance on internal or external imagery. For CV, two trials were completed on each of the eight sport skills for each of the 41 participants, giving 656 trials, 328 on the four open skills, and 328 on the four closed skills. A percentage figure was derived by dividing the number of trials in which switching was believed to have occurred by the total number of trials (656). The RV data was recorded only once after each skill and so there were eight trials for each of the 41 participants, giving 328 trials, 164 on the open skills, and 164 on the closed skills. The RS data was not analysed as participants rarely marked an x at 0 or 100%. In 234 of the 328 trials participants indicated use other than 0 or 100%, suggesting switching in 71.34% of trials, 113 of 164 for the open skill and 121 of 164 of the closed skill. It is assumed that this reflects a response mode effect, that is, people are reluctant to mark the ends of analogue scales, or are not precise to the mm when they intend to.

For the CV data, 148 of the 656 trials participants rated scores other than 0 or 100 %, suggesting that in 22.56% of all trials participants reported switching of one perspective to another. This comprised 76 of 328 trials on the open skills (23.17%), divided among the individual skills as 14 for tennis, 23 for defending, 21 for catching, and 18 for dodging, and 72 of 328 trials on the closed skills (21.95%), divided among the skills as 21 for hitting, 14 for throwing, 13 for forward roll, and 24 for bowling. For the RV, use of a different perspective appeared to occur in 42 of the 328 trials (12.8%), consisting of 20 of 164 trials on the open skills (12.2%), divided among the skills as 2 for tennis, 9 for defending, 5 for catching, and 4 for dodging, and 22 of 164 trials on the closed skills (13.41%), made up of 9 for hitting, 4 for throwing, 5 for forward roll, and 4 for bowling.

In comparing whether individuals switched between trials, on the CV only seven participants used the same perspective across all 656 trials and on the RV eight participants used the same perspective for all 328 trials. These participants consisted of the same seven participants for both measurement techniques, plus one other for the RV, who only switched on one trial on the CV measure. All of these participants adopted an internal perspective in every trial. No participant used an external perspective exclusively. Interestingly, on the CV only 25 participants, and on the RV only 18 participants, switched within a trial, with the other 16, or 23, not switching within a trial, that is, adopting either an entirely internal or entirely external perspective for each trial, but using different perspectives for different skills.

Debriefing Questions

Participants were asked a number of debriefing questions at the conclusion of testing. These concerned the imagery experienced and problems with the procedures used, the actual questions asked are included in Appendix F. The responses to the questions were recorded on audio-tape and later transcribed. From the responses to these questions it appeared that most participants felt that they had used more internal imagery, but switching between perspectives did occur. The sport skill that participants most commonly reported as the most difficult to imagine was dodging a ball thrown at you by surprise. No consistent comments were made with respect to difficulties with the procedure used in this study. Importantly, participants reported that they were able to produce imagery of the sport skills without much difficulty. In addition, it seemed that the CV did not provide too much interference with the imagery task. The only comments consistently made were that CV seemed to slightly slow down the imagery process, but that it did not change how they imaged. The reasons given for the slowing of imagery were that it took longer to describe in words than it did to generate the images, or that it was difficult to find the words to describe the images adequately. Also, many participants made the comment that the descriptions they gave in CV and RV were adequate in describing what had happened, but they felt there were many details that might not have been key elements of the imagery that they were unable to describe.

Discussion

In the discussion section a range of issues are considered. These concern the various measurement techniques used, the use of internal and external imagery in the imagery of the sport skills employed in this study, differences in imagery use between individual sport skills, and differences between perspective use between open and closed skills. Sections on general conclusions, theoretical and measurement implications, methodological issues, implications for future research, and implications for practice cover these issues.

Conclusions

The IUQ provided information about how the participants reported using imagery in their sporting lives. This indicated that imagery use was not very structured or regular and that participants used imagery most often in competition, and before or in bed. The internal and external perspective questions on the IUQ provided a general indication of perspective use, as these data were moderately correlated with the measures of imagery taken during and straight after imagery of the eight sport skills [concurrent verbalisation (CV), rating scales (RS), and retrospective verbalisation (RV)]. The CV, RS, and RV techniques were reliable measures of perspective with inter-rater reports highly correlated. The specific measurement techniques were all highly correlated with one another and seem to be equivalent measures of perspective experienced during imagery, at least when RV and RS are measured immediately after the imagery. Thus, this conclusion is limited somewhat by the fact that the three measures were all administered relatively close together.

It appears that the CV technique in the present study did not interfere greatly with the imagery task, based on the debriefing questions and the fact that participants seemed able to produce imagery of the sport skills easily. The only comment consistently made in the debriefing questions was that the CV seemed to slow the imagery process down a little, because it took longer to describe in words than it did to generate the images, or that participants had trouble finding the words to adequately describe the imagery.

The measurement techniques all indicated a higher use of internal than external imagery, although participants used both perspectives. The IUQ suggested that the general preference across participants was for internal imagery. The additional questions from Gordon et al. (1994) confirmed these general preferences for the present study with more participants reporting that they used internal as opposed to external imagery. The CV, RS, and RV measures all indicated that participants experienced more internal imagery than external imagery during imagery of the eight sport skills, although they did experience both perspectives. It also appears that perspective use varies among tasks, with participants exhibiting greater use of one perspective than the other on different.

The open and closed skill comparison revealed that participants experienced significantly more external imagery during the closed skills than the open skills for all three measures (CV, RS, and RV). Additionally participants rated the clarity and controllability of imagery for the open skills significantly higher than for the closed skills.

An analysis of switching in the CV and RV trials revealed that switching did occur within trials, with 22.56% of CV trials and 12.2% of RV reports considered to involve at least one switch. A comparison of switching between trials revealed that on the CV only seven participants used the same perspective across all trials. On the RV, eight participants reported using the same perspective for all trials. These participants consisted of the seven for the CV plus one other who switched on only one trial of the CV. Interestingly, all of these participants used an internal perspective exclusively, which could indicate a more fixed perspective for those with an internal preference. In addition, on the CV 25 participants and on the RV only 18 participants switched within a trial. The other participants, 16 or 23 of them respectively, did not report switching within a trial on these measures. That is, they adopted either an entirely internal or an entirely external perspective for each trial, but used a different perspective for different skills.

Theoretical and Measurement Implications

The IUQ and additional questions provided a general reflection of imagery preference that was moderately correlated with specific measures taken during or straight after imagery. Hall (1998) reported that the IUQ is a reliable test of imagery use with r values ranging from .65 to .95, but the IUQ has had no psychometric evaluation. Measurements of perspective experience taken as close as possible in time to imagery seem to be more reliable measures than general measures taken before imagery experience. Nonetheless, the results for the IUQ do provide some support for its construct validity, as a general measure of imagery would be expected to correlate with specific measures to a moderate extent. The CV, RS, and RV measure imagery specific to the skill the participant is imaging, so are state measures of imagery experience, whereas the IUQ provided a general trait measure of imagery use. Many of the imagery questionnaires (e.g., QMI, M- SIQ, MIQ, VVIQ, VMIQ) are more of a specific or state measure than the IUQ since they require participants to imagine a movement or activity then rate it on scales. No studies have specifically compared general or trait measures of imagery or imagery perspective with specific or state measures of imagery or imagery perspective. Studies have generally pre-tested imagery or imagery perspective use with a questionnaire but not recorded imagery during imagery training or imagery trials or immediately after these (e.g., Bakker et al., 1996; Epstein, 1980; Gordon et al., 1994; Hale, 1982; Rodgers et al., 1991; White & Hardy, 1995). A commonality between each of these studies was that participants were encouraged to image in one perspective, whereas in the present study participants were not lead to image in one perspective. The present study, therefore, provides important information on the different results and potential uses of trait and state measures of imagery and imagery perspective, something that has not been investigated previously.

The specific measures of imagery (CV, RV, and RS) appear to be equivalent measures of perspective use, provided RV and RS are taken immediately after imagery. Anderson (1981) stated that retrospective reports are most effective if given immediately after a cognitive task. It would seem, therefore, that to understand actual imagery experience, specific measures taken in close proximity to imagery are likely to be most effective. Still, it would be valuable to explore the correlation between concurrent and retrospective reports, as the time between imagery and retrospective testing increases.

From debriefing questions coupled with the fact that participants seemed able to produce imagery of the sport skills easily, it appears that the CV technique did not provide too much interference to the imagery task. The only comment consistently made in the debriefing questions was that the CV seemed to slow the imagery process down because it took longer to describe in words than it did to generate the images, or that participants had trouble finding the words to adequately describe the imagery. Ericsson and Simon (1980) stated that when participants are asked to concurrently verbalise information that is already available to them then verbalisation will not change the course or structure of the cognitive process, or slow down the process.

The CV provided extensive descriptive information, not just on perspective use, but also on aspects of the skill being imagined, and provided a manipulation check on whether the participant was following the imagery script. In applied work as well as research, CV is a useful technique to check whether research participants or athletes are following the treatment protocol during mental training. Murphy (1994) stated that researchers need to provide a careful check of self-reported MP or imagery experience, but this has been carried out in very few studies. A manipulation check is very important in many studies on imagery and MP because often the researcher administers a program of imagery or MP and then examines the effects of this program on skill or task performance. If there is no check whether the imagery experience follows that described in the experimental condition, it might be that the effects of imagery are not due to that experimental condition. Murphy stated that when researchers have checked by asking participants whether their imagery followed the experimental condition, they have often found that participants have changed the imagery script (e.g., Woolfolk, Murphy, Gottesfeld, & Aitken, 1985). CV of imagery would seem to provide a check of whether the participant is following the experimental condition. In general, a problem with CV might be individual differences in verbal abilities of participants, for example, verbal productivity, that is, some people talk more than others do. This was probably not of concern in the present study as word counts from verbal data were not utilised to compare between participants. The percentage of internal and external imagery was used within each participant, and so this would not be influenced by verbal productivity because of within participant comparisons.

Participants used both internal and external imagery during the imagery trials, however there was greater use of internal than external imagery. Smith (1987) argued that new skills might be difficult to imagine from an internal perspective. The research in sport does not entirely support the suggestion that inexperienced athletes may have difficulty in applying internal images (e.g., Blair et al., 1993; Epstein, 1980), nor does the data from this study. This study and the other experimental studies, where participants were either trained or given instruction in internal or external imagery (e.g., Mumford & Hall, 1985; Gordon et al. 1994), have found switching between perspectives with non-elite performers, indicating that they can image from both perspectives.

Another possible reason for the higher use of internal imagery than external imagery across the eight skills might have been the motivational elements of the task.

The motivational function of imagery might not have been strong in this study, as there was no training program or effect for participants to derive. Consequently, the participants might have been more concerned with actual task execution rather than motivational aspects, such as the crowd cheering, seeing themselves winning, and so on. This may have suited an internal imagery more than an external imagery perspective.

Several studies by Hardy and his colleagues (Hardy & Callow, 1999; White & Hardy, 1995) as well as other research (Glisky et al., 1996) have suggested that there are differential effects of imagery perspective on performance of different tasks. Hardy (1997) recognised the failure with much of the research on internal and external imagery to consider different demands of different tasks. Hardy used a purely cognitive theoretical base, that only images that contain information that would not otherwise be available should be beneficial to performance. Therefore, in tasks where body shape and positioning are important an external perspective allows rehearsal of the movements and positions. Alternatively, an internal perspective allows rehearsal of precise locations for initiation of maneuvers. As most of the skills in the present study were not form based, this might explain the greater use of internal imagery in imagining these skills.

In the general preference questionnaire completed before imagery, the IUQ, participants indicated a preference for internal as opposed to external imagery. Previous studies with the IUQ have found different results with perspective. Barr and Hall (1992) and Salmon et al. (1994), in accordance with the present study, found internal use higher than external use, whereas, Hall et al. (1990) found no differences between internal and external imagery use, and Rodgers et al. (1991) found greater use of external than internal imagery in a pre-test with figure skaters. Interestingly, Rodgers et al. found that internal imagery use had increased at post-test after an imagery training program. Rodgers et al. did not report whether they provided internal imagery instructions in the training program. Other general imagery questionnaire studies have also produced mixed findings on perspective preference. Studies comparing successful and less successful elite athlete have found that more successful performers used a greater proportion of internal imagery (Doyle & Landers, 1980; Mahoney & Avener, 1977; Suinn & Andrews, 1981), or no differences (Carpinter & Cratty, 1983; Highlen & Bennett, 1979; Meyers et al., 1979; Rotella et al., 1980), or even that more successful athletes used a larger amount of external imagery (Ungerleider & Golding, 1991). Studies using general questionnaires have found different use patterns among athletes, some studies finding higher preference for internal imagery (e.g., Carpinter & Cratty, 1983; Epstein, 1980), higher preference for external imagery (e.g., Smith, 1983, as cited in Smith, 1987) or mixed preferences (e.g., Ungerleider & Golding, 1991).

CV, RS, and RV measures taken during or immediately following imagery of each of the eight skills in the present study indicated greater use of internal than external imagery. Not many studies have taken measures straight after imagery, but studies that have asked participants to report imagery experience after imagery training or exercises have found greater reliance on internal imagery (e.g., Annett, 1986; Hall & Erffmeyer, 1983), greater reliance on external imagery (e.g., Shick, 1969), mixed preferences (e.g., Blair et al., 1993, Hale, 1982) or extensive switching between perspectives (e.g., Epstein, 1980; Gordon et al., 1994; Harris & Robinson, 1986). The present study confirmed these findings with a greater use of internal imagery, but it was also observed that there were mixed preferences, with some participants adopting an internal perspective for most skills and some participants an external perspective for most skills.

In the present study there was a substantial amount of switching between perspectives. Collins, Smith, and Hale (1998) compared internal and external imagery groups' performance on a karate kata task. Collins et al. found that 'switching" internals performed significantly better than the "per instruction" internals and external-mastery group. Based on participants' self-reported experiences, Collins et al. concluded that constant switching of perspective, like watching a demonstration and then trying to move, was the method utilised by switchers. This, they concluded, suggested that external then kinaesthetic is the actual perspective employed. The present study found extensive switching of perspective and this switching might be related to the conclusions of Collins et al.

The use of imagery across individual tasks varied. No studies have specifically compared perspective use during imagery of two or more skills without instruction to image in a given perspective. The differences between tasks might be due to perceptual elements of the tasks, experience level of the performer, the sporting background of the performer (e.g., whether they play an open or closed sport, whether the participant's primary sport is similar to the one being imagined), or due to prior imagery use or training of the participants. For example, individuals might have undertaken previous training in imagery. Most training recommends an internal perspective, and since they were relatively experienced participants in sport, some or most participants might have had such training. Seven of the eight sport skills imagined were ball sport activities that would require the analysis of a perceptual target, and maybe an internal perspective for tracking the ball. The one skill that did not involve a ball sport was performing a forward roll and it was the skill with the highest external imagery scores. Paivio (1985) suggested the importance of factors to do with the target in an imagery task. Paivio proposed that these different aspects might determine how performers can use imagery most effectively. It may be that what is needed is to determine how to use imagery according to the specific task, rather than which types of task produce superior effects for a given perspective than others. Hardy (1997) tentatively suggested that external imagery might be best for tasks requiring form or body shape elements. Alternatively, internal imagery might be best with tasks requiring simple movements in which form is not important, but timing relative to external cues is. The one skill in the present study with an apparent strong form based element, the forward roll, was the skill with the highest external component, providing support for Hardy. The finding that participants used internal imagery more extensively for the other skills also supports Hardy's suggestion and research. Experience with the tasks may influence perspective reliance as suggested by Smith (1987). Smith suggested that with practice a skill might become easier to imagine from an internal perspective. This suggestion is in contrast to the results of the present study with relatively inexperienced performers, as well as with previous research that has found inexperienced athletes using more internal imagery (Blair et al., 1993; Epstein, 1980) or that they use both perspectives (e.g., Mumford & Hall, 1985; Gordon et al., 1994).

The use of external imagery during the closed skills was higher than during the open skills, which seems to contrast with the suggestion of several researchers (e.g., Harris, 1986; McLean & Richardson, 1994) who proposed that closed skills would benefit more from an internal perspective and open skills from an external perspective. The results of the present study contrast with these suggestions, but not entirely. In this study we were measuring use and the suggestion by McLean and

Richardson was to do with performance, that is, we only found that external imagery was used more in imagining the closed skills, not that this was a more effective imagery practice method.

In summary, the results from the present study suggest that the IUQ provided a general trait measure of imagery use and perspective use. The perspective questions were moderately correlated with specific state measures of perspective. The CV, RS, and RV were reliable, specific state measures of perspective used during the imagery trials. The state measures were equivalent when taken close together in time as in the present study, because they were all highly correlated. The CV seemed to be an effective technique for measuring imagery experience and did not appear to provide too much interference with the imagery process. The IUQ perspective questions had a higher mean for internal than external imagery. Participants experienced more internal than external imagery across the imagery trials for the CV, RS, and RV, although many participants experienced both internal imagery and external imagery. There were differences in the perspective use of individual skills, although participants experienced all skills more from an internal perspective. Significantly, participants experienced more external imagery during the closed skills than the open skills.

Methodological Issues

The methodological issues section considers the methodology employed, such as measurement issues, perspective use, and differences between skills classification. Results from the present study suggested that the IUQ and additional questions provided an indication of general imagery use and general perspective preference, however, the IUQ was a different measure to those taken at actual imagery and so does not specifically record imagery experienced. Correlations with the CV, RS, and RV measures indicated that the IUQ provided a general measure of perspective use. The perspective items on the IUQ are actually visual imagery items and so measure internal visual imagery and external visual imagery. A general questionnaire might be better if it measures internal and external imagery across all sense modalities, rather than just visual imagery.

The very high correlations between the three state measures of imagery perspective, CV, RS, and RV, indicated that they were measuring the same variable. This type of correlational analysis has the danger of confounding within and between subject variation and this may have occurred here. The RS were quick and easy, because they took little time to complete and could be analysed very easily using a ruler, but provided little descriptive content, in terms of what was being imagined, apart from clarity and controllability measures. The RS provided quick, quantitative information on perspective use, but little information on other aspects of imagery such as, successful and unsuccessful imagination, cognitive processing, motivational, or self-confidence aspects. The CV on the other hand provided information rich data on the content of imagery and clarity. RS and RV were recorded immediately following imagery and so might only be equivalent measures when recorded in such a close proximity to actual imagery experience.

Based on information gained from the debriefing questions, it appeared that the CV did not interfere too much with the imagery task. It is possible, given the comments by participants, that the CV might have slowed the imagery process, probably due to the verbal descriptions requiring more time to produce than the actual imagery. In addition, participants reported that sometimes they experienced minor difficulty in finding words to describe the imagery experience adequately. Thus, although the CV technique has good validity for assessing the content of imagery, RV might be a preferred method for acquiring rich information on imagery without any temporal disruption, especially when it is administered straight after the imagery task.

Other methodological issues relate to the choice of sport skills to imagine. Four closed and four open skills were selected as being common skills that would be experienced by most people who played sport. No participants reported great difficulty in generating an imagery scenario based on the description of each skill and none reported that they did not comprehend the instructions for the skill being described. Thus, it seems that the skills were sufficiently common. One problem with skill selection might have been that all of the skills, except one (the forward roll), were ball sport activities. This may have had an effect on the type of imagery experienced. Skills from non-ball sports might have changed the findings, especially for closed skills where there are large numbers of sports without balls (e.g., field throwing and jumping events, skating, gymnastics, trampoline, diving, darts, archery), but, apart from the combat and martial arts there aren't as many open sport skills without balls. It could also be argued that by having ball sports for both open and closed skills, comparison between skill classification was easier, because the only perceptual or motor difference was the open or closed nature of the task. For example, it seems more appropriate to compare an open ball sport with a closed ball sport than an open ball sport with a closed running sport.

Another methodological issue might relate to the imagery instructions given to participants. Great care was taken not to influence participants to use either perspective, however, the instruction to experience all the senses might have led to some participants making the interpretation that internal imagery was what the researcher was looking for. For example, confusion between kinaesthetic imagery and internal imagery might mean that participants who were instructed to report on perspective experienced may have interpreted, because they were being encouraged to "feel" the movement, that the researcher was trying to get them to imagine internal kinaesthetic imagery. In addition, previous training in imagery might have influenced perspective used. Most participants were experienced sportspeople, so some of them may have been exposed to mental training programs where they were instructed in internal imagery, even though their reports of imagery use in the IUQ indicated only moderate levels of use during training and competition.

In analysing the data, statistically significant differences were reported between open and closed skills, although the differences between means were generally in a 10 point range from low 30's to low 40's on a 100-point scale. For example, the CV mean was 33.25 for open and 37.63 for closed skills, meaning that both open and closed skills were experienced more from an internal perspective, although the group of closed skills had higher external imagery use.

In summary, the IUQ and additional questions reflect general imagery use and general perspective use, however, to measure imagery perspective during imagery trials accurately, researchers need to take specific measures, such as CV, RS, and RV during or immediately after imagery. The CV did not appear to interfere with the task, except for some temporal disruption. The choice of sport skills was another issue, but the skills were sufficiently common and understandable for participants to imagine without difficulty. However, the emphasis on ball skills might have had an effect on the perspective use. The imagery instructions appeared to be sufficiently clear; however, the emphasis on encouraging use of all the senses might have influenced perspective use during the trials.

Implications for Future Research

In the implications for research section possible courses of research that have arisen as a result of the findings of the present study are discussed. Thus, future issues associated with measurement of imagery, and imagery perspective in particular, are discussed, as are potential directions for research into imagery perspectives.

The IUQ was moderately correlated with specific measures of imagery (CV, RS, and RV), indicating it was a general indicator of perspective use. Other studies may investigate correlations between specific measures of imagery and other general imagery questionnaires (e.g., MIQ, VMIQ, VVIQ) to see how well they predict actual imagery experienced during imagery of sport skills. One research approach related to the measures could examine whether the correlations between CV, RS, and RV decline as time from imagery increases.

The correlations between RV and CV in the present study were extremely high, but were recorded in close temporal proximity. Thus, another potential investigation is to examine whether RV reflects memory of CV or imagery. Because CV and RV were recorded close together in time, it could be that the participants were just repeating what they said in CV rather than what they experienced in actual imagery. Researchers could introduce an interfering verbal task between CV and RV. If RV reflects memory of CV then correlations between RV and CV should deteriorate compared to a no interference control condition, however, if RV reflects a memory of actual imagery then correlations should remain as high in the interference condition as in the control condition. A critical element for the validity of such research is the selection of appropriate interference tasks (e.g., mental arithmetic versus game imagery).

Additionally, future research should investigate the suggestion of Anderson (1981) that word count measures could reflect qualitative differences in imagery. For instance, whether ratings of clarity relate to amount of verbal output. Researchers might determine the motivational goals of imagery by what the participants report during imagery, such as hearing the crowd, getting pumped after winning the point, feeling happy to have successfully completed the skill and soon. Researchers could then compare this with questionnaire measures of motivational aspects such as the SIQ (Hall, 1998).

The findings of the present study suggest that, if knowledge of perspective use during imagery is important, a specific measure (e.g., CV, RS, and RV) is required rather than a general questionnaire. An aspect that Murphy (1990, 1994) points out is crucial to the effectiveness of imagery training. The checking of imagery content or quality during experimental conditions has been far from standard, yet it has been found that participants in imagery studies can change or vary the imagery script (e.g., Harris & Robinson, 1986; Jowdy & Harris, 1990; Woolfolk, Murphy, Gottesfeld, & Aitken, 1985). Very few studies have measured what the participant actually reports imagining, as opposed to what the researcher told the participant to imagine. Thus, there has been a problem with ensuring the success of independent variable manipulation in the imagery literature. What is required is for participants to give self-reports of their actual imagery experience, such as CV or RV. The CV or RV might be even more effective in the applied setting as much of the time-consuming process of transcription and content analysis would not be required. Researchers in the non-sport setting have also suggested that a process of verbalising during or after imagery might assist the imagery process (e.g., Hurley, 1976; Phillips, 1973; Wolpe, 1973).

The findings for internal and external imagery contrast the suggestion by researchers (e.g., Smith, 1987) that inexperienced or novice athletes in sport rely more on external than internal imagery to image activities from that sport. Future research should compare inexperienced and elite athletes on imagery perspective use, employing specific measurement techniques of imagery such as CV. Further, whether internal or external imagery is more effective for performance enhancement for experienced or inexperienced athletes should be investigated.

The open and closed skill findings did support recent research (e.g., Glisky et al., 1996; White & Hardy, 1995), but were counter-intuitive to the suggestions by several authors that internal imagery would be associated with closed skills and external imagery with open skills (e.g., Harris, 1986; McLean & Richardson, 1994). Perhaps the open and closed classification is not the right classification to be examining. Instead, maybe we should consider the perceptual elements of the task (Paivio, 1985) or motivational factors. It is possible that researchers cannot classify the skills in this way and the required perspective use might be specific to individual tasks (Paivio, 1985; Janssen & Sheikh, 1994). It must be remembered that the findings here are for perspective use, rather than performance. Further studies are needed using a wider range of open and closed skills, especially comparing ball skills with movement skills, as the present study utilised predominantly ball skills. When considering the implication that more external imagery was used in imagining closed skills than open skills it needs to be noted that the significant differences were not large in practical terms as the means were within 10 points on a 100-point scale.

As the present study compared perspective experienced during imagery of sport skills, and found that even though participants experienced both perspectives, there was a greater use of internal imagery overall, future research should investigate factors that mediate this, such as perspective training. Investigations into whether training in a given perspective influences subsequent perspective use during imagery are required. As suggested by the present study, specific measures taken at or immediately after the time of imagery are required to assess what was actually imagined during imagery trials or training.

The present study investigated imagery used during imagination of open and closed skills and found a higher use of internal imagery overall, and a higher use of external imagery on closed skills than open skills. Whereas this indicates that internal imagery is used more by participants asked to imagine sport skills, and that an external perspective might be used more to image closed skills than open skills, it does not provide information on which perspective is more effective for performance enhancement on these skills. Thus, future research needs to investigate which perspective is more effective for performance enhancement for different skills. Recent studies by White and Hardy (1995) and Glisky Williams, and Kihlstrom (1996) have investigated internal and external imagery groups on different skills but not measured actual use. Future research therefore, needs to investigate internal and external training effects on performance further, and studies comparing open and closed skills may be valuable, since the present study found different use patterns for open and closed skills.

Implications for Practice

The implications for practice section discusses how the findings of the present study could impact use of imagery in the applied setting. The indications from the data were that the IUQ provided a general trait measure of imagery use patterns. The general preference for perspective from the IUQ was moderately correlated with state measures taken during or immediately post imagery. Therefore, the applied sport psychologist could use the IUQ as an initial check of imagery perspective use. However, if the applied sport psychologist was concerned with actual imagery perspective experienced during imagery of particular skills from the sport, then state measures would be required.

The CV, RS, seemed to be equivalent measures of imagery perspective if taken close together in time. For applied use the CV may be a useful technique to ensure adherence to the training protocol as it provides immediate, highly descriptive data for the applied practitioner on what the athlete is imaging. It seems an even more appropriate measure in the applied setting because there is not the requirement for lengthy transcription and content analysis procedures. The RV might be useful in applied work to check the imagery manipulation and gain some descriptive comment on imagery experience. Additionally, the instructions on what the athlete is to describe could be manipulated depending on what the practitioner was trying to encourage in the imagery training, e.g., clarity of imagery, motivational or self-confidence aspects, errors made, and so on. For the applied setting the RS might be the easiest measurement technique because of the speed of completing and analysis. The main drawback for RS is that they provide much less information than CV and RV. Perhaps in the applied setting the most effective practice would be to use a combination of the measures as appropriate. For example, CV at the beginning of training programs to ensure correct imagery "script" and to "cement" the script, RV to check on specific components on a regular basis, and RS periodically to check on imagery use and maintenance of script instructions.

The higher use of internal imagery than external imagery across all skills in the present study suggested that internal imagery was more important or easy to produce. However, it must be remembered that means were generally in the 30's to

40's indicating that for all the skills around 30% or 45% of the experience was external. Participants experienced more external imagery for the closed skills, so these skills might require a more external orientation to imagine adequately. Different tasks required more or less internal or external imagery and so perspective use may be specific to the task or elements of the task, e.g., external for setting the scene, and internal to perform actual movement. To get maximum benefit, perhaps athletes need to adopt the appropriate perspective, so they might need to train to image using both perspectives and be able to switch between the two as required by the task. As such, training of weaker ability in one perspective might be useful. Training of a weaker perspective is examined in Study 2.

The present study has suggested that participants, when instructed to image skills, adopt a more internal than external perspective. This, however, is mediated by the fact that most participants reported that they use both internal and external imagery, and sometimes some participants switched during imagery of a skill or between skills. Moreover, the findings on open and closed skills indicate that participants reported more external imagery during the closed skills than the open skills. In Study 2 programs aimed at training a weaker perspective are investigated to find out if perspective use can be changed and whether participants can maintain that desired perspective in imagining open and closed skills.

CHAPTER 4: TRAINING OF IMAGERY PERSPECTIVES

There has been little research investigating whether people can be trained in the use of imagery perspectives. Most perspective studies have either only instructed participants to imagine in one condition and then had them imagine (e.g., Epstein, 1980; Hale, 1982; Harris & Robinson, 1986; Neisser, 1976), asked retrospectively what perspective participants used during their imagery (e.g., Schick, 1969), or selected participants into internal or external groups based on reported preference (e.g., Glisky, Williams, & Kihlstrom, 1996). Studies have used relatively substantial training (e.g., Mumford & Hall, 1985; Gordon, Weinberg, & Jackson, 1994), however, they generally have not matched participants based on preference nor provided manipulation checks to assess perspective use during imagery. Rather, they have relied upon overt performance scores to reflect the success of training. The aim of this study was to examine whether individuals could be trained to image using a pre-determined imagery perspective. Perspective training was mismatched to participant, that is, those with relatively low reported initial use of one perspective were assigned to training in that perspective condition. An open skill and a closed skill were compared because of the suggestion that perspective use might influence effectiveness of imagery for open and closed skills (e.g., Harris, 1986; McLean & Richardson, 1994) and because of recent research that has suggested different effects for different types of skills for open and closed perspectives (e.g., Glisky et al., 1996; White & Hardy, 1995). Performance measures were not recorded because the aim of this study was to determine whether it was possible to increase the proportion of time during imagery when the pre-training, non-preferred imagery perspective was used. It was changes in proportion of use of non-preferred imagery perspective that were of interest and measures of performance would add nothing relevant to our understanding of whether use of imagery perspectives could be altered in response to perspective training. An original study was designed that investigated imagery perspective changes in imagery trials as a result of training. Study 3 was concerned with performance changes that result from imagery perspective training.

Method

Participants

Participants were 25 male and 24 female adults with sports experience aged between 18 and 35, with a mean age of 20 (SD = 3.25). Participants were recruited from undergraduate classes in sport psychology and local sporting teams. Athletes reported their primary sports activity: eight participants reported they played netball, seven played cricket, seven played Australian Rules Football, four played basketball, two played tennis, two played soccer, and two participated in recreational activities. There was one participant in each of the following activities: horseriding, powerlifting, gymnastics, martial arts, calisthenics, surf life saving, kickboxing, ice hockey, swimming, golf, hockey, karate, rowing, ballet, jujitsu, AFL umpiring, and athletics. On the Imagery Use Questionnaire (IUQ), participants rated themselves as 5 novice, 19 intermediate, 20 advanced, and 5 elite, and 12 recreational/house league level, 16 competitive level, 15 provincial competitive level, and 6 national/international level. All participants had prior experience of table tennis and darts and so knew the activities that they were required to imagine. Participants were assigned to either an internal or external imagery training group based on scores on the pre-test for IUQ items 4a and 5a, rating scales (RS), and retrospective verbalisation (RV). The participants were mismatched on imagery perspective preference so that those who scored low or moderate for internal imagery on the pre-test were assigned to the internal imagery training group. Those who scored low or moderate for external imagery on the pre-test were assigned to the external training group. The cut-off on the RS and RV was 50%, so less than 50% was considered internal and 50% and above was considered external imagery, and participants were assigned to the mismatched groups based on this assessment. The IUQ was used as a general back-up to the RS and RV scores. The internal training group consisted of 23 participants with a mean age of 20.22 years (SD = 3.13) and the external training group consisted of 26 participants with a mean age of 19.81 years (SD =3.39). The descriptive statistics for their internal and external imagery scores at pre-test (before training) are displayed in Table 4.1. The scores on the IUQ items show no obvious difference between the two groups using visual inspection, although the internal imagery training group has a higher mean on both the internal and external imagery questions. Independent-samples t tests were conducted to evaluate the difference between scores for the two groups on the IUQ questions. For IUQ question 4a the test was significant, t (47) = 3.3, $p = .002$, with an η^2 (eta squared) of 0.066 indicating a medium effect size. For IUQ question 5a the test was not significant, t (47) = .638, $p = .527$, with an η^2 (eta squared) of 0.0085 indicating a tiny effect size. The RS and RV scores on imagery of the open skill and closed skill clearly show significantly higher scores for the internal training group (indicating higher reported external imagery) than for the external training group, as required for the mis-matching of training with preference. Independent-samples t tests were conducted to evaluate the difference between scores for the two groups on the RV and RS item 1 for each skill. For the RS the tests were significant for the open skill, t (47) = 8.611, $p < .001$, with an η^2 (eta squared) of 0.61 indicating a large effect size, and for the closed skill, t (47) = .7.769, $p < .001$, with an with an η^2 (eta squared) of 0.56 indicating a large effect size. For the RV the test was significant for the open skill, t

(47) = 7.018, $p < .001$, with an η^2 (eta squared) of 0.51 indicating a large effect size. The test for the closed skill was also significant, t (47) = .9.277, $p < .001$, with an with an η^2 (eta squared) of 0.647 also indicating a large effect size. That is, assignment to either the internal or the external training group accounted for 65% of the variance of the perspective variable measured by RV on the closed skill.

Table 4.1.

Internal and External Imagery of Training Groups at Pre-Test

Item		Internal Training Group (ITG)		External Training Group (ETG)	
		M	SD	M	SD
IUQ	4a	4.91	1.86	3.15	1.87
IUQ	5a	5.13	1.36	4.85	1.71
RV	Open	73.55	30.11	19.23	24.01
RV	Closed	70.29	23.04	8.65	16.41
RS	Open	70.91	23.04	21.77	16.74
RS	Closed	64.87	23.93	19.02	17.19

Note. IUQ 4a refers to the external imagery item on the IUQ, and IUQ 5a refers to the internal imagery item on the IUQ.

Design

This study employed a pre-test - intervention - post-test design. Participants were initially assessed for imagery preference and use. This was based on self-reported preference using the IUQ and also rating scales (RS) and retrospective verbalisation (RV), following 10 imagery trials on an open skill and 10 imagery trials on a closed skill. They then undertook an imagery perspective training program in one of two training conditions, an internal perspective training condition or an external perspective training condition. The imagery training intervention was mismatched to use reported in the pre-tests (IUQ, RS, and RV). Participants assigned to the internal perspective training condition were those who reported low to moderate internal imagery use in pre-testing. Participants in the external perspective training condition were those who reported low to moderate use of external imagery in pre-testing. Following the training program, imagery perspective use during open and closed skills was assessed over 10 imagery trials on an open skill and 10 trials on a closed skill using RS as in Study 1. Pre-test/post-test gain score comparisons were used to determine whether use of either perspective was increased by the training program.

Measures

Imagery Use Questionnaire (Hall, Rodgers, & Barr, 1990). The IUQ as described in Study 1, and the three additional questions described in Study 1, were used to assess imagery perspective preferences and typical use.

Rating scales (RS). Rating scales (RS) assessed imagery in the 10 trials of each skill. The RS were those used for Study 1 and were described in Study 1. There were two additional RS on kinaesthetic and visual imagery. The two new items were 7-point Likert scales ranging from (Not clear at all/no image) to (Extremely clear). These two items were included because the type of imagery, visual or kinaesthetic, used in internal and external imagery has been considered by some authors (e.g., Cox, 1998; Janssen & Sheikh, 1994; Weinberg, 1982) as almost synonymous with perspective (visual with external and kinaesthetic with internal). Other researchers, however, have found that kinaesthetic imagery can be experienced in external imagery (e.g., Ungerleider & Golding, 1991; White & Hardy, 1995) and visual imagery is often experienced from an internal perspective (e.g., Barr & Hall, 1992; Hall et al., 1990; White & Hardy, 1995). A copy of the protocol and script for the 10 trials and the RS is included as Appendix H. It was decided to use the RS mean as the measure of imagery because of its extremely high correlation with the concurrent verbalisation (CV) and RV data in Study 1, suggesting it is an acceptable self-report measure of imagery experienced. In addition, the RS are less intrusive to imagery than CV and so allow full concentration on the imagery task as imagery is occurring. They also represent a quick and easy method of assessment because participant response is simple and fast, and there is no need for transcription or content analysis.

Retrospective Verbalisation (RV). Following imagery trials 1, 5, and 10 on each skill, and completion of RS on that skill, participants retrospectively described their imagery experience in that trial. Retrospective verbalisation (RV) was recorded after trials 1, 5, and 10 to provide further corroboration for the RS. The tests of RV were spread in this fashion to observe if there were any changes across the 10 trials, although it was not considered to be necessary to assess imagery in this way after every single trial. Questions probed (a) what happened in the imagery of the sport skill, and (b) when performing the actual skill, which perspective was used. The questions are included in Appendix I. The RV was recorded on audio-tape and later transcribed. The transcripts for RV were scored for proportion of internal and external imagery use, as for CV described in Study 1.

Tasks

There were two tasks, returning a moving ball to a target (open) and throwing a dart at a target (closed). These are now described.

Open skill: Returning a moving ball to a target. Returning projected balls to a target was the open skill imagery task. The task was self-paced, so participants were able to start imaging each of the 10 trials whenever they felt ready. The participant imagined hitting a table tennis ball, projected to them by a ball-projection machine, to a concentric circles target marked on the opposite side of a table tennis table. A diagram of the skill was shown to participants before the first trial to help them understand the skill to be imagined. Instructions described the skill, emphasised experiencing all the senses, and encouraged the participant to imagine the skill at real speed. Copies of the imagery script and diagram for this skill are included in Appendix J.

Closed skill: Throwing a dart at a target. The imaginary dart-throwing task involved the participant imagining throwing a dart at a concentric circles target from a distance of 2.44 metres (the standard competition distance). The task was self-paced, so participants were able to start imaging each of the 10 trials whenever they felt ready. Instructions described the skill, emphasised experiencing all the senses, and encouraged the participant to imagine the skill at real speed. Participants were also shown a diagram of the dartboard to assist in understanding the skill. Copies of the imagery script and the diagram for this skill are included in Appendix H.

Treatments

Internal imagery perspective training condition. The internal imagery perspective training condition consisted of four 30-minute training sessions. Training and instructions emphasised seeing and experiencing the skill from inside one's own body. The participant spent equal time practising open and closed skills. Training followed several stages, increasing in difficulty and complexity of the imagery. A brief relaxation procedure was used prior to imagery in the sessions. Training essentially followed the format of: (a) starting with imagery of very simple static objects, such as a ball, a dart, a dart board, then moving towards more complex, dynamic activities, such as throwing a dart, and hitting a ball; (b) starting with imagery of short duration and gradually increasing the length of each imagery practice trial; (c) asking about experience of the imagery after each practice, especially concerning problems and difficulties, providing guidance, and adjusting training to deal with any problems. Perspective was emphasised throughout the program. This was achieved by emphasising viewing objects from inside the body, and experiencing all the senses from inside the body. Later imagery practices of longer duration skills were initiated with the instruction to image from inside the body. A full copy of the program is included in Appendix J. The program involved two 30-minute sessions designed to train participants to rehearse in the desired perspective during the imagery rehearsal period. Session 1 involved imagining static objects, such as a table tennis bat, a table tennis ball, a dart, and a dartboard. Session 2 involved imaging simple movements, including throwing a ball at a wall, throwing a dart at a dart board, serving a table tennis ball, hitting a backhand, and hitting a forehand. Instructions in these sessions emphasised using all the senses, imagining performing successfully, and maintaining the desired perspective. Sessions 3 and 4 involved imagery of performing the open and closed skills, returning a the projected table tennis ball to the horizontal concentric circles target on the other side of the table and throwing a dart at the dartboard from the predetermined distance. This progression in task difficulty in imagery training was based largely on the recommendations of applied texts (e.g., Vealey & Greeleaf, 1998), which recommend basic training leading to specific training for the skill to be imaged.

External imagery perspective training condition. The external imagery perspective training condition involved four 30-minute training sessions. Training and instructions emphasised seeing and experiencing the skill as if watching oneself on TV, that is, from outside one's own body. Participants spent equal time practising open and closed skills. The program for the external imagery perspective condition followed the same format to the internal perspective training condition described in the previous section, but emphasised and encouraged an external perspective. This was achieved by emphasising viewing objects from outside the body, and experiencing all the senses from outside the body. Later imagery practices of longer duration skills were initiated with the instruction to image from outside the body. A full copy of the program is included in Appendix K. The program followed the same sessions as for the internal program, that is four 30-minute sessions, except that the emphasis of the instructions was on imaging externally. Thus, the program involved two 30-minute sessions designed to train participants to rehearse in the desired perspective during the imagery rehearsal period. A brief relaxation procedure was used prior to imagery in the sessions. Session 1 involved imagining static objects, such as a table tennis bat, a table tennis ball, a dart, and a dartboard. Session 2 involved imaging simple movements, including throwing a ball at a wall, throwing a dart at a dart board, serving a table tennis ball, hitting a backhand, and hitting a forehand. Instructions in these sessions emphasised using all the senses, performing successfully, and maintaining the desired perspective. Sessions 3 and 4 involved imagery of performing the open and closed skills, returning a projected table tennis ball to the horizontal concentric circles target on the other side of the table and throwing a dart at the concentric circles dartboard from the predetermined distance. As for the internal imagery perspective training condition, this progression in task difficulty in imagery training was based largely on the recommendations of applied texts (e.g., Vealey & Greeleaf, 1998), which recommend basic training leading to specific training for the skill to be imaged.

Procedure

The participants for this study were volunteers, accessed through undergraduate classes in sport psychology and local sporting teams. Participants received information on the nature of all procedures involved in the research. They were informed that they were free to withdraw at any time and that all their data was confidential. They were then encouraged to ask any questions or raise any concerns. Then participants completed informed consent forms (Appendix L). Following the signing of informed consent forms the participants completed the IUQ, including the additional questions. Participants were then given instruction as to the protocol for the study. Procedures for the RS and RV measures were explained in detail. The participants then underwent pre-testing of imagery perspective use over 10 trials of an open skill, returning a projected table tennis ball to a target, and 10 trials of a closed skill, throwing a dart at a dartboard. Following the trials, participants completed rating scale measures of imagery perspective use. RV was also recorded after trials 1, 5, and 10. Participants then went into an internal or external imagery training condition based on mismatching reported imagery use. Training involved four 30-minute sessions of instruction and practice at imagery of open and closed skills, in which participants were instructed to use the mismatched perspective. Following the imagery training period, participants were post-tested for imagery perspective use over 10 imagery trials on an open skill, returning a projected table tennis ball to a target, and 10 trials of a closed skill, throwing a dart at a dartboard, by completing rating scale measures and providing RV after trials 1, 5, and 10. Participants then completed the IUQ again. The participants were debriefed to resolve any problems and to acquire additional information about their behaviour, thoughts, and feelings during the study. Finally, the participants were thanked for their involvement.

Analysis of Data

The pre- and post-test data were treated as described in Study 1. A correlational analysis was conducted to assess correspondence between the various measurement techniques used in this study. Pearson Product Moment Correlation Co-efficients were calculated among the internal and external imagery measurement devices (IUQ 4a and 5a, RS and RV).

In addition, gain scores for differences in categories for each task and between tasks were used to compare the training conditions and tasks on imagery perspective use. The pre- to post-test gain scores for open and closed skills were compared using One-way Multivariate Analysis of Variance (MANOVA) and Analysis of Variance (ANOVA) to test for main effect of treatment, main effect of skill, and interaction between treatment and skill type. Gain scores were used because Huck and McLean (1977) noted that in pre-test/post-test designs the MANOVA/ANOVA models assume the treatment is active on all occasions, including pre-test. Thus, the inclusion of a pre-test/post-test factor underestimates the main effect of occasion and interactions involving occasion. Huck and McLean recommended use of gain scores to avoid this problem. The gain scores were calculated by subtracting the pre-test scores for each participant from the post-test scores for each participant. Thus, a mean gain score of 5 represents a 5-point increase in the measure from pre- to post-test.

An independent-samples t test was conducted on the gain scores for the internal imagery training group and the external imagery training group on each of the IUQ items (4a and 5a).

Results

This section first presents analysis of data from the IUQ to describe the general imagery use of participants and any changes due to training programs. In addition, the internal and external imagery perspective questions from the IUQ were examined to assess preferred imagery perspective. The additional questions from Gordon et al. (1994) were also considered to assess imagery perspective use.

The results section then considers RS and RV data to examine changes in imagery perspective use of the two training groups from pre- to post-test. A correlational analysis of the various measurement techniques was conducted to assess correspondence between the techniques. Finally, analysis of variance was conducted on the various measurement techniques, to investigate the interaction between the internal and external imagery training conditions and the open and closed skills.

Imagery Use Questionnaire

This section examines the data from the imagery use questionnaire, which Hall, Rodgers, and Barr (1990) designed to measure general imagery use patterns. The means and standard deviations for imagery items on the IUQ for pre- and post-test are presented in Table 4.2. The table indicates that participants generally did not have very structured or regular imagery sessions. Participants seemed to use imagery more before or during an event than before or during practice. Interestingly, the participants indicated that they often saw themselves winning an event and less often imagined someone else performing or themselves performing poorly, indicating that the motivational function of imagery might be important. Scores on the items on what extent imagery was used in training and competition were moderate, but the mean for training increased slightly from pre- to post-test for both groups, indicating more use of imagery during practice following the intervention. The means for competition did not change for either group and actually decreased slightly for the internal training group.

Table 4.2

Imagery Use Questionnaire Item Descriptive Statistics

Item			Pre-test		Post-test	
1.			M	SD	M	SD
	To what extent do you use mental imagery in your training?					
	Internal Training Group	(ITG)	3.04	1.64	3.17	1.61
	External Training Group	(ETG)	3.73	1.46	4.08	1.57
2.	To what extent do you use mental imagery in competition?	ITG	4.39	1.70	4.17	1.61
		ETG	4.69	1.76	4.69	1.81
3.	Do you use mental imagery:					
a)	before a practice?	ITG	2.57	1.75	3.22	1.78
		ETG	3.35	1.74	3.46	1.79
b)	during a practice?	ITG	2.78	1.54	2.87	1.74
		ETG	3.31	1.35	2.88	1.45
c)	after a practice?	ITG	2.52	1.70	2.96	1.64
		ETG	3.08	1.47	2.92	1.60
d)	before an event?	ITG	4.78	1.62	4.52	1.65
		ETG	5.04	1.73	5.08	1.57

Table 4.2 (continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item			Pre-test		Post-test	
			M	SD	M	SD
e)	during an event?	ITG	3.22	1.70	3.39	2.13
		ETG	3.85	1.95	3.65	1.87
3. f)	after an event?	ITG	3.04	1.80	3.35	1.70
g)	during another unrelated activity (e.g., running)?	ITG	3.09	1.95	3.43	1.78
		ETG	2.85	1.59	3.08	1.70
h)	during breaks in day?	ITG	2.52	1.44	2.61	1.64
		ETG	2.81	1.39	2.88	1.66
4. a)	When you use mental imagery, do you see yourself from outside of your body as if you are watching yourself on a video?	ITG	4.91	1.86	5.17	1.30
		ETG	3.15	1.87	3.12	2.03
b)	If you do, how vivid is this image?	ITG	4.52	3.74	4.96	1.36
		ETG	2.73	2.34	2.65	2.24
c)	How easily can you control that image?	ITG	3.74	1.79	4.30	1.52
		ETG	2.50	2.14	2.38	2.08
5. a)	When you use mental imagery do you see what you would see as if you were actually playing or performing?	ITG	5.13	1.36	4.52	1.83
		ETG	4.85	1.71	5.04	1.73

Table 4.2 (continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item			Pre-test		Post-test	
			M	SD	M	SD
b)	If you do, how vivid is this image?	ITG	5.09	1.38	4.39	1.64
		ETG	4.23	1.63	4.35	1.60
5. c)	How easily can you change that view?	ITG	4.30	1.58	3.78	1.44
		ETG	3.81	1.67	3.92	1.57
6.	When you are imaging, how easily do you see:					
a)	isolated parts of a skill?	ITG	3.57	1.38	3.61	1.44
		ETG	4.08	1.98	4.08	1.87
b)	entire skill?	ITG	4.96	1.49	5.04	1.49
		ETG	5.12	1.70	4.88	1.56
c)	part of an event?	ITG	4.39	1.37	4.43	1.53
		ETG	4.65	1.41	4.77	1.56
d)	entire event?	ITG	4.09	1.62	3.43	1.90
		ETG	3.62	1.81	3.54	1.50
7.	When you are imaging, how often do you see:					
a)	someone else performing (e.g., to imitate)?	ITG	2.78	1.38	3.00	1.57
		ETG	2.62	1.58	2.92	1.62

Table 4.2 (continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item			Pre-test		Post-test	
			M	SD	M	SD
b)	yourself performing incorrectly?	ITG	2.65	1.37	3.09	1.50
		ETG	3.08	1.94	3.08	1.62
7. c)	yourself losing an event?	ITG	2.26	1.29	2.70	1.36
		ETG	2.65	1.72	2.77	1.56
d)	yourself doing a pre-event routine (e.g., warm up)?	ITG	2.26	1.74	2.22	1.62
		ETG	2.04	1.28	2.46	1.45
e)	the atmosphere of the competition day?	ITG	4.13	2.01	3.43	1.90
		ETG	3.85	1.93	3.88	1.68
f)	yourself winning an event?	ITG	5.39	1.37	5.30	1.18
		ETG	4.81	1.90	4.92	1.94
g)	yourself receiving a first place award?	ITG	4.26	2.32	4.30	1.96
		ETG	3.58	2.10	4.04	2.05
8.	When you are using mental imagery to what extent do you actually feel yourself performing?	ITG	4.48	1.68	4.43	1.67
		ETG	4.46	1.56	4.54	1.61

Table 4.2 (continued)

Imagery Use Questionnaire Item Descriptive Statistics

Item			Pre-test		Post-test	
			M	SD	M	SD
9.	How easily do you feel:					
a)	contact with equipment?	ITG	3.61	1.83	3.70	1.58
		ETG	3.54	1.77	3.69	1.74
9. b)	specific muscles	ITG	3.09	1.70	3.57	1.78
		ETG	3.12	1.66	3.50	1.70
c)	body control?	ITG	4.09	1.44	4.13	1.39
		ETG	4.42	1.77	4.62	1.83
10.	Are your imagery sessions structured (i.e., you know in advance what you will do and for how long)?	ITG	2.65	1.64	2.30	1.40
		ETG	2.62	1.68	2.35	1.62
11.	Are your imagery sessions regular (i.e. at a specific time each day)?	ITG	2.43	1.38	2.00	1.38
		ETG	2.58	1.55	2.81	1.70
13.	In preparation for your all time best performance, how much imagery did you do?	ITG	4.61	1.88	4.61	1.59
		ETG	4.12	1.82	4.19	1.67

In terms of internal and external imagery the means at pre-test for the external imagery question (4a) show that the internal training group had a higher mean than the external training group as expected. In addition to this, the means for vividness (4b) and controllability (4c) of external imagery were also higher for the internal training group than the external imagery group. In examining the post-test means for the external imagery questions there was not really a change from pre- to post-test. The external training group means varied only slightly for all three questions (4a, b, c) and the changes were all towards fractionally lower means. The internal training group means increased for all three questions. Although, the changes were only small, they did indicate a movement towards external imagery.

The internal imagery questions (5a, b, c), in contrast to the external imagery questions, went against the patterns expected. In analysing the results for the internal imagery items caution must be advised because of findings reported later (Table 4.9). These results describe the correlations between the various measures. This highlighted that the internal imagery items of the IUQ were poorly correlated with specific measures of imagery (RS and RV), taken at the time of imagery. The means for the internal training group were all higher than for the external training group at pre-test, indicating higher internal imagery use for the internal training group. In addition, changes at post-test did not occur, the internal training group decreasing fractionally on all three questions and the external training group increasing fractionally on all three questions, indicating internal imagery use patterns opposite to those expected. This result could be due in part to the wording of the question, or internal imagers having a more fixed perspective than external imagers, both of these issues are addressed in the discussion section. The means for the kinaesthetic imagery item were around 4.4 to 4.5 for both groups at pre- and post-test, indicating that a moderate level of kinaesthetic imagery was experienced during internal and external imagery.

Additional Questions

On the additional questions from Gordon et al. (1994), participants overall indicated a greater use of internal as opposed to external imagery at both pre- and post-test. Questions 1a and 1b probed internal and external imagery use. At pre-test, in the internal training group, eight participants reported that they saw themselves from an internal perspective and 15 participants reported that they saw themselves from an external perspective. In the external training group at pre-test 22 participants reported that they saw themselves from an internal perspective and four saw themselves from an external perspective. Question 2 concerned switching of perspective during imagery. At pre-test in the internal training group, 12 participants indicated that their perspective does change during imagery and 11 participants reported that their perspective does not change during imagery. In the external training group, eight participants indicated that their perspective does change during imagery and 18 participants indicated that their perspective does not change during imagery. Question 3 concerned which perspective was easiest to use. For the internal training group, five participants reported an internal perspective was easiest to use and 18 participants reported that an external perspective was easiest to use. For the external training group, 19 participants reported that an internal perspective was easiest to use and seven reported that an external perspective was easiest to use.

At post-test, on question 1a and 1b for the internal training group, 19 participants indicated that they used an external perspective and four participants indicated that they used an internal perspective. For the external training group, 21 participants reported that they used an internal perspective and five reported that they used an external perspective. On question 2, for the internal training group, 13 participants reported that they switched perspective and 10 participants reported that they did not switch perspective during imagery. For the external training group, six participants reported that they changed perspective and 20 participants reported that they did not change perspective. On question 3, in the internal training group, one participant reported that an internal perspective was easiest to use and 22 participants reported that an external perspective was easiest to use. In the external training group, 21 participants reported that an internal perspective was easiest to use and five participants reported an external perspective was easiest to use.

Rating Scale (RS) Data

This section examines the rating scale data. Rating scales (RS) were scored based on measuring the 10cm analogue lines with a ruler (items 1-3) or by score circled for the Likert scales (items 4-7). A comparison is made first of internal and external imagery use for each skill and then for each training group. Later analysis centres on control and clarity of imagery, and visual and kinaesthetic imagery.

Internal/external items for all participants. Rating Scales (RS) items 1, 2, and 3 probed the amount of internal and external imagery use during the imagery trials of the two skills. The means and standard deviations of these skills for all participants, irrespective of training condition, at pre- and post-test are summarised in Table 4.3. As can be seen, the means for all items were below 50 indicating that participants experienced more internal than external imagery in the imagery trials. Additionally, the means for imaging the open skill (table tennis) are higher than for imaging the closed skill (darts), indicating a higher use of external imagery for the open skill than the closed skill.

Table 4.3

Rating Scale Descriptive Statistics for the Open and Closed Skills for all Participants

Item		Pre-test		Post-test	
		M	SD	M	SD
Table Tennis (Open Skill)					
Item	1	44.84	31.67	41.46	28.60
	2	40.32	30.01	37.29	26.11
	3	44.10	29.62	42.70	26.03
Darts (Closed Skill)					
Item	1	40.54	30.84	36.45	28.76
	2	35.09	28.16	33.47	27.81
	3	40.96	29.47	38.56	25.49

Note. Higher scores indicate relatively higher external imagery. Item 1 asked participants to rate the relative time they imaged from inside versus outside their body during the imagery period. Item 2 asked participants to rate the relative time spent imaging inside versus outside your body during just the actual execution of the skill. Item 3 asked participants to rate the relative importance or effectiveness of the imagery types for them.

A paired samples t test was conducted to evaluate reported perspective use for all participants on the two skills at pre-test. The results suggested no significant difference between the mean for the open skill on RS item 1 (table tennis) and the mean for the closed skill on RS item 1 (darts), $t(49) = 1.473$, $p = .147$. The magnitude of the differences between the means was small. The d, a standardised effect size index was .21, a small value. The mean difference was 4.3 between two 0 to 100 analogue RS for table tennis and darts. Interestingly, the means for both skills decreased from pre- to post-test, indicating more internal imagery at post-test. The standard deviations for all items are large indicating that scores did vary considerably from the mean.

Internal/external items for the two training groups. Rating Scales (RS) items 1, 2, and 3 probed the amount of internal and external imagery use during the imagery trials of the two skills. The means and standard deviations of these skills for both training groups at pre- and post-test are summarised in Table 4.4. At pre-test the internal training group had a much higher mean than the external training group. In comparing the two skills, the open skill (table tennis) had higher means than the closed skill (darts) for both groups at pre- and post-test, indicating higher external imagery ratings.

In analysing the two training conditions, the internal training group displayed a decrease in their means for both skills from pre- to post-test, indicating an increase in reported use of internal imagery. The means for the external training group increased slightly for the open skill (table tennis) from pre- to post-test, indicating greater use of external imagery, although the change was less than that for the internal training group. The means for the closed skill (darts) remained more constant from pre- to post-test, for the external training group. For item 1, the mean increased slightly, indicating increased reported use of external imagery. This change was very small, being only two points on a 100-point scale. The other two items had slightly increased means, indicating increased reported use of external imagery in line with the assigned condition.

Table 4.4

Rating Scale Descriptive Statistics for Internal and External Imagery Training Groups

Item		Internal Training Group				External Training Group			
		Pre-test		Post-test		Pre-test		Post-test	
		M	SD	M	SD	M	SD	M	SD
Table Tennis (Open Skill)									
Item	1	70.91	23.04	59.33	26.22	21.77	16.74	25.65	20.29
	2	62.29	25.80	52.31	26.60	20.89	17.50	28.17	16.95
	3	65.93	24.11	59.13	24.89	24.78	18.62	24.00	17.18
Darts (Closed Skill)									
Item	1	64.87	23.93	53.04	27.43	19.02	17.19	21.78	21.20
	2	56.37	24.20	49.70	28.45	16.27	14.90	19.12	17.77
	3	64.98	21.85	54.17	23.96	19.71	15.71	24.76	17.89

Note. Higher scores indicate relatively higher external imagery. Item 1 asked participants to rate the relative time they imaged from inside versus outside their body during the imagery period. Item 2 asked participants to rate the relative time spent imaging inside versus outside your body during just the actual execution of the skill. Item 3 asked participants to rate the relative importance or effectiveness of the imagery types for them.

Clarity and control items. RS item 4 probed how clear the image was and item 5 probed controllability during imagery of the skill. Participants rated both these items on 7-point Likert scales. Table 4.5 displays the results of these items. In general, the means for both skills and both groups are similar, although the internal imagery training group appeared to have slightly higher means for both control and clarity. In comparing changes from pre- to post-test there did not appear to be a large change, although six of the eight means increased slightly from pre- to post-test.

Table 4.5

Rating Scale Descriptive Statistics for Clarity and Control Items

Item		Internal Training Group				External Training Group			
		Pre-test		Post-test		Pre-test		Post-test	
	Item	M	SD	M	SD	M	SD	M	SD
Table Tennis									
(Open Skill)	4	5.16	1.03	5.30	.94	5.03	1.30	5.07	1.36
	5	5.31	.88	5.42	.77	4.94	1.21	4.87	1.27
Darts									
(Closed Skill)	4	5.21	.77	5.43	.94	4.69	1.35	4.91	1.23
	5	5.22	.80	5.33	1.06	4.71	1.30	4.71	1.31

Note. RS item 4 probed how clear the image was and item 5 probed controllability during imagery of the skill.

Visual and kinaesthetic items. RS item 6 probed how well the participant felt the movement and RS item 7 probed how well the participant saw the movement. Participants rated both these items on 7-point Likert scales. Table 4.6 displays the results for these items. The means for the kinaesthetic imagery item (item 6) were all above 4.5, indicating that kinaesthetic imagery was also an important component of the images generated. In addition, both groups indicated that they experienced kinaesthetic imagery at pre- and post-test. There did not appear to be a change from pre- to post-test. The means for the visual imagery item (item 7) were high, especially for the internal imagery training group (who use more external imagery), indicating that visual imagery was an important component of images generated. The means did not change from pre- to post-test for either both group.

Table 4.6

Rating Scale Descriptive Statistics for Visual and Kinaesthetic Imagery Items

Item		Internal Training Group				External Training Group			
		Pre-test		Post-test		Pre-test		Post-test	
		M	SD	M	SD	M	SD	M	SD
Table Tennis									
(Open Skill)									
Item	6	4.97	.98	4.72	1.36	4.80	1.33	4.72	1.43
	7	5.48	.93	5.51	.99	4.71	1.34	4.74	1.46
Darts									
(Closed Skill)									
Item	6	4.80	.98	4.73	1.57	4.53	1.46	4.54	1.40
	7	5.48	.73	5.47	.95	4.44	1.55	4.45	1.50

Note. RS item 6 probed how well the participant felt the movement and RS item 7 probed how well the participant saw the movement.

Retrospective Verbalisation (RV) Data

This section examines responses made during retrospective verbalisation (RV). RV responses were transcribed and scored as for Study 1. Data on imagery during the open and closed skills are analysed, and a comparison of the internal and external training groups is described.

Open and closed skills. The data from RV of internal and external imagery use during imagery of the two sport skills by all participants are summarised in Table 4.7.

Table 4.7

Retrospective Verbalisation Data for the Open Skill and Closed Skill

Item	Pre-test		Post-test	
	M	SD	M	SD
Table Tennis (Open Skill)	44.73	38.29	32.28	33.89
Darts (Closed Skill)	37.59	38.64	32.99	37.66

The data indicated that, as for the RS data, participants predominantly experienced both skills at pre- and post-test from an internal perspective. At pre-test the mean for the open skill (table tennis) was higher than for the closed skill (darts), indicating higher reported use of external imagery for the open skill. A paired samples t test was conducted to evaluate reported perspective use for all participants on the two skills at pre-test. The results suggested no significant difference between the mean for the open skill (table tennis) RV and the mean for the closed skill (darts) RV, $t(49) = 1.636$, $p = .108$. The magnitude of the differences between the means was small. The d, a standardised effect size index was .23, a small value. The mean difference was 7.14 between two 0 to 100 analogue RS for table tennis and darts. At post-test the means for the open and closed skills were very similar, indicating a greater change for the open skill than the closed skill from pre- to post-test, with both skills becoming experienced more from an internal perspective. As for the RS, there were large standard deviations on both skills.

Training groups. The data from RV of internal and external imagery use during imagery of the two sport skills by each training group are summarised in Table 4.8. The data indicated that, as for RS, the two training groups were different at pre-test. The internal imagery training group had a much higher mean, indicating greater reported use of external imagery than was reported by the external imagery training group. The means for the internal imagery training group on both skills at pre-test were similar. The means for the external imagery training group between skills were different with the closed skill (darts) having a lower mean than the open skill (table tennis). This indicated that this group used external imagery more for the open skill, although this was still less than 20% of the time.

Table 4.8

Retrospective Verbalisation Data for the Open Skill and Closed Skill for the Internal and External Imagery Training Groups

Item	Internal Training Group				External Training Group			
	Pre-test		Post-test		Pre-test		Post-test	
	M	SD	M	SD	M	SD	M	SD
Table Tennis (Open Skill)	73.55	30.11	54.93	32.84	19.23	24.01	12.24	19.15
Darts (Closed Skill)	70.29	29.07	56.30	39.41	8.65	16.41	12.37	20.34

In comparing pre- to post-test means, the internal imagery training group appears to have become more internal in their reported imagery use with the means for both the open and closed skill decreasing from around 70 to mid 50's. The external imagery training group exhibited a decrease of seven points for the open skill, dropping from 19 to 12. This indicates a decrease in external imagery use, in the direction opposite to what was intended by the training condition. The mean for the closed skill increased a small amount from pre- to post-test. Again, the large standard deviations should be noted, indicating variability within the groups.

Correlational Analyses

A correlational analysis was conducted to assess correspondence between the various measurement techniques used in this study. Pearson Product Moment Correlation Co-efficients were calculated among the internal and external imagery measurement devices, that is, the IUQ items 4a and 5a, RS, and RV. Table 4.9 indicates very close correspondence between the RS and RV data, which the participants provided in close proximity in terms of time. The correlations between the IUQ items and the RS and RV varied between items. The correlations between IUQ 4a (the external imagery question) and the RV and RS were moderate with only the correlation between IUQ 4a and RV of the closed skill at post-test not being significant at $\alpha = .05$. The correlations between IUQ 5a (the internal imagery question) and the RV and RS were poor with only one correlation being significant at $\alpha = .05$.

Table 4.9

Pearson Product Moment Correlation Co-efficient Comparison of the Various Measurement Techniques

	IUQ 4a		IUQ 5a		RV	
	pre	post	pre	Post	pre	post
RS						
Open	.369	.594	.033	-.216	.877	.820
p =	.009	.000	.823	.137	.000	.000
Closed	.306	.465	-.049	-.294	.857	.875
p =	.032	.001	.740	.041	.000	.000
RV						
Open	.369	.589	.001	-.153		
p =	.009	.000	.994	.295		
Closed	.269	.440	-.004	-.248		
p =	.062	.002	.976	.086		

Note. IUQ 4a refers to the external imagery item on the IUQ, and IUQ 5a refers to the internal imagery item on the IUQ. The RS is the mean for rating scale item 1, "Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period".

Analysis of Variance

Gain Scores. The pre- to post-test gain scores for open and closed skills were then compared using One-way Multivariate Analysis of Variance (MANOVA) and Analysis of Variance (ANOVA) to test for main effect of treatment, main effect of skill, and interaction between treatment and skill type. Gain scores were used because Huck and McLean (1977) noted that in pre-test/post-test designs the

MANOVA/ANOVA models assume the treatment is active on all occasions, including pre-test. Thus, the inclusion of a pre-test when the treatment is not active underestimates the main effect of occasion and interactions involving occasion. Huck and McLean recommended use of gain scores to avoid this problem.

The gain scores were calculated by subtracting the pre-test scores for each participant from the post-test scores for each participant, thus a mean gain score of five represents a 5-point increase in the measure from pre- to post-test. Table 4.10 displays the gain scores for the main internal and external measurement items. Once again it should be noted that positive gain scores reflect an increase in the proportion of time that the person used external imagery, whereas negative gain scores indicate more time spent in internal imagery at post-test than at pre-test. These items were analysed as described in the following sections, using inferential statistics to determine differences between training conditions on the measurement techniques across sport skills. As can be seen from Table 4.10, the changes for IUQ item 4a do not appear to be large, however, the changes on item 5a are somewhat greater. The mean gain scores for the internal imagery training group appear to be much greater than the changes for the external imagery training group on both the open and the closed skill. This is unlikely to be a "scale effect" because the internal training group started with high scores (60-70) which fell to moderate scores (50), whereas the external training group had low scores that did not change much (16-25).

IUQ perspective items. An independent-samples t-test was conducted on the gain scores for the internal imagery training group and the external imagery training group on each of the IUQ items (4a and 5a). The test was not significant for item 4a $t(47) = .54$, $p = .59$. The independent samples t test on item 5a was significant, $t(47)$

= -2.02, $p = .05$. This suggests that the internal training group significantly decreased their ratings on IUQ item 5a from pre-test to post-test as shown in Table 4.10.

Table 4.10

Mean gain scores for the internal and external imagery measurement techniques for the internal and external imagery training groups

		Internal Imagery Training Group		External Imagery Training Group	
		M	SD	M	SD
IUQ	4a	.26	2.30	-.04	1.54
	5a	-.61	1.62	.19	1.13
RS	Open Skill	-11.59	25.82	3.88	10.29
	Closed Skill	-11.83	36.32	2.76	14.49
RV	Open Skill	-18.62	40.93	-6.99	21.18
	Closed Skill	-13.99	43.87	3.72	24.23

Note. IUQ 4a refers to the external imagery item on the IUQ, and IUQ 5a refers to the internal imagery item on the IUQ. The rating scale score is the mean for rating scale item 1, "Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period".

MANOVA on RS and RV data. A one-way MANOVA was conducted to determine the effect of the two training programs (internal imagery training group and external imagery training group) on the two dependent variables, the RS and RV scores of internal and external imagery. No significant differences were found among the two training groups on the dependent measures, Wilk's $\Lambda = .833$, $F(4, 44) = 2.207$, $p = .08$. The multivariate effect size, eta squared (η^2) based on Wilk's Λ was moderate, .170. Table 4.10 contains the means and standard deviations on the dependent variables for the two groups.

Analyses of variance (ANOVA) on each dependent variable were conducted as follow-up tests to the MANOVA. Researchers do not normally conduct these analyses unless the MANOVA is significant. It was felt in this case, however, that as the MANOVA approached significance follow up analyses to assess whether there were any differences on certain dependent variables would assist in analysis of the data. The ANOVA on the RS scores for the open skill was significant, F (1, 47) = 7.924, p = .007, whereas the ANOVA for the closed skill approached significance at α = .05, F (1, 47) = 3.566, p = .06. The ANOVA on the RV scores for the open skill was not significant, F (1, 47) = 1.616, p = .21, despite having the largest gain score of -18.62 for the internal imagery training group. The unexpected change in the mean gain scores of the external imagery training group of -6.99 seems to have largely negated the internal training group's change in perspective use. The ANOVA on the RV scores for the closed skill approached significance, F (1, 47) = 3.154, p = .082.

Post hoc analyses to the univariate ANOVAS for the RS and RV scores consisted of conducting pairwise comparisons to find which training condition affected internal and external imagery ratings most strongly. The internal imagery training group produced significantly more change of the gain scores on the RS for the open skill than the external imagery training group (see Table 4.10). In addition, the gain scores for the RS on the closed skill and RV on the closed skill approached significance at .05, with the internal imagery training group displaying greater change, towards reporting more internal imagery. The RV gain scores on the open skill for the internal imagery training group and the external imagery training group were not significantly different from one another.

Discussion

The discussion section reports on imagery use and training effects from the perspective training. First, issues related to measurement of perspectives are discussed. Next, the use of imagery for the open and closed skill is considered. Finally, the effects of internal and external perspective training are discussed. Findings are compared with studies on performance, since no previous studies have specifically investigated actual perspective use changes. These issues are examined in sections on general conclusions, theoretical and measurement implications, implications for future research, and implications for practice.

Conclusions

A description of the major findings of this study is presented in the conclusions section. The perspective questions on the IUQ produced mixed results. The external imagery questions suggested that assignment of individuals to groups at pre-test was according to the mismatch of preferences, however, there was no change in perspective use from pre- to post-test for either training group. The internal imagery questions indicated that reported imagery use was not as expected according to the assignment to mismatch of preference, with the internal training group reporting higher internal imagery use than the external training group. In addition, there was a decrease in reported internal imagery use for the internal training group, who were expected to increase their use of internal imagery according to the training condition. The ratings for the external imagery use question were lower than the ratings for the internal imagery use question for both groups at both pre- and post-test. The kinaesthetic imagery item of the IUQ showed that both groups reported that they experienced kinaesthetic imagery at pre- and post-test at about the same amount.

On the additional perspective questions from Gordon et al. (1994) more participants reported an internal orientation than an external orientation. There was no real change in these preferences from pre- to post-test. An interesting finding was that there was more reported switching of perspective by participants in the internal training group than the external training group.

The correlations between the measurement techniques in the present study mostly followed similar patterns to those found in Study 1, although the correlations between the IUQ items and the RV and RS varied between the two IUQ items. The correlations between IUQ 4a (the external item) and the RS and RV were moderate, indicating that IUQ 4a was a general indicator of external imagery preference. The correlations between IUQ 5a (the internal imagery item) and the RS and RV, were poor. This would seem to suggest that the IUQ item was not a good predictor of internal imagery use in the trials in this study. There was a very close correspondence between the RV and RS.

Participants reported greater external imagery use in imaging the open skill (table tennis) than in imaging the closed skill (darts) on the RV and RS. Participants experienced both skills more from an internal than an external perspective. The assignment of participants to training groups was according to mismatch of preferences based on RV and RS measures. On the RS the ratings for clarity and control were relatively high for both groups, ranging from 4.69 to 5.43 on a 7-point scale. There were no changes for group or skill from pre- to post-test, although six of the eight comparisons increased slightly. Ratings on the visual imagery RS item were also relatively high, with the internal training group reporting slightly higher ratings than the external training group for both skills. For the kinaesthetic imagery RS item the ratings for both groups were similar, and relatively high, indicating that both the internal training group and external training group reported kinaesthetic experience.

An analysis of the effects of the perspective training programs was conducted. This compared scores on the IUQ perspective items at pre- and post-test and scores on the RS and RV at pre- and post-test. The IUQ items provided contradictory results. On the external question of the IUQ, there was no change from pre- to post-test, however, the internal question of the IUQ indicated that internal imagery use decreased in the internal training group from pre- to post-test. This finding contradicts those for the RS and RV data, which indicated a change for the internal training group and a small change for the external training group in line with the training conditions. This finding for the internal question on the IUQ may be due in part to the construction of this item on the IUQ as discussed later in the methodological issues section.

In summary, the general conclusions from the present study were that on the IUQ there were no real differences between the training groups on perspective use at pre-test. At post-test mixed results were found for the IUQ, with the internal training group having a significant decrease in internal imagery use, against the training condition. There was no change for the external training group. As for Study 1, the correlations between the IUQ perspective items and the RV and RS were moderate, whereas the correlations between the RS and RV were very high. The RS and RV data indicated that at pre-test participants experienced both skills more from an internal than an external perspective in accordance with the findings of Study 1. In contrast to Study 1, however, the open skill had higher reported external imagery. At post-test, analysis of the data suggested that the internal training group did increase their use of internal imagery following training.

Theoretical and Measurement Implications

The theoretical and measurement implications section describes how the findings detailed in the conclusions section relate to theories and research on internal and external imagery, as well as imagery in sport. Findings of this study are compared with previous research on imagery perspectives. A direct comparison is not possible because no studies have specifically investigated training of imagery perspectives but rather have focused on performance changes as a result of perspective training. In addition, no studies have utilised test trials where researchers recorded imagery use when no instruction in which perspective to adopt has been carried out. As such, this study is compared with these performance studies (e.g., Collins et al., 1998; Glisky et al., 1996; Hardy & Callow, 1999; White & Hardy, 1995), but it must be kept in mind that these studies measured performance and as such give only clues as to what is occurring in actual imagery and what was expected in this original piece of research. In addition to this comparison, the discussion on the strength and usefulness of the measurement techniques from Study 1 is continued.

The assessment of the measurement techniques used in the present study confirms most of the findings of Study 1. The IUQ and additional questions were intended to provide general information on perspective preference, but there appeared to be problems with the internal imagery item (5a). The correlations between item 5a and the RS and RV were poor, indicating that it was a weak indicator of perspective use on a specific occasion. In addition to this, analyses involving item 5a indicated that from pre- to post-test the internal training group significantly decreased their use of internal imagery, in contrast to the training condition. This was also the reverse of the findings for the RS and RV, which indicated an increase in internal imagery use at post-test for the internal training group. The correlations between IUQ item 4a and the RS and RV were moderate and mainly significant, confirming the findings of Study 1 that this was a general indicator of external imagery preference. The specific measures of imagery (RV and RS) taken immediately after imagery, as in Study 1, appear equivalent measures of perspective use during the imagery trials. This study confirmed that if it is important to understand what the participant is actually imaging during imagery, specific measures of imagery taken as close as possible to imagination are required. Thus, if a manipulation check of imagery experience is required, which Murphy (1994) stated is important, the researcher should employ a specific measure of imagery, such as RS or RV, rather than a general questionnaire.

On the IUQ, the means for both groups on the internal imagery question (5a) were higher than the means on the external imagery questionnaire (4a). This is probably due in part to the wording of the internal imagery question, which asks participants "...do you see as if you were actually playing and performing?". Participants might not have interpreted this as being from one's own eyes, and so some external imagers may have responded in the affirmative. This could explain why the means for the internal questions were higher than those for the external items for both the internal training group and external training group. Alternatively, this finding may be due to external imagers being capable of experiencing both perspectives, whereas internal imagers have difficulty changing from an internal perspective. This could possibly explain the findings of Study 1 in which participants experienced most imagery internally, but some participants also used an external perspective. In addition, the additional questions seemed to indicate that external imagers might have a more flexible orientation than internal imagers might. Previous research with the IUQ has found greater reported preference for internal imagery than external imagery in two studies (Barr & Hall, 1992; Salmon, Hall, & Haslam, 1994), but other studies have found no difference (e.g., Hall et al., 1990) or greater reported use of external imagery (e.g., Rodgers, Hall, & Buckolz, 1991). So there is some evidence for higher reports of internal imagery use than external imagery use on the IUQ, but this is not consistent.

An interesting finding from the additional questions was that there was more reported switching of perspective by participants in the internal training group than the external training group. That would seem to provide further support to the suggestion that external imagers may have a more flexible orientation than internal imagers who are more fixed in their use of perspective.

As for Study 1, internal and external imagery were both used during the imagery trials, as measured by RS and RV, and internal imagery was used more extensively than external imagery. As participants in this study were familiar with the two skills, but were not experienced performers, this finding indicates that participants did not have to be experienced in a skill to imagine it internally as has been suggested by Smith (1987). Other studies with non-elite performers have also found switching between perspectives (e.g., Epstein, 1980; Gordon et al., 1994; Mumford & Hall, 1985; Smith, 1983, as cited in Smith, 1987), indicating that inexperienced performers may image from different perspectives. The finding of more use of internal imagery confirms the results of Study 1 and indicates that experience with the skill may not be a factor determining imagery perspective use.

The use of external imagery during imagery of the open skill (table tennis) was higher than the use of external imagery during of the closed skill (darts). This finding is in contrast to that of Study 1, where it was found that the imagery of the closed skills had a higher external imagery content than imagery of the open skills. In the present study the training and use of internal and external imagery was investigated, which has not been directly studied previously, but suggestions on perspective use from research on performance may help explain this finding. For example, the current finding was consistent, with the suggestion by Harris (1986) and McLean and Richardson (1994) that closed skills would benefit more from an internal perspective and open skills would benefit more from an external perspective. Hardy (1997) suggested that there are differential effects of imagery perspective on performance of different tasks. Hardy stated that only images that contain information that would not otherwise be available should be beneficial to performance. Hardy tentatively suggested that an external perspective might be best for tasks requiring form or body shape elements, especially when combined with kinaesthetic imagery. Alternatively, an internal perspective with kinaesthetic imagery might be best with tasks requiring simple movements in which form is not important, but timing relative to external cues is. Alternatively, as Murphy (1994) suggested, the different perspectives could have differential effects on identification of technical errors. In the present study neither task seems to require form or body type elements. Consequently, the tasks might influence an internal orientation. This would certainly explain the effects found here, that is, more use of internal imagery than external imagery for both tasks and a greater training effect for the internal training group than the external training group.

Both the internal training group and the external training group reported similar and relatively high levels of kinaesthetic experience during the imagery trials of both the open and closed skill. This indicates that kinaesthetic experience can occur during both internal and external imagery and supports the suggestion by Hardy (1997) that performers can experience kinaesthetic imagery to similar levels in internal and external imagery. Recent studies have also found that kinaesthetic sensation can accompany external imagery (e.g., Glisky et al., 1996; Hardy & Callow, 1999; White & Hardy, 1995). This is in spite of even research that would seem to suggest that internal imagery produces greater efferent activity, which has been taken to represent greater kinaesthetic imagery (e.g., Hale, 1982; Harris & Robinson, 1986; Jacobsen, 1931). Many authors have argued that internal imagery involves mainly kinaesthetic processes, whereas external imagery involves primarily visual components (e.g., Collins &Hale, 1997; Corbin, 1972; Cox, 1998; Janssen & Sheikh, 1994; Jeannerod, 1994; Lane, 1980; Suinn, 1983; Vealey, 1986; Weinberg, 1982; Williams et al., 1995).

The IUQ did not identify any training effects from pre- to post-test. This was an interesting finding, because it contradicts the finding for the specific measures of RV and RS, which suggested a significant increase in internal imagery use for the internal training group. This may indicate that the IUQ internal imagery questions are not very accurate measures of specific imagery as it occurs. The poor correlations between the IUQ and specific measures reflect this and might be due to factors associated with the construction of this item that were mentioned earlier. Perhaps it was understandable that there was no great change on the IUQ for the present study, because it is a general measure of imagery use. Consequently, it might take much longer than the short imagery training program presented in this study to alter a participant's trait perspective use, although perspective training may be able to change participants' ability to adopt a different perspective in that particular context.

The specific measures of imagery (RS and RV) highlighted that the internal imagery training program appeared to be effective in increasing internal imagery use of low and moderate internal imagers. This finding confirms previous studies (e.g., Gordon et al., 1994; Templin & Vernacchia, 1995; White & Hardy, 1995), which suggested that internal imagery can be enhanced with training programs, although these studies measured performance, rather than imagery perspective use. The external training group had a very small increase (not significant) in external imagery use. Very few studies have actually tried to train external imagery use (e.g., Burhams et al., 1988; Gordon et al., 1994; Van Gyn et al., 1990), but these studies did not measure external imagery use, examining instead performance following the imagery training. As such, no research has investigated whether external imagery can actually be trained. Perhaps one of the reasons that external imagery use did not change in the present study is that there are no real precedents for designing an external imagery training program and so the program devised might not have been as effective. Another possible explanation for greater change for the internal training group than the external training group is the proposition mentioned earlier that internal imagers might have a more fixed preference than external imagers. That is, those with a more internal orientation have more difficulty introducing external imagery, whereas those with a more external orientation can switch between the two perspectives. This would also explain the finding of Study 1 where participants experienced most imagery internally, but some participants switched between internal and external perspectives. In addition, it would explain the reports on switching given on the additional questions in the present study, i.e., more switching in the external training group (those with low and moderate internal imagery). These findings would also seem to support the suggestions of Hardy (1997) that external imagery is more effective with form-based movements. The two tasks in the present study were not form-based and so might have favoured an internal orientation. Additionally, this may explain why the internals were less likely to switch than externals.

In summary, the IUQ provided a general indication of preference, but there appeared to be problems with the internal imagery question. As for Study 1, the RS and RV were almost equivalent measures of perspective. Internal and external imagery were both used during the trials at pre-test by relatively inexperienced participants, however there was more use of internal than external imagery. The open skill had more external imagery use than the closed skill consistent with the suggestion that closed skills should benefit more from an external orientation (Harris, 1986; McLean & Richardson, 1994), but in contrast to the findings of Study 1. The internal imagery training program appeared to be more effective in changing perspective use than the external imagery training program.

Methodological Issues

The methodological issues section discusses the methodology used, such as issues related to measurement techniques, perspective use, differences between the two skills, the nature of imagery perspective training, and the imagery training scripts employed. The first issues are associated with the IUQ and additional questions. Results from the present study suggest that the IUQ and additional questions did provide a general indication of imagery perspective use, with some reservations. The IUQ perspective questions provided mixed information on imagery perspective preferences. The external imagery questions seemed to reflect general patterns of use in the imagery trials as recorded by the RS and RV measures. The internal imagery questions, however, seemed to be poor measures of perspective use in the imagery trials, which was reflected in poor correlations with the RS and RV measures. The possible problem with the internal imagery questions might be due in part to the wording of the question, as discussed in the theoretical and measurement section.

The additional questions provided information on perspective use and did tend to correspond with specific measures (RS and RV) of imagery use during the imagery trials. The RS and RV measures were highly correlated with one another, however, the correlations with the IUQ were low for the internal imagery questions and moderate for the external questions. It, therefore, appears that studies need specific measures of imagery if it is important to determine what participants are imaging during that session, or to monitor whether participants are following imagery scripts. It also emphasises the need for manipulation checks in imagery studies to ensure that participants are following the assigned condition. The low to moderate correlations of IUQ scores with RS and RV, suggest that general preference does not reliably indicate perspective used on a specific occasion.

The instructions for the imagery trials at pre- and post-test of the open and closed skill emphasised experiencing all the senses, but importantly did not instruct participants to image in a specific perspective. A criticism of the methods employed in this study could be levelled at this emphasis. Several authors (e.g., Gould & Damarjian, 1996; Vealey & Greenleaf, 1998; Glisky et al., 1996; Harris & Harris, 1984; Orlick, 1986) have suggested that the most effective imagery is the most realistic imagery. This would imply that performers should only use all the senses present in the actual performance situation during imagery. Glisky et al. in their study of internal and external imagery emphasised using all the senses in imagery. As such, the scripts in the present study emphasised this, without leading participants to adopt either an internal or an external orientation. It could be argued, however, that this approach might have lead to increased use of internal imagery during the trials because it has been suggested that only in internal imagery can senses other than the visual modality be experienced (Collins & Hale, 1997), or that senses such as kinaesthesis are more likely to occur in internal imagery (Cox, 1998; Janssen & Sheikh, 1994). This could explain the finding that participants reported more internal imagery. It would not, however, explain why, on the IUQ, the mean for the internal question was higher than the external question and why almost twice as many participants at pre-test reported using an internal rather than an external perspective on the additional questions. As such, it could be argued that the greater use of internal imagery than external imagery during the trials was reflected in the general measures completed before any of the participants had even seen the imagery scripts emphasising experiencing all the sense modalities. Thus, the emphasis on sensory experience probably did not influence perspective adopted in the imagery trials.

The training program for internal imagery was more effective than the training program for external imagery. As mentioned earlier this could be due to the program itself, or factors of the individual, e.g., a more fixed perspective for internal imagers. To analyse the training program a manipulation check might have been employed during or at the end of sessions to ensure that participants were imaging in the desired perspective during training. The methodology for the present study did not employ these checks. As such, no information was recorded on whether participants in the external training group were using external imagery in the training session and then for some reason switching back to their natural internal preference during imagery trials.

The analysis of the training effects utilised a MANOVA that was not significant, but approached significance. It was decided to complete follow-up ANOVA's because the MANOVA did approach significance. An examination of the mean gain scores indicated that the failure to attain significance might have been due in part to a relatively large negative gain score for RV on the open skill for the external training group as well as large standard deviations for most of the RS and RV means. All the other mean gain scores seemed to reflect appropriate patterns for the assigned treatments with larger gain scores for the internal training group than the external training group. The ANOVA's and visual inspection of the mean gain scores indicated that there was a training effect for the internal training group and a much smaller training effect for the external training group.

In summary, the measurement techniques showed similar relationships with each other to those found in Study 1, with the IUQ a general indicator of preference and the RS and RV closely related to each other. The IUQ questions, however, provided mixed information, and there were possible problems with the internal imagery question. The internal imagery training program was more effective than the external imagery training program in training perspective, possibly due either to the programs themselves or to aspects of the participants, such as fixed preferences.

Implications for Future Research

The implications of the present study for future research on imagery perspectives, imagery in sport, and other areas of mental training are discussed in this implications for future research section. Therefore, future issues related to measurement of imagery, imagery perspective use, and imagery perspective training are discussed as well as potential directions of research into imagery perspectives. Issues related to measurement of imagery and imagery perspectives are addressed first. Future research that focuses on measuring perspective use needs to consider utilising specific measures such as RS and RV. The wording of questions assessing perspective use also needs careful consideration. Future research could design a general perspective use questionnaire that is more closely correlated (or moderately correlated) with specific measures taken at actual imagination.

The present study did not measure performance changes, but investigated actual perspective used, a variable that researchers have not specifically examined previously. The findings suggest that performance studies need to place more emphasis on measuring actual perspective used. Just putting someone in an internal or external imagery group does not necessarily mean that they are imaging according to the condition, even if the participants are given training in the assigned perspective. In addition, what they report in general measures before or after might not be entirely accurate. Thus, studies that measure performance changes need to be more vigilant in employing manipulation checks.

The open versus closed skill finding raises questions as to whether open or closed skills are experienced more from an internal or external perspective. The results of Study 1 showed that there was more external imagery in closed skills, whereas the results of the present study indicated that there was more external imagery in the open skill. Perhaps an examination of individual skills or individual properties of skills (such as perceptual elements, spatial elements, motor elements) or goals of imagery (such as confidence, motivation) would provide more information on why different tasks seem to produce different perspective use patterns. One research question is whether internal or external imagery of open or closed skills produces greater performance benefits. The present study measured perspective use in imagery trials, but did not assess whether adopting an internal perspective or external perspective when imaging a skill leads to performance enhancement of that skill. This issue is addressed in Study 3. Previous research on perspective and performance has been conducted with different tasks, finding different results for different tasks (e.g., Epstein, 1980; Glisky et al., 1996; Gordon et al., 1994; Nigro & Neisser, as cited in Neisser, 1976; Mumford and Hall, 1985; White and Hardy, 1995). Future research is required to test whether internal or external training enhances performance of certain types of skills more.

The present study suggested that participants experienced kinaesthetic imagery in both internal and external imagery and at similarly high levels. This confirms findings of studies by Glisky et al. (1996) and White and Hardy (1995). Collins et al. (1998) suggested that external visual then kinaesthetic is the actual perspective adopted due to the mono-task perspective nature of attention during imagery. The present study has not assessed kinaesthetic experience specifically and so cannot shed any light on why participants report kinaesthetic sensation in external imagery. Researchers need to examine this and whether there is an external kinaesthetic perspective or switching between external visual and kinaesthetic imagery, as suggested by Collins et al., is a valid explanation.

The training of perspective provided mixed results for the two training conditions. There was a significant training effect for the internal training group and an apparent, but much smaller, trend for the external training group. Future research may further investigate training of an external perspective to internal imagers. Again, the nature of the script as well as the characteristics of the sample might influence this.

The finding of a much smaller effect for the external training supports the idea mentioned earlier in the discussion that internal imagers (those with a preference for internal imagery) might have a more fixed or unchangeable orientation than external imagers. Future research could investigate the flexibility of perspective for those with preference for either perspective and whether one perspective is more prone to switching.

Some of the future research issues highlighted in this section include developing a general perspective use questionnaire that correlates more strongly with specific measures taken at the time of imagery. An examination of specific aspects of skills was suggested as a means of understanding the relationship between perspective use and skill to be imagined. More research on the influence of perspective adopted during imagination and actual task performance is also needed. Other research might address whether an external perspective can be trained effectively to internal imagers and whether internal imagers have a more fixed perspective than external imagers do.

Implications for Practice

The implications for practice section discusses how the methods employed and findings of the present study could influence use of imagery in the applied setting. Measurement applications are discussed initially in this section, then issues to do with perspectives, and training of perspectives are considered. As reported in Study 1, if knowledge of perspective adapted during imagery sessions is important, a specific measure (RS or RV) is required rather than a general measure. In addition to this, the present results highlight the need for manipulation checks to ensure that performers follow treatments as designed. Practitioners must take great care to check on the detailed, actual use of imagery perspectives.

The use of internal imagery was higher than external imagery across both skills, in line with Study 1. This would suggest that internal imagery was more important to imagination of these two skills, or was easier to produce, however, participants still reported at least 30% external imagery experienced for each skill. This may indicate that both perspectives are required to imagine these skills adequately. In contrast to Study 1, participants experienced more external imagery in imaging the open skill than the closed skill. These findings in combination with those of Study 1 appear to suggest that different tasks require more or less internal or external imagery and so perspective adopted might be specific to the task or demands of the task. This could indicate that athletes need training in both perspectives to be able to adopt the appropriate perspective. The present study illustrated that practitioners can train those low in internal imagery to use internal imagery. Although the effect of external training was not as strong, there did appear to be a slight increase in external use indicating that participants can be trained to utilise both perspectives as may be necessary. The training program for internal imagers in external imagery was less effective and this might have been due to a weaker training program or that internal imagers have a more fixed perspective than external imagers do. Perhaps it will be more difficult for practitioners to train strongly internally-fixed imagers to use external imagery than to train external imagers to use internal imagery.

The present study has suggested that, when instructed to image an open skill (table tennis) and a closed skill (dart throwing), participants tend to adopt a more internal than external perspective. Both perspectives, however, do appear to be utilised in imaging these skills. Participants experienced more external imagery in imaging the open skill than the closed skill. In Study 3, the programs designed to develop a weaker imagery perspective are further investigated to examine whether imagery perspectives can be altered and maintained when people are specifically instructed to do so. The focus of Study 3 is on whether actual performance changes as a result of internal and external imagery training programs.

CHAPTER 5: IMAGERY AND PERFORMANCE OF AN OPEN AND A CLOSED SKILL

The results of Study 2 suggested that imagery perspective training might be an effective way of increasing use of a particular perspective during imagery. This training is only useful if it enhances overt performance, but few studies have adequately investigated whether using a certain perspective has an advantageous effect on performance. Those studies that have investigated the effect of perspective on performance have tended to either not provide adequate training sessions (e.g., Epstein, 1980) or they have randomly assigned participants, without taking into account perspective preferences (e.g., Mumford & Hall, 1985; Gordon et al., 1994). It has been rare for researchers in studies to check actual perspective use. Even fewer of the studies that have attempted to train individuals to use an imagery perspective have checked the extent of use of the assigned perspective in training and the relationship between this and performance. The aim of this study was to compare the efficacy of internal and external perspective training treatments, with participants mismatched on preferred perspective, for enhancing the performance of open and closed skills. Study 2 indicated that training could increase the use of the internal perspective in those with a low initial reported use of that perspective. The perspective training did not clearly enhance the external perspective for those weak in external imagery. Perhaps this was due to the emphasis on senses in the specific training program. It might have arisen because the internal perspective was more fixed for these participants, or aspects of the tasks favoured adoption of an internal perspective. External perspective training might work more clearly if imagery instructions emphasise the visual perspective more strongly. This study will consider the effects of perspective training on imagery perspective use and on performance.

Method

Participants

Participants were 20 male and 10 female adults with sports experience, aged between 18 and 35, with a mean age of 23.57 (SD = 4.91). Participants were recruited from undergraduate classes in sport psychology and local sporting teams. Athletes reported their primary sports activity: fourteen participants reported they played cricket, seven played netball, four played Australian Rules Football, three played golf, two played tennis, one participated in horseriding, and one participant was involved in swimming. On the Imagery Use Questionnaire (IUQ: Hall et al., 1990), participants rated themselves as 4 novice, 10 intermediate, 16 advanced, and 0 elite, and 6 recreational/house league level, 10 competitive level, 14 provincial competitive level, and 0 national/international level. Ten low internal perspective participants were assigned to an internal imagery training group and 10 low external perspective participants were assigned to an external imagery training group, based on scores on the pre-test for IUQ items 4a (External) and 5a (Internal), and pre-test rating scale (RS) self-evaluation. Another 10 of the 30 participants were quasi-randomly assigned to a control group (that is, they were not selected for this group based on the imagery pre-test scores). The participants in the two imagery training groups were mismatched on imagery perspective preference so that those who scored low or moderate for internal imagery on the pre-test were assigned to the internal imagery training group, and those who scored low or moderate for external imagery on the pre-test were assigned to the external training group. The cut-off on the RS was 50%, so less than 50% was considered internal and 50% and above was considered external imagery. Based on these allocation criteria, the groups were gender balanced, with three females in each of the training groups and four females in the control group. The internal training group consisted of 10 participants with a mean age of 22.5 years (SD = 3.66), the external training group consisted of 10 participants with a mean age of 24.70 years (SD =5.93), and the control group consisted of 10 participants with a mean age of 23.50 years (SD = 5.15). The descriptive statistics for the internal and external imagery scores at pre-test (before training), for the three imagery conditions, are displayed in Table 5.1.

Table 5.1.

Pre-Test Scores on Perspective Measures by Group

Item		Internal Training Group (ITG)		External Training Group (ETG)		Control Group (CG)	
		M	SD	M	SD	M	SD
IUQ	4a (External)	5.30	1.25	2.40	.97	3.90	1.97
IUQ	5a (Internal)	3.90	.86	5.50	1.18	5.40	1.43
RS	Table Tennis	72.50	25.62	19.63	15.63	42.36	27.96
RS	Darts	72.66	16.30	10.36	11.02	23.44	22.96

The scores on the IUQ items show that the participants were assigned according to perspective use on the pre-test. A One-Way Analysis of Variance (ANOVA) between groups on item 4a was significant, $F(2,27) = 9.894$, $p < .001$, as was a One-Way ANOVA for groups on item 5a, $F(2,27) = 5.738$, $p < .01$. The RS scores on imagery of table tennis and darts clearly show higher scores for the internal training group (indicating higher reported external imagery) than for the external training group, as required for the mismatching of training with pre-test perspective use.. A One-Way ANOVA, with table tennis RS as the dependent variable showed a significant difference between groups, $F(2,27) = 12.543$, $p < .001$, as did a one-way

ANOVA with darts RS as the dependent variable $F(2,27) = 35.404$, $p < .001$. The scores for the control group, as would be expected, lie in between those of the two extreme groups.

Design

This study examined the effect of imagery perspective training on the performance of open and closed skills. An experimental design was employed, as shown in Figure 5.1. Three groups, two experimental (training) groups and one control group, were utilised. The control group participants were assigned to this group without reference to their imagery pre-test score. The two training groups were selected based on reported perspective use on the IUQ and RS pre-test. The pre-test use was mismatched with perspective training so that participants were assigned to training in their weaker perspective. Each training group was trained to use the assigned perspective to image an open and a closed skill. Order of the open skill and the closed skill were balanced within groups, so that half of each group completed the procedure for the closed skill first, then the open skill, and the other half of each group completed the procedure for the open skill first, then the closed skill. The imagery training groups completed general perspective training and specific imagery rehearsal training in that perspective, whereas the control group received no imagery training. General perspective training was conducted prior to splitting into a balanced order for testing. Specific imagery rehearsal was completed between pre-and post-test for performance on each skill.

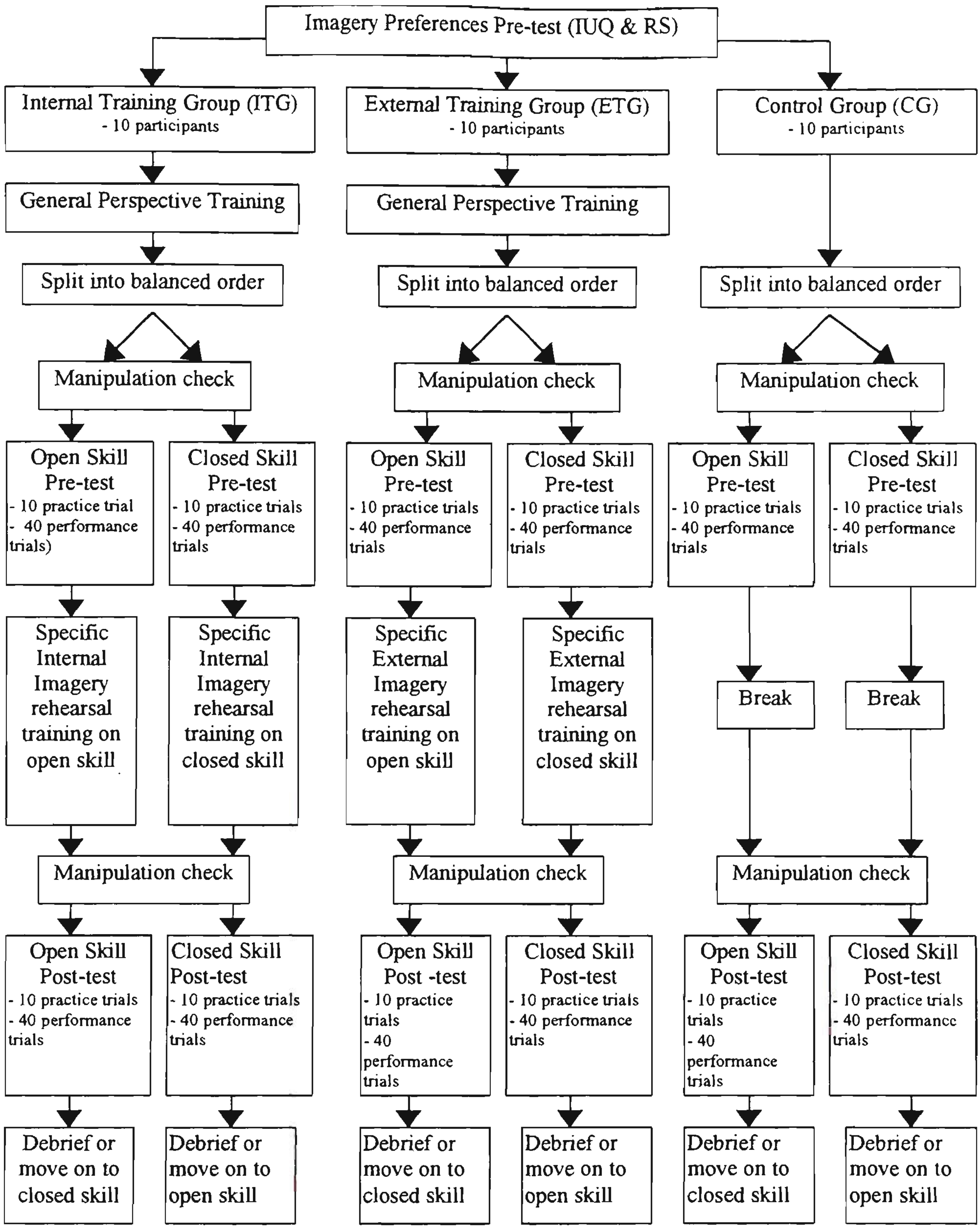

Figure 5.1. Design of study of the effects of perspective training on performance of an open and a closed skill.

Manipulation checks to test for perspective use were taken after general and specific imagery rehearsal training. Performance on the open and closed skills was recorded pre- and post-imagery training for that skill. Analyses compared pre- to post-test gain scores for perspective training group by type of skill. In addition, a post-hoc analysis of actual imagery use, rather than training group, was conducted as the training groups may have included participants who were not imaging according to training condition. This commonly dilutes the effect of experimental treatments examined in imagery perspective studies.

Measures

Imagery Use Questionnaire (Hall et al., 1990). The IUQ was used as described in Study 1, including the three additional questions also described in that study.

Rating scales (RS). The rating scales (RS) were used as described in Study 2. It was decided to use the RS as the measure of imagery because of the extremely high correlation between the RS and the concurrent verbalisation (CV) and retrospective verbalisation (RV) data in Study 1, and, again, with the RV in Study 2. This suggested that RS are an acceptable self-report measure of imagery experienced. In addition, the RS are less intrusive to imagery as it is occurring than CV and so allow full concentration on the imagery task. They also represent a quick and easy method of assessment, because participant response is simple and fast, and there is no need for them to be transcribed or content-analysed. The RS were used to rate imagery of the open and closed skills after the participant had imagined each skill. Thus, they acted as an imagery preference pre-test. The RS were also utilised after imagery in the general and specific training conditions as a manipulation check for imagery perspective used during training. The RS used for pre- and post-test are provided in Appendix M and the RS and instructions used in the manipulation check are provided as Appendix N.

Performance scores. The performance tasks were throwing darts at a concentric circles target (closed skill) and hitting a projected table tennis ball at a concentric circles target (open skill).

Dart throwing: At pre-test and post-test participants performed 40 test trials of throwing darts at a concentric circles dartboard from 244 cm, as shown in Figure 5.2. The distance from the board was the standard competition distance. The diameters of the concentric circles were predetermined as they were already on the dartboard. The original dartboard consisted of 10 concentric circles, but only the five inner circles scored points in the present study, the outer five circles were covered, so that participants only saw the inner five circles. Use of only the five inner circles was determined by pilot work to manipulate the difficulty of the task. The aim in pre-setting the difficulty was for naive performers to achieve a score of approximately 30% of maximum at pre-test, thus creating a sufficiently difficult task that there would be adequate opportunity for improvement due to imagery rehearsal by post-test. There were five concentric circles on the dartboard, with diameters of 1.5 cm, 6.5 cm, 11 cm, 15.5 cm, and 20 cm. For darts hitting the centre circle, participants scored five points, the next circle out scored four points, the next three points, then two, and the outermost circle scored one point. This gave an accumulated score with a range of 0 to 200 for 40 trials. Participants were instructed to stand behind the throwing line, to aim for the bullseye, and to throw whenever they were ready.

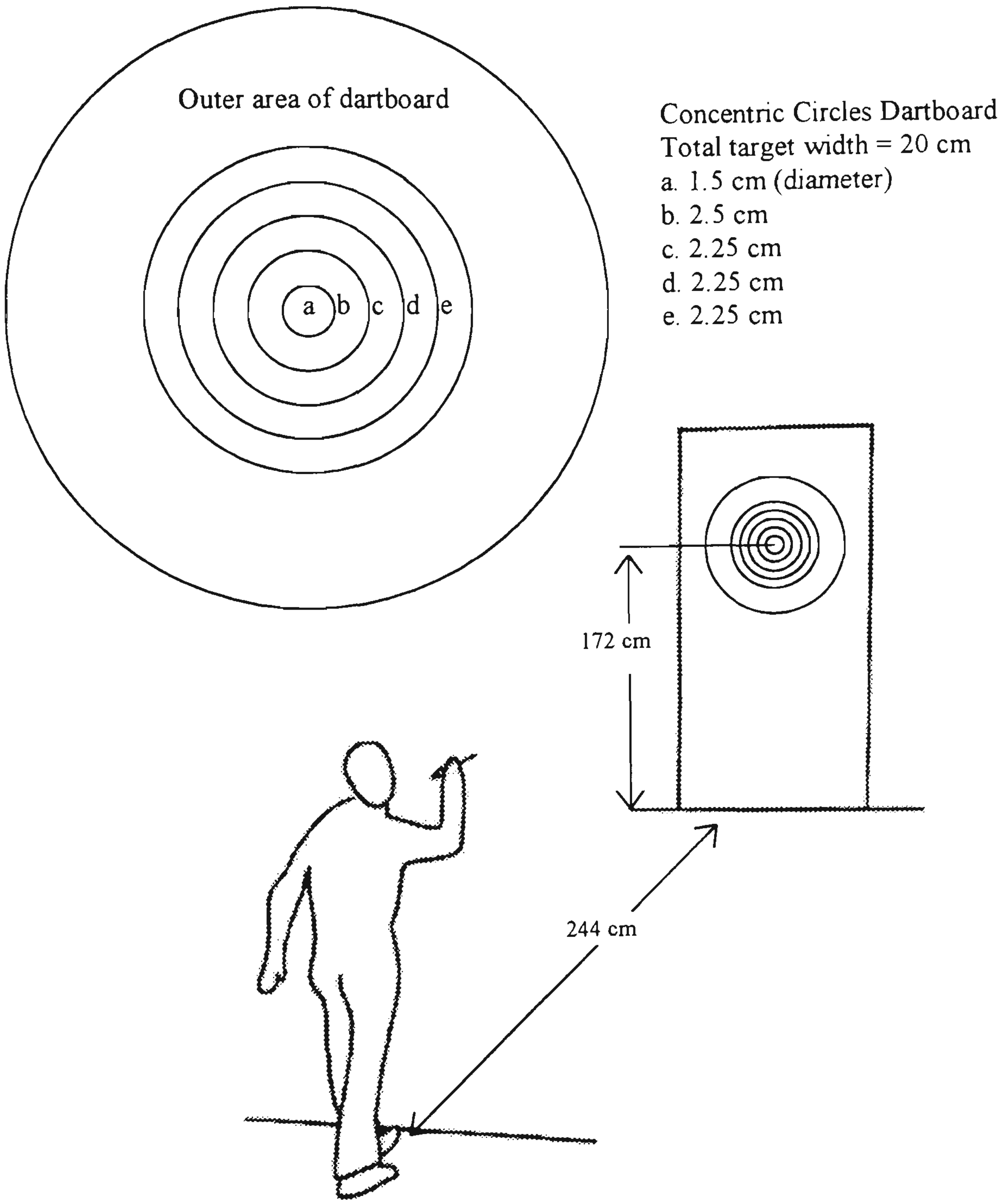

Figure 5.2. Setup and scores for the closed skill.

Hitting projected table tennis balls: At the pre-test and post-test participants performed 40 test trials of hitting a table tennis ball at a target, after the ball was projected from a ball projection machine, as show in Figure 5.3. Participants used a conventional table tennis bat. Scoring was based on hitting the ball back to a horizontal concentric circles target on the table on the opposite side of the net. The concentric circles target on the table comprised five circles, with diameters of 20 cm, 40 cm, 60 cm, 80 cm, and 100 cm. The centre circle scored five points, the next four points, then three points, then two points, and the outermost circle scored one point. Balls landing on a line were scored to the inner circle. The diameters of the circles in the target were determined by pilot work as was the frequency of projection (the inter-trial interval) and the projected speed of the balls, so that naive performers would achieve scores around 30% of maximum. Based on pilot work, balls were projected at a frequency of one every five seconds. The speed of projection was set at 4 on the ball projection machine with a top speed of 10. The ball projection machine was a Newby table tennis robot. The robot was directed to project the ball to the centre of the opposite side of the table. The ball projection machine was stationary so that balls landed consistently in a relatively small area for all participants. Participants were instructed to aim for the centre of the target and there was no restriction on what type of shot they could play or where they stood. Forty shots were played and the overall score was the accumulated target scores for the 40 balls projected, giving a possible range of scores from 0 to 200, as for the darts task.

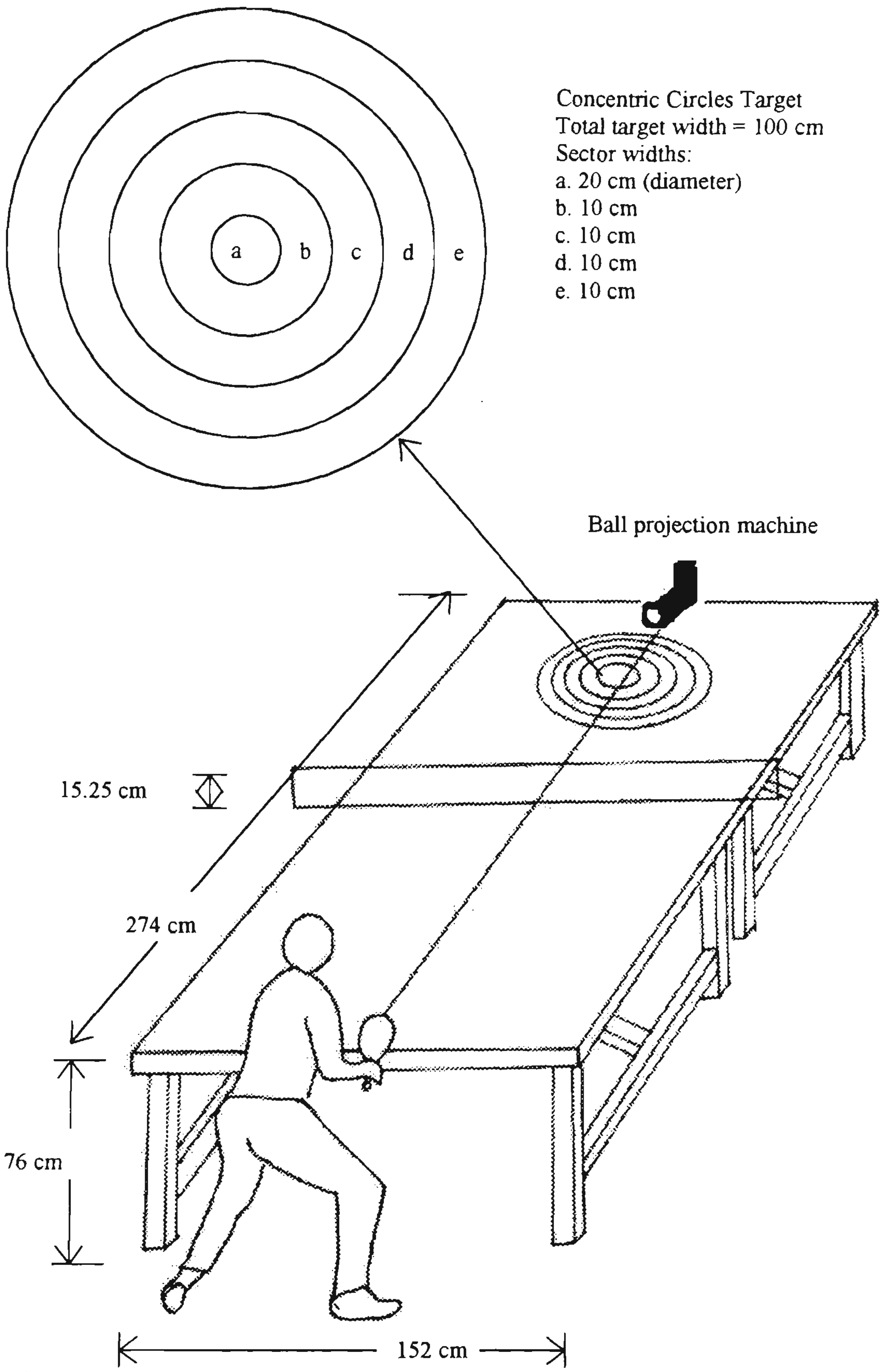

Figure 5.3. Setup and scores for the open skill..

Tasks

The motor skills were dart throwing (closed skill) and hitting a moving table tennis ball to a target (open skill).

Dart throwing. The dart throwing task involved the participants throwing 40 darts at a concentric circles dartboard from a distance of 244 cm. The task was self-paced, in that participants could throw whenever they were ready. The overall score was the accumulated score for the 40 test throws. Participants were given 10 practice trials prior to each performance test of 40 trials.

Hitting projected balls. The task of hitting projected table tennis balls involved the participant hitting table tennis balls that were fired by a ball projection machine. The participant was required to hit the ball to a horizontal, concentric circles target positioned on the opposite side of the table. The task was externally paced as the participant had to respond to balls when the machine, which fired balls at a rate of one ball every five seconds, fired them. Participants were given 10 practice trials prior to each performance test of 40 trials.

Experimental Conditions

Treatments (Internal and External Imagery Groups)

There were two treatment conditions. Each included general imagery perspective training and task specific imagery perspective training. The two conditions were: internal imagery perspective training and external imagery perspective training. All three imagery perspective training procedures are described here.

General perspective training. Both imagery treatments involved two imagery sessions of general imagery training in internal or external imagery at the start. The internal imagery group instructions emphasised seeing and experiencing the skill from inside one's own body. The external imagery group instructions emphasised seeing and experiencing the skill as if watching oneself on TV, that is, outside one's own body. General imagery perspective training involved two 30-minute sessions designed to train participants to rehearse in the desired perspective during the imagery rehearsal period. The general imagery sessions were essentially the first two imagery training sessions from Study 2. The external training was modified slightly to emphasise the visual perspective more strongly than in Study 2. Instructions in these sessions still, however, emphasised using all the senses, imaging successful performance, and maintaining the desired perspective. This progression from basic training leading to specific training for the skill to be imaged was based largely on the recommendations of applied texts (e.g., Vealey & Greeleaf, 1998). The general perspective training scripts for internal imagery are included in Appendix O and the general perspective training scripts for external imagery are included in Appendix P.

Internal imagery rehearsal for specific skills. Internal imagery rehearsal of the specific open and closed skills consisted of two 30-minute sessions, involving imagery rehearsal of the specific skill (similar to sessions 3 and 4 of Study 2), either dart throwing or hitting projected table tennis balls, in each case, at a concentric circles target. Training and instructions emphasised experiencing the skill from inside one's own body. In each imagery rehearsal session of the open and the closed skill, participants performed 20 imagery trials practising the skill. Instructions emphasised experiencing all the senses, imaging successful performance, and performing at the correct speed. Instructions specifically guided participants to imagine in the desired perspective. As for the internal imagery training, this progression from basic training to specific training for the skill to be imaged was based largely on the recommendations of applied texts (e.g., Vealey & Greeleaf, 1998). A full copy of the internal imagery rehearsal script is included in Appendix O.

External imagery rehearsal for specific skills. External imagery rehearsal of the specific open and closed skills consisted of two 30-minute sessions, involving imagery rehearsal of the specific skill (similar to sessions 3 and 4 of Study 2), either dart throwing or hitting projected table tennis balls, in each case at a concentric circles target. Training and instructions emphasised experiencing the skill from outside one's own body, as if watching oneself on TV. In each imagery rehearsal session of the open and the closed skill, participants performed 20 imagery trials practising the skill. Instructions emphasised experiencing all the senses, imaging successful performance, and performing at the correct (real) speed. Instructions specifically guided participants to imagine in the desired perspective. A full copy of the external imagery rehearsal script is included in Appendix P.

Control Group

Participants in the control group did not undertake any of the imagery training and were not given anything to do between pre- and post-test, but they completed the pre- and post-tests, as well as the manipulation checks to assess any changes from pre-test.

Procedure

The participants for this study were volunteers. The nature of all procedures to be used in the research was presented to participants. They were informed that they were free to withdraw at any time and that all their data was confidential. They were encouraged to ask questions or raise concerns at any time. Then participants completed informed consent forms (Appendix Q). Participants were given instruction in the protocol and procedure of the study. The participants then underwent pre-testing of imagery perspective use with the IUQ and RS of the two skills as for Study 2 (hitting a table tennis ball back across the net [open skill] and throwing a dart at a dartboard [closed skill]). Participants were then assigned to one of the three groups. Training groups (internal and external) were assigned, based on the IUQ and RS scores, with those who generated moderate or high external perspective scores assigned to the internal training group and those with moderate or high internal perspective scores assigned to the external training group. As for Study 2, the cut-off on the RS was 50%, so less than 50% was considered internal and 50% and above was considered external imagery, and participants were assigned to the mismatched groups based on this assessment. The IUQ was used as a general back-up to the RS scores. Participants in the external and internal imagery training groups were then trained in imagery perspective use, in general perspective training sessions. RS were completed again, as a manipulation check for the effects of general training. A copy of the manipulation checks is provided as Appendix N. To produce a balanced order, half of each group, determined at random, performed the closed skill first and half performed the open skill first. Participants performed 10 physical practice trials on either the open or closed skill, followed by 40 recorded test trials. The participants in the imagery training groups then imaged the skill in their assigned imagery perspective during imagery rehearsal. After the specific imagery treatment, imagery use and use of perspective were assessed again by RS to check the effectiveness of the treatment. Participants then performed 10 physical practice trials followed by 40 test trials of the motor skill as a post-test of the effect of imagery training on performance. Participants then repeated the procedure for the alternate skill. That is, they performed a physical performance pre-test, imagery rehearsal, manipulation check, and post-test for that skill. Participants in the control group completed just the performance pre- and post-tests as well as the imagery pre-test and manipulation checks, but undertook none of the imagery training. To maintain a balanced order, half the participants in the control group completed the open skill procedure first and then the closed skill procedure. The other half of the participants in the control group completed the closed skill procedure first, and then the open skill procedure. Finally, participants in all groups were debriefed to resolve any problems and to acquire additional information about their behaviour, thoughts, and feelings during the study.

Analysis of Data

Pre-test. The pre-test data on IUQ items and the RS were analysed as described in Study 1. A correlational analysis was conducted to assess correspondence between the RS (including manipulation check RS) and IUQ perspective items. This consisted of calculating Pearson Product Moment Correlation Co-efficients among these items.

Order checks. To test for any order effects, pre- to post-test gain scores on performance were compared for the first and second skills using One-way ANOVA. RS pre-test to final manipulation check gain scores were also compared for the first and second skills using One-Way ANOVA, to check any order effects for imagery training due to skill presentation order.

Imagery perspective and performance scores. Having examined whether there was any order effect, the pre- to post-test gain scores for open and closed skills for imagery perspective and performance were then compared using One-way MANOVA to test for main effect of treatment, main effect of skill, and interaction between treatment and skill type. Gain scores were used because Huck and McLean (1977) noted that, in pre-test/post-test designs, the ANOVA model assumes the treatment is active on all occasions, including pre-test. Thus, the inclusion of a pre-test/post-test factor underestimates the main effect of the treatment and interactions involving the treatment. Huck and McLean recommended use of gain scores to avoid this problem. In addition, an analysis of actual use of imagery in the manipulation checks for each specific skill was conducted to compare with performance for that skill, rather than just comparing according to training group. This is because participants in the mismatched training groups may still have been using a considerable proportion of their original perspective in the imagery of the skills. Participants' scores on the manipulation check for each skill were classified as predominantly internal or predominantly external to give an "actual" imagery use classification. Internals and externals were then compared on pre- to post-test gain scores for each skill, using One-way ANOVA to test for main effect of perspective use.

Results

The results section presents an analysis of the data from the study. The analysis follows the format described in analysis of data in the Method section. Initially, the data from the pre-test imagery measures are analysed. Then the effects of training on perspective use and performance are analysed. Finally, an analysis of actual imagery use during imagery training and the effect of this on performance are presented.

Pre-Test Imagery

Imagery Use Questionnaire. The descriptive statistics from the IUQ, which was designed to measure general imagery use patterns, followed similar patterns to Studies 1 and 2. On the 7-point Likert scale items, ranging from 1 = (never) or (very difficult) to 7 = (always) or (very easy), participants generally reported that they did not have very structured (internal training group M = 2.60, SD = 1.58, external training group M = 2.00, SD = 1.41, control group M = 2.30, SD = 1.42) or regular imagery sessions (internal training group M = 2.40, SD = 1.17, external training group M = 2.20, SD = 1.32, control group M = 2.20, SD = .92). Also, in similar fashion to Studies 1 and 2, participants reported that they used imagery more before an event (internal training group M = 4.90, SD = .99, external training group M = 5.10, SD = 1.10, control group M = 5.00, SD = 1.15) rather than before (internal training group M = 2.00, SD = 1.70, external training group M = 3.30, SD = 1.57, control group M = 3.50, SD = 2.17), during (internal training group M = 2.70, SD = 1.34, external training group M = 3.30, SD = 1.57, control group M = 3.10, SD = 1.45) or after practice (internal training group M = 2.60, SD = 1.84, external training group M = 2.80, SD = 1.40, control group M = 3.10, SD = 1.66).

The descriptive statistics for the perspective items of the IUQ are presented in Table 5.2. The means at pre-test for the external imagery question (4a) show that the internal training group had a larger mean than the external group, as expected, and the control group mean lay between these two. In addition, the means for vividness (4b) and controllability (4c) of external imagery followed this expected pattern with the internal training group (those with higher reported external imagery) having the largest mean, followed by the control group, and the external training group. The internal imagery questions (5a, 5b - vividness, and 5c - controllability) also followed the expected mismatched pattern with the external training group (those with higher reported internal imagery) displaying the largest mean, followed by the control group, and the internal training group in each of the three parts of this item.

Table 5.2

Imagery Use Questionnaire Perspective Item Descriptive Statistics

		ITG		ETG		CG	
Item		M	SD	M	SD	M	SD
4. a)	When you use mental imagery, do you see yourself from outside of your body as if you are watching yourself on a video?	5.30	1.25	2.40	.97	3.90	1.97
b)	If you do, how vivid is this image?	5.00	1.15	1.70	1.64	3.10	2.06
c)	How easily can you control that image?	4.80	1.14	1.80	1.55	2.60	1.65
5. a)	When you use mental imagery do you see what you would see as if you were actually playing or performing?	3.90	.88	5.50	1.18	5.40	1.43
b)	If you do, how vivid is this image?	4.40	1.17	5.10	.99	4.70	1.42
c)	How easily can you change that view?	4.20	1.55	4.40	1.00	4.10	1.60

A One-way Multivariate Analysis of Variance (MANOVA) was conducted to compare the three groups (internal training group, external training group, and control group) at pre-test on the six dependent variables, the IUQ perspective questions (4a, 4b, 4c, 5a, 5b, and 5c). Significant differences were found among the three groups on the dependent measures, Wilk's $\Lambda = .338$, $F(12, 44) = 2.64$, $p < .01$. The multivariate effect size, eta squared (η^2) = .42, based on Wilk's Λ was quite strong. Table 5.2 contains the means and standard deviations of the dependent variables for the three groups.

ANOVA's on each dependent variable were conducted as follow-up tests to the MANOVA. Using the Bonferroni method to control for type I error, each ANOVA was tested at $\alpha = .05$ divided by 6 or .008 level (.05 divided by the number of ANOVA's conducted). The ANOVA on IUQ 4a was significant, $F(2, 27) = 9.89$, $p < .001$, $\eta^2 = .42$, as was the ANOVA on IUQ 4b, $F(2, 27) = 10.055$, $p < .001$, $\eta^2 = .43$, and IUQ 4c, $F(2, 27) = 11.313$, $p < .001$, $\eta^2 = .46$. The ANOVA on IUQ 5a was significant, $F(2, 27) = 5.738$, $p < .01$, $\eta^2 = .298$, however, the ANOVA on IUQ 5b was not significant, $F(2, 27) = .845$, $p = .441$, $\eta^2 = .059$, nor was the ANOVA on IUQ 5c, $F(2, 27) = .119$, $p = .888$, $\eta^2 = .009$. Post hoc analyses to the univariate ANOVAs for IUQ consisted of conducting pairwise comparisons to find which group were significantly different and in what directions. Each pairwise comparison was tested at $\alpha = .05$ divided by 4 or .0125 level. The internal training group had significantly higher ratings on IUQ 4a than the external training group, there were no significant differences between the control group and the other two groups (see Table 5.2). The internal training group had significantly higher ratings on IUQ item 4b than the external training group, but was not significantly different from the control group. In addition, the control group had significantly higher ratings than the external training group. On item 4c, the internal training group had significantly higher ratings than the external training group and the control group, but there was no significant difference between the external training group and control group. The internal training group had significantly lower ratings on IUQ 5a in comparison with either the external training group or control group. The external training group and the control group were not significantly different from each other. There were no significant differences between groups on IUQ items 5b or 5c at pre-test.

Additional questions. On the additional questions from Gordon et al. (1994), participants indicated their believed preference for internal or external imagery at pre-test. Questions 1a and 1b probed internal and external imagery use. As can be seen in Table 5.3 the responses tended to follow assignment to the mismatched perspective training groups.

Table 5.3

Additional Questions Frequency Counts

			Frequency		
Item			ITG	ETG	CG
1a	(Use internal Imagery)		3	10	7
1b	(Use external imagery)		7	0	3
2	(Switching)	Perspective changes	8	2	7
		Perspective does not change	2	8	3
3	(Perspective easiest to use)	Internal	1	9	6
		External	9	1	4

Question 2 concerned switching of perspective during imagery. Interestingly, as illustrated in Table 5.3 more participants in the internal training group and control group indicated switching of perspectives than participants in the external training group. Question 3 concerned which perspective was easiest to use. As can be seen in Table 5.3 the responses tended to follow assignment to the mismatched perspective training groups.

Rating scale (RS) item 1 pre-test data. Rating scale descriptive statistics for item 1 are examined here to describe reported perspective use during imagination of the open and closed skill at pre-test. RS item 1 was scored based on measuring the distance of the response from the left end of the 10 cm analogue line with a ruler. It probed amount of internal and external imagery use during the imagery trials of the two skills. The means and standard deviations of the two skills for each of the conditions and for all participants irrespective of condition are displayed in Table 5.4. The means indicated that, similar to Study 2, both skills were experienced more from an internal than an external perspective, with the overall means below 50 for both skills. The means for the open skill (table tennis) generally appear to be larger than those for the closed skill (darts), except for the internal training group, indicating that there was greater reported use of external imagery in imaging the open skill than the closed skill, as for Study 2. A paired samples t test was conducted to evaluate reported perspective use for all participants on the two skills at pre-test. The results confirmed that the mean for the open skill (table tennis) was significantly greater than the mean for the closed skill (darts), $t(29) = 2.51$, $p = .018$. The magnitude of the differences between the means was moderate. The d, a standardised effect size index was .46, a moderate value. The mean difference was 9.34 between the 0 to 100 analogue RS for table tennis and darts. As shown in Table 5.4, the standard deviations are generally large indicating that the scores did vary considerably from the mean. Additionally, the means clearly show that the internal and external imagery groups were mismatched according to reported preference with much higher means for the internal group as opposed to the external group. As reported earlier in the Methods section, a One-Way ANOVA, with table tennis RS as the dependent variable showed a significant difference between groups, $F(2,27) = 12.543$, $p < .001$, as did a one-way ANOVA with darts RS as the dependent variable $F(2,27) = 35.404$, $p < .001$. The means for the control group lie in between, skewed towards internal imagery as has generally been reported in Studies 1 and 2.

Table 5.4

Rating Scale Item 1 Descriptive Statistics for Table Tennis and Darts for All Participants

	ITG		ETG		CG		All	
	M	SD	M	SD	M	SD	M	SD
Table Tennis	72.50	25.62	19.63	15.63	42.36	27.96	44.83	31.74
Darts	72.66	16.30	10.36	11.02	23.44	22.96	35.49	32.06

Correlational analyses. Pearson product moment correlation co-efficients were calculated between the IUQ perspective items and RS item 1 at pre-test for all participants to check correspondence between measures. The results of this analysis are presented in Table 5.5. The correlations were moderate to high between the IUQ perspective items and the RS item 1 for both skills, with all correlations significant ($p < .01$).

Table 5.5

Pearson Product Moment Correlation Co-efficient Comparison of the Imagery Perspective Measurement Techniques

	IUQ 5a	RS1 Table Tennis	RS1 Darts
IUQ 4a	-.577	.718	.697
p <	.001	.001	.001
IUQ 5a		-.510	-.549
p <		.004	.002
RS1 Table Tennis			.796
p <			.001

Note. IUQ 4a refers to the external imagery item on the IUQ, and IUQ 5a refers to the internal imagery item on the IUQ. The rating scale score is the mean for rating scale item 1, "Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period".

Order Check

A One-way ANOVA was conducted to evaluate whether there was an order effect for gain scores on RS based on whether participants imagined table tennis first or darts first. The ANOVA was not significant for imagination of table tennis $F(1,28) = .987$, $p = .329$, or for darts $F(1,28) = .202$, $p = .656$, indicating that there was no order effect for RS gain scores. One-way ANOVA was also calculated to evaluate if there was an order effect for gain scores from pre- to post-test on performance of the two skills, based on order of testing. The ANOVA's revealed that there was no order effect for table tennis performance $F(1,28) = .438$, $p = .513$, or darts performance $F(1,28) = .033$, $p = .858$.

Effect of Training

Internal/external items for the groups. Rating Scale (RS) items 1, 2, and 3, from the pre-test and two manipulation checks, probed the amount of internal and external imagery use during the imagery trials of the two skills. The means and standard deviations for the three groups at pre-test, manipulation check after general training, and manipulation check after specific training for each skill are summarised in Table 5.6. The means for the RS items at pre-test show that the internal training group (those with lower reported internal imagery) reported a higher level of external imagery (larger mean) than the external group (those with lower reported internal imagery), as expected according to the initial mismatching of perspectives with training. The control group mean lay between these two. A One-way Multivariate Analysis of Variance (MANOVA) was conducted to compare the three groups (internal training group, external training group, and control group) at pre-test on the six dependent variables, the RS perspective items (RS items 1, 2, and 3 for table tennis and RS items 1, 2, and 3 for darts). Significant differences were found among the three groups on the dependent measures, Wilk's Λ = .152, $F(12, 44) = 5.749$, $p < .001$. The multivariate effect size, eta squared (η^2) = .611, based on Wilk's Λ was strong.

ANOVA's on each dependent variable were conducted as follow-up tests to the MANOVA. Using the Bonferroni method to control for type I error, each ANOVA was tested at the .008 level (.05 divided by the number of ANOVA's conducted). The ANOVA on table tennis RS 1 was significant, $F(2, 27) = 12.543$, $p < .001$, $\eta^2 = .48$, as was the ANOVA on table tennis RS 2, $F(2, 27) = 7.805$, $p = .002$, $\eta^2 = .37$, and table tennis RS 3, $F(2, 27) = 14.218$, $p < .001$, $\eta^2 = .51$. The ANOVA on darts RS 1 was significant, $\underline{F}(2, 27) = 35.404$, $\underline{p} < .001$, $\eta^2 = .724$, as was the ANOVA on darts RS 2, $\underline{F}(2, 27) = .21.347$, $\underline{p} < .001$, $\eta^2 = ..61$, and the ANOVA on darts RS 3, $\underline{F}(2, 27) = 31.277$, $\underline{p} < .001$, $\eta^2 = 70$.

Post hoc analyses to the univariate ANOVAs for RS consisted of conducting pairwise comparisons to find which group groups were significantly different and in what directions. Each pairwise comparison was tested at the .008 level (.05 divided by the number of ANOVA's conducted). For the table tennis imagery, the internal training group reported a significantly higher level of external perspective imagery than the external training group and the control group on all three RS perspective items (RS items 1, 2, and 3). On RS items 1 and 3 the internal training group ratings reported a significantly higher level of external imagery than the control group, but not on RS item 2. On all three perspective RS items there was no significant difference between the external training group and the control group (see Table 5.6). For the darts imagery, the internal training group reported significantly higher use of external imagery than the external training group and the control group on all three RS perspective items (RS items 1, 2, and 3). The external training group and the control group were not significantly different from each other on any of the three RS items.

A visual comparison of the pre-test means with the manipulation check general and manipulation check specific means in Table 5.6 indicates a training effect from pre- to post-test on the gain scores according to perspective, for internal and external training. In addition, the control group scores seem to be relatively stable. These training effects were tested for statistical significance, using One-way Multivariate Analysis of Variance (MANOVA) reported later in the Results section.

Table 5.6

Perspective Training Effects for Imagery Ratings (RS)

	Pre-test RS		Manipulation Check –General (MCG)		Manipulation Check - Specific (MCS)		Gain Score (GS) (MCS - RS)	
Table	M	SD	M	SD	M	SD	M	SD
Tennis:								
ITG								
Item 1	72.50	25.62	54.02	31.75	50.58	31.78	-21.92	28.44
Item 2	67.47	25.99	41.04	30.30	45.98	29.60	-21.49	29.02
Item 3	70.41	27.53	56.28	28.72	52.40	30.30	-18.01	29.89
ETG								
Item 1	19.63	15.63	30.68	23.93	35.56	21.42	15.93	9.07
Item 2	24.00	22.71	26.18	18.92	30.36	19.80	6.36	11.22
Item 3	20.25	13.81	31.66	25.03	32.08	19.52	11.83	9.48
CG								
Item 1	42.36	27.96	37.90	31.09	37.34	28.23	-5.02	15.41
Item 2	40.47	25.68	31.38	30.04	33.64	27.48	-6.83	20.50
Item 3	36.11	20.94	30.38	28.35	32.46	26.61	-3.65	15.49

Note. Item 1 asked participants to rate the relative time they imaged from inside versus outside their body during the imagery period. Item 2 asked participants to rate the relative time spent imaging inside versus outside your body during just the actual execution of the skill. Item 3 asked participants to rate the relative importance or effectiveness of the imagery types for them.

Table 5.6 (Continued)

Perspective Training Effects for Imagery Ratings (RS)

	Pre-test RS		Manipulation Check –General (MCG)		Manipulation Check - Specific (MCS)		Gain Score (GS) (MCS - RS)	
Darts:	M	SD	M	SD	M	SD	M	SD
ITG								
Item 1	72.66	16.30	55.06	29.25	49.22	27.56	-23.44	31.74
Item 2	64.80	17.00	47.28	26.63	47.34	27.60	-17.46	35.07
Item 3	72.87	18.00	54.94	30.73	46.34	24.22	-26.53	28.07
ETG								
Item 1	10.36	11.02	24.96	27.05	28.62	24.16	18.26	15.79
Item 2	12.73	16.36	20.56	20.71	27.72	23.80	14.99	17.30
Item 3	11.49	11.11	24.22	22.43	27.02	20.89	15.53	15.12
CG								
Item 1	23.44	22.96	24.28	19.41	25.24	21.00	1.80	5.28
Item 2	26.06	21.71	23.56	19.30	25.68	20.69	-.38	11.30
Item 3	26.13	23.20	28.78	20.24	26.34	21.25	.21	5.83

Note. Item 1 asked participants to rate the relative time they imaged from inside versus outside their body during the imagery period. Item 2 asked participants to rate the relative time spent imaging inside versus outside your body during just the actual execution of the skill. Item 3 asked participants to rate the relative importance or effectiveness of the imagery types for them.

Rating scale control and clarity items. RS item 4 probed how clear the image was and item 5 probed controllability during imagery of the skill. Both these items were rated on 7-point Likert scales. The results are described briefly here, as they do not appear to be central to the issues of the study. In general, the means for both skills and the three groups were similar, although the external training group appeared to have slightly lower means on clarity and control on the table tennis task. In addition, the gain scores indicated small increases in clarity and control from pre-test to final manipulation check for all groups on both tasks.

On the clarity item, for the table tennis imagery the internal training group increased slightly from pre-test (M = 5.27, SD = 1.00) to the final manipulation check (gain score M = .49, SD = .91), as did the external training group (pre–test M = 4.83, SD = 1.34, gain score M = .29, SD = .85) and control group (pre-test M = 5.28, SD = .60, gain score M = .12, SD = .75). For the darts imagery the findings were similar. The internal training group (pre-test M = 5.06, SD = .89, gain score M = .88, SD = .95), external training group (pre-test M = 5.13, SD = 1.02, gain score M = .17, SD = .76), and control group (pre-test M = 5.29, SD = .57, gain score M = .33, SD = .57) all had relatively high initial means on the 7-point scale and increased slightly.

On the control item for the table tennis imagery, means were also initially high and increased very slightly or remained steady for the internal training group (pre-test M =5.30, SD = .79, gain score M = .54, SD = .63), external training group (pre-test M =4.65, SD = 1.15, gain score M = .47, SD = .92), and control group (pre-test M = 5.14, SD = .55, gain score M = .10, SD = .97). This was generally the case for the darts imagery for the three groups - internal training group (pre-test M = 5.04, SD = .83, gain score M = .60, SD = .93), external training group (pre-test M = 5.12, SD = 1.11, gain score M = .00, SD = .69), and control group (pre-test M = 5.20, SD = .73, gain score M = .46, SD = .61).

Rating scale kinaesthetic and visual items. RS item 6 probed how well the participant felt the movement and RS item 7 probed how well the participant saw the movement. Both these items were scored on 7-point Likert scales. The means for the kinaesthetic imagery item (item 6) were all above 4.45, indicating that kinaesthetic imagery was reported as being experienced during the trials for both skills, by all groups. In addition, the gain scores indicated that the groups generally increased slightly in their reported kinaesthetic imagery experience, with the exception of the internal training group ratings on table tennis. The means for the table tennis imagery for the internal training group (pre-test M = 5.12, SD = .91, gain score M = -.32, SD = 1.11), external training group (pre-test M = 4.67, SD = 1.35, gain score M = .41, SD = 1.38), and control group (pre-test M = 4.90, SD = .60, gain score M = .74, SD = .78) were generally above the middle point of the 7-point scale. On the darts task, similarly, the scores for the internal training group (pre-test M = 4.45, SD = 1.17, gain score M = .07, SD = .93) external training group (pre-test M = 4.91, SD = 1.35, gain score M = .13, SD = .73), and control group (pre-test M = 5.02, SD = .74, gain score M = .48, SD = .68) are generally above the mid-point on the scale and increase very slightly or remain steady.

The means for RS reports of visual imagery (item 7) were high indicating that visual imagery was an important component of images generated. On the table tennis imagery the means are around five and increase for the internal training group (pre-test M = 5.72, SD = .65, gain score M = .18, SD = 1.06), external training group (pre-test M =

4.65, SD = 1.18, gain score M = .47, SD = .83), and control group (pre-test M = 5.33, SD = .55, gain score M = .33, SD = .56). For the darts imagery the internal training group (pre-test M = 5.50, SD = .74, gain score M = .36, SD = .77), external training group (pre-test M = 5.09, SD = 1.18, gain score M = .01, SD = .88), and control group (pre-test M = 5.41, SD = .55, gain score M = .05, SD = .62) all displayed means around five on the 7-point scale and all had positive gain scores, even though the gains scores were very small.

Effects of Training on Performance

Training groups. The means and standard deviations from performance trials on the open skill (table tennis) and closed skill (darts), as well as the gain scores from pre- to post-test are presented in Table 5.7.

Table 5.7

Performance Task Pre-test, Post-test, and Gain Scores for Table Tennis and Darts

	Pre-Test		Post-Test		Gain Score	
	M	SD	M	SD	M	SD
Table Tennis:						
ITG	57.90	32.68	84.00	23.77	26.10	14.93
ETG	61.30	26.18	85.70	22.07	24.40	8.51
CG	58.40	24.74	74.30	21.20	15.90	10.16
Darts:						
ITG	84.20	13.15	101.20	8.82	17.00	10.48
ETG	83.20	10.77	100.50	12.69	17.30	10.79
CG	83.60	14.21	92.00	8.97	8.40	10.05

A visual inspection of Table 5.7 suggests that there are similar gain scores for the internal and external training groups for the table tennis task, that seem larger than those for the control group. The same pattern appears for the darts task. The difference between performance gain scores for the three groups was tested by a One-way MANOVA, which is reported next. A point that should be made here, however, is that despite the pilot work on the performance tasks, participants performed better at pre-test on the darts tasks than the table tennis task. The darts task is also the task that shows the least improvement in performance.

Analysis of variance of training effects. A One-way MANOVA was conducted to determine the effect of the training (internal training group, external training group, and control group) on the dependent variables, RS item 1 gain scores for table tennis and darts, and performance gain scores for the table tennis task and darts task. Significant differences were found among the three groups on the dependent measures, Wilk's Λ = .42, F(8, 48) = 4.26, $p < .001$. The multivariate effect size, eta squared (η^2) = .415, based on Wilk's Λ, was quite strong. Tables 5.5 and 5.8 contain the means and standard deviations of the dependent variables for the three groups.

ANOVA's on each dependent variable were conducted as follow-up tests to the MANOVA. Using the Bonferroni method, each ANOVA was tested at $\alpha = .05$ divided by 4 or .0125 level. The ANOVA on the table tennis RS gain scores was significant, $F(2, 27) = 9.56$, $p = .001$, $\eta^2 = .41$, as was the ANOVA on the darts RS gain scores, $F(2, 27) = 10.303$, $p < .001$, $\eta^2 = .43$. The ANOVA on the table tennis performance gain scores was not significant, $F(2, 27) = 2.247$, $p = .125$, $\eta^2 = .143$, nor was the ANOVA on the darts performance gain scores, $F(2, 27) = 2.342$, $p = .115$, $\eta^2 = .148$.

Post hoc analyses to the univariate ANOVAs for the RS gain scores for darts and table tennis consisted of conducting pairwise comparisons to find which training program affected RS gain scores more. Each pairwise comparison was tested at $\alpha = .05$ divided by 4 or .0125 level. The internal imagery group had significantly different table tennis RS gain scores from the external imagery training group, with positive gain scores (increased external imagery) for the external imagery training group and negative gain scores (increased internal imagery) for the internal imagery training group. The internal imagery group and external imagery group were not different from the control group. The internal imagery training group also had significantly different darts RS gain scores from the external imagery training group, however, the internal imagery group and external imagery group were not significantly different from the control group, although the internal training group approached significance ($p = .033$).

Imagery training versus no imagery training. A separate analysis of imagery training versus no training was conducted. This was to examine if there was an effect for training versus no training on performance of the table tennis performance task and darts performance task. A One-way ANOVA was conducted to compare the effect of imagery training and no training on performance of the table tennis task. The independent variable, imagery training, had two levels, imagery training (internal and external groups combined) or no imagery training (control group). The dependent variable was the performance gain scores for table tennis. The ANOVA was significant, $F(1, 28) = 4.53$, $p < .05$, $\eta^2 = .139$, indicating greater performance gain scores for imagery training than no training. The strength of the effect of the independent variable, imagery training or no imagery training, was moderate as assessed by η^2, with the independent factor accounting for 14 percent of the variance of the dependent variable.

A One-way ANOVA was also conducted to compare the effect of imagery training and no training on performance of the darts task. The independent variable, imagery training, had two levels, imagery training (internal or external) or no imagery training (control group). The dependent variable was the performance gain scores for darts. The ANOVA was significant $F(1, 28) = 4.853$, $p < .05$, $\eta^2 = .148$. The strength of the effect of the independent variable, imagery training or no imagery training, was moderate as assessed by η^2, with the independent factor accounting for 15 percent of the variance of the dependent variable. The means and standard deviations for imagery training and no imagery training are presented in Table 5.8. The means show that participants who received imagery training (internal or external) had significantly greater performance gain scores than those who received no imagery training for both the darts and the table tennis task.

Table 5.8

Performance Task Gain Scores for Table Tennis and Darts of Imagery Training and No Imagery Training Participants

	Darts		Table Tennis	
	M	SD	M	SD
Imagery Training	17.15	10.35	25.25	11.86
No Imagery Training	8.40	10.047	15.90	10.16

Actual Perspective Use

Actual imagery perspective use. An analysis of performance in terms of actual use of imagery in the manipulation checks for each specific skill was conducted to examine whether imagery use was related to performance for that skill, rather than just comparing according to training group. This is because participants in the mismatched training groups may still have been using a considerable proportion of their original perspective in the imagery of the skills. Participants' scores on the manipulation check for each skill on RS Item 1, which asked participants to (rate the relative time they imaged from inside versus outside your body during the imagery period), were classified as predominantly internal or predominantly external to give an "actual" imagery use classification. Those with a score on the manipulation check for each skill of 50 or more were classified as external, those with a score of less than 50 on the specific manipulation check for each skill were classified as internal. This gave 12 internals and eight externals for the table tennis task and 11 internals and nine externals for the darts task. The means for these groups on RS1 are displayed in Table 5.9. and clearly show that the participants were assigned according to the actual reported perspective use during imagery trial.

Table 5.9

Imagery Perspective Ratings Based on Actual Imagery Use

	Table Tennis (MCS)		Darts (MCS)	
	M	SD	M	SD
Internals	25.58	18.55	17.96	14.06
Externals	69.30	14.07	64.53	13.69

Actual imagery perspective use and performance. A One-way ANOVA was conducted to compare actual imagery perspective use for table tennis, according to the manipulation check, and gain scores on performance of the table tennis task. One-way ANOVA was conducted rather than an independent-samples t test as it allows calculation of an effect size, eta squared, in SPSS that is not available in the independent-samples t test program. At the same time, ANOVA yields identical probability outcomes in that the p-values are the same (Green, Salkind, & Akey, 1997). The independent variable was assignment to actual use of internal or external imagery on the manipulation check for table tennis. The dependent variable was gain scores on performance of the table tennis task. The ANOVA was significant, F (1, 18) = 5.821, $p < .027$, partial $\eta^2 = .244$. The strength of the effect of actual table tennis perspective group on table tennis performance gain scores, as assessed by η^2, was moderately strong, with the actual group factor accounting for 24 percent of the variance. The means and standard deviations for performance of the table tennis task by the two actual perspective groups for table tennis are presented in Table 5.10, along with the gain scores for each group. The participants who reported greater use of external imagery on the final manipulation check had a higher mean gain score than the participants who reported greater use of internal imagery at that time.

A One-way ANOVA was also conducted to compare actual imagery perspective use for darts, according to the manipulation check, and gain scores on performance of the darts task. The independent variable was assignment to actual use of internal or external imagery based on the manipulation check for darts. The dependent variable was gain score on performance of the darts task. The ANOVA was significant, F (1, 18) = 5.148, p

= .036, partial η^2 = .222. The strength of the effect of actual darts perspective group on darts performance gain scores, as assessed by η^2, was again moderately strong, with the actual group factor accounting for 22 percent of the variance. The means and standard deviations for performance of the darts task by the two actual perspective groups for darts are presented in Table 5.10. The participants who reported greater use of internal imagery on the final manipulation check had a higher mean performance gain score than the participants who reported greater use of external imagery at that time. This is the opposite of the pattern found for the table tennis task.

Table 5.10

Actual Imagery Use and Performance

	Pre-Test		Post-Test		Gain Score	
	M	SD	M	SD	M	SD
Table Tennis:						
Internals	65.50	26.36	86.08	20.73	20.58	11.21
Externals	50.75	31.65	83.00	25.95	32.25	9.54
Darts:						
Internals	81.73	11.42	103.18	7.82	21.45	10.45
Externals	86.11	12.27	98.00	13.26	11.89	7.83

Discussion

This discussion section reports on imagery use and performance effects from the study of imagery perspective training and performance. First, issues related to measurement and use of imagery perspectives are discussed. Next, training of perspectives is considered and, finally, the effects of training on performance are discussed. These issues are examined in sections on general conclusions, theoretical and measurement implications, implications for future research, and implications for practice.

Conclusions

A description of the major findings of this study is presented in this conclusions section. The IUQ indicated that there did not appear to be any differences between groups on imagery use patterns, except for the perspective questions. The responses to perspective questions on the IUQ, additional questions from Gordon et al. (1994), and pre-test RS suggested that assignment of individuals to perspective training groups at pre-test was achieved as intended, according to the mismatching of preference. A comparison of the imagery perspective measurement techniques at pre-test indicated that the IUQ was a good general predictor of reported imagery perspective at the specific imagery trial, with moderate correlations between the IUQ and RS. At pre-test on the RS, participants reported using more internal than external imagery, however, there was a substantial external component. Participants also reported greater use of external imagery in imaging the open skill (table tennis) than the closed skill (darts). The RS data also indicated that all groups experienced kinaesthetic imagery. The perspective training programs did appear to change perspective use, making participants more moderate and less extreme in their use of preferred perspective. The perspective training programs were effective in enhancing performance in comparison with the control group; however, there was no difference in performance gain between the two training groups on either task. An analysis of actual perspective use for the table tennis task (open skill), regardless of training group, indicated that those who actually used predominantly external imagery improved performance significantly more than those who predominantly used internal imagery. The pattern reversed for the darts task (open skill), where participants who used predominantly internal imagery improved performance significantly more than participants who predominantly used external imagery.

Theoretical and Measurement Implications

The theoretical and measurement implications section details how findings described in the conclusions section relate to theories and research on imagery perspectives, as well as imagery in sport. In addition, the discussion on measurement techniques from Studies 1 and 2 is extended. The measurement of perspectives again suggested that researchers or practitioners need a specific measure of perspectives taken at the time of imagery, if they require information on actual perspective that is accurate. This is something many of the studies on imagery perspectives and performance have failed to do. In this study, however, as opposed to Study 2, the IUQ was a good general predictor of perspective use with moderate correlations with the RS. The additional questions from Gordon et al. (1994) at pre-test confirmed the findings of the IUQ and RS that participants were assigned according to mismatched reported preferences. As was the case in Study 2, more participants in the internal training group than participants in the external training group reported that their perspective changed during imagery on the additional questions. This seems to provide further support for the suggestion that external imagers may have a more flexible orientation than internal imagers.

The finding that there was more internal than external imagery reported at pre-test, but with a considerable external component, confirms the findings of Studies 1 and 2. The pre-test RS data also indicated greater use of external imagery in the table tennis (open skill) task than the darts (closed skill) task. This finding is in line with Study 2 and suggests that the skill, or elements of the skill, such as perceptual and spatial elements may influence perspective use (e.g., Paivio, 1985).

The RS included control and clarity and visual and kinaesthetic imagery items. The ratings on the control and clarity items were similar between groups and skills and were reasonably high, ranging from 4.6 to 5.3 on 7-point Likert scales. The gain scores from pre- to post-test indicated slight increases for all groups. Similarly, the ratings on the visual and kinaesthetic imagery scales were all above 4.45 and the gain scores increased slightly from pre- to post-test. This indicated that visual and kinaesthetic imagery were important components of imagery and that all groups reported experiencing kinaesthetic imagery. As for Study 2, all groups at similar levels reported kinaesthetic imagery. This indicates that kinaesthetic imagery can occur with internal and external imagery, supporting Hardy's suggestion and several recent studies (e.g., Glisky et al., 1996; Hardy & Callow, 1999; White & Hardy, 1995).

The present study also investigated the training of internal and external imagery and found that perspective use became less extreme. There was a stronger training effect for the internal training than the external training, as for Study 2, but the external training program was more effective in this study than it was in Study 2. This finding confirms previous studies (e.g., Gordon et al., 1994; Templin & Vernacchia, 1995; White & Hardy, 1995), which have suggested that internal imagery can be enhanced with training programs, although these studies measured performance, rather than imagery perspective use. Some studies have also suggested that external imagery can be trained (e.g., Burhams, Richman, & Bergey, 1988; Gordon et al., 1994; Van Gyn, Wenger, & Gaul, 1990), but again these researchers did not measure perspective use, basing their conclusions on performance changes as a result of training. As such, we cannot draw any direct conclusions on perspective change from those studies. A possible explanation for greater perspective change for the internal training group than the external training group is the proposition, mentioned in Study 2 and earlier in relation to the additional questions, that internal imagers may have a more fixed preference than external imagers. Such a proposition would also explain the higher incidence of participants in the internal training group reporting on the additional questions that their perspective changed during imagery.

The analysis of the effects of perspective training on perspective use in imagery trials and resulting performance suggested that the perspective training was effective in altering perspective use in the desired direction. However, even changes of the magnitude reported for the training groups did not guarantee that participants were predominantly using the assigned perspective. A mean change as large as –23.44 on a 100-point scale may not mean that the participant has changed to using the other perspective. For example, if the participant initially rated at 75 they would still have a score over 50 if they experienced the mean change. This suggests that participants shifted from a strong reliance on a perspective to a more moderate position where they used both perspectives. In addition, there were large standard deviations in the RS as for Studies 1 and 2, which indicate that the mean may not be representative of each individual. The possibility also exists, of course, that the shift from a strong reliance on one perspective to a more moderate use of perspective is due to regression to the mean, where participants who reported extremely low or high scores on the pre-test tend to move toward more moderate scores irrespective of training. This is probably an unlikely explanation because the control group, selected quasi-randomly (not based on the imagery perspectives pre-test) had relatively stable gain scores on the RS. That is, they had similar means and standard deviations on all measurement occasions, and if regression to the mean was occurring this may have been reflected in the scores of this group regressing towards the mean, as the participants in this group did not report using equal amounts of internal and external imagery at pre-test (reflected in the large standard deviations). In addition, even if the shift in perspective use was due to regression to the mean, the change in performance by the imagery perspective training groups is real.

This study also investigated performance changes as a result of perspective training. The main finding of this study was that imagery training lead to greater performance improvement than no training; however, there was no difference between internal and external training on performance improvement. The finding of no difference between the two training groups may have been due to both having an equivalent training effect on performance for each skill. Thus, it does not matter which perspective you use for either skill as long as you are using imagery. Alternatively, perhaps the finding that both training groups improved performance similarly is due to the finding discussed earlier that the perspective training may have made participants less extreme and more moderate in their use of perspective, rather than changing them from a strong internal preference to a strong external or vice versa. For instance, both groups may have become more alike with training. In particular, they both used a combination of internal and external imagery. It must be noted that using both perspectives is not necessarily the same as extensive switching. Participants reporting using more than one perspective could be using extensive switching within a trial. Alternatively, it could be that the participant is using one long period of internal imagery, then a long period of external imagery, rather than lots of going back and forth. In considering the suggestion that participants having a more balanced perspective (closer to 50/50) and this leading to better performance for the training groups, an analysis of the use patterns and performance might be constructive. At pre-test the control group was more balanced (table tennis M = 42.36, darts M = 23.44) than the internal training group table tennis M = 72.50, darts M = 72.66) or the external training group (table tennis M = 19.63, darts M = 10.36), but the control group, with the more balanced use, was not different to the internal training group or external training group on performance. This is probably not unexpected as even though all three groups had done the same amount of imagery of the tasks (10 trials on each skill at pre-test) this was not a large amount of practice. At the manipulation check following specific imagery training specific, after training for the training groups, the internal training group was more balanced (table tennis M =50.58, darts M = 49.22) than the external training group (table tennis M = 35.56, darts M = 28.62) or the control group (table tennis M = 37.34, darts M = 25.24), but did not exhibit better performance. This analysis doesn't test whether extensive switching is beneficial for performance enhancement, but it does indicate that balanced use of perspective itself is not enough. As can be seen from the means of the training groups the internal training group is much more balanced than the external training group, and yet does not perform better. A comparison with the control group is probably not as useful here because the control group did not undertake any official training, even though it is reasonable to assume that control group participants did some informal imagery practice, since they knew they would be tested on imagery and performance again. Another related consideration with the changing of perspective use is that participants in the assigned training group would not necessarily have been using significantly more of the assigned perspective than the other perspective. To illustrate, some participants in the internal training group may still have been relying heavily on their initial external perspective, although they were being encouraged to image internally and vice versa. Because of these possibilities, an analysis of performance was conducted in terms of actual reported perspective use in the manipulation checks for each skill, regardless of training group.

The analysis of performance in terms of actual perspective used suggested different effects for the open and closed skills based on actual use. Those who used external imagery more had significantly greater gain scores than those who used internal imagery more on the table tennis task (open skill), whereas internals had significantly greater gain scores than externals on the darts task (closed skill). Interestingly, and perhaps related, was the finding in the present study of greater reported external imagery in the open skill at pre-test, which externals improved more on. Perhaps this skill was better suited to an external orientation. This finding obviously supports the proposals made by McLean and Richardson (1994), Annett (1995), and Harris (1986) and suggests that the type of task may influence which perspective is more beneficial to use in imagining performance.

A factor that may have influenced these results is perspective preference. In this study, participants were mismatched initially according to reported perspective use and trained in a mismatched perspective, this may have made them more moderate in their use of that perspective. In addition, the findings for actual use may reflect preference rather than training. Hall (1997) stated that the most effective visual imagery perspective depends partly on the demands of the task, but that preference for internal or external imagery is just as important. Hall suggested that to make an athlete change their perspective might be detrimental, even if the task characteristics seem to warrant it. In addition, athletes should be encouraged to use both internal and external perspectives and employ the perspective that they prefer and that works for them. The present study has suggested that altering use of imagery perspective may not be detrimental and in fact, may be beneficial. Moderating this is the point that participants were not forced to use a perspective, which is what Hall was probably suggesting might be detrimental. The design in this study, rather than forcing participants to adopt a perspective that they did not want to use, encouraged use of the perspective that participants initially used less. This may have lead to participants being encouraged to use both perspectives and employing the one that works best in a given task or specific part of a task, as Hall suggested. As such, the present study suggests that the task and the preferences of performers influence the most effective perspective for performance acquisition or execution.

In summary, the findings of the present study suggest that manipulation checks are required to acquire information on actual perspective use during training. More internal than external imagery was reported in imaging the skills at pre-test, however, there was a large external component. Additionally, participants experienced more external imagery in imaging the open skill than the closed skill. The perspective training seemed to alter perspective use, making participants less extreme in their use of imagery perspectives. The internal training seemed to have a greater training effect than external training and this may be due to a more fixed perspective of participants with an internal preference. The training groups had greater performance gain scores on both performance tasks than the control group, but were not different from one another, possibly due to the moderating effects of perspective training. The analysis of actual perspective use indicated superior effects for externals on the open skill (table tennis) and for internals on the closed skill (darts). This seems to reflect aspects of the task and actual imagery use, which might reflect imagery preference.

Methodological Issues

The methodological issues section includes discussion of the methods used, including issues related to the imagery measurement techniques, the imagery perspective training programs, the research design, and the performance tasks. The imagery measurement techniques used in this study were the IUQ and additional questions (Gordon et al., 1994) and RS (pre-test and manipulation check). Results suggested that the IUQ and additional questions did provide a general indication of imagery perspective use. The RS, as for Studies 1 and 2, had large standard deviations, and therefore variability, which obviously reduces the probability of gaining statistically significant differences. This could also indicate that the means do not adequately reflect individuals within each group.

The instructions for imagination of the open and closed skills at pre-test and each of the manipulation checks emphasised experiencing all the senses, but importantly did not instruct participants to image in a specific perspective. This was employed because many authors (e.g., Glisky et al., 1996; Gould & Damarjian, 1996; Harris & Harris, 1984; Orlick, 1986; Vealey & Greenleaf, 1998) have suggested that the most effective imagery is the most realistic imagery. This would imply that all the senses present in the actual performance situation should be used during imagery. As discussed in Study 2, critics could argue that this approach might have lead to increased use of internal imagery during the trials. This could explain the finding that more of the imagery reported by participants on the RS in the trials for both the open and closed skill was internal. It would not explain why there was a higher mean for the internal item than the external item on the IUQ perspective items and the stronger internal leaning on the additional questions. Participants completed both of these before the imagery trials on the open and closed skills. This would suggest that the emphasis on sensory experience probably did not influence perspective adopted in the imagery trials.

The training programs appeared to be effective in altering perspective use from a high use of one perspective to more moderate use. The external training was much more effective than that in Study 2. This may have been due to a greater emphasis on visual perspective aspects in the scripts or because more sessions were utilised in the design of this study. In this study, there were two general perspective training sessions, and then two specific sessions on the open skill and two specific sessions on the closed skill, that is six sessions in all, as opposed to four sessions in total in Study 2. This may have given participants enough opportunity to practice using the perspective and, coupled with the slightly modified scripts, assisted in making the external imagery perspective training more effective in this study.

This study utilised a control group. The participants in the control group did no imagery practice on the skills or any other organised activity in the period while the training groups underwent imagery perspective training. This may be a limitation of the design of the study because it may have lead to a Hawthorne Effect, where the participants' performance might have been influenced by knowing they were in one of the experimental groups or the control group. That is, those in the experimental groups expected to perform better, whereas the control group did not expect to improve. The training groups did have significantly greater performance gains than the control group, but were not significantly different from one another. This may have been due to this Hawthorne Effect. Alternatively, it is possible that the larger gains occurred because the training groups were doing imagery training, irrespective of perspective. Imagery training in general has been shown to increase performance (e.g., Kendall, Hrycaiko, Martin, & Kendall, 1990; Lee & Hewitt, 1987; Mumford & Hall, 1983; Wrisberg & Anshel, 1989). The control group had no imagery training, that is, the study again might have demonstrated that imagery training leads to increased performance, but that perspective emphasised is not critical. The design of the study could have been improved if, instead of using a control group, a mismatched and matched design using extreme perspective use groups, as advocated later in the implications for future research section, was used. An alternative, but similar design would be to use extreme groups again, but give some training and some not, that is, use extreme control groups. The control group was used in this study to check the effects of perspective training on not only performance, but also on perspective use. The control group did not seem to show the changes that occurred in the training groups, as there was no real change in control group perspective use.

As stated earlier, the imagery training did shift people to a more balanced use of perspectives, and it was tentatively suggested a balanced use of perspective might be beneficial. This is perhaps unlikely because there was no difference between the internal and external training groups in performance, although the internal training group had a more balanced perspective after imagery training. There was a difference between open and closed skill performance for actual imagery use as measured on the manipulation check, indicating that using one perspective on one skill was more beneficial than on the other. That is, adapting imagery perspective use to suit the task, not a balanced (50/50) use, might be best.

The performance tasks in the study involved darts and table tennis skills. They were adapted tasks requiring participants to aim for a concentric circles target. These tasks were designed to be well controlled and measurable as well as comparable to some degree. These laboratory tasks could be criticised for not being real-world sport skills, however, it must be recognised that open skills are very difficult to measure in the real-world. The tasks were designed in pilot work, so that naïve performers would score around 30% of maximum creating a sufficiently difficult task that there would be adequate opportunity for improvement due to imagery rehearsal. This aim seemed to be achieved, however, there did seem to be reasonably large standard deviations and therefore, variability in scores on the table tennis task, especially at pre-test. The possibility existed that improvements on the relatively novel tasks can be attributed to a practice effect, however, this seems unlikely as the control group improved significantly less than either imagery training group.

In summary, following discussion of a range of methodological issues, it was concluded that the general imagery measures of the IUQ and additional questions were good general predictors of actual reported imagery use and perspective preference. The instructions for the imagery trials of the open and closed skill emphasised experiencing all the senses and it was argued that the impact of this on perspective was positive. Consideration of the training program design and scripts included discussion on why external training was more effective than in Study 2. It was suggested that this might have been due to the number of imagery sessions or the greater emphasis on visual perspective aspects in the imagery scripts. In this discussion, problems with an inactive control group were also considered and how this may have influenced the finding that the training groups had superior performance acquisition on the tasks than the control group.

Implications for Future Research

In this section, the implications of the study for future research on imagery perspectives and imagery in sport are discussed. Thus, future issues related to measurement of imagery, imagery perspective use, imagery perspective training, and task-type and preference as moderators in the perspective-performance relationship are discussed. Future research that focuses on measuring perspectives or assigning participants to perspective groups needs to consider utilising specific measures of perspective use, as was suggested in Studies 1 and 2. The information gleaned from the manipulation checks also highlighted how important it is in future research to determine what participants in imagery protocols actually did image, to ensure that perspective assignment is adhered to, as was discussed in more detail in Study 2. If manipulation checks are used, it is possible to analyse data based on the imagery perspective actually employed, as was demonstrated in this study by the reanalysis by actual perspective. Useful information about the effect of perspective on performance of open and closed skills was derived in that analysis although there was no discernable relationship between performance change on the open and closed skills and perspective based on the training groups.

The findings for internal and external imagery use at pre-test for the two skills were similar to Study 2. Participants reported greater use of internal imagery than external imagery, but with a significant external component and greater external use in imagination of the open skill than the closed skill. This was in opposition to Study 1, where participants reported greater external experience for imaging the closed skills than the open skills; however, there was greater use of internal imagery overall, as for Studies 2 and 3. Perhaps the open/closed skill classification is too general. Researchers may need to examine individual skills or particular properties of skills (such as perceptual elements, spatial elements, motor elements) or goals of imagery (such as confidence, motivation) more systematically to discover why different tasks seem to produce different perspective use patterns (e.g., Hardy & Callow, 1999).

The measures of kinaesthetic imagery taken in the present study, and Study 2, indicated that participants reported experiencing kinaesthetic imagery in both internal and external imagery and at similarly high levels as has been found in other studies (e.g., Glisky et al., 1996; White & Hardy, 1995) and suggested by authors (e.g., Hall, 1997; Hardy, 1997). Collins, Smith, and Hale (1998) suggested that external visual imagery then kinaesthetic imagery is the actual perspective adopted during imagery. The present study has not assessed kinaesthetic experience specifically. Future research is needed to examine whether there is an external kinaesthetic perspective or whether results can be explained by switching between external visual and internal kinaesthetic imagery.

The training of perspectives indicated that there was a training effect for both groups. Although the external training had a slightly smaller effect than the internal training, it was much stronger than in Study 2. The finding of a smaller effect for the training of an external orientation to that with an internal orientation would suggest that researchers might further investigate whether strongly internal imagers can be trained to use an external perspective. Future research could investigate the flexibility of perspective for those with a preference for either perspective and whether one perspective is more prone to switching. The present study investigated the influence of imagery training on imagery perspective use. Imagery training is usually carried out to improve imagery ability. Perhaps the training improves ability in the trained perspective, but participants still choose the untrained perspective. Future research might investigate the influence of imagery perspective training on imagery ability, rather than imagery perspective use. Another question that arises is whether it is useful to change imagery perspective use by training. The present study suggests that it is because a more mixed approach (probably incorporating changing between perspectives) did seem to be effective, and this has also been suggested by other research (e.g., Collins et al., 1998). A possible future research project would be to have matched and mismatched training groups and compare performance. For example, participants could be pre-tested on perspective use and assigned to either a matched internal training group (internals trained in internal imagery), a mismatched internal training group (externals trained in internal imagery), a matched external training group (externals trained in external imagery), or a mismatched external training group (internals trained in external imagery). If researchers adopt a matched training and mismatched training design with extreme internal and external groups, they could check if there is a regression effect. If regression only is operative then all groups will shift in a central direction. If regression and training are both active, then all groups will move centrally, but the mismatched groups will move more or the matched groups will stay where they are, as regression and training cancel each other out. If only training is operating, then the mismatched groups will move centrally and the matched groups will become more extreme, subject to ceiling effects. In addition, this would test whether performance changes were due to participants using a more balanced perspective or not. If the performance of the matched groups improved as much as the mismatched groups (assuming changes in perspective use were due to training and not regression to the mean), then the changes in performance are due to imagery training in general, but if the mismatched training groups exhibited greater performance increments, then it is training that balances perspective use that is important. Of course, the study would also need to use manipulation checks to measure actual perspective use. The researcher might also have a high rejection rate in trying to recruit enough extreme imagers, especially external imagers, if the experience of the studies in this thesis is any indication.

The performance findings suggested that the type of task and preference of the individual influence the most efficacious use of perspective. There were no differences between the effects of internal and external imagery training on performance enhancement, but this training was significantly better than no training. The possibility of a Hawthorne Effect for the trained groups compared with the inactive control group was discussed earlier. As such, it is recommended that future studies should compare perspective training with an active control group, or even a control group that undergoes general imagery training, or the matched and mismatched design for extreme groups. The two training groups enhanced performance of each task to similar levels, so there was no task-type difference, based on assigned training group. Previous research on perspective and performance has been conducted with various tasks and has contrasting results for different skills, but also different results for the same task (e.g., Epstein, 1980; Glisky et al., 1996; Gordon et al., 1994; Hardy and Callow, 1999; Mumford and Hall, 1985; Nigro & Neisser, as cited in Neisser, 1976; White and Hardy, 1995). Future research is required to test whether internal or external training enhances performance of certain types of skills more. In the present study, the analysis of actual perspective revealed that externals had greater performance gains than internals on the open skill (table tennis), and internals had greater performance gains than externals on the closed skill (darts). This seems to suggest that the task can influence which perspective is more efficacious. So future research is needed that focuses on whether certain tasks (e.g., open and closed skills) or elements of tasks (e.g., perceptual or form-based) respond better to internal or external imagery. The findings for actual use also suggest that perspective preference, regardless of assigned condition, may influence imagery effects. To find the actual task-type by perspective interaction, researchers need to conduct a systematic research program. The recommendation is that following a methodological classification of previous studies, a substantial research program involving a wide range of tasks, not just two or three, needs to be conducted. The program would need to control for perspective preference and include manipulation checks for actual imagery use. The program should also vary one aspect of task-type while keeping others constant to examine the interactions within a task. For example, one study could compare the perceptual versus form issue for only closed tasks and then separately for open tasks in another study. Having made this recommendation for a substantial program, the question is whether the findings from such a program, and such an investment of time and energy would be worthwhile. It might not add enough understanding beyond what sport psychologists already know about imagery perspectives to be really beneficial for practical application. At present, sport psychologists seem to recognise that different tasks, or elements of tasks, respond to different uses of imagery perspectives, and switching between internal and external imagery. Sport psychologists also seem to recognise that individual perspective preference mediates between task and actual perspective use. The recommendation at present is that athletes should be encouraged to learn to use both internal and external imagery and adapt to suit their needs or the needs of the task (of course we really don't know what the needs of the task are without an extensive program and this is the main justification for such a program). An extensive program is likely to provide similar recommendations, but be specific about when to use internal imagery and when to use external imagery for various tasks.

Hall (1997) stated that the most effective visual imagery perspective depends partly on the demands of the task, but also that preference for internal or external imagery is just as important. Hall suggested that to make an athlete change their perspective may be detrimental, even if the task characteristics seem to warrant it, and that athletes should be encouraged to use both internal and external perspectives and employ the perspective that they prefer and that works for them. This has not been adequately investigated. The present study suggests that altering a perspective preference may not be detrimental. Participants, however, were not forced to use a perspective, and in fact, the training may have lead to participants being encouraged to use both perspectives, employing the one that they felt most comfortable with for a part of a task or at a particular time in their imagery process. Future research needs to address the interaction of preference and task-type. Another issue arises in relation to the perspective used. The question is whether the decision on the perspective to use is a conscious, voluntary decision, or a largely automatic process, determined by preference, the task, or some other process. Researchers might be able to determine these issues by starting with qualitative studies. For example, it might be informative to give participants with extreme perspectives different tasks to image and then use RV, with probes, to ascertain whether they thought about how to image, or if it just happened, and if it just happened when it happened. This issue was investigated to some extent in Study 2, where participants in the debriefing interview, not RV, were asked “If you did switch between inside and outside your body, was it a conscious decision to switch?”. Most participants who switched indicated that it just happened. This issue will be discussed in detail in Chapter 6 of this thesis.

The training of perspectives appears to have produced a change so that participants who initially indicted a more extreme use for one perspective were less reliant upon this perspective in their final manipulation checks than they were at pre-test. Thus, the training assisted participants to use internal and external imagery in a more balanced manner. Recent research by Collins et al. (1998) suggested that switching assisted performance. Researchers need to investigate the possibility that switching between perspectives is advantageous. Moreover, if switching is effective, it is important to examine how it can best be utilised. For example, studies could be devised to examine when participants should switch in imaging a skill, how they should switch, and what elements should be imaged internally or externally.

Some of the future research issues discussed in this section include using specific measures taken as close as possible to imagery in terms of time, in addition to general measures of perspective that question general imagery use patterns. Examination of specific aspects of the task and perspective preference is recommended to understand the relationship between perspective use and task to be performed. Another issue that researchers need to be address is whether internal imagers have a more fixed perspective than external imagers and why external training was less effective than internal training in changing perspective use. Also of interest is whether experience of the participants with the skill being imaged and performed affects the perspective-performance relationship. Future research directed at perspective switching or use of a combination of perspectives is also warranted. It is proposed that, rather than tinkering around with these issues, a systematic research program that examines perspective preferences, task types, switching, and training of perspectives in relation to each other is needed if we want to clearly resolve all the issues of task type and perspective use.

Implications for Practice

The discussion of implications for practice focuses on how the methods employed and findings of the present study could be used to assist in the effective application of imagery. The findings provide useful information about the measurement of perspectives and imagery and perspective use for those working in applied settings. As reported in Studies 1 and 2, a specific measure of perspective is necessary, so practitioners have knowledge of the actual imagery experience of athletes, on that task, on that occasion.

Also highlighted by the results, is the need for practitioners to utilise manipulation checks in imagery programs to ensure that athletes adhere to treatments or, more realistically, to determine the extent to which athletes are able to control their imagery to concur with training or practice instructions.

The use of internal imagery was higher than external imagery across both skills, as was the case in Studies 1 and 2. This seems to indicate that internal imagery was more important or easier to produce in imagination of these skills, however, there was still a significant external component. More external imagery was experienced imaging the open skill (table tennis) than the closed skill (darts), as for Study 2, which could indicate that external imagery was more important to imagination of this skill than internal imagery. These findings, in combination with those of Study 1, suggest that on different tasks athletes use perspectives in different ways. As such, training in both perspectives may assist athletes to be able to adopt the appropriate perspective. Of course, just because an athlete uses a perspective with a task, does not necessarily mean that it is more efficacious for performance enhancement. If most people use that perspective for that task, it is probably not a dispositional factor, but might involve an interaction between perspective and task type. Because the actual perspective use analysis showed an advantage for external imagery in performance of the table tennis task, it could be that the claim is supported. The training programs indicated that training could alter participants' perspective use, so that they were less reliant on one perspective. The external training was more effective than in Study 2 and this may have been due to the increase in the number of sessions or it might have been facilitated by a greater emphasis of the visual perspective in the external imagery scripts. Applied sport psychologists need to recognise that learning to use imagery in an altered way may take time.

The effects of perspective training on performance suggested that the two training groups had greater performance gains than the control group. As such, imagery training appears to be more efficacious for performance than no training. The analysis of actual perspective use revealed greater performance gains for externals (participants who reported greater use of external imagery) than internals (participants who reported greater use of internal imagery) on the open skill (table tennis), and greater performance gains for internals than externals on the closed skill (darts). This suggests that practitioners need to consider the task-type as well as preference of individuals (Hall, 1997; Hardy, 1997). As stated earlier, the training might have assisted participants in using both perspectives. Consequently, perhaps practitioners should encourage athletes to use both perspectives, or they should train athletes in both perspectives and let the athletes use what seems most appropriate for them.

Some of the practical suggestions from the present study are that in the applied setting manipulation checks are necessary to ensure adherence to training programs and imagery scripts. Use of both perspectives, which seemed to be encouraged by training in a mismatched preference, also may be advantageous to effective imagery rehearsal. Imagery training lead to greater performance gains than no training, so imagery training is recommended, regardless of perspective adopted. The task and individual perspective preference influence the benefits of imagery perspective, and so need consideration when working with athletes.

Concluding remarks

This study investigated the effects of imagery perspective training or imagery perspective use and performance of an open skill and a closed skill. The perspective training programs did appear to change perspective use, making participants less extreme in their use of imagery perspectives, during imagery of the tasks in this study. The perspective training programs were effective in enhancing performance in comparison to the control group, but were not different from one another in performance gain on either task. Reasons were put forward for this, including that the perspective training made participants more balanced in the use of imagery perspective, or that perhaps, doing imager, regardless of perspective adopted was the important factor. An analysis of actual perspective use, regardless of training group, indicated that participants who used more external imagery improved performance significantly more than participants who used more internal imagery on the table tennis task (open skill). The pattern reversed for the darts task (closed skill), where participants who used more internal imagery improved performance significantly more than participants who used more external imagery. This highlights the need for researchers to consider actual use of imagery, rather than just relying upon assigned groups in assessing the effects of imagery on performance. It also suggests that there may well be a task type influence on which perspective to use during imagery.

CHAPTER SIX: DISCUSSION

The aim of this thesis was to enhance our understanding of internal and external imagery perspectives in sport. Despite a considerable amount of research on internal and external imagery, there has been little study of what perspectives people actually use to image various sport tasks. Participants have usually been assessed for preference of perspective and assigned to an internal or external imagery group, and/or given instructions or training in a perspective and asked to use that perspective to image the task. In addition, researchers have not endeavoured to ascertain how best to measure imagery perspective. Study 1 examined the use of internal and external imagery in imaging various open and closed sport skills. Furthermore, general measures and a range of specific measures of imagery perspective use were compared to examine how sport psychologists might best measure imagery perspectives. This included concurrent and retrospective reports that researchers have not used specifically to investigate imagery perspectives in sport. Various claims have been made in the literature about internal and external imagery being superior, or superior for imagery of certain tasks, but there has been no direct investigation of whether people can be trained to use a particular perspective in imaging a specific task. Study 2 investigated the training of internal and external imagery with participants mis-matched on reported imagery perspective use in imagery of an open and a closed skill. Assuming that most people can be trained to image from an internal or external perspective, little research exists that has examined whether training in internal or external imagery leads to enhanced performance in predictable ways in terms of sport skill classification. Study 3 examined the effects of imagery perspective training on performance of an open and closed skill and the effects of actual reported perspective use on performance of an open and closed skill. This chapter provides an overall summary of the findings of the three studies in this thesis and draws the findings together into a discussion of what the thesis means for the research and use of imagery and imagery perspectives in sport. This is detailed in sections covering the main conclusions of the thesis, theoretical and measurement implications, methodological issues, implications for future research, and implications for practice.

Conclusions

The measures of imagery perspective use in the three studies of this thesis included general measures of perspective, the Imagery Use Questionnaire (IUQ: Hall et al., 1990) and additional questions (Gordon, et al., 1994), and specific measures of perspective use in an imagery trial, concurrent verbalisation (CV), retrospective verbalisation (RV), and rating scales (RS). The IUQ and additional questions were satisfactory general indicators of perspective use, like a trait measure, but were not good indicators of imagery perspective use on a specific trial, accounting for about 25% of the variance on most occasions. In Study 2, however, the internal imagery question of the IUQ had poor correlations with the specific measures of imagery perspective use, suggesting that there might be a problem with this item. The specific measures (CV, RV, and RS) were all highly correlated when used together and appeared to be equivalent and precise measures of perspective use in a specific imagery trial.

The general and specific measures of imagery perspective in all three studies suggested that participants reported greater use of internal than external imagery, however, they also reported a significant component of external imagery use (35%-45%). The specific measures for imagination of the various open and closed skills identified different imagery use patterns for the skills. In Study 1, participants reported greater use of external imagery in imagining the designated closed skills than imagining the designated open skills. In addition, switching between perspective was quite common within trials, with estimates of switching occurring in 22.5% of trials according to CV and 12.2% of trials according to RV. In the pre-test imagery trials in Studies 2 and 3, participants reported greater use of external imagery in imagining the open skill (table tennis) than in imagining the closed skill (darts). This might suggest that the open and closed skill classification is too broad, or is not the factor that determines how athletes use imagery perspectives. An analysis of individual skills or elements of skills might be more fruitful, perhaps similar to that advocated by Paivio (1985). In Study 1, there were differences in the use of internal and external imagery in imagining the individual skills. The skill with the highest reported use of internal imagery was catching a ball thrown when not knowing which side. The skill with the highest reported use of external imagery was performing a forward roll. It might be that these skills have elements more suited to a particular perspective.

The scores for imagery perspective training in Studies 2 and 3 suggested that the training was effective in altering perspective use of participants with lower reported use of that perspective. The internal perspective training significantly increased the use of internal imagery in Studies 2 and 3. The external perspective training effect was not as strong as the internal perspective training, but did change perspective use with participants using their mis-matched perspective more than they did before training. The effect for external perspective training was not significant in Study 2, but seemed to reflect an increasing trend. There was a significant change in external imagery use in Study 3. The perspective training did change perspective use, but did not reverse initial use patterns, participants simply became less extreme in their use of perspective.

Performance change on an open skill (table tennis) and a closed skill (darts) as a result of imagery perspective training was investigated in Study 3. There was no difference between the perspective training groups on performance gains, however, the perspective training groups improved performance on the darts and table tennis tasks significantly more than the control group. An analysis of the effect of actual reported perspective use, irrespective of training group, on performance gains on the darts and table tennis skills was also conducted. This analysis was carried out because participants in the mis-matched perspective training groups might still have been using a considerable amount of their initial perspective in imagining the skills. The analysis of performance on the darts and table tennis skills suggested that participants with higher actual use of internal imagery had significantly greater performance gains on the darts skill than participants with higher actual use of external imagery. On the table tennis skill the finding was reversed, participants who used more external imagery had significantly greater performance gains on the table tennis skill than participants who used more internal imagery.

Theoretical and Measurement Implications

The implications from the findings of this thesis for theoretical explanations of internal and external imagery and measurement of internal and external imagery are examined in this section. This thesis tells us little about theoretical accounts of how imagery in general works to enhance performance of sport skills. The thesis was not designed to investigate how imagery works, but to enhance our understanding of internal and external imagery perspectives in sport. The principles of the effective application of imagery in sport are just as valuable as theoretical investigation. On a theoretical basis, this thesis investigated a hypothesised explanation of why there have been mixed findings for imagery perspectives in sport, specifically, that researchers have not until recently considered the nature of the task. It was hypothesised that there would be differential effects for imagery use and resulting performance on open and closed skills (e.g., Annett, 1995; Harris, 1986; McLean & Richardson, 1994).

The measurement of perspectives suggested that researchers or practitioners need a specific measure of perspective taken at the time of imagery, if they require accurate information on perspective use during imagery. This is because the general measures used were just that, general predictors, but not clearly accurate reflectors of actual imagery use in specific imagery trials. The CV, RV, and RS were all closely related to each other and seemed to be equivalent and precise measures of perspective use, so might be useful instruments in future research and in the field. The CV technique did not appear to interfere appreciably with the imagery task and provided descriptive detail of the imagery, so might be a useful technique for investigating other aspects of imagery, especially image content (e.g., Bertini et al., 1969; Kazdin, 1975). Based on participant reports it did seem to slow down the imagery slightly and this may have influenced imagery use.

The findings for imagery use indicated that participants overall used significantly more internal than external imagery, however, they still used a substantial proportion of external imagery in imagining the skills. Thus, these relatively inexperienced participants could use internal imagery, and, in fact, favoured internal imagery in opposition to suggestions by some authors that internal imagery is used more by experts (e.g., Smith, 1983, as cited in Smith, 1987). The skills were predominantly not form-based, so might have favoured using internal imagery (Hardy & Callow, 1999). The findings for perspective use across open and closed skills were not consistent from study to study, but suggested that the use of perspectives did differ according to different skills. No previous studies have specifically compared perspective use of two or more skills without instruction to image in a given perspective, so it is difficult to compare these findings with other research. In Study 1, external imagery use was greater on the closed skills than the open skills. In the pre-test imagery trials in Studies 2 and 3, participants reported greater use of external imagery in imagining the open skill (table tennis) than in imagining the closed skill (darts). These findings on imagery perspective use seem to suggest that the open and closed skill classification might not adequately differentiate the task type effects on perspective use. It must be remembered, however, that the hypothesised effects of task type on imagery perspective relate to performance results, not the perspective adopted during imagery trials. That is, just because participants used a perspective does not mean that it is necessarily more efficacious for performance enhancement. It might be more fruitful to consider individual skills or elements of skills as suggested by Paivio (1985). A problem also might occur with imagination of open skills and whether a participant can actually image an open skill. This is because it is difficult for a person to produce images of the unexpected. There is really no environmental unpredictability in imagery, because the person must generate the image. In Study 1, the skill with the highest reported use of external imagery was performing a forward roll, this seems consistent with Hardy and Callow (1999) who suggested that form-based movements might be best suited to external imagery. This would not explain all the findings for Studies 2 and 3, but the findings do not rule out that the influence of form is important.

Kinaesthetic imagery use in all three studies in all conditions was high on the IUQ and on the RS in Studies 2 and 3, indicating that participants can experience kinaesthetic imagery with internal and external perspectives (e.g., Glisky et al., 1996; Hardy & Callow, 1999; White & Hardy, 1995). This thesis did not specifically set out to investigate the influence of kinaesthetic imagery, and so cannot shed any light on whether these reports are due to constant switching of perspective with the actual perspective employed in external imagery being external then kinaesthetic imagery, as suggested by Collins, Smith, and Hale (1998).

The switching of perspective between internal and external imagery found in this thesis has been found in previous studies (e.g., Epstein, 1980; Gordon et al., 1994; Harris & Robinson, 1986; Mumford & Hall, 1985). Interestingly, in Studies 2 and 3 the internal perspective training group (those lower in reported internal imagery use, and higher in reported external imagery use) reported greater switching on the additional questions (Gordon et al., 1994) and exhibited greater changes in perspective use due to perspective training. This might indicate that imagers who use external imagery more have a more flexible imagery perspective than imagers with a preference for internal imagery.

The findings for training of imagery perspectives with mis-matched perspective groups suggested that perspective training made perspective use more moderate. In Studies 2 and 3, there was a stronger training effect for internal perspective training than external perspective training, but the external perspective training did alter perspective use. This finding confirms previous studies that suggested that internal imagery can be enhanced with training programs, although these studies measured performance, rather than imagery perspective use (e.g., Gordon et al., 1994; Templin & Vernacchia, 1995; White & Hardy, 1995). Some studies have also suggested that external imagery can be trained, but again these researchers did not measure perspective use, basing their conclusions on performance changes as a result of training (e.g., Burhams et al., 1988; Gordon et al., 1994; Van Gyn, et al., 1990). Additionally, this finding would seem to support the suggestions of Hardy (1997) and. Hardy and Callow (1999) that external imagery is more effective with form-based movements, even though their suggestions were for the efficacious use of perspective for performance enhancement as opposed to actual perspective use. The two tasks in Studies 2 and 3 were not form-based and so might have been suited to an internal orientation. As such, greater internal imagery was reported at pre-test and it was more difficult to get internal imagers to adopt an external orientation than to train external imagers to use more internal imagery.

The results of the training from Studies 2 and 3 suggested that even with a substantial perspective training program researchers cannot assume that people will use the trained perspective, so studies that have merely instructed participants to use internal or external imagery, or given participants a brief training session, with no manipulation check, are seriously questioned. Another consideration with the training is that extreme mis-matched perspective groups were used. Participants were mis-matched based on initial reported use of imagery perspective at pre-test. If this was a transient state, i.e., they just happened to do this on this occasion (which is less likely, since they also responded to the IUQ), then regression to the mean is a possible explanation of the training effects as discussed in detail in Study 3. If the initial use represented a stable disposition, or preference, however, a large shift towards the central position, or even to a use of the alternative perspective for extreme groups would not be expected, or might be very difficult to achieve in a short period of time. The measures of perspective use for the control group in Study

3 did not change from pre- to post-test. This suggests that the pre-test measures represent dispositions, or that perspective use differs between tasks in a systematic way, but is consistent for the same task when a training intervention is not imposed. This provides a stronger case that training did alter a dispositional use of perspective by extreme perspective groups, which is probably a difficult task, as evidenced by the small change for the external perspective training groups, that is, those who predominantly image internally.

Performance changes as a result of perspective training suggested that imagery perspective training produced greater performance gains on the open and the closed skill, than the control group experienced. This might suggest that imagery training, regardless of perspective, enhances performance. One of the aims of the thesis was to examine whether task type influences whether it is more efficacious for performance enhancement to utilise an internal or external perspective in imagery. Based on the suggestions of several researchers, who have hypothesised that closed skills might benefit more from an internal perspective and open skills might benefit more from an external perspective (e.g., Annett, 1995; Harris, 1986; McLean & Richardson, 1994), Study 3 compared performance gains on an open skill (table tennis) and a closed skill (darts). There was no difference between internal perspective training and external perspective training on performance gains on either skill. This might have been due to perspective training making participants, who were chosen because they were extreme at the start, more moderate in their use of perspective, not completely reversing the use of perspective from one extreme to the other. An analysis of actual perspective use, regardless of perspective training group, did suggest that there were differences between performance gains on the two tasks based on imagery perspective use. Performance gains were greater on the closed skill (darts) for participants who reported greater use of internal imagery. Performance gains were greater on the open skill (table tennis) for participants who reported greater use of external imagery. This obviously supports the suggestions that closed skills benefit more from an internal perspective and open skills benefit more from an external perspective. This might throw some light on the confused findings regarding internal and external imagery perspectives and open and closed skills in previous research. Because most previous research has not measured actual perspective use, it might be that perspective groups derived from preferences or instructions did not reflect actual use in many studies, as in the training groups in Study 3 here. Thus, the conditions in some studies might have reflected intended perspective use, showing the predicted effects, whereas in other studies, the conditions each had a mixture of internal and external perspective use, so there was no effect for different tasks. The point is that without checking on actual perspective use we just do not know what perspective participants actually used during imagery in these studies.

Another issue that should be considered in interpreting the results of the studies is perspective preference. In Studies 2 and 3, participants were mismatched initially according to reported perspective use and trained in a mismatched perspective. This might have made them more moderate in their use of that perspective. In addition, the findings for actual use may reflect preference rather than training. Hall (1997) stated that the most effective imagery perspective depends on the demands of the task, and preference for internal or external imagery. Hall suggested that to make an athlete change their perspective might be detrimental, even if the task characteristics seem to warrant it. This thesis suggested that altering use of imagery perspective might not be detrimental and in fact, may be beneficial. Moderating this is the point that participants were not forced to use a perspective, which is what Hall was probably suggesting might be detrimental. The design in Study 3 might have lead to participants being encouraged to use both perspectives and employing the one that works best in a given task or specific part of a task. As such, the present thesis suggests that the task and the preferences of performers influence the use of imagery perspectives and the most effective perspective for performance acquisition or execution.

Methodological Issues

Issues related to the methods employed in this thesis, including the imagery measurement techniques, the imagery perspective training, and the performance tasks, are discussed in this section. The imagery measures used in the three studies included the IUQ, additional questions from Gordon et al., (1994), and CV, RV, and RS. The IUQ and additional questions provided a general indication of perspective use, except in Study 2. In Study 2, the IUQ perspective questions provided mixed information on imagery perspective use. For example, the internal imagery question produced poor correlations with the RS and RV measures. This might be due in part to the wording of the question, which asks ".... did you see as if you were actually playing and performing?". Participants might not have interpreted this as being from one's own eyes. Consequently, it might have been marked by external imagers who do see as if they were actually playing and performing, but from outside their bodies. The CV, RS, and RV in the three studies had large standard deviations, and therefore variability, which obviously reduces the probability of gaining statistically significant differences. Additionally, this might indicate that the means do not adequately reflect most individuals within each group.

In Study 1, four closed and four open skills were selected as being common skills that would be experienced by most people who played sport. One problem with skill selection might have been that all of the skills, except one (the forward roll), were ball sport activities. This might have had an effect on the type of imagery experienced. Skills from non-ball sports might have changed the findings, especially for closed skills where there are large numbers of sports without balls (e.g., field throwing and jumping events, skating, gymnastics, trampoline, diving, darts, and archery). It could be argued that having ball sports for both open and closed skills made comparison between skill classification easier, because the only perceptual or motor difference was the open or closed nature of the task. The skills in Studies 2 and 3 were also throwing and hitting tasks, rather than form-based movements for example. In addition, there is the problem mentioned earlier of whether it is possible to image the unpredictability of a truly open skill.

The instructions for the imagery trials in all three studies emphasised experiencing all the senses, but did not instruct participants to image in a specific perspective. This approach was employed because many authors (e.g., Glisky et al., 1996; Gould & Damarjian, 1996; Harris & Harris, 1984; Orlick, 1986; Vealey & Greenleaf, 1998) have suggested that the most effective imagery is the most realistic imagery. This would imply that athletes should use all the senses present in the actual performance situation during imagery. Critics might argue that this might have lead to increased use of internal imagery during the trials. For example, it has been suggested that only in internal imagery can senses other than the visual modality be experienced (Collins & Hale, 1997), or that senses such as kinaesthesis are more likely to occur in internal imagery (Cox, 1998; Janssen & Sheikh, 1994). This could explain the finding of more reported internal imagery on the CV, RV, and RS. It would not explain the higher ratings of internal imagery on the IUQ perspective items and the additional questions which participants completed before the imagery trials in all three studies. Consequently, it is unlikely that the emphasis on multi-sensory experience influenced perspective adopted in the imagery trials.

The training programs appeared to be effective in altering perspective use from a high use of one perspective to more moderate use. In Study 2, the external perspective training did not significantly change perspective use, although there was a trend towards increased use of external imagery. This might have been due to the training scripts used, or a more fixed perspective for internal imagers. The external training was more effective in Study 3 than in Study 2. This might have been because of a greater emphasis on visual perspective aspects in the scripts or because more sessions were used in Study 3. More sessions might have given participants enough opportunity to practice using the perspective and, coupled with the slightly modified scripts, assisted in making the external imagery perspective training more effective.

Study 3 included a control group. This was an inactive control group, in that the participants in that group did no organised activity while the training groups undertook imagery perspective training. This might be a limitation of Study 3 and could be responsible for the greater performance gains for the training groups in relation to the control group. Alternatively, it is possible that the larger gains occurred because the training groups were doing imagery training, irrespective of perspective. Imagery training in general has been shown to increase performance (e.g., Kendall et al., 1990; Lee & Hewitt, 1987; Mumford & Hall, 1983; Wrisberg & Anshel, 1989). The control group had no imagery training, that is, the study again might have demonstrated that imagery training leads to increased performance, but that perspective emphasised is not critical.

The performance tasks in Study 3 were adapted darts and table tennis tasks requiring participants to aim for a target. The tasks were designed to be well controlled and measurable as well as relatively comparable. These tasks could be criticised for not being real-world sport skills, however, it must be recognised that open skills are very difficult to measure in the real-world. There were large standard deviations and, therefore, variability in scores on the table tennis task, which might be a problem for interpreting results. It was unlikely, however, that improvements on the relatively novel tasks could be attributed purely to a practice effect as the control group improved significantly less than either imagery training group.

Implications for Future Research

Implications for future research on imagery and imagery perspectives in sport that have arisen from the studies in this thesis are discussed in this section. Proposals for future research discussed include the further examination of measurement of imagery and imagery perspectives, continued investigation of perspective training, and systematic study of the mediating effects of task type and perspective preference on the relationship between imagery perspective and performance enhancement.

Future research on imagery perspectives, and probably other aspects of imagery, needs to consider using specific measures of that aspect of imagery. In all three studies of this thesis, the IUQ and additional questions provided a general indicator of perspective use, rather than reflecting specifically what occurred during imagery trials. Investigation of correlations between specific measures of imagery (e.g., CV, RV, and RS) and other general imagery questionnaires (e.g., MIQ, VMIQ, VVIQ) to see how well those general measures predict actual imagery experienced during imagery of sport skills might be useful. A research project might explore whether it is possible to design a general perspective use questionnaire that is more closely correlated with specific measures taken at actual imagination, although it is questionable whether this would be a fruitful exercise. The correlations between the specific measures (CV, RV, and RS) were extremely high, but were recorded in close temporal proximity. Researchers could examine whether the correlations between RS, and RV decline as time from imagery increases. Perhaps correlations of RV and RS with the IUQ would become higher as the time after imagery increases because memory of actual imagery experience is reduced and so participants rely more heavily on their general preference. Another issue raised by the moderate correlations between the IUQ and specific measures of perspective in all three studies is how stable imagery perspective is. Researchers might conduct studies using the specific measures on several occasions for the same tasks to see whether individuals use the same perspective on different occasions. This seems to be a fundamental question, which has not been answered. Questionnaires like the IUQ, that ask what the individual usually does, assume that there is a relatively stable disposition or trait, but there is no evidence that this is the case.

The finding that general measures reflected general patterns, but not specific use suggested that future research into perspectives needs to use manipulation checks to ensure that participants follow perspective assignments. Study 2 did not measure performance changes, but investigated actual perspective used, a variable that researchers have not specifically examined previously. In Study 3, this was measured in addition to performance. The findings of Studies 2 and 3 indicate that performance studies need to place more emphasis on measuring actual perspective used and need to be more vigilant in employing manipulation checks. Simply assigning someone to an external or internal imagery group does not mean that they are imaging according to the condition, even if the researcher gives training in the assigned perspective, as in Studies 2 and 3 here. Additionally, what participants report in general measures before or after may not be an accurate reflection of what they do in imaging a particular task. In studies where researchers instruct participants to image using a particular perspective, there is clearly some pressure for them to report that this is what they did, if asked after. There is also the memory effect as time from imagery increases. In the present studies, participants were not instructed to image using one perspective, just trained in internal or external imagery, so they might not have felt so restricted. The information obtained from the manipulation checks also demonstrated how important it is in future research to determine what participants in imagery protocols actually imagined, even if researchers employ a thorough training protocol. If manipulation checks are used, it is possible to analyse data based on the imagery perspective actually employed. Useful information about the effect of perspective on performance of open and closed skills was derived in the reanalysis by actual perspective in Study 3.

In all three studies, internal imagery use was higher than external imagery use on all imagery perspective measures. As the participants in these studies were not experienced performers on all the skills imagined, this suggests that inexperienced performers might use internal imagery more than external imagery, at least under some circumstances. It could be argued that this effect was simply due to chance, a majority of internal imagers having volunteered for the research. This could be plausible for one study, but seems improbable across three independent studies. Future research might compare experienced and inexperienced performers on perspective use in a number of sports with specific measures such as CV, RV, and RS, rather than general measures of perspective. As mentioned earlier, the open and closed skill imagery tasks used in the three studies might have influenced the greater use of internal imagery. For example, there were few form-based tasks and most skills were ball sport or target skills. Researchers might investigate whether these ball sport and target skills are more suited to imagery from an internal perspective than other types of sport skills.

The findings for internal and external imagery use in imagining the open and closed skills across studies varied. In Study 1, participants reported more external imagery use in imagining the closed skills than the open skills. In Studies 2 and 3, participants reported greater external imagery use in imagination of the open skill than the closed skill. Perhaps the open/closed skill classification is too general. Researchers might examine individual skills or particular properties of skills (such as perceptual elements, spatial elements, motor elements) or goals of imagery (such as confidence, motivation) more systematically to discover why different tasks seem to produce different perspective use patterns (e.g., Hardy & Callow, 1999). The results, however, do indicate that the task does influence perspective use, and, in Study 3, the most efficacious perspective for performance enhancement. An issue that needs to be considered in more depth from a theoretical perspective is whether it is really possible to image fully open skills or whether all that is possible to image the perceptual-motor elements of open skills in a predictable manner. This was beyond the remit of this thesis, but consideration of this from a theoretical viewpoint is warranted and should lead to research that explores what happens in this case, especially in terms of internal and external imagery perspectives. It might be that an external perspective would allow one to achieve a greater degree of "unpredictability".

The imagery scripts for the imagery trials emphasised utilising all the senses. This might have lead to increased use of the internal perspective. Future research should investigate if the specific directions in imagery scripts influence perspective used. For example, studies could compare scripts with senses emphasised and scripts with no mention of sensory experience. This would be similar to comparing whether stimulus and response laiden scripts influence internal or external perspective use, rather than confusing stimulus and response propositions with internal and external imagery (e.g., Budney et al., 1994; Janssen, & Sheikh, 1994. Wang &Morgan, 1992) The measures of kinaesthetic imagery taken in the thesis indicated that participants reported experiencing similarly high levels of kinaesthetic imagery in both internal and external imagery. The thesis did not set out to investigate kinaesthetic experience specifically. Future research is needed to examine the influence of kinaesthetic imagery on perspective use and performance enhancement. Research by Hardy and Callow (1999) offered some support for the proposition that kinaesthetic imagery provides an additional beneficial effect regardless of perspective adopted.

Imagery use results, based on training of imagery perspectives in Studies 2 and 3 indicated that there was a training effect for both internal and external perspective training, although the effect was not as strong for external perspective training as for internal perspective training. Future research on factors affecting the efficacy of external imagery scripts and the most efficacious method of altering perspective use might be valuable. An issue that might need to be considered in assessing the impact of training on perspective use is that the training lead to a specific test in the context of the studies. It is not known to what extent the imagery perspective training encouraged participants to alter their perspective use a bit to make the researcher happy or whether it actually changed their general practical use of imagery perspectives. It might have been a useful exercise to follow-up with participants from Studies 2 and 3, with the same two skills and different skills, to observe if, at some later date, there was any retention in the shift in perspective use and/or generalisation to other tasks.

The finding of a smaller effect for the training of an external orientation to that with an internal orientation would suggest that researchers might further investigate whether strongly internal imagers can be trained to use an external perspective. Again, the nature of the script, as well as the characteristics of the sample, might influence this. Research on this use might suggest that individuals with a preference for internal imagery have a more fixed or unchangeable orientation than individuals with a preference for external imagery. Future research could investigate the flexibility of perspective for individuals with a preference for either perspective and whether one perspective is more prone to switching. A future research issue that arises from Studies 2 and 3 is whether it is effective for performance enhancement to change imagery perspective use by training. Study 3 suggests that it is because a more mixed approach (probably incorporating changing between perspectives) did seem to be effective, and this has also been suggested by other research (e.g., Collins et al., 1998).

Imagery perspective training in Study 3 lead to increased performance, but no difference between internal perspective training and external perspective training. Because the training lead to a more moderate use of internal and external imagery, perhaps a mixed perspective use is best for performance enhancement, or this allowed participants to alter perspective freely as it seemed appropriate in the task (Hall, 1997). In addition, Hardy (1997) suggested that imagery's beneficial effect on performance depends on the extent that the images add to the useful information that would otherwise be available. External imagery might assist the imager to see precise positions of players relative to themself in a team game, for instance, and movements required for successful performance (e.g., gymnastics, rock climbing, team ball sports). Alternatively, internal imagery might allow the performer to practice the spatial locations, environmental conditions, and timings of movements (e.g., slalom type tasks, dart throwing). Perhaps if both are used at different times during imagery, greater insight or a more holistic experience of the task might result. This needs to be investigated, especially in the sport context. Future research might examine whether a mixed perspective is better for performance enhancement than internal or external imagery. This finding might support research by Collins et al., (1998) who found that switching internals performed better than per instruction internals or per instruction externals. Mixed use does not necessarily mean constant switching, it could just as easily be one switch at a crucial point, but switching or changing perspectives could be a fruitful line of research. The RS approach to measurement in Study 3 did not provide an indication of how switching occurred, only the reported percentage of time spent using each perspective. Researchers need to investigate switching in simple and complex tasks, using a carefully structured qualitative approach such as CV.

There were no differences on performance gains between internal perspective training and external perspective training in Study 3. This finding suggested that trained perspective and task type did not interact. The findings for actual use did suggest that the use of perspective interacted with task type. Research comparing actual perspective use and different open and closed skills seems warranted. As discussed in Study 3, rather than playing around with issues of perspective preferences, task types, switching, and training of perspectives, a systematic research program that investigates these variables in relation to each other is needed if we want to clearly resolve all the issues of task type and perspective use. Such a research program would need to explore a substantial number of tasks from each category of each classification thought to be relevant. Again, fine-grained analysis of actual imagery use from moment to moment would be necessary, using a technique like CV, to determine which perspective is used for each element of each task and where switching occurs. Researchers would need to consider the investment of effort that such an extensive program would involve and whether it would add sufficiently to the effective practical application of imagery.

Implications for Practice

The implications of the findings and methodologies used in this thesis for the effective application of imagery perspectives and imagery in sport are discussed in this section. The indications from the three studies were that the IUQ and additional questions provided a general trait measure of imagery use patterns. The general preference for perspective from the IUQ was moderately correlated with state measures taken during (CV) or immediately post imagery (RS and RV). Therefore, the applied sport psychologist could use the IUQ as an initial check of imagery perspective use. If the applied sport psychologist was concerned with actual imagery perspective experienced during imagery of particular skills from the sport or for specific tasks within the sport, then state measures would be required. The findings provide information about measuring perspective use for those working in applied settings. It appears that a specific measure of perspective is necessary, so applied sport psychologists have knowledge of the actual imagery experience of athletes, on that task on that occasion. Practitioners also need to use manipulation checks in imagery programs to ensure that athletes adhere to treatments or, more realistically, to determine the extent to which athletes are able to control their imagery to concur with training or practice instructions. In addition, the CV, RS, and RV were equivalent measures when taken close together in time. They appear to be useful measures of perspective and all seem readily applicable to fieldwork.

The use of internal imagery was higher than external imagery in imagining all skills in all studies. This indicated that internal imagery might be more important or easier to produce in imagination of these skills. There was still a significant external component (35% to 45%), however. The findings on internal and external imagery use on imagination of open and closed skills in the three studies was mixed, but indicated that perspective use changed for imagining different tasks. Thus, it seems that individual skills produced different combinations of use of internal and external imagery. Remember that this finding is for imagery perspective use, and not performance enhancement, but training athletes to be able to use both perspectives might be beneficial.

The perspective training in Studies 2 and 3 indicated that perspective training could alter perspective use, so that participants were less extreme in their use of one perspective. The external perspective training was less effective than the internal perspective training in altering perspective use. Perhaps applied sport psychologists will find it more difficult to train internal imagers to use more external imagery.

The effects of perspective training on performance suggested that the two perspective training groups had greater performance gains than the control group. As such, imagery training appears to be more efficacious for performance than no training. The training might have encouraged the use of both perspectives. Perhaps practitioners should encourage athletes to use both perspectives, or they should train athletes in both perspectives and let the athletes use what seems most appropriate for them. Alternatively, even training participants in switching between perspectives may be useful. Hardy (1997) suggested that the beneficial effect of imagery on the acquisition and performance of a motor skill depends on the extent that the images add to the useful information that would otherwise be available. Perhaps, for many skills, such as those in sports, imaging the skill in both perspectives allows the athlete to gain as much information as possible. Paivio (1985) suggested that an issue is whether the task involves a perceptual target, whether the target is moving or stationary, and what the performer is doing in relation to the target. It might be that these different elements in a task determine how athletes use imagery perspective. Alternatively, switching, which the mis-matched training might have encouraged, may be the most effective approach in line with the findings of Collins et al. (1998). These explanations, however, do not account for actual use and task type interactions, but even then the participants were classified with 50% as the dividing point. Thus, for instance, externals may have been using up to 49% internal imagery in imagination. The analysis of actual perspective use revealed greater performance gains for externals (participants who reported greater use of external imagery) than internals (participants who reported greater use of internal imagery) on the open skill (table tennis), and greater performance gains for internals than externals on the closed skill (darts). Consequently, applied sport psychologists need to consider the task-type as well as preference of individuals (Hall, 1997; Hardy, 1997). This finding supported the suggestion of several researchers, that closed skills might benefit more from an internal perspective and open skills might benefit more from an external perspective (e.g., Annett, 1995; Harris, 1986; McLean & Richardson, 1994). Applied sport psychologists need to consider the sport skill the athlete is practicing. The tentative recommendation from Study 3 is that the most beneficial form of imagery rehearsal for closed skills might utilise mainly internal imagery and the most beneficial form of imagery rehearsal for open skills might utilise mainly external imagery. This recommendation must be considered in light of the fact that only one closed skill and one open skill were compared for performance, and this broad classification of skills did not tend to differentiate imagery perspective use patterns in a consistent manner across studies. That is, in Study 1 more external imagery was experienced in imaging the closed skill, but in Studies 2 and 3 more external imagery was used in imaging the open skill. A stronger recommendation is that the athlete and applied sport psychologist need to take the individual skill into account when deciding how to employ imagery perspectives most effectively.

Concluding Remarks

The aim of this thesis was to enhance our understanding of internal and external imagery perspectives in sport. This involved investigating the measurement, actual use, training, and performance enhancing effects of internal and external imagery on open and closed skills. Although the main focus was on internal and external imagery processes, attention was paid to measuring and monitoring internal and external imagery because this is crucial to understanding their use and researchers have not rigorously examined actual perspective use in previous research. Therefore, the thesis had several related purposes. First, to examine actual imagery perspective use during imagination of a range of open and closed skills to ascertain the effects of the task on imagery perspective use. This original investigation of actual perspective use utilising innovative measurement protocols revealed that perspective use did vary between individual skills, but might not vary according to the broad classification of open and closed skills. Consequently, future research might need to use a more detailed classification of skills. Second, the thesis aimed to compare imagery perspective preference with actual perspective use using general measures of perspective and specific measures of perspective taken during or immediately after imagery. This measurement technique comparison revealed that the general measures (IUQ and additional questions) were not strong predictors of actual imagery use, accounting for around 25% of the variance on specific occasion. The specific measures (CV, RV, and RS) were precise and equivalent measures of perspective use in a specific trial. Researchers in the future need to consider utilising specific measurement techniques rather than relying on general preference tests at the outset. Third, it was intended to discover how people actually use imagery perspectives during imagery. Participants generally used more internal than external imagery in imaging all the skills, but also used a large amount of external imagery (35-45%). Fourth, it was intended to examine whether people can be trained to image in a given perspective. The results of the second study suggested that imagery perspective training altered the use of imagery perspectives by participants in mis-matched perspective training groups. Perspective training did not reverse the participants from high use of one perspective to high use of the other perspective, but did make them more moderate in their use of perspective during imagery. Researchers might look towards investigating whether perspective preference is stable. Finally, it was intended to investigate how imagery perspective training and imagery perspective use affect performance on an open and a closed skill. Imagery perspective training produced greater performance gains on an open skill (table tennis) and a closed skill (darts), but there was no difference between internal perspective training and external perspective training. For actual perspective use, regardless of perspective training, externals (those who reported greater use of external imagery) had significantly greater performance gains on and open skill (table tennis) than internals (those who reported greater use of internal imagery). Conversely, internals had greater performance gains on a closed skill (darts) than externals. Thus, actual perspective use produced different performance effects on an open and a closed skill. This suggests that for some tasks at least, when people are classified according to the imagery perspective they actually used, the task does influence and which perspective is most efficacious for performance enhancement. I hope that the methods and findings of this thesis stimulate future research on the measurement of imagery perspectives, the relationship between the task and imagery perspective use, and between imagery perspective use and task performance. Understanding the fascinating process of imagery for its own sake and to help athletes and sport psychologists use it more efficaciously in sport are good reasons to continue the quest to understand the nature of imagery and imagery perspectives.

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Appendix A: Imagery Use Questionnaire (IUQ)

Imagery Use Questionnaire

NAME: ______________________ AGE: __________ SEX: __________

SPORT: ______________________ CLUB: ______________________

SKILL LEVEL: NOVICE: _____
INTERMEDIATE: _____
ADVANCED: _____
ELITE: _____

NATURE OF PARTICIPATION: RECREATIONAL / HOUSE LEAGUE: _____
COMPETITIVE: _____
PROVINCIAL COMPETITIVE: _____
NATIONAL / INTERNATIONAL COMPETITIVE: _____

Please complete the following before answering the imagery use questionnaire. This information will provide background information on your experiences with some types of mental training techniques. Indicate the mental training techniques to which you have been exposed. This might have been through readings, courses, or discussions with fellow athletes, coaches and professionals.

A. Technique: Focusing: Definition: an attention control technique to bring your concentration on your task.

Have you been exposed to this technique? Yes_______ No_______

If yes, how? ______________________

Have you had formal instruction ? Yes_______ No_______

If yes, # of sessions in which it was taught: _______

Average length of each session: _______

Do you personally use this technique? Yes_______ No_______

If yes, why do you use this technique? ______________________

____

____

B. Technique: <u>Relaxation</u>; Definition: a passive, calming technique to relieve tension and/or reduce anxiety; might include deep breathing and/or alternating muscle tensing and relaxing.

Have you been exposed to this technique? Yes______ No______

If yes, how?____

Have you had formal instruction ? Yes______ No______

If yes, # of sessions in which it was taught:______

Average length of each session:______

Do you personally use this technique? Yes______ No______

If yes, why do you use this technique?____________________

____

____

C. Other:______________ Definition:________________________

____

How were you exposed to this technique?___________________

____

Have you had formal instruction in this

in this technique? Yes______ No______

If yes, # of sessions in which it was taught:______

Average length of each session:______

Do you personally use this technique? Yes______ No______

If yes, why do you use this technique?____________________

____

____

Many athletes go through their event or stages of it in their minds before actually competing. Mental imagery is a method of seeing yourself in action or seeing the action as you would perform but in your "mind's eye" (visualization). It can also include the sensations and feelings associated with an action or the atmosphere and environment surrounding an event. This is a questionnaire designed to assess the USE of mental imagery by skaters. There are no right or wrong answers, but please try to answer as accurately as possible. If you need more space than is available, use the back of the page.

In the following questions where a scale is given, please circle the appropriate number corresponding to your degree of imagery use.

1. To what extent do you use mental imagery in your training ?

1	2	3	4	5	6	7
never						always

2. To what extent do you use mental imagery in competition?

1	2	3	4	5	6	7
never						always

3. Do you use mental imagery:

	1	2	3	4	5	6	7
a) before a practice	1 never	2	3	4	5	6	7 always
b) during a practice	1 never	2	3	4	5	6	7 always
c) after a practice	1 never	2	3	4	5	6	7 always
d) before an event	1 never	2	3	4	5	6	7 always

	1	2	3	4	5	6	7
e) during an event	1 never	2	3	4	5	6	7 always
f) after an event	1 never	2	3	4	5	6	7 always
g) during another unrelated activity (e.g., running)	1 never	2	3	4	5	6	7 always
h) during breaks in day	1 never	2	3	4	5	6	7 always
i) before/in bed	1 never	2	3	4	5	6	7 always

4. When you use mental imagery, do you see yourself from outside of your body as if you are watching yourself on a video?

1 never   2   3   4   5   6   7 always

If you do, how vivid is this image?

1 not vivid   2   3   4   5   6   7 very detailed

How easily can you change that image?

1 very difficult   2   3   4   5   6   7 very easy

5. When you use mental imagery do you see what you would see as if you were actually playing or performing?

1 never   2   3   4   5   6   7 always

If you do, how vivid is this image?

1 not vivid   2   3   4   5   6   7 very detailed

How easily can you change that view?

1	2	3	4	5	6	7
very difficult						very easy

6. When you are imaging, how easily do you see:

	1	2	3	4	5	6	7
a) isolated parts of a skill	1 very difficult	2	3	4	5	6	7 very easy
b) entire skill	1 very difficult	2	3	4	5	6	7 very easy
c) part of an event	1 very difficult	2	3	4	5	6	7 very easy
d) entire event	1 very difficult	2	3	4	5	6	7 very easy

7. When you are imaging, how often do you see:

	1	2	3	4	5	6	7
a) someone else performing (e.g., to imitate)	1 never	2	3	4	5	6	7 always
b) yourself performing incorrectly	1 never	2	3	4	5	6	7 always
c) yourself losing an event	1 never	2	3	4	5	6	8 always
d) yourself doing a pre-event routine (e.g., warm up)	1 never	2	3	4	5	6	7 always
e) the atmosphere of the competion day	1 never	2	3	4	5	6	7 always
f) yourself winning an event	1 never	2	3	4	5	6	7 always
g) yourself receiving a first place award	1 never	2	3	4	5	6	7 always

8. When you are using mental imagery to what extent do you actually feel yourself performing?

1	2	3	4	5	6	7
never						always

How easily do you feel:

a)contact with equipment 1 2 3 4 5 6 7
very difficult very easy

b)specific muscles 1 2 3 4 5 6 7
very difficult very easy

c)body control 1 2 3 4 5 6 7
very difficult very easy

9. Does the amount that you use mental imagery vary during the year? If yes, how and why?____________________________

____

____

10. Are your imagery sessions structured (i.e., you know in advance what you will image and for how long)?

1 2 3 4 5 6 7
never always

11. Are your imagery sessions regular (i.e. at a specific time each day)?

1 2 3 4 5 6 7
never always
(i.e., are spontaneous) (i.e., very regular)

12. Do your imagery sessions always take the same amount of time? If yes, how long?________________________________

If no, what range of time?____________________________

13. In preparation for your all-time best performance, how much mental imagery did you do?

1	2	3	4	5	6	7
less than usual						more than usual

14. Are there some ways you use mental imagery which are not covered in this questionnaire?____________________________

____

____

____

____

15. Are there any further comments you would like to make regarding your mental preparation for your sport?________________

____

____

____

____

Thank you for your time.

Appendix B: Additional questions

Perspective Questions.

In imaging yourself performing a skill:

1.) a.) Do you " see" yourself as if on a video/TV (external image?

b.) or do you " see" yourself as if performing the actual activity (internal image)?

2.)During your imagery of the skill does your perspective (internal or external)change?

Yes/No

3.)Which perspective (internal or external) do you find easiest to use?

Appendix C: Instructions for imagery trials of the open and closed skills in Study 1

Verbalisation Protocol and Imagery Script

General Instructions - General nature of procedure.

We are interested in finding out about imagery - which is when you imagine a scene or activity in your mind. To find out more about what goes on during imagery of a number of sports skills, you will to be asked to "think aloud". To "think aloud" you will describe everything you experience while imaging the sport skills, for example, what you see, hear, feel, taste, smell, whether you are successful or not, and whether you feel you are really there. It is really important that you describe whether you are inside your own body, or outside your body experiencing the imagery, so make sure you keep telling me where you are experiencing the skill from, that is, whether "inside" or "outside" your body. Use these terms, so it is clear what you mean and easy for you while imaging. Your "thinking aloud" will be recorded on a tape recorder and the tape will remain strictly confidential. If you have any problems or concerns as we progress you are free to stop at any time and ask any questions about the procedure.

Specific Instructions - What the subject has to do.

You will be asked to image some common skills from sport, imaging each of the skills for about one minute. When you image the skills try to experience all the senses associated with that skill, such as the sounds, sights, taste, smell, touch and feelings in your muscles or physical aspects of the skill. Try to make the image as vivid, clear and realistic as you can. Also image yourself performing the skill successfully. Make sure you describe whether you are experiencing the skill from inside or outside your body, and also if you change or "switch" from one to the other. Say aloud everything that you experience or comes to mind during your imagery of the sport skill. If nothing is happening it is okay to say "no image", what is important is that you continually say what you are experiencing or thinking, or that there is no image. There is nothing that you cannot say - there are no limits. What you say will be recorded, but please remember that the tapes will be treated in the strictest confidence. You can speak in whatever fashion you like. This does not have to be in complete sentences. Don't worry about being grammatically correct, it might only be one word. Say whatever you experience, that is, whatever you hear, feel, touch, taste, or see concerning the actual execution of the skill. It is important that I understand whether you are inside your body or observing yourself from outside your body during the skill, so try to use the words "inside" or "outside" to tell me. Make sure that you tell me if you switch from one to the other. If you say "inside" (or "outside") it will be assumed that you are inside (or outside) until you say otherwise - so it is important that you keep saying "inside" or "outside". Do you have any questions before you begin your imagery?

Practice Run

To help make sure you know what to do and to give you a go at imagery before imaging the specific scenes, first we will go through a practice imagery session with "thinking aloud". The practice just involves imaging a ball from a sport you are very familiar with. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to decide on the type of ball you are going to image (e.g. tennis ball, soccer ball, cricket ball, netball, football etc.). Have you decided on the ball? Decide and plan now what the ball will look, feel, smell, sound and move like. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. What you will do when I ask you to start your imagery is to image yourself holding the ball. Feel the texture of the ball by moving it through your hands. Look at it - note the colour, markings, shape. Raise it to your nose and smell it, what is the aroma? As you move it through your hands how does it feel? Light or heavy? Easy to spin or awkward? Are you inside your body or outside? Throw it up a metre from your hands and catch it as it drops. Sense your muscles as you throw, move to catch, and grip the ball in your hands. Were you inside or outside of your body as you moved? You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then for about one minute imagine playing with the ball as you have decided. Try to experience all the senses and feelings associated with the skill. Describe these and the actual execution and whether you are inside or outside of your body when performing the skill by "thinking aloud", remember to keep talking even if there is no image.

Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Specific Imagery Scenes

Hitting a tennis ball back over the net

The sport skill to imagine is hitting a tennis ball back over the net. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the ball is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are returning a tennis ball hit over the net - hit the ball back over the net. The ball is hit successfully back over the net and to the point on the court where you were aiming. Try to experience all the senses and feelings associated with the skill. Describe these and the actual execution and whether you are inside or outside of your body when performing the skill by "thinking aloud", remember to keep talking even if there is no image.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Defending against an attack in a team ball game

The sport skill to imagine next is defending against an attack in a team ball game. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. What is the sport, what is the specific situation? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you are to imagine you are defending against an attack in a team ball game. Sense the opposition coming forward, moving into attack. You read the play and are successful in preventing the opposition attack. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Catching a ball thrown to you when not knowing which side

The sport skill to imagine next is catching a thrown ball when you don't know which side of your body it will be thrown to. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Decide on the context of the skill and what you are going to do. Is it in a match or practice? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you will imagine you are catching a ball thrown to you when you don't know which side of your body the ball will be thrown to, the ball could go to the left or right. Be aware of the person who has the ball. Try to pick up clues as to where they will throw the ball. Catch the ball successfully. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Dodging a ball thrown at you by surprise

The sport skill to imagine next is dodging a ball thrown at you by surprise. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Think about the context, is it in practice or a game? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you are to imagine you are dodging a ball thrown at you by surprise. You are not aware of the ball and then all of a sudden you are and have to get out of the way quickly. The ball could come at you from any direction, but you are successful in dodging the ball. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Hitting a stationary ball with a stick or club

The sport skill to imagine next is hitting a stationary ball with a stick or club. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Think about the context, is it in practice or a game? What kind of ball and stick or club are you using? What kind of target? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you are to imagine you are hitting a stationary ball with a stick or club of some sort. Imagine successfully hitting the ball as far as you intended and in the direction you intended. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Throwing a ball at a stationary target

The sport skill to imagine next is throwing a ball at a stationary target. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Think about the context, is it in practice or a game? What kind of ball are you using? What kind of target, is it an object or a person? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you are to imagine you are throwing a ball at a stationary target. Imagine successfully throwing the ball and hitting the target. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Performing a forward roll on a mat

The sport skill to imagine next is performing a forward roll on a mat. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then you are to imagine yourself performing a forward roll on a mat. Imagine successfully rolling forward and standing up upon completion. Be aware of everything that is going on, whether you are inside or outside of your body, and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

(Rest for 30 seconds)

Rolling a bowl across a bowling green to a target

The sport skill to imagine next is rolling a bowl across a bowling green to a target. First make yourself as comfortable as possible. Take a couple of deep breaths and exhale slowly. Put all other thoughts aside for a moment. Decide and plan now, before you do the imagery, what you are going to image. Think about the bowl, where you are going to aim, how far away is the target, how hard do you need to roll the bowl? Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open. Then imagine yourself rolling a bowl across a bowling green to a target on the green, the white "jack". Imagine successfully and smoothly rolling the bowl across the green, the bowl never looks like missing the target, and pulls up right by it. Be aware of everything that is going on, whether you are inside or outside of your body and try to experience everything associated with the skill. Try to experience all the senses and feelings associated with the skill. Describe what you experience by "thinking aloud", remember to keep talking even if no image is present.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image and remember to keep talking about it, and tell me whether you are "inside" or "outside" your body.

Appendix D: Rating scales for Study 1

Instructions to give the participant

Rate your imagery of the skill on the scales provided. Remember that there are no right or wrong answers and that everyone is different in their use of imagery.

For items 1 - 3 just mark the point on the line that best represents your imagery of the sport skill.

For items 4 & 5 circle the response that best describes your imagery.

Imagery Rating

1.) Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period.

Internal |————————————+————————————| External

2.) Rate the relative time spent imaging inside (internal imagery) versus outside your body (external imagery) during just the actual execution of the skill. Just think of the actual movement, not before or after.

Internal |————————————+————————————| External

3.) Rate the relative IMPORTANCE or EFFECTIVENESS of the imagery types for you.

Internal |————————————+————————————| External

4.) Rate how clear the image was.

Not clear at all /no image	1	2	3	4	5	6	7	Extremely clear
				moderately clear				

5.) Rate your ability to control the image. (Were you able to image the skill as you wanted it to be performed?)

No control	1	2	3	4	5	6	7	Complete control
				moderate control				

Appendix E: Retrospective verbalisation questions after each skill in Study 1

Retrospective Verbalisation Questions

1.) Could you tell me about what happened in your imagery of the sport skill?

2.) Tell me what you remember most clearly from your imagery? (was there something that stood out?)

3.) Was imagery from the inside or outside stronger or clearer for you?

4.) When performing the actual skill itself were you inside or outside your body?

Appendix F: Debriefing questions for Study 1

Questions for end of the study

1.) What did you think of the imagery of all the skills?

2.) Is there anything you would like to tell me about any of the imagery you have just undertaken?

3.) Do you think you spent more time imaging from inside or outside of your body?

4.) Do you think imaging from inside or outside is more important to you?

5.) Before you performed the skills were you inside or outside your body?

6.) After you had completed the skills were you inside or outside your body?

7.) If you did switch between inside and outside your body, was it a conscious decision to switch?

Debriefing

1.) What problems did you experience with the procedure?

2.) What problems did you have with "talking aloud" while imaging?

3.) Which of the imagery scenes/sport skills did you find particularly difficult to produce? Why?

4.) How did "thinking aloud" affect your ability to image?

5.) Are there any questions you have?

Thank you for your participation in this study.

Appendix G: Informed consent form for Study 1

VICTORIA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF PHYSICAL EDUCATION AND RECREATION
CENTRE FOR REHABILITATION, EXERCISE AND SPORT SCIENCE

Informed Consent

This study is concerned with investigating imagery of different types of motor skills. Many studies have shown imagery can help sportspeople improve sports performance. Imagery involves imagining a scene or activity in your mind. Participating in this study will involve you imaging performing eight sport skills.

You will be asked to perform imagery while providing concurrent verbalisation, which essentially means telling the researcher what you are imaging while you are actually imaging. You will also be asked to fill in questionnaires aimed at finding out about your imagery session.

During the session your verbalisations will be recorded. If you do feel uncomfortable, you are free to take a break at any time. You are also free to withdraw from the program at any time. Your responses will be kept confidential at all times. We will be happy to answer any questions you have at any time.

STATEMENT

I certify that:

I have the legal ability to give valid consent
I understand the procedures to be used in the study
I am aware of the risks associated with the study
I have had the chance to have my questions answered
I am free to withdraw at any time
My responses will be totally confidential
and
I freely give my consent to participation using the procedures.

Signed: ________________________________)
Participant)
) Date:________________

Signed: ________________________________)
Parent/Guardian)
) Date:________________

Appendix H: Protocol, imagery script and diagrams for pre-test and post-test for Study 2

Procedure for Study 2

- Fill in informed consent form

- Fill in IUQ and additional questions

- General instructions

- Specific instructions

- Pre-test: perform imagery of each skill for 10 trials

- After each trial fill in rating scales

- Retrospective verbalisation after trials 1, 5, and 10

- Imagery training: four 30 minute sessions

- Post-test: perform imagery of each skill for 10 trials

- After each skill fill in rating scales

- Complete IUQ again

- Debrief

Protocol and Imagery Script for Pre-Test and Post-Test for Study 2

General Instructions - General nature of procedure.

We are interested in finding out about imagery - which is when you imagine a scene or activity in your mind. To find out more about what goes on during imagery of sports skills, you will to be asked to imagine two different sport skills over 10 trials. The two sports skills in this study are hitting a table tennis ball that has been projected by a ball machine back over the net to a concentric circles target and throwing a dart at a concentric circles target.

(Provide participants with a diagram of each skill.)

After each trial you will be asked to rate your imagery during that trial on a number of scales by marking on a line or circling a number. If you have any problems or concerns as we progress you are free to stop at any time and ask any questions about the procedure.

Specific Instructions - What the subject has to do.

When you image the skills try to experience all the senses associated with that skill, such as the sounds, sights, taste, smell, touch and feelings in your muscles or physical aspects of the skill. Try to imagine the activity at reals speed, so not in slo-mo or at a faster speed. Try to make the image as vivid, clear and realistic as you can. Also image yourself performing the skill successfully. Do you have any questions before you begin your imagery?

Imagery Pre-test/post-test for Study 2

Open Skill: Returning a moving ball to a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is hitting a table ball that has been projected by a ball machine back over the net to a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the ball is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are hitting a projected table tennis ball back over the net to a concentric circles target. The ball is hit successfully back over the net and to the point on the court where you were aiming. Try to experience all the senses and feelings associated with the skill.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 9 more times.

Closed Skill: Throwing a dart at a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is throwing a dart at a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the dart is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are throwing a dart to a concentric circles target. The dart is successfully thrown to the point on the dartboard where you were aiming. Try to experience all the senses and feelings associated with the skill.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 9 more times.

Diagram of Open Skill

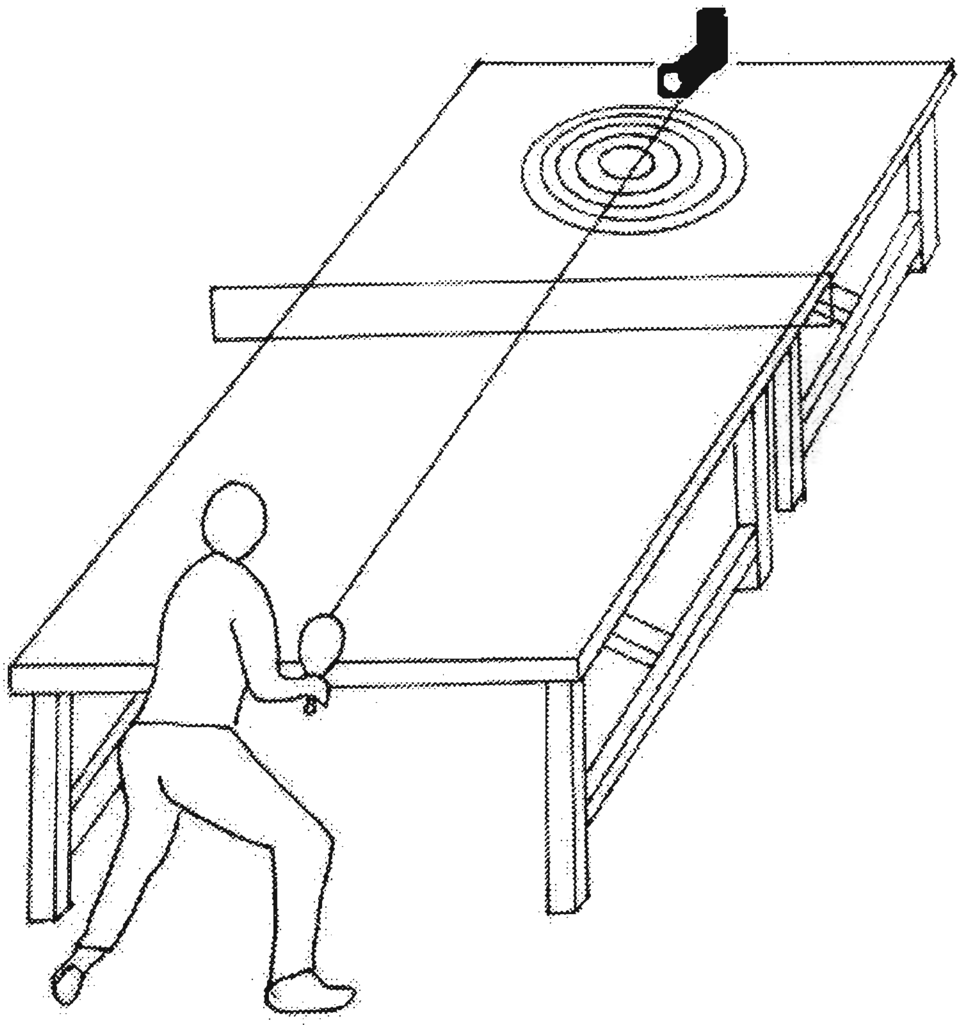
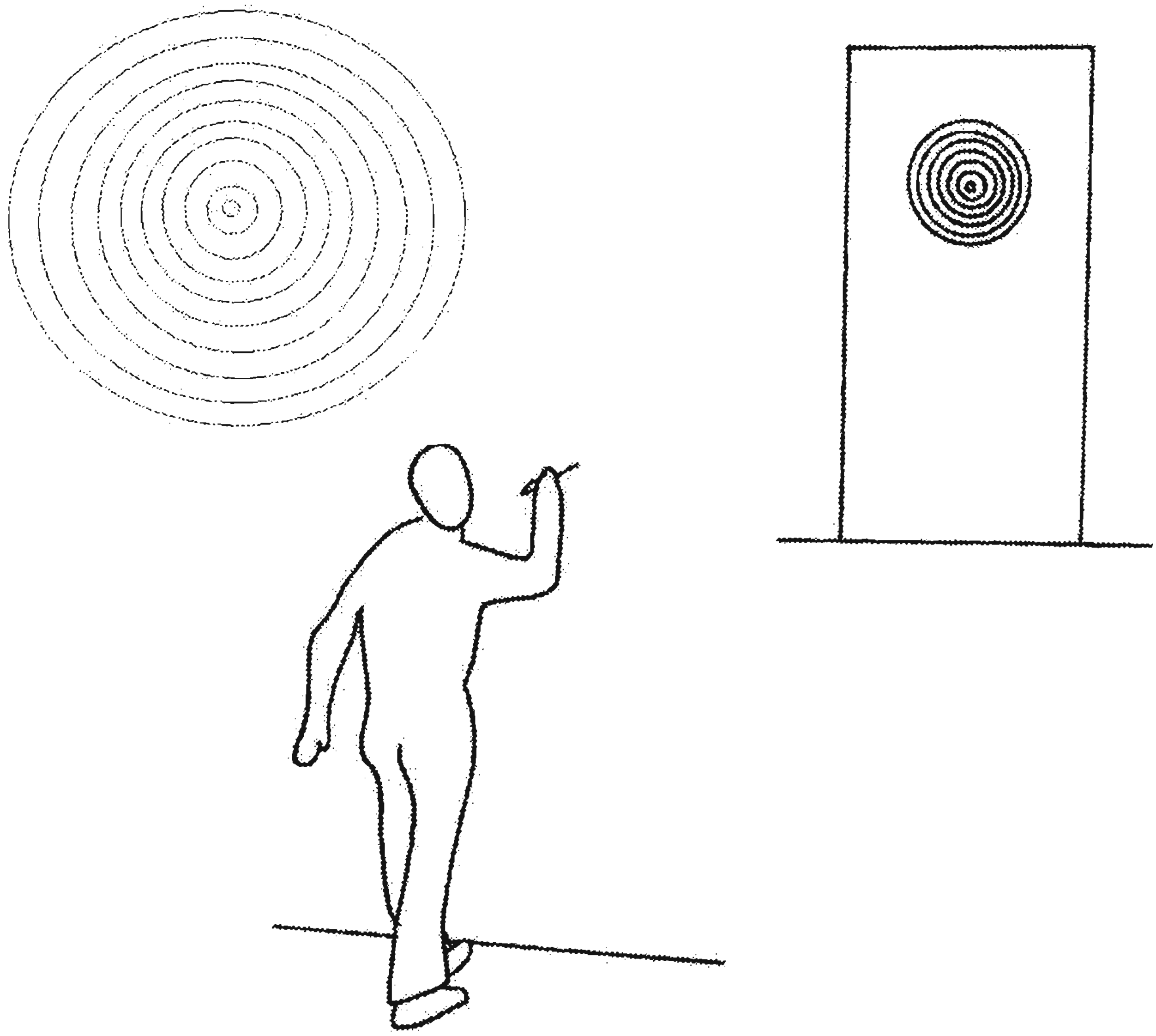


Diagram of Closed Skill



Imagery Rating

1.) Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period.

Internal |—————————+—————————| External

2.) Rate the relative time spent imaging inside (internal imagery) versus outside your body (external imagery) during just the actual execution of the skill. Just think of the actual movement, not before or after.

Internal |—————————+—————————| External

3.) Rate the relative IMPORTANCE or EFFECTIVENESS of the imagery types for you.

Internal |—————————+—————————| External

4.) Rate how clear the image was.

Not clear at all /no image	1	2	3	4 moderately clear	5	6	7	Extremely clear

5.) Rate your ability to control the image. (Were you able to image the skill as you wanted it to be performed?)

No control	1	2	3	4 moderate control	5	6	7	Complete control

Appendix I: Retrospective verbalisation questions for Study 2

Retrospective Verbalisation Questions

1.) Could you tell me about what happened in your imagery of the sport skill?

2.) Tell me what you remember most clearly from your imagery? (was there something that stood out?)

3.) Was imagery from the inside or outside stronger or clearer for you?

4.) When performing the actual skill itself were you inside or outside your body?

Appendix J: Internal imagery training program for Study 2

Imagery Training Program

4 x 30 min sessions

Session 1 - Imagining Static Objects

- table tennis bat
- table tennis ball
- dart
- dartboard

Session 2 - Imagining Simple Movements

- throwing a ball at a wall
- throwing dart at a board
- serving a table tennis ball
- hitting a backhand
- hitting a forehand

Session 3 - Imagery of 2 Skills

- dart throwing at concentric circles target
- hitting projected table tennis balls to a target

Session 4 - - Imagery of 2 Skills

- dart throwing at concentric circles target
- hitting projected table tennis balls to a target

Imagery Session 1 - Imagining Static Objects

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax[5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First we are going to imagine some objects from 2 sports: darts and table tennis. When you imagine these objects try to imagine them from inside your own body, as if you are there and experiencing it from your own eyes.

Imagining Table Tennis Bat

[Provide an example of holding the bat as a third person.]

[Give the participant a bat to experience for a period of 2 minutes.]

Now imagine that you have a table tennis bat in your hand [5 secs]. Look down your arm to the bat [5 secs]. The bat has a red rubber surface on one side and is blue on the other [5 secs]. Feel the bat in your hand, and the pressure of the handle on the palm of your hand [5 secs]. The handle is wooden, feel the texture of the handle [5 secs]. Experience this from inside your body [5 secs]. Slide your hand up the bat from the handle to the blade and feel the texture of the rubber surface against your skin [5 secs]. Bring the bat up in front of your face, right up in front of your eyes so that you can see it in close up [5 secs]. Focus closely on the bat see what is written on the rubber[5 secs]. Try to smell the wood and rubber of the bat [5 secs]. Take the bat away from your face [5 secs]. This concludes this imagery exercise.

Imagining Table Tennis Ball

[Provide an example of holding the ball as a third person.]

[Give the participant a ball to experience for a period of 2 minutes.]

The next object you are to imagine is a table tennis ball. Try to experience imagining the ball from inside your body, as if you are experiencing it from your own eyes. The ball is yellow and is lying on a green table tennis table in front of you [5 secs]. Look down at your hand, now reach your hand forward and pick up the ball, feel your arm and hand move towards the ball and pick it up [5 secs]. The ball is extremely light in the palm of your hand. [5 secs]. Look down at the ball in your hand. The ball is a yellow colour against your skin [5 secs]. Look at the name written on the ball [5 secs]. Smell the aroma of the ball [5 secs]. Now move your other hand over to your palm and feel the surface of the yellow table tennis ball with your index finger [5 secs]. Look down on your hands and the ball [5 secs]. Put the ball back down on the table, focus on the ball [5 secs]. There is a bat on the table next to the ball, pick up both the ball and the bat [5 secs]. Now bounce the ball on the bat and hear the sound [5 secs]. Feel the vibration as the ball hits the bat. Once again, place the ball and the bat back down on the table [5 secs]. Now walk away from the table [5 secs]. That concludes this imagery exercise.

Imagining Dart

[Provide an example of holding the dart as a third person.]

[Give the participant a dart to experience for a period of 2 minutes.]

Now you are to imagine a dart. Try to imagine experiencing this from inside your body [5 secs]. Focus on the dart, the dart is in your hand [5 secs]. Imagine the fine details of the dart [5 secs], the tail [5 secs], the sharp point [5 secs]. Look down at your hand, turn the dart in your hand and examine every part of the object [5 secs]. Feel its outline and texture [5 secs]. What colour is the tail of the dart [5 secs]. Change the colour of the dart's tail [5 secs]. Listen to the dart as you play with it in your hand [5 secs]. Bring the dart up in front of your face for a closer inspection, feel the muscles in your arm as you bring the dart up to your face [5 secs]. Focus in on the dart [5 secs]. Try to smell the dart [5 secs]. Take the dart up to your ears and flick its tail [5 secs]. Now take the dart away again and hold it in front of your body [5 secs]. This concludes this imagery exercise.

Imagining Dartboard

[Provide an example of performing this action for the participant to give a third person perspective.]

[Provide a dartboard for the participant to experience for a period of 2 minutes.]

The next object you are to imagine is a dart board. Imagine experiencing this from inside your body, from your own eyes [5 secs]. The dart board is located 9 ft away from you on a wall [5 secs]. Look directly towards the dartboard, away from you in the distance [5 secs]. The board has conentric circles of different colours on it, that is there is a big circle almost the size of the board, a smaller one within that, and a smaller one still, focus in on those circles [5 secs]. Now look down at your feet [5 secs]. Take a step forward and walk towards the board, feel the muscles in your legs as you move and listen to your feet on the ground [5 secs]. Stop yourself just in front of the dartboard, so the board is right in front of your eyes [5 secs]. Look closely at the board, it's really close to your face [5 secs]. Now reach up with your hand and touch the board with your fingers [5 secs]. Feel the texture of the board with your fingers [5 secs]. Step back from the board [5 secs]. Focus on the board again [5 secs]. Take another step back and focus on the board again [5 secs]. notice that it appears to be getting smaller with each step you take [5 secs]. Step back again and focus on the board [5 secs]. This concludes this imagery exercise.

Imagery Session 2 - Imagining Simple Movements

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First you are going to imagine some simple movements from 2 sports: darts and table tennis. When you imagine these movements try to imagine them from inside your own body, as if you are there and experiencing it from your own eyes.

Throwing a Ball at a Wall

[Third person demonstration of the task.]

[Actual performance of task.]

Now imagine that you are going to throw a ball at a wall [5 secs]. Experience this from inside your body, and from your own eyes [5 secs]. You have a ball in your hand [5 secs]. Look down your arm to the ball [5 secs]. Now feel the texture of the ball in your hand [5 secs]. What type of ball is it? [5 secs]. Try to smell the aroma of the ball, and the surroundings [5 secs]. Where are you? [5 secs]. Look towards the wall [5 secs]. Line up your target [5 secs]. Now feel your arm go back [5 secs]. Concentrate on feeling your body move as you throw the ball [5 secs]. Now throw the ball at the target [5 secs]. Hear the ball hit the wall and bounce off [5 secs]. That concludes this imagery exercise.

Throwing a Dart at a Board

[Third person demonstration of the task.]

[Actual performance of task.]

The next skill you are to imagine is throwing a dart at a dart board [5 secs]. Experience this from inside your body, as if you are really there [5 secs].Look down on the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. It is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Feel the sensation in your fingers as you release the dart. Hear the sound of the dart hit the board and stick in the spot you were aiming for [5 secs]. Walk over to the board and feel the muscular sensations in your arm and listen as you pull the dart out of the board.

Serving a Table Tennis Ball

[Third person demonstration of the task.]

[Actual performance of task.]

The next skill to imagine is serving a table tennis ball [5 secs]. Imagine performing this skill from inside your body, try to experience all the senses that would normally be associated with actually serving a table tennis ball, such as vision, sound, touch, taste, and the feeling of the movement [5 secs]. You are to serve the ball from the right side of the court to the left side of the court over the net [5 secs]. Feel the ball in your hand, its texture is smooth [5 secs].Feel how the ball rests on the ppalm of the hand. Throw it up about a foot vertically, check visually that it has been thrown in the correct trajectory, and time the movement of your bat forward to coincide with the ball dropping. Sense the vibratiuon and hear the click as the ball hits your bat, and feel your body move as you serve the ball [5 secs]. Hear the ball bounce on the table and then bounce again on the other side of the table.

For the next skills, I will describe the skill to be imagined, then you are to imagine the skill as instructed, when I tell you to start imaging. Let me know when you have finished imaging.

Hitting a Backhand

[Third person demonstration of the task.]

[Actual performance of task.]

The next skill to imagine is hitting a backhand shot in table tennis.Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from inside your body, and try to experience all the senses associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting a Forehand

[Third person demonstration of the task.]

[Actual performance of task.]

The next skill to imagine is hitting a forehand shot in table tennis. Imagine that your opponent is going to serve the ball to your forehand side, and you successfully hit a forehand shot past him for a winner. Experience performing this skill from inside your body, and try to experience all the senses associated with hitting a forehand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that your opponent has served the ball to your forehand side and hit a forehand return for a winner.

Imagery Session 3 - Imagery of 2 Skills

[Provide third person display of performance.] and then [Actual performance of task.] for both tasks.

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board, and imagery of hitting projected table tennis balls to a target. Try to experience the imagery from inside your body.

Dart Throwing at Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from inside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 5 times.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball the you hit will be projected by a ball projection machine and could land any where on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from inside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 5 times.

Imagery Session 4 - Imagery of 2 Skills

Provide third person display of performance.] and then [Actual performance of task.]for both tasks.

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board, and imagery of hitting projected table tennis balls to a target. Try to experience the imagery from inside your body.

Dart Throwing at Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from inside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 5 times.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball the you hit will be projected by a ball projection machine and could land any where on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from inside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 5 times.

Appendix K: External imagery training program for Study 2

Imagery Training Program

4 x 30 min sessions

Session 1 - Imagining Static Objects

- table tennis bat
- table tennis ball
- dart
- dartboard

Session 2 - Imagining Simple Movements

- throwing a ball at a wall
- throwing dart at a board
- serving a table tennis ball
- hitting a backhand
- hitting a forehand

Session 3 - Imagery of 2 Skills

- dart throwing at concentric circles target
- hitting projected table tennis balls to a target

Session 4 - - Imagery of 2 Skills

- dart throwing at concentric circles target
- hitting projected table tennis balls to a target

Imagery Session 1 - Imagining Static Objects

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First we are going to imagine some objects from 2 sports: darts and table tennis. When you imagine these objects try to imagine them from outside of your body, as if you are watching yourself on TV.

Imagining Table Tennis Bat

[Give the participants a bat to experience for a period of 2 minutes.]

[Provide an example of holding the bat as a third person.]

Now imagine that you are outside your body and experience yourself with a table tennis bat in your hand [5 secs]. Look at the bat in your hand [5 secs]. Experience the imagery from an angle of 45 degrees so that you are looking at yourself from side on [5 secs]. The bat has a red rubber surface on one side and is blue on the other [5 secs]. Feel the bat in your hand, and the pressure of the handle on the palm of your hand [5 secs]. Experience this from outside your body, change the angle you are experiencing the imagery from to a front on angle, so that you are looking directly at yourself [5 secs]. The handle is wooden, feel the texture of the handle [5 secs]. Slide your hand up the bat from the handle to the blade and feel the texture of the rubber surface against your skin [5 secs]. Now change the angle you are viewing from to side on, this time from the other side [5 secs]. Bring the bat up in front of your face [5 secs]. Try to smell the rubber and wood of the bat [5 secs]. Take the bat away from your face [5 secs]. Change to view yourself from behind your body, so that you can see the back of your head [5 secs]. This concludes this imagery exercise.

Imagining Table Tennis Ball

[Give the participant a ball to experience for a period of 2 minutes.]

[Provide and example of holding the ball as a third person.]

The next object you are to imagine is a table tennis ball. Try to experience the ball from outside your body, as if you are watching yourself on TV. The ball is yellow and is lying on a green table tennis table in front of you [5 secs]. View yourself from side on as you reach your hand towards the ball and pick it up [5 secs]. Change the view so that you are experiencing the imagery from front on, so that you are looking directly towards yourself [5 secs]. Concentrate on the ball, it is extremely light in the palm of your hand. The ball is a yellow colour against the palm of your hand [5 secs]. Look at the name written on the ball [5 secs]. Smell the aroma of the ball [5 secs]. Now move your other hand over to your palm and feel the surface of the yellow table tennis ball with your index finger [5 secs]. Change the view so that you are experiencing the imagery from side on [5 secs]. Put the ball back down on the table [5 secs]. Look at the ball on the table [5 secs]. There is a bat on the table next to the ball, pick up both the ball and the bat [5 secs]. Now bounce the ball on the bat and hear the sound [5 secs]. Once again, place the ball and the bat back down on the table [5 secs]. Now walk away from the table, that concludes this imagery exercise.

<u>Imagining Dart</u>

[Give the participant a dart to experience for a period of 2 minutes.]

[Provide an example of holding a dart from a third person persepctive.]

Now you are to imagine a dart. Try to imagine experiencing this from outside your body [5 secs]. Focus on the dart in your hand [5 secs]. Imagine the fine details of the dart, the tail, the sharp point [5 secs]. From front on, imagine turning the dart in your hand, and examining every part of the object [5 secs]. Feel its outline and texture [5 secs]. What colour is the tail of the dart [5 secs].Change the colour of the dart's tail [5 secs]. Listen to the dart as you play with it in your hands [5 secs]. Now from side on, experience yourself bringing the dart up in front of your face, feel the muscles in your arm move as you bring the dart up to your face [5 secs]. Try to smell the dart [5 secs]. Flick the tail of the dart and listen [5 secs]. Now take the dart away again and hold it in front of your body [5 secs]. Change the angle you are experiencing the imagery from to behind yourself, so that you can see the back of your head, and can no longer see the dart [5 secs]. This concludes the imagery exercise.

<u>Imagining Dart Board</u>

[Provide a dartboard for the participant to experience for a period of 2 minutes.]

[Provide an example of performing this action for the participant to give a third person perspective.]

The next object you are to imagine is a dart board. Imagine experiencing this from outside your body, as if watching yourself on TV [5 secs]. The dartboard is located 9 ft away from you on a wall [5 secs]. look directly towards the dartboard from behind yourself [5 secs]. You can see the back of your head and the dartboard in the distance [5 secs]. The board has concentric circles of different colours on it, that is there is a big circle alomost the size of the board, a smaller one within that, and a smaller one still, focus on those circles [5 secs]. now change the angle so that you are experiencing the imagery from side on to your body [5 secs]. Take a step forward and walk towards the board, feel the muscles in your legs as you move and listen to your feet on the ground [5 secs]. Stop yourself just in front of the board [5 secs]. Now reach up with your hand and touch the board with your finger [5 secs]. Feel the texture of the board with your fingers [5 secs]. Step back from the board [5 secs]. Change your angle to behind your body so that you can see the back of your head and your back [5 secs]. Focus on the board [5 secs]. Take another step back, notice that the board appears to be getting smaller as it gets further away [5 secs]. Step back again [5 secs]. This concludes this imagery exercise.

Imagery Session 2 - Imagining Simple Movements

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First you are going to imagine some simple movements from 2 sports: darts and table tennis. When you imagine these movements try to imagine them from outside your own body, as if you are watching yourself on TV.

Throwing a Ball at a Wall

[Actual performance of task.]

[Third person demonstration of the task.]

Now imagine that you are going to throw a ball at a wall [5 secs]. Experience this from outside your body, so that your whole body is visible, as if it is on TV, and you can hear and see all the movements, but can also experience the feelings, touch, taste, smell, and feel of the movements. [5 secs]. You have a ball in your hand [5 secs]. Now feel the texture of the ball in your hand [5 secs]. What type of ball is it? [5 secs]. Try to smell the aroma of the ball and the surroundings [5 secs]. Where are you? [5 secs]. Remember to experience this from outside your body [5 secs]. Visualise the wall [5 secs]. You are now going to throw the ball at the wall [5 secs]. Line up the target [5 secs]. Now feel your arm go back [5 secs]. Concentrate on feeling your body move as you throw the ball [5 secs]. Now throw the ball at the target [5 secs]. Hear the ball hit the wall and bounce off [5 secs]. That concludes this imagery exercise.

Throwing a Dart at a Board

[Actual performance of task.]

[Third person demonstration of the task.]

The next skill to imagine is throwing a dart at a dart board [5 secs]. experience this from outside your body, as if it is on TV, but also you can experience all the sensations, as if you were really there [5 secs]. You have the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. Remember to experience this from outside your body, it is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Hear the sound of the dart hit the board and stick in the spot you were aiming [5 secs]. From side on, view yourself as you walk over to the board and feel your arm and listen as you pull the dart out of the board.

Serving a Table Tennis Ball

[Actual performance of task.]

[Third person demonstration of the task.]

The next skill to imagine is serving a table tennis ball [5 secs]. Imagine performing this skill from outside your body, as if you are on TV, but try to experience all the senses that would normally be associated with actually serving a table tennis ball, such as vision, sound, touch, taste, and the feeling of the movement [5 secs]. You can experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you [5 secs]. You are to serve the ball from the right side of the court to the left side of the court over the net [5 secs]. Feel the ball in your hand, its texture is smooth [5 secs]. Feel how the ball rests on the ppalm of the hand. Throw it up about a foot vertically, check visually that it has been thrown in the correct trajectory, and time the movement of your bat forward to coincide with the ball dropping. Sense the vibratiuon and hear the click as the ball hits your bat, and feel your body move as you serve the ball [5 secs]. Hear the ball bounce on the table and then bounce again on the other side of the table.

For the next skills, I will describe the skill to be imagined, then you are to imagine the skill as instructed, when I tell you to start imaging. Let me know when you have finished imaging.

Hitting a Backhand

[Actual performance of task.] & [Provide third person display of performance.]

The next skill to imagine is hitting a backhand shot in table tennis. Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from outside your body, and try to experience all the skills associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting a Forehand

[Actual performance of task.]

[Third person demonstration of the task.]

The next skill to imagine is hitting a forehand shot in table tennis. Imagine that your opponent is going to serve the ball to your forehand side, and you successfully hit a forehand shot past him for a winner. Experience performing this skill from outside your body, and try to experience all the skills associated with hitting a forehand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that your opponent has served the ball to your forehand side and hit a forehand return for a winner.

Imagery Session 3 - Imagery of 2 Skills

[Actual performance of task.] & then [Provide third person display of performance.] for both tasks.

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board, and imagery of hitting projected table tennis balls to a target. Try to experience the imagery from outside your body.

Dart Throwing at a Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from outside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 5 times.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball that you hit will be projected by a ball projection machine and could land anywhere on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from outside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 5 times.

Imagery Session 4 - Imagery of 2 Skills

[Actual performance of task.] and then [Provide third person display of performance.] for both tasks.

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board, and imagery of hitting projected table tennis balls to a target. Try to experience the imagery from outside your body.

Dart Throwing at a Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from outside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 5 times.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball that you hit will be projected by a ball projection machine and could land anywhere on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from outside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 5 times.

Appendix L: Informed consent form for Study 2

VICTORIA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF HUMAN MOVEMENT, RECREATION, AND PERFORMANCE

Informed Consent

This study is concerned about imagery training programs with different motor skills. Imagery involves imagining a scene or activity in your mind. Participating in this study will involve doing four imagery training sessions and two testing sessions.

You will be pre-tested for imagery use by imagining two different motor skills over ten trials for each motor skill. After imagining the skill you will fill in ratings scales and describe what occurred in the imagery. You will also be asked to fill in a questionnaire aimed at finding out about how you generally use imagery. You will then be asked to practice imagery in four 30 minute training sessions. Finally you will be post-tested on the imagery of the two motor skills again.

If you feel uncomfortable, you are free to take a break at any time. You are also free to withdraw from the program at any time. Your responses will be kept confidential at all times. We will be happy to answer any questions you have at any time

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STATEMENT

I certify that:

I have the legal ability to give valid consent
I understand the procedures to be used in the study
I have had the chance to have my questions answered
I am free to withdraw at any time
My responses will be totally confidential
and
I freely give my consent to participation using the procedures described above.

Signed: ________________________________)
Participant)
) Date:________________

Signed: ________________________________)
Parent/Guardian)
) Date:________________

Appendix M: Protocol, imagery script, and rating scales for pre-test for Study 3

Procedure for Study 3

- Fill in informed consent form

- Imagery preferences pre-test
  - Fill in IUQ and additional questions
  - RS of 10 trials on each skill (open and closed)

- Assign to training condition (ITG/ETG/CG) based on preferences test

- General Perspective Training

- Manipulation Check

- Split into balanced order
  - ½ table tennis then darts
  - ½ darts than table tennis

- Skill 1 (darts or table tennis)
  - performance pre-test
  - I/E imagery rehearsal training on skill
  - manipulation check
  - performance post-test

- Skill 2 (darts or table tennis)
  - performance pre-test
  - I/E imagery rehearsal training on skill
  - manipulation check
  - performance post-test

- Debriefing

Protocol and Imagery Script for Pre-Test for Study 3

General Instructions - General nature of procedure.

We are interested in finding out about imagery - which is when you imagine a scene or activity in your mind. To find out more about what goes on during imagery of sports skills, you will to be asked to imagine two different sport skills over 10 trials. The two sports skills in this study are hitting a table tennis ball that has been projected by a ball machine back over the net to a concentric circles target and throwing a dart at a concentric circles target.

(Provide participants with a diagram of each skill.)

After each trial you will be asked to rate your imagery during that trial on a number of scales by marking on a line or circling a number. If you have any problems or concerns as we progress you are free to stop at any time and ask any questions about the procedure.

Specific Instructions - What the subject has to do.

When you image the skills try to experience all the senses associated with that skill, such as the sounds, sights, taste, smell, touch and feelings in your muscles or physical aspects of the skill. Try to imagine the activity at real speed, so not in slo-mo or at a faster speed. Try to make the image as vivid, clear and realistic as you can. Also image yourself performing the skill successfully. Do you have any questions before you begin your imagery?

Imagery Pre-test for Study 3

Open Skill: Returning a moving ball to a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is hitting a table ball that has been projected by a ball machine back over the net to a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the ball is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are hitting a projected table tennis ball back over the net to a concentric circles target. The ball is hit successfully back over the net and to the point on the court where you were aiming. Try to experience all the senses and feelings associated with the skill.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 9 more times.

Closed Skill: Throwing a dart at a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is throwing a dart at a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the dart is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are throwing a dart to a concentric circles target. The dart is successfully thrown to the point on the dartboard where you were aiming. Try to experience all the senses and feelings associated with the skill.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 9 more times.

Diagram of Open Skill

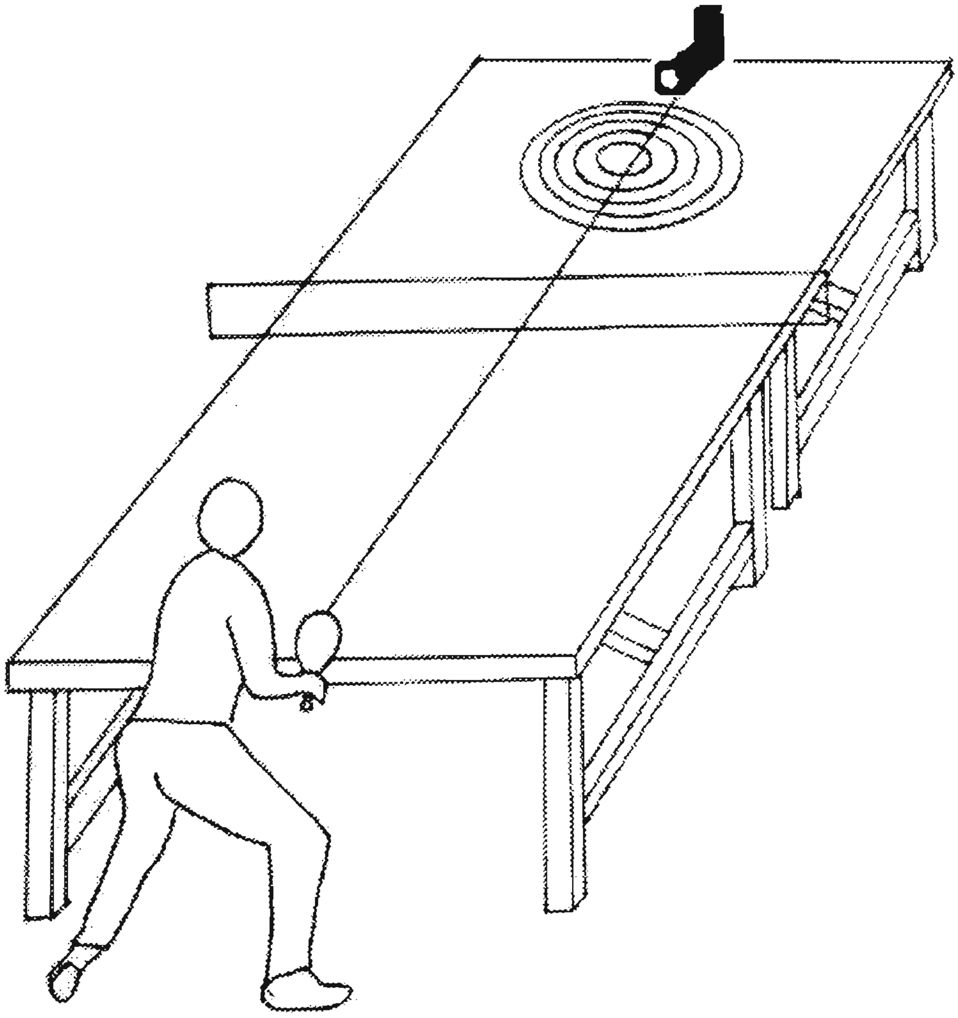
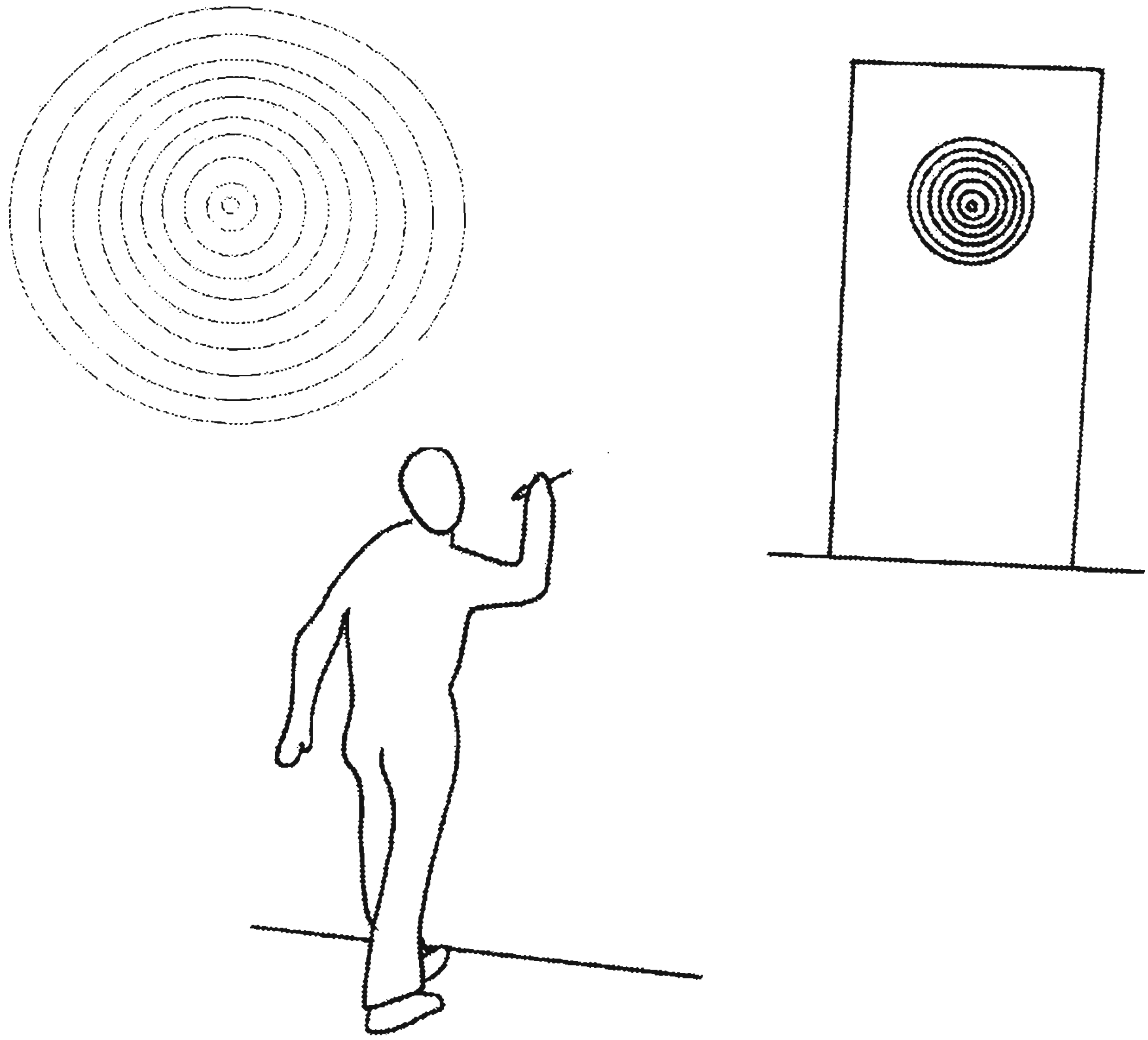


Diagram of Closed Skill



Imagery Rating

1.) Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period.

Internal |————————+————————| External

2.) Rate the relative time spent imaging inside (internal imagery) versus outside your body (external imagery) during just the actual execution of the skill. Just think of the actual movement, not before or after.

Internal |————————+————————| External

3.) Rate the relative IMPORTANCE or EFFECTIVENESS of the imagery types for you.

Internal |————————+————————| External

4.) Rate how clear the image was.

Not clear at all /no image	1	2	3	4	5	6	7	Extremely clear
				moderately clear				

5.) Rate your ability to control the image. (Were you able to image the skill as you wanted it to be performed?)

No control	1	2	3	4	5	6	7	Complete control
				moderate control				

Appendix N: Manipulation checks for Study 3

Manipulation Check for Table Tennis Study 3

Open Skill: Returning a moving ball to a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is hitting a table ball that has been projected by a ball machine back over the net to a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the ball is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are hitting a projected table tennis ball back over the net to a concentric circles target. The ball is hit successfully back over the net and to the point on the court where you were aiming. Try to experience all the senses and feelings associated with the skill.
Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 4 more times.

Manipulation Check for Darts Study 3

Closed Skill: Throwing a dart at a target.

(Provide participant with a diagram of the task.)

The sport skill to imagine is throwing a dart at a concentric circles target. Make yourself as comfortable as possible and take a couple of deep breaths and exhale slowly. Take a few moments now to plan exactly what you are going to image. Decide and plan now, before you do the imagery, what you are going to do, and where the dart is going to go. Make the speed of the action that you image just like it would be in the real situation, not slower or faster. You may close your eyes or leave them open depending on which your practice or previous experience suggests is easier for you. Then you are to imagine you are throwing a dart to a concentric circles target. The dart is successfully thrown to the point on the dartboard where you were aiming. Try to experience all the senses and feelings associated with the skill. Are you ready? Prepare yourself, get comfortable, focus on what you are to image, now start to image.

Fill in rating scales.

(Rest for 30 seconds) Repeat 9 more times.

Imagery Rating

1.) Rate the relative time you imaged from inside (internal imagery) versus outside your body (external imagery) during the imagery period.

Internal |——————————+——————————| External

2.) Rate the relative time spent imaging inside (internal imagery) versus outside your body (external imagery) during just the actual execution of the skill. Just think of the actual movement, not before or after.

Internal |——————————+——————————| External

3.) Rate the relative IMPORTANCE or EFFECTIVENESS of the imagery types for you.

Internal |——————————+——————————| External

4.) Rate how clear the image was.

Not clear at all /no image	1	2	3	4 moderately clear	5	6	7	Extremely clear

5.) Rate your ability to control the image. (Were you able to image the skill as you wanted it to be performed?)

No control	1	2	3	4 moderate control	5	6	7	Complete control

Appendix O: Internal imagery training program (general and specific) for Study 3

Imagery Training Program

General Perspective Training

2 x 30 min sessions

Session 1 - Imagining Static Objects

- table tennis bat
- table tennis ball
- dart
- dartboard

Session 2 - Imagining Simple Movements

- throwing a ball at a wall
- throwing dart at a board
- serving a table tennis ball
- hitting a backhand
- hitting a forehand

Specific Imagery Training

Table Tennis

Session 1 - Imagery of Table Tennis

- hitting projected table tennis balls to a target

Session 2 - - Imagery of Table Tennis

- hitting projected table tennis balls to a target

Darts

Session 1 - Imagery of Darts

- dart throwing at concentric circles target

Session 2 - - Imagery of Darts

- dart throwing at concentric circles target

General Perspective Training
Session 1 - Imagining Static Objects

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax[5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First we are going to imagine some objects from 2 sports: darts and table tennis. When you imagine these objects try to imagine them from inside your own body, as if you are there and experiencing it from your own eyes.

Imagining Table Tennis Bat

Now imagine that you have a table tennis bat in your hand [5 secs]. Look down your arm to the bat [5 secs]. The bat has a red rubber surface on one side and is blue on the other [5 secs]. Feel the bat in your hand, and the pressure of the handle on the palm of your hand [5 secs]. The handle is wooden, feel the texture of the handle [5 secs]. Experience this from inside your body [5 secs]. Slide your hand up the bat from the handle to the blade and feel the texture of the rubber surface against your skin [5 secs]. Bring the bat up in front of your face, right up in front of your eyes so that you can see it in close up [5 secs]. Focus closely on the bat see what is written on the rubber[5 secs]. Try to smell the wood and rubber of the bat [5 secs]. Take the bat away from your face [5 secs]. This concludes this imagery exercise.

Imagining Table Tennis Ball

The next object you are to imagine is a table tennis ball. Try to experience imagining the ball from inside your body, as if you are experiencing it from your own eyes. The ball is yellow and is lying on a green table tennis table in front of you [5 secs]. Look down at your hand, now reach your hand forward and pick up the ball, feel your arm and hand move towards the ball and pick it up [5 secs]. The ball is extremely light in the palm of your hand. [5 secs]. Look down at the ball in your hand. The ball is a yellow colour against your skin [5 secs]. Look at the name written on the ball [5 secs]. Smell the aroma of the ball [5 secs]. Now move your other hand over to your palm and feel the surface of the yellow table tennis ball with your index finger [5 secs]. Look down on your hands and the ball [5 secs]. Put the ball back down on the table, focus on the ball [5 secs]. There is a bat on the table next to the ball, pick up both the ball and the bat [5 secs]. Now bounce the ball on the bat and hear the sound [5 secs]. Feel the vibration as the ball hits the bat. Once again, place the ball and the bat back down on the table [5 secs]. Now walk away from the table [5 secs]. That concludes this imagery exercise.

Imagining Dart

Now you are to imagine a dart. Try to imagine experiencing this from inside your body [5 secs]. Focus on the dart, the dart is in your hand [5 secs]. Imagine the fine details of the dart [5 secs], the tail [5 secs], the sharp point [5 secs]. Look down at your hand, turn the dart in your hand and examine every part of the object [5 secs]. Feel its outline and texture [5 secs]. What colour is the tail of the dart [5 secs]. Change the colour of the dart's tail [5 secs]. Listen to the dart as you play with it in your hand [5 secs]. Bring the dart up in front of your face for a closer inspection, feel the muscles in your arm as you bring the dart up to your face [5 secs]. Focus in on the dart [5 secs]. Try to smell the dart [5 secs]. Take the dart up to your ears and flick its tail [5 secs]. Now take the dart away again and hold it in front of your body [5 secs]. This concludes this imagery exercise.

Imagining Dartboard

The next object you are to imagine is a dart board. Imagine experiencing this from inside your body, from your own eyes [5 secs]. The dart board is located 9 ft away from you on a wall [5 secs]. Look directly towards the dartboard, away from you in the distance [5 secs]. The board has conentric circles of different colours on it, that is there is a big circle almost the size of the board, a smaller one within that, and a smaller one still, focus in on those circles [5 secs]. Now look down at your feet [5 secs]. Take a step forward and walk towards the board, feel the muscles in your legs as you move and listen to your feet on the ground [5 secs]. Stop yourself just in front of the dartboard, so the board is right in front of your eyes [5 secs]. Look closely at the board, it's really close to your face [5 secs]. Now reach up with your hand and touch the board with your fingers [5 secs]. Feel the texture of the board with your fingers [5 secs]. Step back from the board [5 secs]. Focus on the board again [5 secs]. Take another step back and focus on the board again [5 secs]. notice that it appears to be getting smaller with each step you take [5 secs]. Step back again and focus on the board [5 secs]. This concludes this imagery exercise.

General Perspective Training
Session 2 - Imagining Simple Movements

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First you are going to imagine some simple movements from 2 sports: darts and table tennis. When you imagine these movements try to imagine them from inside your own body, as if you are there and experiencing it from your own eyes.

Throwing a Ball at a Wall

Now imagine that you are going to throw a ball at a wall [5 secs]. Experience this from inside your body, and from your own eyes [5 secs]. You have a ball in your hand [5 secs]. Look down your arm to the ball [5 secs]. Now feel the texture of the ball in your hand [5 secs]. What type of ball is it? [5 secs]. Try to smell the aroma of the ball, and the surroundings [5 secs]. Where are you? [5 secs]. Look towards the wall [5 secs]. Line up your target [5 secs]. Now feel your arm go back [5 secs]. Concentrate on feeling your body move as you throw the ball [5 secs]. Now throw the ball at the target [5 secs]. Hear the ball hit the wall and bounce off [5 secs]. That concludes this imagery exercise.

Throwing a Dart at a Board

The next skill you are to imagine is throwing a dart at a dart board [5 secs]. Experience this from inside your body, as if you are really there [5 secs].Look down on the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. It is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Feel the sensation in your fingers as you release the dart. Hear the sound of the dart hit the board and stick in the spot you were aiming for [5 secs]. Walk over to the board and feel the muscular sensations in your arm and listen as you pull the dart out of the board.

Serving a Table Tennis Ball

The next skill to imagine is serving a table tennis ball [5 secs]. Imagine performing this skill from inside your body, try to experience all the senses that would normally be associated with actually serving a table tennis ball, such as vision, sound, touch, taste, and the feeling of the movement [5 secs]. You are to serve the ball from the right side of the court to the left side of the court over the net [5 secs]. Feel the ball in your hand, its texture is smooth [5 secs].Feel how the ball rests on the ppalm of the hand. Throw it up about a foot vertically, check visually that it has been thrown in the correct trajectory, and time the movement of your bat forward to coincide with the ball dropping. Sense the vibratiuon and hear the click as the ball hits your bat, and feel your body move as you serve the ball [5 secs]. Hear the ball bounce on the table and then bounce again on the other side of the table.

For the next skills, I will describe the skill to be imagined, then you are to imagine the skill as instructed, when I tell you to start imaging. Let me know when you have finished imaging.

Hitting a Backhand

The next skill to imagine is hitting a backhand shot in table tennis. Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from inside your body, and try to experience all the senses associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting a Forehand

The next skill to imagine is hitting a forehand shot in table tennis. Imagine that your opponent is going to serve the ball to your forehand side, and you successfully hit a forehand shot past him for a winner. Experience performing this skill from inside your body, and try to experience all the senses associated with hitting a forehand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that your opponent has served the ball to your forehand side and hit a forehand return for a winner.

Specific Training Table Tennis
Session 1

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of hitting projected table tennis balls to a target. Try to experience the imagery from inside your body.

Hitting a Backhand

The next skill to imagine is hitting a backhand shot in table tennis. Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from inside your body, and try to experience all the senses associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball the you hit will be projected by a ball projection machine and could land any where on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from inside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 15 times.

Specific Training Table Tennis
Session 2

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of hitting projected table tennis balls to a target. Try to experience the imagery from inside your body.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball the you hit will be projected by a ball projection machine and could land any where on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from inside your body. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 20 times.

Specific Training Darts
Session 1

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board. Try to experience the imagery from inside your body.

Throwing a Dart at a Board

The skill you are to imagine is throwing a dart at a dart board [5 secs]. Experience this from inside your body, as if you are really there [5 secs].Look down on the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. It is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Feel the sensation in your fingers as you release the dart. Hear the sound of the dart hit the board and stick in the spot you were aiming for [5 secs]. Walk over to the board and feel the muscular sensations in your arm and listen as you pull the dart out of the board.

Dart Throwing at Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from inside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 15 times.

Specific Training Darts
Session 2

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board. Try to experience the imagery from inside your body.

Dart Throwing at Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from inside your body. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 20 times.

Appendix P: External imagery training program (general and specific) for Study 3

Imagery Training Program

General Perspective Training

2 x 30 min sessions

Session 1 - Imagining Static Objects

- table tennis bat
- table tennis ball
- dart
- dartboard

Session 2 - Imagining Simple Movements

- throwing a ball at a wall
- throwing dart at a board
- serving a table tennis ball
- hitting a backhand
- hitting a forehand

Specific Imagery Training

Table Tennis

Session 1 - Imagery of Table Tennis

- hitting projected table tennis balls to a target

Session 2 - - Imagery of Table Tennis

- hitting projected table tennis balls to a target

Darts

Session 1 - Imagery of Darts

- dart throwing at concentric circles target

Session 2 - - Imagery of Darts

- dart throwing at concentric circles target

General Perspective Training
Session 1 - Imagining Static Objects

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First we are going to imagine some objects from 2 sports: darts and table tennis. When you imagine these objects try to imagine them from outside of your body, as if you are watching yourself on TV.

Imagining Table Tennis Bat

Now imagine that you are outside your body and experience yourself with a table tennis bat in your hand [5 secs]. Look at the bat in your hand [5 secs]. Experience the imagery from an angle of 45 degrees so that you are looking at yourself from side on [5 secs]. The bat has a red rubber surface on one side and is blue on the other [5 secs]. Feel the bat in your hand, and the pressure of the handle on the palm of your hand [5 secs]. Experience this from outside your body, change the angle you are experiencing the imagery from to a front on angle, so that you are looking directly at yourself [5 secs]. The handle is wooden, feel the texture of the handle [5 secs]. Slide your hand up the bat from the handle to the blade and feel the texture of the rubber surface against your skin [5 secs]. Now change the angle you are viewing from to side on, this time from the other side [5 secs]. Bring the bat up in front of your face [5 secs]. Try to smell the rubber and wood of the bat [5 secs]. Take the bat away from your face [5 secs]. Change to view yourself from behind your body, so that you can see the back of your head [5 secs]. This concludes this imagery exercise.

Imagining Table Tennis Ball

The next object you are to imagine is a table tennis ball. Try to experience the ball from outside your body, as if you are watching yourself on TV. The ball is yellow and is lying on a green table tennis table in front of you [5 secs]. View yourself from side on as you reach your hand towards the ball and pick it up [5 secs]. Change the view so that you are experiencing the imagery from front on, so that you are looking directly towards yourself [5 secs]. Concentrate on the ball, it is extremely light in the palm of your hand. The ball is a yellow colour against the palm of your hand [5 secs]. Look at the name written on the ball [5 secs]. Smell the aroma of the ball [5 secs]. Now move your other hand over to your palm and feel the surface of the yellow table tennis ball with your index finger [5 secs]. Change the view so that you are experiencing the imagery from side on [5 secs]. Put the ball back down on the table [5 secs]. Look at the ball on the table [5 secs]. There is a bat on the table next to the ball, pick up both the ball and the bat [5 secs]. Now bounce the ball on the bat and hear the sound [5 secs]. Once again, place the ball and the bat back down on the table [5 secs]. Now walk away from the table, that concludes this imagery exercise.

Imagining Dart

Now you are to imagine a dart. Try to imagine experiencing this from outside your body [5 secs]. Focus on the dart in your hand [5 secs]. Imagine the fine details of the dart, the tail, the sharp point [5 secs]. From front on, imagine turning the dart in your hand, and examining every part of the object [5 secs]. Feel its outline and texture [5 secs]. What colour is the tail of the dart [5 secs].Change the colour of the dart's tail [5 secs]. Listen to the dart as you play with it in your hands [5 secs]. Now from side on, experience yourself bringing the dart up in front of your face, feel the muscles in your arm move as you bring the dart up to your face [5 secs]. Try to smell the dart [5 secs]. Flick the tail of the dart and listen [5 secs]. Now take the dart away again and hold it in front of your body [5 secs]. Change the angle you are experiencing the imagery from to behind yourself, so that you can see the back of your head, and can no longer see the dart [5 secs]. This concludes the imagery exercise.

Imagining Dart Board

The next object you are to imagine is a dart board. Imagine experiencing this from outside your body, as if watching yourself on TV [5 secs]. The dartboard is located 9 ft away from you on a wall [5 secs]. look directly towards the dartboard from behind yourself [5 secs]. You can see the back of your head and the dartboard in the distance [5 secs]. The board has concentric circles of different colours on it, that is there is a big circle alomost the size of the board, a smaller one within that, and a smaller one still, focus on those circles [5 secs]. now change the angle so that you are experiencing the imagery from side on to your body [5 secs]. Take a step forward and walk towards the board, feel the muscles in your legs as you move and listen to your feet on the ground [5 secs]. Stop yourself just in front of the board [5 secs]. Now reach up with your hand and touch the board with your finger [5 secs]. Feel the texture of the board with your fingers [5 secs]. Step back from the board [5 secs]. Change your angle to behind your body so that you can see the back of your head and your back [5 secs]. Focus on the board [5 secs]. Take another step back, notice that the board appears to be getting smaller as it gets further away [5 secs]. Step back again [5 secs]. This concludes this imagery exercise.

General Perspective Training
Session 2 - Imagining Simple Movements

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing [10 secs], feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

Listen and follow the instructions. First you are going to imagine some simple movements from 2 sports: darts and table tennis. When you imagine these movements try to imagine them from outside your own body, as if you are watching yourself on TV.

Throwing a Ball at a Wall

Now imagine that you are going to throw a ball at a wall [5 secs]. Experience this from outside your body, so that your whole body is visible, as if it is on TV, and you can hear and see all the movements, but can also experience the feelings, touch, taste, smell, and feel of the movements. [5 secs]. You have a ball in your hand [5 secs]. Now feel the texture of the ball in your hand [5 secs]. What type of ball is it? [5 secs]. Try to smell the aroma of the ball and the surroundings [5 secs]. Where are you? [5 secs]. Remember to experience this from outside your body [5 secs]. Visualise the wall [5 secs]. You are now going to throw the ball at the wall [5 secs]. Line up the target [5 secs]. Now feel your arm go back [5 secs]. Concentrate on feeling your body move as you throw the ball [5 secs]. Now throw the ball at the target [5 secs]. Hear the ball hit the wall and bounce off [5 secs]. That concludes this imagery exercise.

Throwing a Dart at a Board

The next skill to imagine is throwing a dart at a dart board [5 secs]. experience this from outside your body, as if it is on TV, but also you can experience all the sensations, as if you were really there [5 secs]. You have the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. Remember to experience this from outside your body, it is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Hear the sound of the dart hit the board and stick in the spot you were aiming [5 secs]. From side on, view yourself as you walk over to the board and feel your arm and listen as you pull the dart out of the board.

Serving a Table Tennis Ball

The next skill to imagine is serving a table tennis ball [5 secs]. Imagine performing this skill from outside your body, as if you are on TV, but try to experience all the senses that would normally be associated with actually serving a table tennis ball, such as vision, sound, touch, taste, and the feeling of the movement [5 secs]. You can experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you [5 secs]. You are to serve the ball from the right side of the court to the left side of the court over the net [5 secs]. Feel the ball in your hand, its texture is smooth [5 secs]. Feel how the ball rests on the ppalm of the hand. Throw it up about a foot vertically, check visually that it has been thrown in the correct trajectory, and time the movement of your bat forward to coincide with the ball dropping. Sense the vibratiuon and hear the click as the ball hits your bat, and feel your body move as you serve the ball [5 secs]. Hear the ball bounce on the table and then bounce again on the other side of the table.

For the next skills, I will describe the skill to be imagined, then you are to imagine the skill as instructed, when I tell you to start imaging. Let me know when you have finished imaging.

Hitting a Backhand

The next skill to imagine is hitting a backhand shot in table tennis. Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from outside your body, and try to experience all the skills associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting a Forehand

The next skill to imagine is hitting a forehand shot in table tennis. Imagine that your opponent is going to serve the ball to your forehand side, and you successfully hit a forehand shot past him for a winner. Experience performing this skill from outside your body, and try to experience all the skills associated with hitting a forehand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that your opponent has served the ball to your forehand side and hit a forehand return for a winner.

Specific Training Table Tennis
Session 1

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of hitting projected table tennis balls to a target. Try to experience the imagery from outside your body.

Hitting a Backhand

The next skill to imagine is hitting a backhand shot in table tennis. Imagine that your opponent is going to serve the ball to your backhand side, and you successfully hit a backhand shot past him for a winner. Experience performing this skill from outside your body, and try to experience all the senses associated with hitting a backhand shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. See yourself as if you are on TV and can change the angle of the camera. Now imagine that your opponent has served the ball to your backhand side and hit a backhand return for a winner.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball that you hit will be projected by a ball projection machine and could land anywhere on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from outside your body, see yourself hit the ball like watching yourself on TV. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 15 times.

Specific Training Table Tennis
Session 2

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will imagery of hitting projected table tennis balls to a target. Try to experience the imagery from outside your body.

Hitting Projected Table Tennis Balls to a Target

Now you are to imagine hitting a table tennis ball to a concentric circles target on the other side of the net. The ball that you hit will be projected by a ball projection machine and could land anywhere on your side of the court. You are to imagine successfully hitting the ball back over the net to the centre of the target on the table. For this skill experience the imagery from outside your body, see yourself hit the ball like watching yourself on TV. Try to experience all the senses associated with hitting a shot in table tennis, such as the feeling of your muscles moving, the sight of the ball leaving the bat, the sound of the ball hitting the bat and bouncing on the table, and the smell of the ball, the table and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are hitting a table tennis ball to a concentric circles target on the other side of the net.

Repeat 20 times.

Specific Training Darts

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board. Try to experience the imagery from outside your body.

Throwing a Dart at a Board

The next skill to imagine is throwing a dart at a dart board [5 secs]. experience this from outside your body, as if it is on TV, but also you can experience all the sensations, as if you were really there [5 secs]. You have the dart in your hand [5 secs]. Feel the texture of the dart in your hand, the tip feels shiny and sharp, the tail is feathered [5 secs]. Take a deep breath and smell the environment [5 secs]. Now line up the part of the dartboard you are aiming for [5 secs]. Remember to experience this from outside your body, it is now time to throw the dart [5 secs]. Feel the movements of your muscles as you take your arm back and throw at the board [5 secs]. Hear the sound of the dart hit the board and stick in the spot you were aiming [5 secs]. From side on, view yourself as you walk over to the board and feel your arm and listen as you pull the dart out of the board.

Dart Throwing at a Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from outside your body see yourself throw the dart like watching yourself on TV. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 15 times.

Specific Training Darts
Session 2

Relaxation

Close your eyes and get yourself comfortable[5 secs]. Concentrate on your breathing, feel your muscles relax [5 secs]. Feel your arms relax [5 secs], your head [5 secs], your neck [5 secs], your shoulders [5 secs], chest [5 secs], back [5 secs], thighs [5 secs], calves [5 secs]. Feel the relaxation all over.

In this imagery session you will practice imagery of throwing a dart at a concentric circles target dart board, and imagery of hitting projected table tennis balls to a target. Try to experience the imagery from outside your body.

Dart Throwing at a Concentric Circles Target

Now you are to imagine throwing a dart at a concentric circles target dart board. In this skill you are to successfully throw the dart to the centre of the dart board. For this skill experience the imagery from outside your body, see yourself throw the dart like watching yourself on TV. Try to experience all the senses associated with throwing a dart at a dart board, such as the feeling of your muscles moving, the sight of the dart leaving your hand, the sound of the dart hitting the board, and the smell of the dart, the board, and the environment. Experience this from different angles, such as side on, front on, behind, depending on what seems most appropriate for you. Now imagine that you are throwing a dart at a concentric circles dartboard and successfully hit the target.

Repeat 20 times.

Appendix Q: Informed consent form for Study 3

VICTORIA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF HUMAN MOVEMENT, RECREATION, AND PERFORMANCE

Informed Consent

This study is concerned about imagery training for open and closed skill performance. Imagery involves imagining a scene or activity in your mind. Participating in this study will involve doing four imagery training sessions and two testing sessions.

You will be tested for performance on two sports skills and also be asked to fill in questionnaires aimed at finding out about your use of imagery. You will then be asked to practice imagery in four 30 minute sessions. After the imagery training you will be tested again on performance on the two sport skills.

If you feel uncomfortable, you are free to take a break at any time. You are also free to withdraw from the program at any time. Your responses will be kept confidential at all times. We will be happy to answer any questions you have at any time

Any queries about your participation in this project may be directed to the researcher (Name:Michael Spittle ph. 9248-1133 / 9779-9160). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710).

Victoria University of Technology

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study into... **[response to Question 17a to be inserted here.]**

CERTIFICATION BY SUBJECT

I,
of

certify that I am at least 17 years old* and that I am voluntarily giving my consent to participate in the experiment entitled:

being conducted at Victoria University of Technology by: Michael Spittle

I certify that the objectives of the experiment, together with any risks to me associated with the procedures listed hereunder to be carried out in the experiment, have been fully explained to me by:

and that I freely consent to participation involving the use on me of these procedures.

Procedures:

You will first be asked to fill in a questionnaire aimed at finding out about how you generally use imagery. You will then be pre-tested for imagery use by imagining two different motor skills over ten trials for each motor skill. After imagining the skill you will fill in ratings scales to describe what happened during the imagery. You will be pre-tested for performance on two skills, dart throwing and table tennis. You will then be asked to practice using different approaches in six 30 minute training sessions. Finally you will be post-tested on performance and imagery of the two motor skills again.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this experiment at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: .... }

Witness other than the experimenter: } **Date: ....**

....}

Any queries about your participation in this project may be directed to the researcher (Name:Michael Spittle ph. 9248-1133 / 9779-9160). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710).

[*please note: where the subject/s is aged under 18, separate parental consent is required; where the subject is unable to answer for themselves due to mental illness or disability, parental or guardian consent may be required.]