Enhancing Athletic and Psychic Performances Through the Use of Imagery Based Mental Strategies

Ph.D. Thesis

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The effect of using imagery as a mental strategy to affect performance was studied in this thesis. Two main areas of research were conducted in parallel. The first explored the effect that imagery strategies have on athletic performance. The second was the use of imagery as a strategy to show an anomalous interaction between a human participant and the output of a pseudo-random algorithm of a personal computer. This latter line of research is commonly conducted by parapsychologists. Conceptually there are numerous ties between the two areas studied although these were not experimentally directly assessed in this thesis.

There is a common coaching 'wisdom' that mentally rehearsing an athletic endeavour will increase actual athletic performance. A quantitative review of the experimental literature has revealed a medium-sized beneficial effect for mental rehearsal (Feltz & Landers 1983), to back up this 'coaching wisdom'. In four different sports (vaulting in gymnastics, trampolining, shooting and novice jugglers) this hypothesis was not supported significantly. In three of the experiments the opposite trend to the hypothesis was observed, that is the control condition showed a higher performance compared to the experimental group that was using imagery (even if this group was specifically trained in imagery skills).

Subsequent experiments assessed the impact of the qualitative differences in experimental participants' imagery whilst using it in mental rehearsal. Internal imagery is when the scene is experienced from the point of view of the performer of an athletic event — an external perspective has the imager experience the scene from the point of view of an external observer. Three experiments were conducted to see which perspective would confer the highest performance enhancement when used in mental rehearsal. The results from these experiments were used to develop a tentative model to suggest which of the two perspectives would be better depending on: whether the athlete is familiar with employing a mental rehearsal strategy; whether he/she can successfully generate the appropriate imagery ; and what type of task is to be imaged.

The results are discussed with regard to the four sports studied, other aspects of sports psychology and relevant concepts from psychological areas. Implications of the research for athletes and coaches are explored and recommendations for future research are made.

Psychokinesis ('mind over matter'), is studied in modern parapsychological laboratories by observing the statistical output of a random event generator, which a participant (who is not linked to the random event generator in any 'normal' way) has tried to exert her or his 'will' on the random process and bias it in a pre-specified direction. Many such experiments have been conducted and assessed via a meta-analysis (Radin & Nelson 1989), who conclude that there is an anomaly in need of an explanation. Various researchers have tried to increase this effect by various manipulations, such as asking their participants to adopt a particular mental strategy. From anecdotal reports and folk literature, it appears that imagery might play a large role in such anomalous interactions. Some of the experimental literature supports a positive effect when a mental strategy employing imagery is used, whilst others do not. It was decided to try and replicate the positive findings.

Four experiments showed a positive effect that a goal directed mental imagery strategy appeared to be associated with successful psychokinetic performance, although only one of the experiments approached statistical significance at an alpha level of 0.05. There were some suggestive positive correlations between participants' imagery ability and their psychokinetic performance scores, although this was not consistent across all the experiments.

A final experiment was unsuccessful in showing any strong relationship between the strength of the psychokinetic scores and three experimental measurements that were believed to be linked to higher scoring. They were: a majority vote procedure, the imagery perspective that a participant might take in their imagery and their supposed state of absorption in the experimental task.

The results are discussed with respect to some of the current parapsychological literature on paranormal interactions and imagery ability. Implications for future research strategies are discussed.

Acknowledgments

I would like to acknowledge and thank the following for their financial support of this thesis: the Economic and Social Research Council, the Koestler Chair of Parapsychology, Sheila Matthew and the Scottish Sports Council. I am grateful for being guided into the world of sport psychology by Lew Hardy, Richard Cox, David Marks and Anne Issac. I had considerable support for computing related matters from Donald Morse, Alex Nolan, Paul Hutton, Hamish McLeod, Toby Morris and David Taylor, to whom I am deeply grateful. I would also like to thank my colleagues and friends for helping me throughout the thesis, Bob Morris, Caroline Watt, Jessica Utts, Davey Wilkinson, Jimmy Cuthbert, Richard Wiseman, Audrey van der Meer, Ruud van der Weel, Chris Roe, Chuck Honorton, Stanley Krippner, Anthony Taylor and especially to Sheila Matthew.

Finally I would like to acknowledge and thank all the athletes and participants that took part in my experiments.

Declaration

I declare that the work conducted for and presented in this thesis has been composed by myself.

Robin Taylor
September 1992

CHAPTER 1

Introduction to the Main Areas of the Study

Imagery has been used as a method to enhance performance for a variety of activities. Two of these that are explored in this thesis, is the enhancement of athletic performance, and the ability to demonstrate micro-psychokinetic effects (defined below). The thesis is split up into two main sections, each of which explored performance enhancement by imagery, as a parallel track of research. The first deals with the effect of imagery as it affects sports performance. The second deals with imagery and micro-PK performance. A final section summarizes the thesis and draws out some of the links between these two sub-disciplines of psychology. This first chapter outlines the overall reasoning and structure of the thesis.

Enhancing Sports Performance through the Use of Imagery Procedures

In the Wimbledon men's tennis final of 1975, Arthur Ashe was repeatedly seen closing his eyes between matches in what looked like meditation. In fact he was mentally rehearsing and replaying his tennis match (Ashe 1986). After he won the tournament, mental rehearsal suddenly became the latest technique to enhance athletic performance. However, top athletes had been using this technique much earlier than 1975. The effects of benefits derived from using a mental technique (MT), or several MTs, are far from empirically established facts and sport psychologists are only just getting their research teeth stuck into the subject. For this report an MT is any mental strategy that is used to try and improve athletic performance. It is the anecdotal reports of athletes using MTs which has spawned the research into the area rather than sport psychologists originating the idea themselves and making recommendations to athletes. Sport psychologists today (eg Railo 1986, Nideffer 1985) almost invariably recommend that athletes use imagery to mentally rehearse their sport in order to make significant improvements to their actual sporting performance; although this advice is given more on the basis that the anecdotal reports of top athletes do it, rather than any firm establishment of scientific fact. However, there is no reason to suppose that academic sport psychology cannot refine and improve what some athletes do naturally or 'applied sport psychologists' routinely recommend to their athletes, to further enhance any beneficial effect that might occur (Cox 1990). Other occupations have much to gain from this type of research and benefits are likely to arise for any job which requires very good or accurate motor performance, such as in the armed forces, the fire–fighting services or in the medical professions.

The majority of mental techniques employed in sport psychology have used imagery which may be defined as:

> ... the mental invention or recreation of an experience that in at least some respects resembles the experience of actually perceiving an object or an event, either in conjunction with, or in the absence of, direct sensory stimulation (Finke 1989, p.2).

Examples include visual imagery such as when a person visualises a picture of a friend's face in their mind without the friend being present. Analogous examples can occur for all the sense organs such as, auditory imagery (hearing imagined sounds), olfactory imagery (smelling imagined scents) and kinesthetic imagery (feeling body movements with respect to the body itself or through space, with no ostensible movement taking place).

Enhancing Psi Performance through the Use of Imagery Procedures

Psi is the general 'ability' attributed to people who can interact with the environment through means not presently understood by science. Two broad categories of psi are recognised by parapsychologists (scientists researching into psi), they are extrasensory perception (ESP) and psychokinesis (PK). The former generally refers to organisms being able to perceive the environment through means not presently understood, whereas PK refers to the apparent ability of an organism to influence the environment through means not presently understood (Rush 1986). Macro-PK refers to large scale PK effects that are visible to the naked eye, such as spoon bending or levitation. Micro-PK refers to effects on the environment that are so small that they need to be magnified. This currently most often refers to statistical evaluation of events that are probabilistic in nature, for example the count rate of a radioactive source, the electronic properties of diodes or the output of a pseudo random algorithm. There is no doubt that whether these 'abilities' are real or not remains controversial (Marks & Kammann 1980, Alcock 1981, Druckman & Swets 1988), however there is a considerable body of research that finds consistent results, not only in demonstrating that "... there is an anomaly that needs an explanation [Utts 1991, p.377]." but also in finding relationships between psi performance and individual differences. The latter point is an example of 'process oriented research'. 'Proof oriented research' focuses more on trying to establish the veridicality of psi abilities. One might question the worth of doing process oriented research, before proof oriented research provides enough good evidence to establish psi abilities as fact. Palmer (1986) defends process oriented research on the grounds that: if significant and reliable relationships (between psi abilities and other variables such as personality) are found then this is worthy of further research in and of itself (even if these relationships are themselves an indication of inadequate knowledge of statistical theory, such as the current understanding of the probability distribution of chance); process orientated research can help us to make elusive psi effects more reliable; and finally process orientated research will eventually help us to build theories and models of psi processes.

Part of this process orientated research has been to look at successful mental strategies that appear to produce psi effects. Using imagery as a MT shows some promise in being a successful cognitive strategy to bring about both ESP and PK effects, although the research results are far from neat (George & Krippner 1984). This has prompted some researchers to try and increase psi effects by trying to train people's imagery ability. Only one researcher appears to have been successful in being able to increase people's imagery ability and show a correlated increase in psi scores (Braud 1982). However, George & Krippner (1984) note that this may, in part, be due to a design flaw of the other experiments in that they did not check to see if their respective experimental subjects imagery scores really did increase, on account of the imagery training that they received.

Rationale Behind the Thesis

Chapters 2, 3 and 9 will give a more detailed account of why the work in the thesis needs to be done. However, in order to orient the reader, the rationale will be put forward briefly. Given that imagery has been used in MTs to improve athletic and psi performance, the question arises whether a person who improves their imagery ability skills (and assuming that they can be improved) can use these improved skills in MT procedures that will further enhance either their athletic or their micro-PK performance scores — or both. For the purposes of this thesis, subjects were recruited to take part in both an athletic and a micro-PK experiment. This was deemed beneficial for at least two reasons, the first was that it allowed for economy of recruitment effort and the imagery instruction need only be given to one set of experimental participants (as opposed to giving the imagery instruction both to one set of athletes and to another set of 'psychics'). The second reason was that the imagery training for the athletic improvement would probably be perceived as having more concrete gains than a psi study. This would be because athletic improvement would be considerably more tangible than micro-PK evaluation which by nature would be purely statistical.

It was felt that previous studies, in both sport psychology and parapsychology, using MTs had not employed sophisticated control techniques to guard against expectancy or conformancy effects — that is subjects may have guessed the experimental hypothesis and changed their behaviour to substantiate the experimental hypothesis. Hence these studies would be among the few to rigorously implement controls against expectancy.

Qualitative differences in the actual imagery have been postulated to have a differing effect of the potential performance enhancement that it could have for both sports and micro-PK. For sport psychology, differences in using imagery as an MT, mostly in perspective and/or modality, have previously warranted some investigation in the past, but the results have been vague (Feltz & Landers 1983). It seemed potentially fruitful to use the athletes who had been trained to use their imagery in an MT, to further examine whether qualitative differences in their imagery in MTs made any difference to their sporting performance. The role of imagery perspective could also have potential implications in parapsychology research if any differences were found. Braud's (1981) 'Lability hypothesis', briefly stated, postulates that (for a micro-PK study) the largest psi effect will occur when the intention of a subject closely resembles the desired outcome of a labile system by, for instance, having imagery that closely resembles the desired outcome of a random process. The outcome of a random process may be coupled to visual display that experimental participants can easily image.

The experimental investigation of imagery in related areas of psychology has potentially real contributions to make to our general knowledge in psychology. Marks (1990) makes the point that,

> ... imagery did not evolve so that college students could demonstrate significant 'imagery effects' in psychological laboratories: something else a little more fundamental must be involved [p.2]

and instead asks

> ... what is the function of imagery in mental and physical development? How do we explain the ability to improve physical skill using imagery rehearsal [p.2]?

Obtaining a theoretical understanding of imagery is seen by many psychologists as fundamental to psychology as a whole (Rollins 1989, Aylwin 1990), whilst others regard it as holding a pivotal position in our understanding of cognition and language (Denis 1989). Although the contribution of the studies' results to more general issues in psychology was not specifically addressed, it was recognised the studies' results had implications beyond its own confines of sport performance and psi effects, and may help us further into understanding what the function of imagery is.

Limitations of the Study

Kline (1988) has written:

> ... academic psychology....is not concerned with what appear to non-psychologists to be the most important or interesting aspects of being human. This, in my view, is the cause of the failure of psychology to offer anything of intellectual or practical value [p.11].

Also from the same source:

> ... experimental psychology is found to be wanting, regrettably because for more than one hundred years so much time and energy has been put into it and been ineluctably wasted [p.31].

Sadly some researchers feel that the study of imagery in psychology have been similarly trivialised. Murphy (1990) asserts that much of the research into imagery by sport psychologists is limited, compared to anecdotal reports by individual athletes, because researchers have not taken into account the highly individual ability to conjure up imagery scenes and what each of the scenes means to each and every athlete. Williams Cook (1991) has warned that parapsychology is in real danger of falling into the same trap that Kline contends psychology has, in an effort to be accepted as a 'real science'. In imagery research Yuille (1985) also states that laboratory research is an inappropriate way to research into imagery and said,

> ...it is impossible for laboratory-based experiments to tell us anything about the ordinary (or even non-laboratory extraordinary) context–dependent aspects of cognition [p.141].

In the same article he wrote,

> The laboratory permits the study of contrived meaning responses to unusual situations, nothing more [p.141].

This problem is sometimes referred to in the context of ecological validity, that is the laboratory and experimental situation are, according to psychologists such as Kline and Yuille, not ecologically valid because they do not reflect the situations that most people find themselves in outside the laboratory. The main reason why I chose to focus on using athletes was because the experiments could maintain ecological validity, since they would train skills that an athlete could ostensibly use to improve their sporting skills; in contrast there would be little ecological validity in training subjects a skill that was only ever used in the laboratory. The experiments were run on the site of each sport club's training ground at the usual training times. Imagery training was mostly home-based and self-administered. This meant that tightly controlled laboratory conditions could not be maintained and protocols for administering psychological tools (such as questionnaires) were usually not strictly followed, in order to work within the space and time constraints of the club. This lack of control was thought to be a valid sacrifice in order to maintain ecological validity.

There is an additional price to pay in doing ecologically valid experiments namely being only able to use a small number of subjects. All the sport clubs used in the experiments of the thesis, were of individual skills and not team sports. The number of volunteers from each of these clubs was small. My time and resources as the sole experimenter, did not allow me to recruit larger numbers from other similar clubs. Several of the experiments also used volunteers that were not from a particular club, however although the sample sizes were bigger, they too were restricted by logistical limitations, so that they were not as large as they ought to have been (in order to have a reasonable chance of showing statistically significant results). To counter this problem the formal statistical analyses concentrated more on reporting effect sizes and running power analyses as well as reporting statistical significance — this is a relatively new method in behavioural research (see Rosenthal and Rosnow 1991) and is explained in more detail in chapter 3.

With only three years and severely restricted funds and personnel there are obvious limitations to the thesis, which were borne in mind whilst designing and implementing the experiments. Rather than designing and running a few 'perfect' experiments, I would focus my resources on more studies that were less tightly controlled (but which were ecologically valid) and whose results could be used as indicators for future research and could be combined to produce an overall picture of what is actually occurring.

Outline of the Study

This chapter introduces the study, its basic concepts, rationale and its limitations. The first section (chapters 2-8) covers the sports aspects of the study. Chapter 2 is concerned with a literature review of some elements of imagery in the fields of psychology and sport psychology. Chapter 3 reviews and discusses the statistical methodology of the proposed experiments. Chapter 4 deals with an experiment that attempted to train imagery as a mental skill that could be incorporated as a MT to improve sporting performance. Chapter 5 reports on two experiments that took a closer look at the role of expectancy and chapter 6 re-examines the question of training imagery in another experiment similar to the one in chapter 4. Chapter 7 reports on the experiments that looked at the role that imagery perspective plays in MT. The final chapter of the section, summarizes all the experiments from section 1 with respect to the previous literature and concludes with practical recommendations resulting from the studies and directions for future studies.

The second section (chapters 9-11) consists of the parapsychological aspects of the thesis. Chapter 9 introduces the literature on micro-PK and the use of imagery strategies to enhance micro-PK scoring. Chapter 10 explains the details and the results of the micro-PK experiments that were done for this study. Chapter 11 summarizes the results of the micro-PK experiments and outlines some future research recommendations. In a third section, the final chapter of the thesis, briefly summarizes and concludes the results and implications of all the studies from both previous sections of this thesis.

Summary

This chapter has mapped out the plan of the study's report and tried to give the reader an idea of its main purpose. Some definitions of the main areas of enquiry were given. The final part was a defence of why I have not adopted the conventional wisdom of doing experiments that would show statistically significant results, because I wanted the studies to have ecological validity and because of this, I knew that I would be working with small numbers of participants. Recent thoughts in statistical theory have however, come to 'save the day' by placing more emphasis on effect sizes and confidence intervals; indeed these measures are now seen to be more informative than simple tests of significance. This aspect will be covered in more detail in Chapter 3.

SECTION 1:

Mental Imagery in Sports Performance

CHAPTER 2
Imagery in the Psychological and Sport Psychological Literature

This chapter will deal with the literature pertaining to imagery in both psychology, and sports psychology.

Imagery in Psychology

Imagery research began along with the formal schools of psychology, primarily due to the introspective nature of these early schools. The theory was that thoughts could be broken down into elements and hence researchers should be able to find the fundamental structure of thought. However, with the emergence of behaviourism which rejected introspective reports, imagery research waned over the years until the late 1950s and early 1960s. Imagery's re-entry into psychology was, in part, due to psychologists' dissatisfaction with the confinement of psychological research to behavioural or physiological explanations of behaviour (Richardson 1983). Richardson has also pointed out that experimental interest in imagery arose as a result of trying to understand brainwashing techniques and the effects of hallucinogenic drugs. Also cognitive scientists using a behaviouristic approach, began to think of imagery:

> .... as a helpful, if unexplained, mnemonic device [Bugelski 1977, quoted in Richardson 1983].

Experiments involving imagery have produced results which have been difficult to explain away as mental artefacts (Marks 1983) some of these are illustrated below.

Experimental

Imagery has been shown to be an invaluable mnemonic device to aid memory. For instance Bower (1971) explained how the ancient Greek art of 'the Method of Loci' relied heavily on imagery. Bower (1972) showed that paired words are remembered better if they are visualised interacting in some way as opposed to just trying to remember them rote fashion. However, this is open to interpretation as to whether it is the actual imagery that is important or whether it is just the act of elaborating that is the crucial factor (Anderson and Bower 1973).

Cooper and Shepherd (1973) describe a number of experiments which show that when asked to compare the similarity between two objects, people behave as if the strategy they use to answer the question is to image one of the objects and rotate it around to an orientation similar to that of the other object and then mentally compare the two objects. People take longer to respond if the objects have a larger angle between first and last orientation than for smaller angles because, the authors argue, it takes them longer mentally to rotate one of the objects to line up with the other.

Moyer (1973) found that when he asked people to say which was larger, a moth versus a flea, or a moose versus a roach, he found that people responded much faster to the second pair. The argument is that people translate the objects to be compared with each other into a mental image and then look at the image, much as someone might look at a picture.

Kosslyn, Ball and Reisser (1978) found that if people were asked to remember a fictitious map so that they could reproduce it accurately, and then were asked questions such as which landmarks were closer or further away from other landmarks, they would take longer to respond if the distances on the map were closer together. Interestingly, the not unreasonable point is made that the experimental hypothesis must be highly obvious and that the subjects in the experiment may be behaving deliberately to support it. In order to counter this criticism, Jolicoeur and Kosslyn (1985) repeated the experiment but gave naive experimenters false expectations about what results they should expect from the experiments. The real results did not conform to experimenter's belief and backed up the original results found by Kosslyn et al (1978).

Applied Imagery

Imagery is also used by various professionals in applied settings although often there is little or no empirical support for its implementation, not because the research has been done and refutes the use to which it is being put, but because the research was never done in the first place (Hardy and Nelson 1988).

Imagery is routinely used by clinical psychologists in behaviour therapy, for example in desensitisation programmes to cure or alleviate people of the debilitating effects of phobias (Lazarus 1966, Wolpe 1969). For instance a fear of snakes might be treated by the clinical psychologist talking about snakes and rationalising with the patients any fear that he of she may have until they did not feel anxious. This process is repeated with a successively stronger presence of snakes, first through the use of imagery, and then as the patient becomes comfortable with their imagery they 'graduate' onto successively stronger exposure to live snakes (maybe through the use of videos), until often the patient can happily touch and handle snakes. However, it appears that the effectiveness of such techniques is more complex than previously thought (Martin & Williams 1990).

In a similar manner sport psychologists use imagery to help athletes cope with the stresses of a competitive life. As well as desensitisation programmes (such as alleviating apprehension about a particular opponent or sporting venue, other techniques are used such as to reduce stress or relieve conflicts with themselves or others. Another practical application of imagery which sport psychologists advocate, is to advise the athlete to prepare for an athletic performance by mentally rehearsing an athletic skill. This will be more fully explored in the section dealing specifically with imagery in sport psychology and in chapters 4, 5 and 6.

Medical uses of imagery include using it to try and bring about placebo recovery effects from illness such as cancer. This use has been reviewed by Achterberg (1984).

Theories of Imagery in Psychology

Given that imagery appears to be a real ability that can be demonstrated experimentally, psychologists have tried to construct theories that will explain these effects. Relevant discussion of these theories can be found in Pinker and Kosslyn (1983). The following list is a synopsis of the more common theories.

Quasi-Sensorial Theories

These theories hold that the image is analogous to a picture in the head. It is important to note that modern 'quasi-sensorialists' do not actually believe that there is a real picture, rather that the neurological make up of the image is such that we could regard it as the neurological equivalent of a picture. Hebb's Cell Assemblies use the same neurological mechanisms (or almost equivalent ones) to normal perception, except there is no sensory input (Hebb 1968). Despite most psychologists not holding to a real 'picture in the head' being present, this may in part be true given that several areas of the brain involved in visual processing, actually preserve the local geometry of the retina (Van Essen 1985). Tootell, Silverman, Switkes & De Valois (1982) for instance showed that the uptake of a radioactive marker in a visual processing area, followed the spatial pattern of a stimulus shown to monkeys, and could be recognised as such.

Dual Code Theory

Paivio (1971, 1986) believes that people can think in two primary codes which are independent of each other but can interact together — the codes being either verbal or non-verbal. Denis (1989) believes that Paivio is for the large part responsible for bringing imagery research back into the limelight of modern psychological research. The two systems are basically capable of working independently of each other although there are referential connections between the two. The verbal systems consists of 'logogens' which contain information underlying the use of the word. 'Imagens' in contrast are the units in the non-verbal system which contain information that generates mental images. Logogens operate sequentially (words spoken in a sentence are not all present at one time), whereas imagens operate synchronously (all the elements in an image are present at the same time). Denis (1989) describes how some of Paivio's work has been reinterpreted as verbal and non-verbal stimuli accessing the same type of information, but activating different subsets of semantic information.

Propositional Theories

These theories regard the experience of the image in consciousness as an epiphenomenon of some underlying cognitive processing and therefore not essential to the imagery process (Pylyshyn 1981). Instead, imagery is composed of fundamental propositional units, similar in quality to those used in abstract knowledge or conceptual reasoning. The visual imagery propositions have the equivalent of mathematical descriptors such as size and orientation. This allows us to image any object and then to perform transformations on it such as to increase its size, to distort the image and to change the viewing angle; even if we have never actually seen the transformation in real life. It is the manipulation of the imagery propositions that gives us the imagery effects and not the introspective conscious experience of imagery. The theory meant that there was only one deep meaningful code that had to be stored and manipulated rather than at least two as in Paivio's Dual Code Theory.

The propositional argument has also been expounded on the basis of a perceived inadequacy of quasi-pictorialists, chiefly on conceptual cognitive grounds. Haugeland (1982) argues that images cannot by definition be cognitive. Cognition it is argued is *rule* based and not *law* based. As an analogy Haugeland (1982) explains that particles have no choice or difficulty in obeying the laws of physics. People on the other hand have to work (sometimes quite hard) at being reasonable and on occasions this can be extremely difficult. However, the properties of images appear to follow laws (see Finke's Unifying principles below) and are therefore not subject to cognitive scrutiny. Pylyshyn (1985) explains in a similar vein that cognition is "nomologically arbitrary" that is computational states can change from one sort to another via a number of arbitrary means. It is this aspect that makes cognitive life so varied and flexible, unlike a slavish following of 'laws'. Images are bound to a medium that maintains spatio-temporal equivalence to the objects that the images represent. They therefore are by definition, not cognitive in structure. Rollins (1989) argues that it is not logical to define cognitive science in this way *a priori*, and thus by definition exclude imagery from cognitive research. For instance, he suggests that images could be seen as a valid cognitive process that encodes information more efficiently (compared to information stored in a potentially lengthy propositional construct), and can therefore increase the flexibility of thinking rather than as Pylyshyn would believe, constrain it. However, Rollins (1989) warns that such a "pluralistic cognitive psychology" is fraught with problems of its own. In part this stems from the fact that images appear to be,

> ... neither simply physical structures nor full-blown, rule-governed representations. They appear to be formal configurations without formal rules [p. 31].

Array Theory

Pinker and Kosslyn (1983), describe their own theory which tries to blend aspects of both the quasi–sensorial and the propositional theories. Images are stored in long-term memory in a propositional format. This knowledge is used to generate quasi-pictorial images by recalling the relevant propositions into a 'medium' (neurological in structure) which exhibits the spatio-temporal characteristics of the imaged object. Transformations can be made on the propositions which are translated onto the matrix — and the whole matrix can be rotated and scaled in any plane in order to 'view' the image from any angle (they do not describe who is doing the viewing). The whole process is very similar to the modern process of rendering scenes on computer screens (Jankel and Morton 1984). The advantage of this theory is that the long term memory of objects to be imaged can be stored in an amodal propositional format, which Pinker & Kosslyn (1983) argue is a more parsimonious explanation than Dual Code theory. However despite its reliance on propositions, it does not deny the reality of images which are necessary end products of the cognitive propositional manipulations.

The Activity Cycle

A theory of imagery as proposed by Marks (1990) is an extension of Neisser's (1976) 'perceptual cycle', which adds in the important contribution of affect to the cycle. Imagery thus is not only the activation of the cycle of schema and activity in the absence of a real objects but also contains affective components (such as emotions associated with the image of the Eiffel Tower; for some it will have none, for others it might signal the romance of a holiday in Paris or the fear as they looked down from the top of it). Marks (1990) writes that the purpose of imagery as seen from this model, is to act as a mental simulation, allowing individuals to rehearse actions in the real world or examine future possible outcomes.

Clinical Theories of Imagery

Triple Code Theory (ISM)

Ahsen's theory (1984) postulates that imagery is made up of three components:

the **image (I)** which is traditionally what has been considered when discussing imagery;

the **somatic** response **(S)** which is the physiological change associated with the image; and

the **meaning (M)** which varies between individuals.

This theory tries to stress the S and M components having a real effect on the value of imagery in whatever use it is put to — measuring imagery requires all three elements to be measured at the same time. The use of this theory was primarily developed for the clinical uses. Ahsen (1984) feels that most mental illnesses can be attributed to repression of one or more of the elements of ISM. As a clinical perspective on imagery, this may have important contributions to make to sport psychology when considering intervention methods using imagery to alter behaviour.

Bio-Informational Theory

Lang's theory (1977,1979) is similar to Ahsen's triple code theory but instead it concentrates on the image and somatic response of the individual to the imagery — the claim is that the two cannot be separated. The image component is also thought of as a 'stimulus proposition' and a 'response proposition'. The former describes the content of an imaged scenario and the latter describes the appropriate response to the imaged scenario. This theory too was originally developed for clinical use, especially for phobia treatment. The use of imagery in treating phobias in this theory will only work if the imagery maps onto the actual response that would occur in the real behaviour. It had also been used in sport psychological findings (Hale 1982) for instance by stressing the somatic responses that would occur whilst imaging an athletic activity and not just concentrating on the visual input of imaging that athletic event.

Finke's Unifying Principles

Finke (1989) argues for not stating a formal model to try to account for imagery as this typically leads to good explanatory power but has no predictive benefit. Finke argues too that the models have sufficient variability to allow them to be 'fine-tuned' into specialised (and perhaps trivial) laboratory circumstances. With formal models, Finke argues there is a higher chance of reaching a theoretical 'dead end'. Instead he prefers to state the principles that unify common threads in imagery models and experimental results. Unifying principles are elegant in their simplicity and Finke rejects calls for complex models just because the mind is complex. Although there are exceptions to these unifying principles, these are not considered a serious problem, as long as the exceptions are known and that they are too infrequent to pose any serious restriction in the use of the principles. As an analogy, Finke points out that just because we know of exceptions to Newton's laws of physics, it does not mean to say that they are without worth and should be abandoned. Based on empirical results, Finke states five unifying principles:

> **implicit coding** — people can retrieve information about objects, when asked to remember them by using imagery, which were not explicitly remembered at the time of coding;
>
> **perceptual equivalence** — imagery activates the same cognitive mechanisms that are used in normal perception and thus has similar restraints as in normal perception (eg there is a finite resolution);
>
> **spatial equivalence** — spatial layouts in imaged scenes correspond to what would be the real layout in physical space;
>
> **transformational equivalence** — imaged transformations have corresponding dynamic motions and exhibit the same laws of motion as the real objects would if they underwent similar transformations; and
>
> **structural equivalence** — imaged structures are like real objects in that they are coherent, well organised and can be re–organised and reinterpreted.

Conclusions of the Imagery Theories

For the moment my own preference lies with Finke's (1989) unifying principles. The other models offer little other than a description of imagery effects (of varying complexity). They can offer little in terms of predictive value, that is making a recommendation based on the particular model. For instance, when would it pay for us, under certain circumstances, to think in an imagery mode as opposed to a verbal one. Marks (1990) in offering a function of imagery, is a positive step in the right direction, because it allows us to state when imagery will have a positive survival value to those that use it. If one takes the position that the model has ecological validity, then this theory would suggest that there will be predispositions for us to think in an imagery code, such as deciding what possible course of action to take. For instance, one could rationalise that it would be easier to use an imagery code to plot an escape route, if an imaginary hunter/gatherer encounters a herd of stampeding wildebeest, rather than thinking in a propositional format, which of the possible routes is likely to result in a successful escape. Lang's theory ostensibly has predictive value — for imagery to work, the imagery script must contain the correct response propositions that would occur in real life. However, this is unlikely to be particularly effective until we can find someway to assess what the correct response propositions are. We cannot do that because the responses propositions experienced in real life, remain private and personal for each person. In the mean time we can 'guesstimate' what a correct response proposition might be, but if it appears to have little practical effect, one could always claim that this was obviously not a correct response proposition to emphasise. Eventually this theory could develop by trial and error but it would then only become an elaborate description, which is the contention that Kline (1988) makes for most of cognitive psychology. Ahsen's Triple Code theory, possibly has the potential to develop into a sophisticated theory because we can certainly map the correct somatic responses by taking physiological measures of people engaged in a variety of tasks, and thus build up a population distribution, of normal somatic responses in common situations. This knowledge could then be combined with the other convergent measures such as the verbal description of the image and the reported meaning that the image has for a particular person. Although these latter two measures still suffer from their subjective nature, they do at least represent an attempt at a more convergent approach (see below). However, for the moment the theory is in its early stages and until such calibration work is done, it cannot offer us further insights into imagery.

Measuring Imagery

The measurement of imagery can be split into two camps. One method is to use self report questionnaires which are more objective than pure introspection of the type used by Binet (1886) or Titchener (1898), via their associated battery of statistical reliabilities and internal stability. A second major measure is through the use of tasks that are believed to require imagery (by mental transformations of images of objects presented to people), to obtain the correct answer (Thurstone & Jeffrey 1956, Guilford 1967, Shepherd & Metzler 1971, Vandenberg & Kuse 1978). Researchers though are well aware of the problems of both these types of measures and more recently some other methods have been proposed to measure the more qualitative aspects of imagery. For instance Sheehan, Ashton & White (1983) have used probes to ask their subjects to comment on their thought processes whilst looking at a video tape of some pre-set imagery task. Thus we appear to be coming around full circle to the original introspectionist way of looking at imagery. Marks (1990) writes that we are unlikely to understand the function of imagery until we take the content of imagery into consideration, as opposed to purely looking at cognitive component. Psychologists are now advocating a convergent operations approach for measuring imagery (Honorton 1975, Lang 1979, Ahsen 1984, Marks 1985, Ward 1985). However, no-one has risen yet to the challenge of integrating this convergent approach into a method that can be readily interpreted to be able to categorise experimental participants into 'high' or 'low' imagers for instance.

Self-Report Measures

In the main the most common assessment of imagery ability is through the use of self report questionnaires. This is defended by Marks (1983, 1985) on grounds that imagery reports will be incomplete if we do not ascertain what the conscious experience was. Furthermore, there is sufficient experimental evidence to suggest that verbal reports of imagery show consistent results over time and different situations, such that demand characteristics are unlikely to cause large response biases (White, Sheehan & Ashton 1977). It is probably also not an inconsequential fact that these measures tend on face value to be the easiest to administer. A brief outline of some of the main measures is given below.

- Galton's (1880) Breakfast Questionnaire — so called because it asked subjects to imagine what was on their breakfast table.
- Betts' (1909) Questionnaire upon Mental Imagery (QMI).
- Sheehan's (1967) Revised version of the QMI — tests across seven different modalities.
- Gordon's (1949) Control of Imagery — focuses instead on the ability to control imagery.
- Marks' (1973) Vividness of Visual Imagery Questionnaire (VVIQ) — a shortened version of Sheehan's revised QMI with only visual imagery items included — includes two scales, one with imagery occurring with eyes open and the other with eyes shut.

- Paivio's (1971) Individual Differences Questionnaire (IDQ) — measures the tendency for individuals to think in a visual mode or in a verbal mode.
- Hall, Pongrac and Buckholz's (1985) Movement Imagery Questionnaire (MIQ) — concerns itself with a visual and a kinesthetic sub-scale, specified movements are made and subjects respond to both sub-scales as to how easily they could image the movement.
- Isaac, Marks and Russel's (1986) Vividness of Movement Imagery Questionnaire (VMIQ) similar in construction to the VVIQ except that it concentrates on kinesthetic imagery — includes two scales, one with imagery to occurring with the eyes open and the other with eyes shut.

Imagery in Sport Psychology

On embarking on a literature review of imagery in sport psychology a reader has three sub-divisions of the literature to contend with. The first is the anecdotal reports especially from elite athletes, of their apparent success in using imagery (eg Gallwey and Kriegel 1977, Nicklaus 1974). The second is the popular sport psychology literature which is usually written by practising sport psychologists who advocate the use of imagery as a viable method for training but rarely back up their arguments with scientific facts. This is not a shortfall as the literature is deliberately based at the level of the athlete or coach. Well-written books in this class of literature include Nideffer (1985), Railo (1986) and Loehr (1986). Their main shortfall is that whilst they all advocate that imagery is a valuable skill for the elite athlete, they do not go on to explain how someone can acquire imagery skills which could then be usefully employed for mental rehearsal.

However, this review is based mainly in the third area of literature — the scientific investigation of imagery and how it relates to athletic performance. Firstly, though, it is necessary to clear up some semantic confusions that abound in the literature between the terms mental practice (MP) and mental rehearsal (MR). Previously the sport psychological literature has used these terms synonymously. However, like Smith (1987) and Vealey (1986), I would like to refer to MP as the practice of mental skills (such as imagery) that can then be used in a variety of mental techniques (MTs) to enhance performance (such as arousal control or motor rehearsal). On the other hand, MR refers to the mental rehearsal of an athletic activity. It is this latter definition that most sport psychologists refer to when they talk about either 'mental rehearsal or practice'. MR is but one of the MTs that can be used by athletes to try and enhance their performance. The relationship between MT, MP and MR is mapped out schematically below.

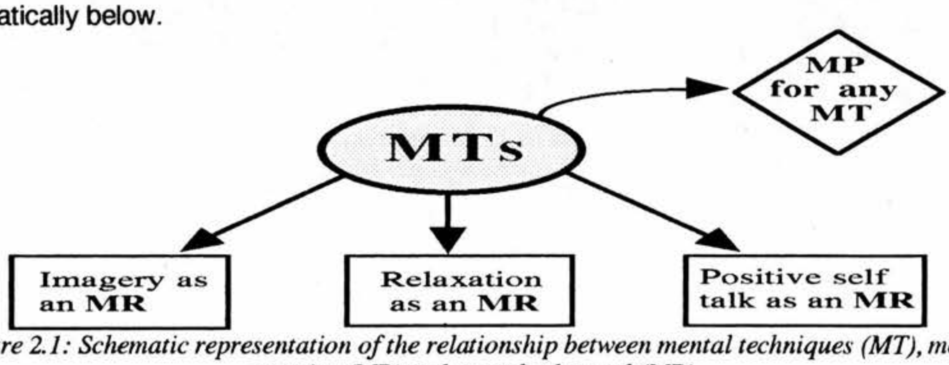

Figure 2.1: Schematic representation of the relationship between mental techniques (MT), mental practice (MP) and mental rehearsal (MR).

Correlating Imagery with Superior Performance

Mahoney and Avener (1977) found from a questionnaire that gymnasts who qualified for the 1976 Olympic team used imagery in MR more frequently than their non-qualifying counterparts. Highlen and Bennett (1983) studied, amongst a variety of attributes, the frequency of use and the quality of imagery in elite divers and wrestlers. They were interested in differences between sports and whether or not their questionnaires could distinguish between the qualifiers of each sport type compared to the non-qualifiers (or winners and losers in the case of wrestling). The sports were specifically chosen as representatives of open and closed skill sports. Open skill refers to where the the athletic environment is not totally within control of the athlete; so wrestling is an open skill sport as the opponent is not predictable. Closed skill sports refer to when the environment is relatively constant and predictable; so diving is a closed skill sport. Highlen and Bennett (1983) found that qualifying divers had more vivid and controllable imagery and used it more frequently in training. Although the wrestlers used imagery, there was no such distinction between the qualifiers and non qualifiers (although they too used imagery). Overall they found no difference in imagery use between the divers and wrestlers, as they had initially expected. Overby (1990) found that experienced dancers differed from their inexperienced counterparts on several self-administered questionnaires. The former had a more positive body image, were more verbal in their thinking style but just as visually oriented as the inexperienced dancers. The experienced dancers also scored higher on a spatial relations task but there was no difference between the experienced and inexperienced dancers on an imagery questionnaire measuring visual and kinesthetic imagery vividness. Overby concludes that the experienced dancers were just as visually orientated as their inexperienced counterparts but they showed '. . . a better ability to utilize both cerebral hemispheres more effectively' which showed in their higher ability to use verbal thoughts. Start and Richardson (1964) found no overall correlation of imagery with performance on a single gymnastic movement, but did find that the combination of imagery controllability and vividness was related to increased performance. Highlen and Bennett (1979) did not find that imagery correlated with the selection of elite wrestlers for national teams.

It is not clear whether imagery should be correlated with higher performance or not. The results were positive or no relationship was found. Certainly no significant negative relationships were found, which might lead one to suggest that maybe these latter studies were of too low a statistical power to show a positive finding.

Experimentation on the Effects of Mental Rehearsal

Sport psychologists have studied whether there is an appreciable increase in athletes' actual performances if the athletes are, prior to their performance, asked to rehearse it mentally. For instance Isaac and Marks (1986) split novice and experienced trampolinists into 'high' and 'low' imagers according to two questionnaires developed by both Marks (VVIQ) and Isaac (VMIQ). Over 18 weeks subjects used a combination of physical and mental rehearsal (MR) to help learn three new acrobatic moves for use on the trampoline. Their first and last attempts were videotaped and scored independently by national trampoline judges, who were 'blind' as to the experimental hypothesis. They concluded from their results that both high and low imagers benefited from MR but the improvement was significantly greater for the experienced trampolinists. There was no control group because the numbers were so low. However, there have been other studies exploring the same question and including a control group (eg Aniscoe and Hardy 1987). Their control group did a task that was not supposed to involve imagery, which was to count backwards in multiples of 3, 4 or 5 from a large number. Their results supported the efficacy of MR.

Early reviews were either ambivalent about the results of the studies conducted (Corbin 1972) or mildly in favour of the efficacy of MR (Richardson 1967). However, both concluded that the experimental procedures and designs needed to be tightened in order to support or refute the findings. Rather than just list many studies that have been conducted into this area the reader is referred to the excellent review by Feltz & Landers (1983) which despite its age is still one of the most sophisticated because of the meta–analysis that they conducted (this technique is discussed in further detail in chapter 3). They located as many of the studies that they could that looked at the effect of MR on athletic performance. From the 60 studies whose results they were able to use they obtained 146 'effect sizes'; these are scale free measurements that summarize differences found between two groups — the one that they use (d) is the difference between two groups divided by the groups' pooled standard deviation. These they regarded as data points and subsequently analysed them in a statistical manner. They also coded the effects for various attributes which they were to look at in more detail after the main effect was calculated, such as sex differences, age, how much of a cognitive element the task involved and the experimental design. Their results support the notion that mental practice produces better results than no practice at all. The average effect that they measured for all the studies translates into the equivalent of changing a competitor's ranking out of 100 competitors, from 50th to 30th rank. Statistically this is considered a 'medium effect' but in athletic terms this is a very considerable one. Amongst some of the characteristics studied, it appeared that the only significant differences in effect size were between cognitive tasks versus motor or strength tasks. Cognitive tasks are those having a large component of thinking required to complete the task and the motor response is just a way of responding to the task — for instance a finger maze task (Sackett 1934). A motor task is one which places emphasis in making body movements in an 'intelligent way' such as in gymnastics (Mahoney and Avener 1977). A strength task is one in which the emphasis is on pure strength or muscular response such as in a bicep curl (Hale 1982). The effect was largest for the cognitive tasks followed by the motor and then the strength tasks. The effect appears to increase as the cognitive component becomes more prominent: for cognitive tasks, $d = 1.44$; motor tasks $d = 0.43$; and strength tasks, $d = 0.20$.

They then went on to state the implications of their analysis for four major assertions in the sport psychological literature: MR effects are associated with cognitive rather than motor elements of the task (supported), MR has the most effect at a particular stage in learning either earlier or later (no clear support either way), MR effects produce low gain innervation of muscles that would be employed in the athletic task (not supported), MR prepares athlete for the actual athletic skill (non-significant support). This last proposition agrees with an extended version of symbolic learning theory (attention–arousal set). This postulates that the act of mental rehearsal activates or primes the cognitive domains which are relevant to the task thus allowing the athlete's attention to be focussed. In addition it may be that while the athlete is concentrating on the task in hand, the ability to be distracted by disruptive or task irrelevant thoughts has effectively been blocked. A key phrase Feltz & Landers use is that this skill could be used by novice or elite performers alike provided performers have perfected psychological skills that enable them to set appropriate arousal levels and maintain their attention toward task-relevant cues.

Qualitative Differences in Imagery Used in Mental Rehearsal (MR)

Vividness and Controllability in Imagery

Bird and Cripe (1986) contend that imagery vividness and controllability are important for successful athletes. Nicklaus (1974) 'goes to the movies in his head' during his golf game by visualising exactly where the ball should go; he then visualises the exact stroke he needs to place the ball in the desired position. There is some experimental evidence to suggest that vivid and controllable imagery is a good predictor of success, for instance, Meyers et al (1979) for raquetball, Start and Richardson (1964) for gymnasts, Suinn and Andrews (1981) for alpine skiers, Marks and Isaac (1988) for trampolining.

The Time and Place to use MR

Morris and Ball (1991) feel that imagery in MR has four important roles to play: mental practice, instant pre-play, instant replay, and performance review.

- **Mental Practice** is the equivalent of physical practice although it is purely mental. Bird and Cripe (1986) relate how a world-class collegiate gymnast of the 1970s was able, during a period of injury recovery, to practise mentally a new and difficult movement for the asymmetric bars. On her first physical try of the movement she executed it flawlessly. There are a number of studies that show that the better athletes practise imagery and mental rehearsal more often than others (Gould , Weiss and Weinberg 1981, Highlen and Bennett 1979, Meyers Cooke, Cullen and Liles 1979, Rotella, Gansneder, Ojala and Billing 1980). A criticism of this type of research is that since relationships are correlational it is not clear experimentally what the chain of cause and effect is. It is assumed that the more frequent use of imagery and mental rehearsal sessions makes the better athlete. Heyman (1982) has shown, however, that it is equally likely that the improved performance could bring about higher frequency of imagery use.
- **Instant Pre-play** is when MR is executed just prior to actually doing the athletic movement. The meta-analysis of Feltz & Landers (1983) indicated that the largest overall effect was either when the MR was done for less than 1 minute or less than 6 times before the actual performance (there was another peak associated with either longer than 15 minutes or longer than 36 repetitions). However, this effect appears to be primarily for cognitive tasks such that Feltz & Landers write:

.... if larger effects are to be achieved in motor and strength tasks, more time needs to be spent in mental practice (both in minutes and number of trials) than for tasks that are high in cognitive elements [p.46].

- **Instant Replay** is the ability to image the successful completion of a performance just after it has occurred.
- **Performance Review** is the imaging of previous performance in order to review good or bad points for future consideration.

Despite looking through the relevant literature, I can find little anecdotal and even less experimental evidence that the last two methods of using imagery have any beneficial effect.

Rate of Imagery

Andre and Means (1986) conducted an ingenious experiment that looked at the benefits of mental rehearsal under two different rates of imagery generation, either normal speed or in slow motion. The athletic task was frisbee golf, the novice participants used mental rehearsal to improve their throwing technique. Although their results are not significant the mean gain from pre-to post-test was that the normal speed MR gave higher gains than the slow motion MR. This would be an interesting line of investigation to follow up, given more subjects to increase the statistical power of the experiment and with perhaps more experienced subjects in the art of frisbee golf.

Perspectives and Modalities of Imagery in MR

When someone is imaging a particular scene it can often be classified as either being from an **internal** or an **external** perspective. If the perspective is internal then the scene is viewed as if the imager were actually there moving through the environment. An external perspective, however, is a static point of view as if they were seeing the scene as an impartial observer or a judge might see the action. As previously mentioned, imagery can occur across all the sensory modalities.The one most often quoted in sport after visual imagery is kinesthetic imagery (body awareness). Often when sport psychologists talk about an internal perspective this means both an internal visual scene and the corresponding kinesthetic imagery (Hardy 1989). People find it very difficult to make the separation between modalities with an internal perspective. There is some suggestion that an internal perspective gives superior performance to an external perspective. However, this topic will be discussed at length in chapter 7.

Problems with the Imagery Research in Sport Psychology

The Use of Psychological Models in Sports Psychology

As the reader might be thinking from the chapter so far the use of imagery in sport psychology is still very confusing. For instance, sport psychologists still cannot answer these questions:

> Does imagery training facilitate athletic performance, or do certain conditions facilitate sport imagery training? Why does some sport imagery research show improved performance while others do not? Does some sport imagery research utilize certain conditions to facilitate the imagery training while others do not? [Smith 1987 pp.244 – 245].

Shane Murphy (1990) is fairly damning about the progress of sport psychology whose models:

> .... fall short in their ability to explain the efficacy of the various types of imagery interventions employed by sport psychologists working with athletes [p.153].

In part this is due to the lack of theoretical or conceptual understanding of imagery as it relates to the alleged benefits of MR. Murphy is fairly critical of the little theorizing that has been done, because none adequately describes most of the phenomena observed in MR. The two most popular models used have been the psychoneuromuscular and the symbolic learning models.

The first, **psychoneuromuscular** theory, was advocated by Jacobsen (1931) and basically states that the effect of imagery is to send tiny innervations to the relevant muscles that would be called into play in the reality of the actual movement being used. Bird & Cripe (1986) describe this model as the 'Inflow' model which in terms of cognitive theories, would suggest that imagery mental rehearsal retrieves an appropriate propositional network for the movement being imaged. This produces efferent outflow along the relevant nerves to the actual muscles that are used in the real movement. Proprioceptive feedback back into the propositional network (the 'inflow') from these muscles, provides the opportunity to either compare the imagery to real performances (and make appropriate corrections) or to prime the athlete into making the correct response in a future performance. This model suggests that the greatest gain in using imagery should occur with experienced athletes, as there must already be a neural connection between wishing to make a specialised athletic movement and the actual muscles which would actually be used for that movement.

Symbolic learning theory (Sackett 1934), on the other hand, suggests that imagery retrieves the cognitive (propositional) network associated with a particular movement. These are then coded into symbols which are more easily manipulated than say a list of verbal instructions. These symbols can be used to make the appropriate athletic movement (Bird & Cripe term this the 'Outflow' model).This theory is similar to Bandura's (1977) observational learning mechanisms in social learning. Mental corrections can be made to the cognitive network which can in turn be translated into corrections of the real performance. This model suggests that the largest effect for imagery should occur at the novice stage where much of the learning of the new sport is cognitive in nature. The model also suggests that the largest learning effects will occur with sports that are more 'cognitive' that is that the athletic movement is more easily coded into a symbol.

In their meta–analysis Feltz & Landers (1983) point out that MR appears to provide beneficial effects for both novice and advanced athletes, however, the effect size is larger for the experienced athletes than the novices, lending more support to the 'inflow' model. Savoyant (1988) has argued that the two models may have been artefactually presented as orthogonal to each other. By considering how the mental rehearsal is related to the actual physical practice, Savoyant claims to show how the two models are complementary to each other. The relationship from his perspective is not so much bound to the presence or absence of kinesthetic feedback, but the degree to which the MR helps to activate the spatio-temporal sequence of the actual movement. The role of imagery perspective plays an important part in what type of effects are seen in the data (which supports one or other of the two models). Murphy (1990) concludes that the plethora of phenomena seen in the MR literature cannot be accounted for by a single model. Rather, one has to resort to the inelegant solution of employing several models operating at the same time.

The research models and their associated findings supporting one or the other model can do no more than describe the processes that are already known naturally by some athletes and coaches. Neither model can prescribe to a particular athlete what type of MR he or she should practise, how often, when and which modality or perspective would be most suited to his or her personality and particular sport. All we can say is that, if the imagery is of a good performance, then it is probably more beneficial than doing nothing. Budney and Woolfolk

(1990) describe several experiments that show that imaging detrimental performance will have a worse effect on actual performance than if they had done no MR at all.

Poor Experimental Methodology and Design

Murphy (1990) also points out that the methodology for experiments that are trying to research MR effects is essentially flawed mainly because of poor design, procedural of reporting problems. Of the latter Murphy cites:

- experimenters report imagery scripts very briefly such as 'The subjects were instructed to use imagery';
- descriptions of opportunities for imagery practice are either missing or absent from the experimental report;
- there is no check to see if the experimental subject actually tries to follow the imagery script that they were given (see also Hale 1986); and
- failure to view imagery as an individual skill such that people can have preferences in the way that imagery is used or be poor in some imagery attribute such as vividness or a particular imagery mode.

In terms of design, Murphy writes that the experiments are flawed because they do not contain adequate control groups. Specifically it is clear from the literature that expectancy has not been controlled for. Control groups are either asked to do nothing in the time that the imagery group are doing their imagery rehearsal, or they are asked to do a cognitive task such as count backwards in multiples of a number from another large number — eg count backwards from 999 in multiples of 4 (see Gould, Weinberg and Jackson 1980). It is quite transparent to the experimental subjects in the control condition that the experimenters probably do not expect them to do better than the other groups and this may lead them to decreased motivation and thus to conform to the experimenters' expectations (Marks 1983, Yuille 1985).

Training Mental Skills

Despite the common belief that imagery as used in MR is an important training method there appears to be very little emphasis in research on ascertaining how proficient experimental subjects are at aspects of imagery and training these attributes if need be. This is an area in which the theoretical and the applied sport psychologists appear to be diverging in that applied sport psychologists are already implementing training procedures for imagery. Unfortunately these programmes have very little experimental evaluation and it is generally seen that these methods should be tested more rigourously (Hardy and Nelson 1988). Smith writes in a similar manner:

> We may now need to investigate methods for improving the sport imagery program itself and incorporate these methods into the training program for elite athletes [p. 245].

More recently Hird, Landers, Thomas and Horan (1991) say:

> ... it is common in research studies to instruct subjects to use mental practice without teaching them how to use it. Mental practice may be more effective in producing performance enhancement if subjects are first trained in its use [p.292].

This is the topic that will be dealt with in some depth in chapter 4.

The Research Does Not Relate to the Practice

By taking a rather limited look at imagery as it relates to sport psychology and not taking in the broader picture of imagery models in psychology as a whole, sport psychologists are missing out on potentially important issues. For instance, Murphy (1990) wrote about how he gave a particular imagery exercise to 'activate' speed skaters. The athletes had to imagine they had swallowed a ball of golden light which would then spread throughout their body and give them energy. One of the skaters said of the exercise that he had imaged the ball of golden light,

> ... exploding in my stomach, leaving a gaping hole in my body, so that I was crippled and unable to compete [p.168].

Another said,

> ... (it) blinded me, so that when I began skating I could not see where I was going, and I crashed into the wall of the rink and lay there, unmoving [p.168].

The point being made is that the sport psychological models do not take account of personal emotional interpretations of imagery and as a consequence do not contribute to an understanding of why a negative result could occur with these particular athletes. Consequently Murphy claims that there is an ever increasing gap between what applied sport psychologists are doing with athletes and what research sport psychologists are studying. For instance applied sport psychologists use imagery for other purposes such as goal setting, or helping an athlete to recover or prevent injury, or using imagery as another method for relaxing to cope with stress and anxiety.

Conclusions and Recommendations for Future Research

It is clear that mentally rehearsing an athletic movement using imagery, has a real effect on sporting performance which translates into changing a competitor's rank from 50th to 30th rank in a competition of 100 contestants. However, as Hardy (1989) points out, there is no agreement as to why or how imagery appears to have this effect. So far researchers believe that vividness and controllability are important contributors to the effect. Imagery perspective and modality are also believed to be important. The best results appear to come from sports that have a large cognitive component, that is where successful completion of the athletic task depends more on correct thinking rather than correct body movements. The less the cognitive component, the larger the amount of time or repetitions that are required for a beneficial effect. Case studies and correlational work appear to back up the efficacy of imagery in MR. The more frequent use of imagery by so-called 'elite athletes', appears to distinguish them from sub-elite athletes.

What cannot be said is what the cause and effect of the increased imagery is and there is experimental proof that MR effects occur both for the novice and the advanced athlete. Feltz & Landers (1983) suggest that this could be because imagery is operating in different ways for both ability groups. The reason for this lack of knowledge in part appears to be because of poor experimental design or methodology. Some of the common recommendations from the literature are given below.

- Researchers ought to work with a well-developed model that encompasses more than just the mental training model.
- The imagery script given to the subjects should be completely described.
- The actual imagery script of the subject should be recorded.
- Psychophysiological measures should be taken during mental rehearsal using imagery.
- The meaning of the image to the subject should be recorded.
- Adequate controls for MR effects should be included especially against expectancy.
- Imagery should be trained up as a skill to reap higher potential benefits of mental rehearsal.
- The role of perspective should be investigated more thoroughly to see if it is more sport specific.
- The beneficial effects of imagery do not lie purely in the MR protocol and other uses for imagery should be explored such as alleviating stress or in the use of injury prevention/pain control.

The following experiments follow up on three of these recommendations, that is to train up imagery skills and control against expectancy more effectively (chapters 4, 5 and 6), as well as to look at the effect on performance of qualitative differences in imagery perspective used in MR (chapter 7).

The next chapter (chapter 3) explains the Feltz & Landers meta-analysis in more detail to give the reader a clearer understanding of their results, and to illustrate the statistical techniques employed in the experiments described in the thesis.

CHAPTER 3 Experimental Design and Ecological Validity in Small Sample Design

Introduction

This chapter is written to try and help the reader understand some of the statistical tools that were used to help analyse the experimental results. As previously mentioned, the experiments were conducted in a manner that tried to maintain ecological validity. The price to pay for this is that typically only small sample sizes can be used in the experiments, which is unlikely to achieve traditional statistical significance. In these circumstances the experimental data is treated with a slightly different emphasis. Meta-analysis was mentioned several times in the last chapter and the first section tries to explain why this quantitative way of looking across research literature is believed to be so important in the behavioural sciences. Implicit in modern meta-analyses is a change in priority on the measures that are computed from single experiments. The new emphasis shows us that we cannot judge a single experiment to have 'succeeded' or 'failed' on the basis of whether the experiment achieved 'significant' results. Responsibility is placed more on the reader of the experiment to decide how much worth to put on the results. One consequence of this is that it is perfectly valid to conduct a large number of small studies (that is using small numbers of subjects) rather than a single or a few number of large 'definitive' studies. Previously small studies were deemed a waste of effort as the power of the experimental design was too weak to stand much chance of obtaining a significant result. Meta-analysis partly overcomes the main limitation of the experiments conducted in the study — namely, that in order to achieve ecological validity I was restricted to using small numbers of experimental subjects.

The Changing Face of Statistics

Traditional Fisherian Statistics

Jacob Cohen (1990) describes how the statistics that sociobiological sciences use today, are taken as the standard way to conduct science, and that:

> ...scientific fact should be regarded as experimentally established only if a properly designed experiment rarely fails to give this [5 %] level of significance (Fisher 1926, p. 504; quoted from Utts 1986).

What is being referred to here is the rejection of the null hypothesis (that there is no real difference in a data set) when the chance of the difference actually observed in the data is less than a pre-specified level (in this case 5 %). Take for example an experiment that observes whether a mental rehearsal (MR) protocol for high jump in field athletics will give superior performance than not using MR. In our fictitious experiment there are two groups of high jumpers, one which uses MR and the other which does not. After taking the measurements we find that the average of the MR group is 5 cm higher than the non–MR group. The null hypothesis states that this difference between the two groups is not real and is instead due to some random fluctuations of other variables that we cannot account for. For instance, perhaps the two groups we supposedly randomly chose had, purely by chance, better athletes in the MR group than the non-MR group. If after we have run the statistics on the data we find that the probability that this 5 cm difference between the groups occurred purely by chance was less than one in a hundred ($p<0.01$), then we 'reject the null hypothesis' and claim that the difference is probably a real one. It could be, of course, that this experiment was the one in a hundred that we expect by chance of seeing these results; this is referred to as a *type I* error. Cohen (1990) writes that this method of statistics was appropriate to the field of agriculture from whence Fisher came, but has since been adopted as the *de facto* method of conducting statistics because it offers a:

> ... deterministic scheme, mechanical and objective, independent of content and led to clear cut yes–no decisions (Cohen 1990, p.1307).

The latter feature was appropriate in agriculture where there were huge numbers of 'subjects' participating in experiments; this type of deterministic statistics could lead to a relatively clear cut decision being made to use a certain amount of manure (or not), or use a certain strain of wheat (or not) under certain conditions.

Problems with Traditional Fisherian Statistics

In the study of human behaviour, the emphasis on rejecting the null hypothesis on the basis of a pre–defined probability (denoted as a 'p value') level is inappropriate. This is because in the real world there are limited resources (funds, time, training, personnel) that running an experiment with large numbers of subjects is certainly impractical and almost always impossible.

The Real Effect is NOT the Significance Level

Utts (1986) remarks:

> . . . the size of the p value is incorrectly interpreted as the size of the effect [p.309].

That is, a researcher is tempted to say that an experiment is always 'better' if it shows a p value of less than 0.0001 rather than 0.01. All else being equal this is correct, but usually all else is not equal, for instance the number of subjects used in experiments is often different. Many researchers do not understand the meaning of p values (Utts 1986) and she goes on to explain that they do not appreciate how the p value is closely associated with the sample size. For instance, take our high jumpers again with the MR group scoring on average 5 cm higher than the non–MR group. For the sake of argument the 5 cm difference could have equated to a z score of 0.30 when ***n*** subjects were used with an associated p value of 0.38. If the same study had been run with 100***n*** subjects then our z score becomes 3.00 and the p value becomes 0.0013. Most researchers would regard the latter experiment as somehow 'better' despite the difference in height between the two groups in both experiments being **exactly the same** (ie 5 cm). The only sense in which the latter experiment is 'better' is that larger numbers of subjects were used, which allows us to place more confidence in the effect being a real one. However, the real effect is still the 5 cm difference between the groups in both experiments and not the p value of 0.38 or 0.0013 (adapted from Utts 1986, p.309).

Power Analysis

Cohen (1990) describes how hypothesis testing requires four parameters, any one of which is a function of the other three — they are the **alpha significance** (*type I* error), the **sample size**, the **population effect** size and the **power** of the test. The power coefficient of the test tells us how likely we are to correctly reject the null hypothesis at the alpha level, knowing the effect size and the number of subjects we are going to run in the experiment. Cohen (1962) found that the median power of the articles written up in the 1960 volume of the *Journal of Abnormal and Social Psychology* (for a two-tailed alpha of 0.05) was 0.46, that is there was only 46 % chance of correctly rejecting the null hypothesis which Cohen (1990) describes as ... 'a rather abysmal result' [p.1308].

The most common usage of power is in making a 'power analysis' which is the assessment of what the sample size needs to be in order to reject the null hypothesis at a given alpha level and a given beta level (the beta level is a *type II* error which is 1 minus the power coefficient, and gives the probability of incorrectly retaining the null hypothesis). The effect size must be known or estimated in order to run a power analysis. Howell (1982) maintains that the 'I–wonder–what–would–happen–if' experiment is extremely rare and considers that most researchers have a gut feeling as to what type (large or small) of effect they are looking for in an experiment, otherwise they would not be conducting the experiment in the first place. Cohen (1969) has proposed three arbitrary levels for a particular measure of effect sizes **(Cohen's d** which is measured in standard deviation units) which are: large — 0.80, medium — 0.50, small — 0.20. Thus for instance it is possible to calculate that for our high jumpers, if we expected a medium size effect (ie the 5cm translates into $d = 0.5$), then to have an 80% chance of correctly rejecting the null hypothesis at the $p < 0.05$ level (ie the alpha level) one would need to run an experiment with about 63 subjects in each group (ie 63 in the MR group and 63 in the non—MR group) or 126 subjects in total (assuming that the experiment is conducted between two independent groups with equal sample sizes).

There is another way to use power analysis when conducting replication studies (Cohen 1988). Rosenthal (1990) recommends the power should be reported:

> Especially if the results of either the original study or its replication were not significant, the statistical power at which the test of significance was made .... should be reported [p.26].

This releases the reader from exclusively relying on the researcher's decision as to whether the replication was successful or not. For instance, a reader may read that an attempted replication of our theoretical high jumpers, failed to obtain a result with an alpha level of less than 0.05. However, the reader may not want to lay much worth on this replication when she/he also reads that the associated power of the experiment was less than 0.1 (in other words, assuming the effect to be really present, there was a less than 1 in 10 chance of showing it).

Combining the Results of Several Replications

As researchers, the real essence of the experiment that we should be interested in is the effect size. Of course, how seriously we take that effect size is why we are interested in running a statistical analysis (the p value tells us how much confidence we can put on the result). However, this effect size is only an estimate. Say that we had run a number of experiments to assess the efficacy of an MR protocol on high jumpers. Over three experiments the effect size estimates were 0.38, 0.37 and 0.51. Which is the correct effect size (there is no other information given that could help us)? The logical step would be to take the mean of these effect sizes as our best estimate of the real effect size, which in this case would be 0.42. This is one way to conduct a meta-analysis. Just like any median statistic, the standard deviation of these effect sizes can be computed and from that the 95 % confidence intervals can be calculated. Furthermore if the 95% confidence intervals do not encompass zero then we can also give a p value for our meta-analysis which is 'significant' at the 0.05 level. Stated in this way meta–analysis is not a difficult concept to follow. However, there are many refinements that can be made to make better sense of the data, for instance by weighting the studies by the number of subjects used in each experiment. Studies can be weighted by other characteristics such as whether replications are conducted by independent researchers (Rosenthal 1990). One could also test to see how alike experiments are by seeing if their effects are significantly different or if they are similar (a homogeneity test). Coding as to slight variations in the experimental protocol can also be applied to test the differences of these smaller sub-groups from the larger database.

Problems with Meta-Analysis

Meta-analysis is not without considerable criticism. Wachter (1988) claims that the scepticism associated with meta-analysis centres around four concepts:

- bad studies are being camouflaged by fancy statistics;
- statistics are used without the benefit of control conditions or independence that make the meta-analytic procedures valid;
- studies stand to lose qualitative description by being coded into numbers; and
- meta-analyses are catering to an environment whereby bad studies by sheer numbers begin to override good studies.

Wachter then goes on to describe how these charges do not hold up under close scrutiny. Firstly there is nothing fancy about the statistics used in meta-analysis. Studies are often coded according to pre-specified criteria to reflect the quality of a study and thus different effect sizes can be computed for good and bad quality studies. The second charge is countered by Wachter by pointing out that actually meta-analysts are aware of this problem and are taking steps to counter it. For instance by looking at the 'filedrawer' problem, it is possible to compute an index as to how many extra non-significant studies are required to be 'hidden in researchers file drawers' in order to nullify any effect found in the meta-analyses. Feltz & Landers (1983) found a significant difference in effect size between published (0.74) and unpublished (0.32) studies. This result points to the 'file drawer effect'. Note, however, that the effect size in the unpublished studies is still positive albeit a smaller one. Often it is up to the reader to decide if the ratio of published results to hidden results makes the file drawer problem a serious one. Rosenthal (1990) has explained that studies can also be weighted so that we lay more worth on a replication that was done by a totally independent researcher, rather than one that was done by the same researcher. Wachter argues *reductio ad absurdum* that if we bemoan the fact that studies lose their quality by being decoded by research interest then we must be devaluing the reading of those studies (which is required in order to code them), and then we must by definition devalue writing, which in turn devalues thinking. Lastly he argues that not only are meta-analyses concerned with quality of studies (coding to pre-specified indices of quality) but they also have evolved methodologies such as the 'file drawer fail- safe' index. Also the sheer number of studies conducted today surely argues for the worth of a meta-analysis — which reviewer of the literature can keep all the studies in mind simultaneously?

Problems with the Feltz & Landers' Meta-Analysis

Previously in chapter 2, a meta-analysis by Feltz & Landers (1983) was reported. From sixty reports they obtained one hundred and forty-six effect sizes which they used to compute an overall beneficial effect size (d) of 0.48 for athletes using MR. There are a number of shortfalls in Feltz & Landers' analysis one of which is that it appears from their summary table, that there are numerous occasions when they have computed more than one effect size from a single study using the same subjects. This means that these effect sizes are not independent of each other, which can have serious implications on the results unless corrections are made. Feltz & Landers reported that they found 146 effect sizes whereas from their summary table in their paper it appears that there are probably nearer 86 effect sizes (several reports contained more than one experiment, hence the discrepancy between the number of studies found and the number of effect sizes reported). Secondly, they have not attempted to weight their effect sizes; for instance they give equal worth to a study which has relatively few subjects (such as Hall's (1983) study which had 4 subjects) compared to a study that had a large number of subjects (Johnson's (1967) study used 133 subjects). Weighting by numbers is not the only way to weight a study but with no other weighting scheme it is considered normal to weight by the degrees of freedom in modern meta-analyses. I did a re-analysis of the Feltz & Landers' data by taking the studies that appeared to be using the same subjects to create more than one effect size, and averaging those effects to give a single effect size. The resultant 86 effect sizes were then weighted by their degrees of freedom and a new mean effect size of (0.50) was calculated. The new effect size is not that much different from the original one and in terms of increased ranks it amounts to one place higher than the old estimate.

Conclusions and Summary of Chapter 3

There is a growing realisation amongst some modern researchers and statisticians that the traditional Fisherian mode of null hypothesis testing in statistics is inappropriate for studies which either have limited resources so that they cannot run large sample sizes, or use research questions for which a simple 'yes–no' decision is meaningless — psychology is one science that asks such questions. For instance let us take the results of Feltz & Landers' meta-analysis at face value that MR improves an athlete's performance. Can we therefore conclude that this will always be appropriate for each and every athlete on every occasion. Clearly the answer must be no. Athletes like other humans are likely to have different concerns and worries which affect their arousal and attention both between athletes on any one occasion and between sessions for the same athlete. Recommendations are that researchers should discard complete reliance on significance testing as the only criterion for whether an experiment was 'successful' or not. Researchers should also not always equate a lower significance level with a larger success rate — rather they should concentrate on the real effect size. Utts (1986) recommends that along with the effect size the confidence interval ought to be stated (this will also indicate whether the result was above or below a specified p value).

In terms of replicating a study, a power analysis can be conducted in order to maximise one's success at replicating a study at a given alpha level. However, as is often the case, one cannot always obtain the number of subjects required for an experiment, especially if, as argued in chapter 1, there should be a move towards conducting experiments outside the laboratory and using non-student populations (ie 'real people' !) for one's studies. In such cases, and especially if the replication was non-significant, a power analysis ought to be conducted so that readers of the research can ascertain the risk of making a *type II* error (concluding that there is no effect when in reality there is one).

Combining replication results into a meta-analysis can give a more accurate account of what is really going on. In the modern meta-analyses the reliance is on effect sizes. Studies that previously had been regarded as 'failures', can still be usefully used and are still relevant to the overall hypothesis. There is, therefore, much to be gained from conducting more studies with smaller sample sizes when limitations of the researcher mean that they cannot conduct large sample sized studies, since they can be subsequently incorporated into a meta-analysis.

The first two chapters of the thesis have outlined possible areas of research that need to be addressed in order to clear up some of the ambiguities of MR. Principally of interest was to conduct some experiments to train up imagery ability and see what effect this would have on athletic performance when imagery was employed in MR just prior to performance. Special care would be taken to ensure that the expectancy of a control group would be maintained as high as the group being trained in imagery. The role of imagery perspective would be studied with athletes who had been trained in the use of imagery in MR. A priority for these experiments was to maintain as much ecological validity as possible. However, it was realised that this would mean only working with small sample sizes. Fortunately a new emphasis on how results are treated in the behavioural sciences is emerging. This chapter has explained some aspects of this new emphasis. Recent thoughts on using statistics in the behavioural sciences have abandoned significance testing as the sole calculation stating the experimental outcome. It is now recognised that the p value is not the only or even necessarily the more important index of the success or failure of an experiment. Instead, indices that measure the actual experimental outcome (and which are translated into scale free units) are reported as effect sizes. Effect sizes from several experiments can be combined in a meta-analysis to give a mean effect size. This statistic can be employed as an aid to quantitatively summarize an area of research literature. One consequence of this change in emphasis on the indices reported from an experiment, is that it is seen as a perfectly valid research process to run a number of experiments using small numbers of subjects in each, rather than a single experiment that uses a large number of subjects. This fits in well with the experiments concerned in this study which, in an attempt to make the experiments ecologically valid, can only use a small number of participants.

The next chapter describes two pilot experiments and an experiment that looked at the effect of training up imagery and employing it in mental rehearsal (MR) just prior to performance.

CHAPTER 4
Training Imagery and its Use in Mental Rehearsal

Introduction

To summarise the first three chapters briefly, there is still a strong belief amongst experienced athletes and coaches that mental rehearsal (MR) is a valuable aid to increase athletic performance. Traditional reviews of empirical studies have concluded conservatively that there appears to be a weak effect or, more tentatively, that more research is warranted (Richardson 1967, Corbin 1972). However, modern quantitative review techniques point to there being a consistent beneficial 'medium size' effect resulting from MR (Feltz & Landers 1983). There are two major methodological problems in the experimental literature assessing MR. First, many researchers have pointed out the fact that MR may only start to show a real effect when we train an athlete in imagery ability (eg Smith 1987, Hird et al 1991). If an athlete's imagery ability is low then one might argue that the benefits from MR might be insignificant. Second, it is also recognised that experimental design has not given enough emphasis to consider the potential biasing effects of expectation resulting from the experimental procedure. The possibility exists that the medium size effects seen in the quantitative reviews are a consistent artifact of such an experimental design flaw.

This chapter describes two pilot studies and an experimental investigation of training imagery skills to athletes, who should subsequently gain higher benefits using MR prior to performance.

General Hypotheses

The formal hypotheses will be stated in each experimental write up but to set the experiments in context, general working hypotheses will be stated which were borne in mind whilst running all the experiments.

- Firstly it was predicted that the imagery training would work, ie participants' imagery ability (as measured by a self-report questionnaire) would increase from pre- to post- training for those experiments which trained imagery.
- Secondly, in the training experiments this hypothesized increase would correspond to an increase in each subject's benefit from MR, through improved sporting performance.
- All the experiments were expected to show that imagery would show a higher benefit from using MR than any of the control conditions that were specially designed to control against expectancy.

Subjects in these experiments are referred to as participants. It was hoped to change the emphasis of dichotomizing the athletes as being 'under the experimental microscope' and myself as the impartial observer, to one of joint enquiry into a research problem where the role of the athletes is only slightly different from that of the observer/researcher's. This attitude was much appreciated by the coaches that I worked in close association with, and I did not get any adverse feedback from the athletes.

Pilot Studies

Two pilot studies were undertaken to try out some of the methodologies used and also to test some of the general hypotheses. The methodologies are not written here as they are more completely written up for the formal experimentation for the gymnastic study later in this chapter. A brief resumé of the pilot studies is offered here.

Pilot 1: Training Imagery

From the university's trampoline club, 22 student participants were recruited for the first study which was to last for 10 weeks. In this period they were split into two groups and each group was given a different amount of imagery training to increase their imagery ability (the experimental group was given twice as much as the control group). The imagery training was constructed to emphasize gaining height off the trampoline bed, as this was seen to be the single factor that could dramatically improve the trampolining skills of all the participants taking part in the pilot study. Training audio tapes were constructed that allowed participants to train at their own pace in the comfort of their own home (see below in the materials section for a more complete description of the imagery training course, and appendix II for the complete transcript of the exercises). The hypothesis was that participants receiving more imagery training would increase their self rated imagery than those receiving less training. Also the more often a participant did the training (indicated by a self report measure of the number of times that they did a particular exercise) the more their imagery ability would increase. Correlated with this increase would be an increase in the trampoline performance scores. This would be reflected also by a difference between the two experimental groups. The experimental group would show a higher increase in trampoline scores over the training period than the control group.

Procedure

The trampolinists were randomly split into two groups, one of which received imagery training throughout the 10 week training period. The other group only received the imagery training for the last 5 weeks of the 10 training period. In the first 5 weeks the control group received a tape of five pieces of music. These participants were given the strong impression that the music also contained subliminal suggestions that would help improve their trampolining skills. This elaborate procedure was taken so that all the participants would eventually be given the training that was believed to provide a benefit to their athletic performance (this was believed to be ethically important), the only difference being that the ***subliminal*** group[1] were given

[1]The use of the word ***subliminal*** which is both emboldened and italicized is to denote the

less imagery training. In order to try and maintain the ***subliminal*** group's expectation of success as high as the imagery group, they were given the music tapes and instructions so that they too thought that they were receiving special 'training'.

Participants were given the Movement Imagery Questionnaire (MIQ) to fill out in the first week during their physical practice. This took at least 20 minutes to fill out which was regarded by all the participants as a waste of their valuable training time. Thereafter, participants were issued with a copy of the MIQ to keep at home along with several response sheets for them to fill out in their own time, at weekly intervals. I collected these answer sheets every week during their normal training time.

During the training, I would video each of the trampolinists doing ten timed bounces (this is a common training exercise) and their set routine (ten acrobatic moves).

Scoring

From the videos the total time for the trampolinists ten bounces and set routine was calculated. This was used as an indirect measure of the height obtained by the trampolinist so that the longer the trampolinist stayed in the air, the higher her or his total 10 bounces must have been. Another score was also calculated which tried to assess the vertical height of the trampolinist from the trampoline bed. This was devised by myself as an attempt to use a relatively cheap method to obtain a more direct measure of the trampolinists' vertical height. At the start of each session a measured length of pole was placed on the trampoline bed and videoed. Later in the department's video editing suite, this measure was used to generate a calibrated computer grid which was superimposed onto the video image via a mixing device. For the timed bounces the video was wound to the location of the maximum height of trampolinist (via slow motion and for fine control, frame by frame) and a cursor was placed at the ankle of the trampolinist. this was chosen because the trampolinists ankle was kept more or less in the same relative position to the rest of the trampolinists body and was relatively easy to spot on the video. For the trampolinist's routine the ankle could not be used because it constantly changed with respect to the trampolinist's body position therefore an estimate of the centre of gravity was used to estimate the vertical height gain of the trampolinist during an acrobatic move. This point was considerably harder to see on the video and a fair amount of estimation was involved. Having entered the estimated height of the trampolinist via the cursor the computer displayed the vertical height that was calculated via the calibration made at the beginning of the video.

Results

There were far too few participants' data to use for any meaningful analysis for either of the performance scores calculated. In any one session there was at most only half the number of recruited participants taking part. The maximum number of participants that appeared both in an initial and a final session was five! There was not one participant who appeared in all the

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description of the placebo condition and not the usual psychological term. In the case of the latter, no special character format will be used.

sessions. This lack of commitment from the participants was probably due to the participants being a student population whose members had other demands on their time that prevented them from turning up to the majority of sessions. In addition the MIQ was not filled out regularly by any of the participants so that I could not even correlate the MIQ scores with the few participants that did turn up. The same was true for the diaries that were supposed to be kept by the participants to the frequency of the taped exercise that they did.

Discussion

Valuable lessons were learnt from the study relating to the design, implementation and logistics of running such a study. I had not appreciated that the instructions had to be totally unambiguous and yet concise which in practice is extraordinarily difficult. There seemed to be an extension to Murphy's Law that however unlikely it was that some reasonable instructions could conceivably be misinterpreted, there would 'always be one' who would misinterpret the instructions (and this appeared to be so regardless of the number of participants I was dealing with). I also resolved that it was better to recruit a smaller number of participants whilst stressing the minimum commitment that I required in order not to waste my time or theirs. Initially my attitude towards my participants could be phrased as 'Please help me with my experiments which I am not entirely sure are going to work'. In later experiments I changed it to 'I am here to be helpful to you so make sure you make the most of me'.

However, in part it must be said that I probably asked the participants to do too much in their own time, especially with regard to filling out the MIQ every week. On reflection one would have to seriously doubt any results that would have come out of a successful analysis (ie if more of the participants had actually done the questionnaire and brought it to me), as the demand characteristics must have been very obvious (especially to the imagery training group) that they were expected to increase their imagery scores over time. For those participants that did fill out the MIQ more regularly, many said that they could remember the response that they had put down in the previous week. It was decided for future experiments to only take two scores of the MIQ, one at the beginning of the training and one at the end.

On reflection of the first pilot, I decided that it was perhaps unlikely to show a differential effect due to the increased imagery use as the participants were never specifically asked to use a mental rehearsal (MR) strategy which employed their imagery. It was decided that future experiments would specifically instruct participants to use an MR strategy.

Pilot 2: Using Mental Rehearsal for Trampolining

Following the last recommendation of the first pilot, a second pilot study was undertaken with five of the participants from the first pilot, who appeared to be keener than the rest. The purpose of the study was not so much to generate data but just to try out the logistics of running such an experimental protocol. The participants had to perform the two routines — one with and one without MR; the order was counterbalanced across the weeks. The scores computed similarly to the first pilot, supported the hypotheses (not significantly) that MR gave superior performance than no MR just prior to performance. However, these results were not taken seriously as the number of participants used was small and data were only gathered over two sessions. No attempt was made to counter any expectancy effects that would expect higher performance when using MR, so that the experimental design was seriously flawed.

Conclusions from the Pilots

The dreadful attendance of the first study indicated that much more commitment was required from potential participants before they agreed to take part in the study. This could in part have been my fault in that my attitude was far too accommodating — this may have led the participants either to believe that miracles could be performed with statistics on five participants or, and perhaps more likely, they felt that the study was of no real importance. Future studies would therefore see me take a much more professional outlook indicating that my training was invaluable. If participants could or did not take the the study seriously then I had to cut my losses and not further waste either my time or theirs. Instead it would be more productive to pursue other contacts that would lead me to other athletes who would take the training seriously.

The taped exercises were received well and enjoyed by all the participants. The control condition anecdotally appeared to work in that participants in this condition did not guess that it was a placebo training module and all the participants commented that they found it highly relaxing and enjoyable.

The specific hypothesis for this pilot was that giving the trampolinists imagery training would somehow increase their actual trampolining ability as they would either benefit from practising their routines mentally at home or they would divine that they should use their imagery skills in MR just before their actual performance. If the first case is true then the effect is so small that it either needs much more training than the first 10 weeks or the effect is trivial. Anecdotal reports from the trampolinists suggested that they had no idea that they were to use imagery to mentally rehearse their routines just before they stepped onto the trampoline. Therefore (and with hindsight it seems obvious), the athletes need to be told specifically that they need to do MR using imagery prior to actually doing the routine.

The novel method used to calculate the height by integrating video and computer technology, while in principle a good objective measure of trampoline performance, was in practice very problematical. Foremost was the fact that the location to assess the actual height of the trampolinist can only be accurately measured by the trampolinists change in vertical height of their centre of gravity. However, this is not easy to spot by eye as the location of the centre of gravity changes as the body shape changes. Hence it was decided to use the ankle for the timed bounces since this was a more easily identifiable spot. A future version would have to ascertain more precisely the centre of gravity, probably by digitizing the complete movement of key points of the body and using an algorithm to calculate the centre of gravity, from the dynamics of these key points. The method was also practically very slow. This was due to the poor quality of the video and computer equipment being used. The video / computer 'lock' often caused the computer to 'crash' and the calibration procedure would have to begin from anew (rewinding the tape to the start where the calibrating measuring rod was videoed). I have no doubt that if these major flaws could be overcome then the measure would have been an extremely good one. For the present thesis, I did not have the facilities to make these corrections and it was decided to use more traditional measures of acrobatic sports performances using judging procedures.

Experiment 1: Using Mental Rehearsal in Gymnastics

Introduction

This experiment was supposed to be a combined replication of the design and procedure from the first and second pilot studies. That was to train athletes' imagery abilities and then to record the change in athletic performance over time when using MR prior to actual performance. The athletic task that was being studied was vaulting ability in women's gymnastics. Participants would be matched for ability and split up into an experimental and a placebo/control group.

Materials used in the Experiments

Over the course of the project's experiments various tools had to be acquired, devised or customised. They were heavily dependent on which sports were studied. I personally only wanted to become involved in sports for which I had some experience. The reasoning behind this was, that I felt it important to have a moderate idea of what elements were required to do a particular skill properly. From experience I know that one can ask for specialised advice from coaches and athletes and totally miss the point, because language is being used in a specialised way, whereas the interviewer may be thinking of the language in its common usage. For instance in springboard diving there is a movement on the board known as the 'hurdle step' which is a radically different movement from what most people would think of as a hurdle (the movement used in the athletic track event). Knowledge of these terms allowed me to customise the imagery training to specific sports using the relevant terms. A general training regime which can be found commercially or in the popular sport psychology books, is too abstract (in order to be applicable to most athletes) and therefore difficult for athletes to transfer specifics of their particular sport to the described exercise.

Movement Imagery Questionnaire

In the experimental literature there are two classes of tests that purportedly measure imagery. One is self-report questionnaires, the other is spatial relations tasks. The latter are tasks that usually require subjects mentally to transform some object in order to complete the task set by the test. Both types of tests have proved to be quite robust and correlate with various other measures. However, as pointed out by Richardson (1983) the tests do not correlate highly between themselves and this suggests that the tests are measuring different phenomena.

The justification for self-report questionnaires has been made by several researchers, despite apparent weaknesses in them because of their subjective elements, as the questionnaires appear to correlate with measures that theoretically would support the use of imagery (Marks 1983). There have been criticisms that these correlations are obvious to subjects and therefore have a degree of conformity in them (that is that subjects conform to the obvious nature of the test). However, there have been some effects demonstrated that are counter-intuitive and still correlate with the self-report questionnaires and thus avoid the problem of experimental conformity (Finke and Schmidt 1977, Marks 1983).

Spatial relation tasks also have this criticism fired at them, but through an ingenious set-up Jolicoeur and Kosslyn (1985) have still shown positive effects despite trying to bias experimenters into confirming a different hypothesis. Their main weakness is that the tests assume that the quasi-pictorial element is necessary in order to complete the task; some researchers contest this assumption and claim that a propositional code could also explain the results. Self-report questionnaires, on the other hand, make no such assumption as to the validity of the imagery *per se* and only require the subject to report on any quasi-pictorial perception of imagery. Hence, there is not the conceptual problem of debating whether imagery is an epiphenomenon of underlying cognitive processing, or not.

Because of this it was decided to use self-report questionnaires. However, there are numerous questionnaires that could be used: Galton's Breakfast Questionnaire, Betts' Questionnaire upon Mental Imagery — QMI, Gordon's Test of Controllability, Marks' Vividness of Visual Imagery Questionnaire — VVIQ, Isaac's Vividness of Movement Imagery Questionnaire — VMIQ, and Hall, Pongrac and Buckholz's Movement Imagery Questionnaire — MIQ.

The MIQ was eventually selected for the reasons given below.

> Working with athletes it was felt it was important to include a questionnaire that measured kinesthetic imagery. The MIQ appeared to be better than the VMIQ as it had both a visual and a kinesthetic sub-scale, in contrast with the VMIQ which only had the kinesthetic scale. Therefore the VMIQ would have required administering a different questionnaire (probably the VVIQ) in order to measure visual as well as kinesthetic imagery (the total of both the VMIQ and the VVIQ was 30 items, each of which required two answers, ie 60 ratings had to be given in total, in contrast to 18 ratings for the MIQ).
>
> I personally liked the format of the test (appendix I) which is roughly as follows; participants from a described starting position, are asked to perform a particular movement, return to the starting position and mentally repeat the action either visually or kinesthetically. Thereafter they give a rating to how easy or difficult they found the task. Isaac (personal communication 1989) has pointed out that this questionnaire may rely too much on memory and not on imagery. However, all imagery models require a memory input at some stage and it is argued that it makes no conceptual difference whether the memory input is from long-term memory or from more immediate memory.
>
> The test has been shown to be internally stable, have a high test-retest reliability and appears to have construct validity (Hall, Pongrac & Buckholz 1985). *

Video Equipment

All acrobatic sports were videoed for finer analysis and allowed 'blind judging' to be done on the performance of the athletes by randomising the order in which the judge sees the actual performance. The video equipment is part of the psychology department's audio-visual unit and the training and advice needed to run the experiments were provided by Jimmy Cuthbert and Davey Wilkinson, the technical staff at the unit.

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* Please see the end of the MIQ in appendix I for a discussion on the construct validity of the MIQ

Training Modules

Imagery Training

Ideas for the training course came from some of many self-help courses found in popular sport psychology books. The course was cassette-based to allow athletes an easy entry into the art of imagery at their own pace in the comfort of their own home (or familiar surroundings). The course itself consisted of five exercises each of which was preceded by the same short relaxation procedure. The scripts are original material and a fair amount of effort was put into their construction. The rationale of the course's construction did not follow any theoretical recommendations, nor was the training based on any specific recommendations that 'applied' sport psychologists had made, simply because these were never stated. My approach was to regard the mental skills that I wanted to develop as analogous to physical skills. As a qualified springboard and tower diving teacher and coach, I teach skills according to the principle of breaking down a skill into easy to do component parts. These are practised until they can be successfully used in conjunction with each other or followed on from one another. The course was envisaged in two sections. The first (three exercises) would be general and teach the athlete about visual imagery (both from an internal and external point of view) and kinesthetic imagery. Participants were invited to do this first part of the course a number of times before they attempted the second part. The second part of the course would be specific to the participants' athletic performance. The skills learnt in the first part would be incorporated in imagery instructions that were designed to focus on, at most, a few key elements to increase the athlete's motor performance. Within each of the exercises, the emphasis was to start trying to image something simple and then to build upon these simple images until they were relatively complex.

Some trials were conducted with various speakers and some pilot work (with undergraduate listeners from 1st year tutorial groups) revealed a Dutch colleague, Audrey Van de Meer, to have the most intriguing voice in terms of maintaining interest over several repetitions of hearing the same instructions. My aim was to find a voice that was clear but would not become monotonous after listening to the same exercise several times. Although Audrey has excellent diction there are occasions where her speaking rhyme becomes abnormal (presumably following a Dutch rhyme) and I suspect that it was this aspect that made the voice interesting. Jimmy Cuthbert (the department's chief audio-visual technician) and I, spent some time experimenting with the excellent audio-visual facilities to achieve relatively professional recordings. The cassette box had a laser typeset inlay card, which was thought to give a more professional aura around the package in the hope that this would increase the participants' confidence in the training modules. A written handout tried to explain the ideas behind the training modules and how they should be used. All this latter material was explained verbally on the day that the training modules were handed out. A short description is given below (the complete transcript can be found in appendix II).

Exercise 1. Participants were guided around their own home. The tour was designed to incorporate visual, kinesthetic, auditory and gustatory imagery. This was supposed to introduce the participant to many of the possibilities of imagery. In this sense the exercise was not supposed to 'teach' anything in particular, only to ask the participant to try and experience the many different modalities of imagery.

Exercise 2. Participants were required to obtain a small hand-held object (a mug was recommended). Having studied the mug they were asked to visualise it, and then look at the mug again to see how well their imagery compared to it. Features such as the colour and the contours of the mug were stressed for the participant to observe and try to visualise. The participants were invited to do this action (observation of the mug and imaging it and re-observing it) as many times as they wished by turning off the audio tape, until they felt they could successfully image it. After this stage they were instructed in their imagery, to transform themselves into the size of a housefly and fly around and into the mug. The intention of this exercise was several fold: they would experience visual imagery both from an internal and an external perspective; by turning themselves into the size of a small creature they had to transform the mug into a considerably larger object than they were used to; 'flying' around the mug brought in the concept of dynamic visual imagery. Participants were invited to do this exercise in future with other hand held objects apart from mugs.

Exercise 3. A guided kinesthetic exercise asked participants to do a specific movement and then recreate that movement using kinesthetic imagery. This was based on the format of the Movement Imagery Questionnaire (MIQ). The exercise started off with simple movements (moving ones right arm from below the body until it points directly above your head) and progressively becomes more complicated in that the whole body is used (standing on tip toes with both arms stretched fully above the head). The latter part of the exercise reverses the sequence and asks the participant to image a movement and then to actually do that movement for feedback purposes.

Exercise 4. A guided external imagery exercise was designed specifically to highlight key points in obtaining height in the acrobatic flight phase for a gymnast vaulting off the horse. Specifically they were to try and see a low approach to the springboard, a low take off from the springboard and to see themselves 'pop' off the vaulting horse.

Exercise 5. A guided internal and kinesthetic imagery exercise was designed specifically to highlight key points in obtaining height for the acrobatic flight phase for a gymnast vaulting off the horse. Specifically they were to try and see and feel a low approach to the springboard, a low take off from the springboard and to feel themselves shrug their shoulders violently as they reached the vertical on the vaulting horse so that they would 'pop' off it.

A Placebo Training Module

Another training module was constructed using an almost identical structure to the training course above. Its aim was to keep participants' motivation as high as that of the experimental group and hence control against any expectancy effects. Basically it consisted of the same relaxation procedure that the experimental group had followed by a piece of relatively pleasant (but hopefully not too arousing) music. There were five such exercises and along with the taped exercises a written handout explained the use of subliminal perception to increase performance. This information was also repeated verbally as the tapes were handed out. The plan was to seed the idea that the tapes contained subliminal perception instructions that would help their particular sport. In fact there were **no** subliminal instructions put onto the training tape.

Diaries

A small diary was produced for athletes to record the number of times they used a particular mental exercise. For each day's entry, participants would simply enter the numbered exercise(s) that they had done for a particular day. The diaries were returned to me at the end of the training.

Information Leaflets About the Training

An associated piece of text explained how the training was supposed to work. That is the imagery training group received knowledge about how imagery was used by top athletes and appeared to give successful performance. The ***subliminal*** placebo group received knowledge about subliminal perception and how it was believed to have an influence on people to some extent but, it was stressed, suggestions could not force anyone to do anything that they disagreed with (to allay fears of being unwittingly manipulated). It was never actually stated that they were receiving subliminal suggestions but the wording gave a strong impression that the tapes that they received did contain subliminal suggestions that would help participants' sporting performance.

Participants

Initial enquires led to Maggie Bisset, the coach for the Meadowbank Ladies Olympic Gymnastic Club. Informal talks with her at one of the club nights tried to explain in principle what the experiment was trying to achieve and accordingly twenty- two female participants from the ages of 8 to 16 years old were recruited. Their ability ranged from novice to junior international standard.

Procedure

Participants were matched for ability and then randomly split into the two groups (experimental and placebo/control). The treatment procedure over the 10 week period was a **multiple baseline** method whereby both groups received the imagery training and differed only in their time of starting the training. This was done for ethical reasons in that every participant would receive the training that was believed to be beneficial. This procedure would ensure that those participants in the control condition would not feel that the experiment had been a waste of time for them, once they found out the experimental design. The general multiple baseline design is shown in the table below.

	1st half of training	2nd half of training
Experimental	Imagery training	Imagery training
Control	Placebo training	Imagery training

Table 4.1: The general multiple baseline design

The change-over (where the control group also received imagery training) was at the end of the seventh week.

Training packs were handed out which contained:

- instructions on using the tapes and a written explanation of the effect the tape was supposed to have;
- the appropriate cassette tape; and
- a diary to record the number of times participants used their taped exercises.

Participants were also told by the experimenter (ie myself) more or less exactly what was said on the instruction leaflet so that any queries could be dealt with there and then. It was impressed on the participants that they were to try to do at least four of the exercises per week and record their use in the diary. While it was stressed that they ought to make every attempt to try to do four exercises, it was stressed even harder that they would not be penalised for not doing this, they were simply to record the number of times they did the exercises faithfully and not to 'cheat'.

In the first experimental session the MIQ was administered collectively to the intermediate group (this is not an experimental grouping, rather it is the group that was physically worked with on a particular apparatus) during normal training. While this is not how the test is supposed to be administered, I felt it necessary in order to ensure that they tried to take the test in a reasonably sensible manner. One still has to contend with the fact that the participants of this group (aged between ten and twelve years old) thought that this was some sort of assessed test such as school tests, and would just on principle score their answer sheets highly or even try to cheat on their colleagues. Gentle persuasion was used in order to counter these behaviours. The advanced group were given a copy of the test along with its instruction and told to do the test at home. The following week the novices were tested collectively for the same reason as the intermediates. Whilst the conditions were far from perfect it must be emphasised that these experiments were carried out 'in the field' where it is not feasible or even justified to insist on laboratory conditions. The testing took place in the gym hall during their regular training sessions. Participants, it was felt would quickly 'unvolunteer' themselves from the experiment if they found that by taking part they were sacrificing large amounts of training time.

Recording of the vaulting ability occurred in the last six weeks of the 10 week period. Gymnasts were allowed to do some warm–up vaults and they indicated when they were ready to be recorded. For the first three data collecting sessions, three vaults for each gymnast were videoed. In the remaining three sessions, four vaults each were videoed; gymnasts were asked to use MR just prior to their second and fourth vault. It was at the beginning of the last three sessions that the placebo group were given the alternative imagery training tapes with the cover story that the previous ***subliminal*** tapes (placebo) were in fact 'priming' them to use the imagery on their new tape more effectively. At the end of the data collection, the participants either took the MIQ in the gym (following similar reasoning as in the first time that the MIQ was administered), or in the case of the advanced gymnasts they took the MIQ home to fill out in their own time.

After the preliminary analysis (about five weeks after the experiment had ended) all participants were debriefed collectively with the aid of large flip charts in a language that would be meaningful to the audience bearing in mind their average young age. A written handout tried to do the same job and was handed out the following week. Those not present at the week's verbal debriefing, received an individual debriefing which was conducted in the following week.

Scoring and analysis

The complete videoed sessions were edited onto a separate video tape randomly. This edited tape was copied and sent off to two independent national judges. For each week, there were only two of the four vaults recorded and scored on to the edited tape, these were selected randomly but always (in the last three weekly sessions), included a MR vault (when the gymnast used MR prior to performance) and a non- MR vault (where they did not use MR). The reason for this rather elaborate procedure was to decrease the number of vaults that the judge would have to score (they were unpaid volunteers and the work took approximately five to six hours to complete). There was an attempt to take out any ordering effects (the MR condition was always vault number 2 and 4), which might swamp any effect due to the imagery training. For the first three weeks gymnasts were not asked to use MR prior to their vault. Therefore, in order for these weekly sessions to have a comparable score with the last three weekly sessions, one of the vaults was randomly selected to represent an MR condition and another was randomly assigned to represent the non-MR condition. To counteract any ordering effect that may have occurred in the last three weekly sessions (in terms of the ratio of the MR vault preceding the non-MR vault compared to the reverse situation), the pseudo MR / non-MR vaults were selected to reflect a similar ordering ratio as in the last three weekly sessions.

It was explained to each judge that the order of sessions had been randomly placed on the tape in order to keep them 'blind' and hence remove any unintentional bias (eg that the judge would naturally expect an improvement over time regardless of training). The judges were not told the experimental hypothesis in great detail so that they were also blind to which gymnast belonged to which experimental group and to which type of vault they were judging (MR vs non-MR). Judges also received a scoring card and for every fifth vault on the video tape the number of vaults was displayed over the video image (such as, "This is vault number 15"). This helped ensure that they did not get lost when scoring approximately 200 vaults. Both judges scored exactly the same vaults. The returned scores from the judges were entered into a computer along with the MIQ scores and the diary usage, for data analysis.

Participants' diaries were marked according to the number of times they used their taped exercises. A distinction was made between the number of imagery related exercises done and the overall number of exercises done (for the control group this included the placebo exercises as well).

Design and Hypotheses

A placebo training protocol was given to the control group in order to maintain motivation and counter expectancy effects. Calculation of effect sizes was deemed essential in order to compare the results to the larger databases in the research literature. Exploratory correlational analyses were also planned between the MIQ and diary use variables.

The hypotheses were those given below.

① Over the training period the within participant imagery scores on the MIQ would decrease significantly (lower MIQ score denotes higher self-reported imagery ability).

② The change in imagery ability as measured by the MIQ would be correlated with the diary usage.

③ The change in imagery ability as measured by the MIQ would give a higher correlation with the diary usage specifically for the imagery exercises as opposed to the placebo exercises.

④ The change in imagery ability as measured by the MIQ would be significantly higher for the experimental group compared to the control group.

⑤ The MR advantage score (or gain in vaulting ability) would be significantly higher for the imagery group compared to the subliminal group.

⑥ The gain in vaulting ability would be larger in the last three weeks when all gymnasts were asked to use MR prior to performance, than in the first three weeks.

Exploratory analyses would assess the effect of ability although no clear hypotheses were formulated.

Results

MIQ results

A Wilcoxon signed rank test on participants' pre- and post- training scores of the MIQ showed a highly significant difference in the hypothesized direction (for the overall MIQ score corrected $Z = -3.172$, $p < 0.005$; visual sub-scale corrected $Z = -2.667$, $p < 0.01$; kinesthetic sub-scale corrected $Z = -3.184$, $p < 0.005$). The respective effect sizes (d) were: 1.24, 0.87, 1.53. Thus hypothesis ① is significantly supported.

A Mann–Whitney test showed no significant difference between the control and the experimental group. Hypothesis ④ is not supported.

The diary scores were simple frequencies of use, and correlated (Spearman rank correlation) with the gain over the MIQ scores. The correlation between MIQ improvement and overall frequency of exercise use was not significant but in the expected direction ($r = 0.33$, $N= 8$, $p > 0.05$). The same was true for the use of specific imagery exercises ($r = 0.42$, $N= 8$,

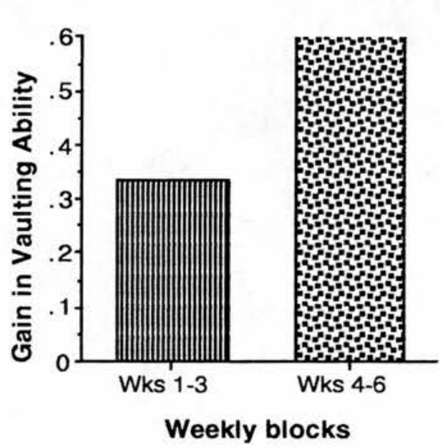
$p > 0.05$). Thus hypothesis ② is supported but not significantly. The first correlation included both the imagery specific exercises and the ***subliminal*** exercises of the first three weeks of the experiment. The correlation for the imagery specific exercises did not include the ***subliminal*** exercises — note that it is larger than the overall correlation. This would suggest that it was the imagery specific exercises that improved participants' imagery ability over the training sessions. Therefore, hypothesis ③ is also supported but again not significantly.

A Kruskal–Wallis test showed no significant difference between participants MIQ improvement and their ability group (advanced, intermediate, novice).

A Wilcoxon signed rank test between the sub-scales of the MIQ gave a corrected Z of –3.606 ($p=0.0003$) before the training and –2.879 ($p=0.004$) after the training. This suggests that participants find kinesthetic imagery much harder than visual imagery even after the imagery training.

Vault Score Results

The scoring of the two independent judges was correlated to give a significant correlation ($r = 0.80$, $p < 0.05$). Therefore the analyses could hereafter incorporate the combined judges' scores. The difference between the rehearsal and the non-rehearsal conditions was calculated — that is the **Gain in Vaulting Ability** (GVA). The pseudo GVA was averaged for the first three weeks (ie in this period participants did not specifically use MR just prior to any of their vault) and the last three-weeks (all participants tried to use MR prior to selected vaults). A two-way ANOVA was computed for the the groups and the two three-week blocks showed no significance for the grouping factor ($F=1.556$, $p=.227$), nor between the two three- week blocks ($F=0.056$, $p=0.816$) and neither for the interaction ($F=0.295$, $p=0.593$). A plot of the means of the GVA in each of the periods is shown in graph below and shows the GVA for both groups over both blocks of three weeks. It seems to suggest that the imagery group derived more benefit from using MR than the ***subliminal*** group.



Graph 4.1: To show the mean between the two three–week blocks.

The effect sizes (d) were computed for each of the groups by dividing the mean MR advantage score for each group by the standard deviation for each weekly block (ie across both groups) and weighting them by the degrees of freedom. The table below summarizes the effect size results.

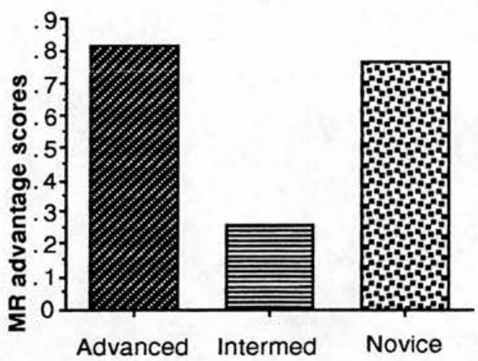
Week blocks	Subliminal	Imagery	Mean
1-3	-0.131	0.272	0.071
4-6	0.049	0.200	0.125
Mean	-0.041	0.236	0.098

Table 4.2: The effect sizes calculated from the mental rehearsal advantage scores.

It can be seen from the table that the effect sizes support hypothesis ⑤ albeit not significantly, that is the imagery effect sizes are bigger than the subliminal group's effect sizes in both halves of the experiment. The effect size (d) is considered 'small' (Cohen 1988) and the associated power for the ANOVA is less than 0.1. That is assuming this effect to be a real one, the statistics gives a less than one in ten chance of correctly concluding that the effects could only be due to chance at the 5% or less level. Hypothesis ⑥ is also supported but again not significantly, that is the effect size for the first half across both groups is lower than the effect size for the last half. However, looking at the scores one can see that the replication of the combined results is a bit artificial, in that the ***subliminal*** group' effect size changed over the two halves from a negative effect size to an albeit smaller but positive effect size. The effect size for the imagery group is slightly smaller in the second half than the first half (which is counter to the direction expected for any learning effect), but both effect sizes are positive and larger than those for the ***subliminal*** group.

None of the Spearman correlations between MIQ changes and the mean GVA was significant in any of the three-week blocks. The strongest correlation was the participants' visual imagery at the end of the experiment ($r = 0.427$, $n=8$) which is in the unexpected direction (the smaller the imagery score the stronger the perceived ability). Almost all the other correlations were also opposite to the predicted direction.

A one way ANOVA was run between GVA and the ability groups on their GVA in the last half of the experiment. There was no significant difference between the groups ($F= 0.062$, $p=0.94$). The means for each ability group's GVA over the last half of the experiment are shown in the graph below for interest's sake. It indicates that each of the groups benefited from using MR prior to performance. The advanced group showed the highest gain, then the novices and then the intermediates.



Graph 2.2: To show the means of the GVA between the different ability groups in the last half of the experiment (weeks 4–6).

Discussion

The results suggest that the imagery training did work over the training period. However, there was no significant difference between the two experimental groups for their imagery scores or even the sub-scales of the imagery scores. There was a flaw in the timing of administering the MIQ questionnaire before and after the training. The post-training MIQ was administered right at the end of the experiment which, due to its multiple baseline nature, meant the ***subliminal*** (control) group had received three weeks imagery training by the time the post-training MIQ was taken. It is conceivable that the rate of imagery learning is at its fastest within the first three weeks; that is, a 'law of diminishing returns' exists for imagery ability learning, whereby further comparable gains in imagery ability take considerably more time than the initial three weeks. A future study of this type would have to take a post-training MIQ score just before the imagery training started for the control group. An alternative explanation for the gain in self-perceived imagery scores is to suggest that the very act of taking the imagery questionnaire may have primed the participants to think in terms of using imagery even if they were assigned to ***subliminal*** training. A future experiment would have to guard against this possibility by including a dummy questionnaire similar in structure and length to the MIQ, that would prime for an alternative 'mental training' programme such as the placebo ***subliminal*** training.

Not withstanding these possibilities, there is some indication that the imagery training was actually responsible for the increase in self-reported imagery. The correlation between the MIQ and the frequency of use of the imagery exercises was higher than the correlation for all the exercises which included the ***subliminal*** (control) exercises. The control exercises were specifically designed to control against expectancy and even after the control group members were given the imagery exercises, it was explained to them that the purpose of the first set of exercises was to make them even more receptive to the imagery training than they otherwise would have been.

Assuming that it is valid to compare the two modalities on the MIQ then the results appear to suggest strongly that most participants find kinesthetic imagery considerably harder to image than visual imagery. The sub-scales are question for question the same, they are conducted at the same time, the format of the question is identical and the scaled answers are in the same range. Comparisons between the ease of generating visual and kinesthetic imagery, as measured by these scales, does not,in this light, seem unreasonable.

The evidence from the GVA is difficult to interpret. Although the ANOVA testing was not significant, an analysis of the means and weighted effect sizes between the groups at first appearance seems to support hypotheses ⑤ and ⑥. However, the means and weighted effect sizes of the GVA for the first half of the training period (weeks one to three), are perplexing because they should theoretically be close to zero. These scores were semi-randomly assigned to a pseudo-MR and 'pseudo non-MR' condition in order to work out an equivalent GVA. The scores had to be semi-selected, to balance the ordering ratio of the last three weeks, ie sometimes the MR vault would be before the non-MR vault and vice versa — the ratio of these orders was not 1:1. Ordering effects, it was felt, would probably overshadow any real MR effects. It is possible that the ratios have artificially inflated the GVA in the experiment. In retrospect the method of selecting vaults to be scored, was overly clumsy and probably does not give an accurate reflection of the contribution of imagery training. The evidence between the ability groups is not significant but supports the notion that most experienced athletes show the strongest gain from using MR. What is not clear is why the novice group appear to be gaining more benefit from the MR over the intermediates. The only observation that I can offer is that the intermediate group members were typically about ten to twelve years old, whereas the novice group members were between seven and nine years old. I found that the novice group had a shorter concentration span, but when I had their attention they appeared keen and willing to co-operate as best they could. The intermediates, on the other hand, I felt, were prone to treat the mental rehearsal as a soft option that was a sort of 'cop out' from their otherwise strenuous training regime. I had tried to correct this on numerous occasions, by pointing out the potential benefits of taking the experiment seriously. However, I suspect that to most children at this age, anyone who is over 20 years old probably comes into the category of a 'teacher' and thus "need not be taken too seriously".

The correlations of the MIQ and its various sub-scales are hard to explain except to say that they are all not significant. Their direction runs counter to the wisdom that vivid imagery would be of more benefit to the athlete in any MR that they might engage in prior to performance. The completion rate for the MIQ at the end of the experiment was disappointingly low (15 out of 22).

In conclusion there is support for the notion that imagery training does work as assessed by a self- report measure. However, due to a procedural flaw, it cannot be ascertained whether the training occurs in less than three weeks or whether the participants were conforming to the experimental expectancy. However, self reported frequency of using the imagery training exercises correlated positively with participants' perceived imagery gain. The correlation was stronger still for the frequency of use for the actual imagery exercises (as opposed to the ***subliminal*** exercises). This result provides some support to suggest that the participants are not merely conforming to some demand characteristics. There was no significant support for the hypothesis that the imagery group had more to gain in a MR just prior to performance — however, the calculated effect sizes were in the predicted direction. An effect size (d) of 0.20, is probably not a true reflection of the actual contribution of the imagery training due to a cumbersome method of scoring. There was no significant support for the experience of the gymnast having any bearing on the effectiveness of the imagery training and hence its worth in MR. Despite being able to correct the procedural flaws in a future training study, it was felt that it would be worth going back to the original format of a MR experiment as typically seen in the research literature (ie without extended mental training) before doing another training study, in order to assess the efficacy of MR if expectancy was sufficiently controlled for.

CHAPTER 5
A Closer Examination of Controlling against Expectancies

Experiment 2: Learning to Juggle (1)

Introduction

The gymnastic study took the best part of five months to complete and it did not appear to give clear cut results that showed mental rehearsal (MR) to give a positive benefit to the athlete. Although this was not surprising given the low experimental power, my 'feeling' for the experiment made me want to pursue the expectancy issue further before trying to replicate the gymnastic study. In essence this was because I was not convinced that the MR effect was as robust as I had expected it would be since the extra six weeks of imagery training appeared to only show half the effect size seen in the Feltz & Landers (1983) meta-analysis. If anything it was expected that the imagery training would increase the positive effect of using MR. It was therefore decided to run a study similar in format to those in the MR literature (ie no imagery training) but unlike the previous literature, this study would concentrate on controlling against expectancy in a similar fashion to the gymnastic study. As such it was not a training experiment in that it did not give training over a number of weeks, however, there was some time devoted to preliminary mental training in the procedure. The task was to be quick to administer, in order to process more participants than in the training studies, and the whole experiment was to take only one session. Some pilot studies that I conducted, indicated that it was perfectly possible to teach someone to juggle three balls in a 'cascade fashion', in a couple of hours. The experimental task was to see if MR using imagery, would improve the learning rate of participants acquiring juggling skills, over a control condition. It appears from the literature that there is very little to control against a participant's expectation of success. This experiment had two control groups. The first had the placebo ***subliminal*** suggestion training as used in the gymnastic training. The second group members were informed that they were going to be receiving no mental training but they were to behave as if they had been given some mental training that would help them learn the juggling skills. In order to give the participants from this group, a task equivalent in time to the other two training groups, they were asked to count backwards in multiples of 7 from 999, whilst the others did their training.

Following on from the suggestions of the gymnastic training study, a questionnaire was included along with the MIQ to guard against the potential priming effect of using imagery having taken the MIQ. Called the 'Subliminal Susceptibility Questionnaire' or SSQ it asked for ratings on questions that related to supposedly picking up subliminal suggestions from the environment (appendix I).

Participants

Twenty -two first year university undergraduates (15 females, 7 males) were recruited from a variety of academic subjects. The only selection requirement was that they should not be able to juggle before the experiment started. There were three experimenters; myself, Richard Wiseman, a friend and colleague at the department, and Anthony Taylor, a brother of mine; all of us could juggle in a cascade fashion.

Materials

Four imagery exercises for learning juggling. The first exercise was a tour of the types of imagery that were possible. The last three exercises were specific to the juggling steps that participants were learning.

An audio tape of relaxation and music that acted as a placebo control against expectancy.

The Subliminal Suggestibility Questionnaire (SSQ). Before the first juggling experiment it was decided that maybe the MIQ would prime the participants too much to think that there was something special about imagery and thus undo the control for expectancy that I had hoped for. Instead a bogus questionnaire was included, alongside the MIQ, that ostensibly measured suggestibility. It consisted of 18 items that asked for a frequency rating (often–never) between 1 and 7, similar to the MIQ. Questions were things like 'Have you ever taken a subliminal suggestion course in order to relax or give up smoking?'. The questionnaire was not taken to be a serious one and no psychometric tests were done with it. Its function was purely to control against any priming effects that the MIQ might have.

The Movement Imagery Questionnaire (MIQ).

A video tape, giving three lessons in how to juggle in a cascade fashion, was specially designed for the experiment.

Two video cameras with associated recorders.

A 26" screen monitor and playback facilities to show the training tape.

Two audio stereo cassette tape recorders.

Over 50 commercial, tetrahedron beanbags made for juggling.

A variety of rooms and cubicles in the psychology department to separate the participants.

Procedure

There were two, two-hourly sessions during the day: one in the morning and one in the afternoon. Both sessions followed the same procedure. Each session had different participants.

After the participants were welcomed to the department and briefly introduced to the expected timetable of events for the experiment, they were all handed answer sheets for the MIQ and the question and answer sheet for the SSQ. As time was short a group MIQ measurement session was conducted. This is against the procedure for the MIQ, which is that participants should be in a quiet room by themselves and should read and follow the instructions of the questionnaire by themselves. As can be seen from appendix I the MIQ requires the participant to adopt a starting position, execute a movement and then through visual or kinesthetic imagery, to reproduce that movement and finally to rate the realism with which they imaged it. Instead, the instructions were read out, the movement demonstrated and then the participants were asked to proceed in the normal manner. As there were no soft mats questions 9 and 18 (which required participants to execute a forward roll) were omitted. The participants could see each other doing the movements as they were all facing in an inward semi-circle looking at me demonstrating the initial movement. Although the participants were probably self-conscious at first, they did not appear to be so self-conscious that completion of the MIQ was affected. After the MIQ was completed participants were asked to read and answer the SSQ in their own time.

The participants were given a short demonstration by an experimenter (Richard), of what juggling in a cascade fashion looked like. All the participants were videoed having three attempts to juggle in the fashion just demonstrated. It was stressed that they were not expected to be able to juggle at this stage and we explained that this procedure was just to check that they really could not juggle. One attempt was counted at the start of continuous throwing of the three beanbags until one of the beanbags was dropped.

The participants were then split into the three experimental groups — imagery, ***subliminal*** and 'as if' — and assigned to an experimenter. These groups were given an introductory talk as to what their training would consist of. The experimental group members were given a guided imagery tour, exposing them to external and internal visual imagery and kinesthetic imagery. They were asked to use whichever imagery mode they found easier or, if they found no difference, then the imagery mode they preferred. The first control group (***subliminal***), was given a short verbal account of what subliminal perception is and how it has been used in other areas. Although it was never actually stated as such, there was a very strong inference that they would be played some music that would contain subliminal suggestions to improve their rate of learning to juggle. The music they heard contained **no** subliminal suggestions. The second control group ('as if' training) was specifically told that they, unlike the other groups, would be given no mental training whatsoever. Instead they were to pretend at the end of these sessions 'as if' they had been given some special mental training that would help them to learn to juggle better than if they had not had this pretend 'mental training'. To help them distract their minds from the juggling while they were doing these 'mental training' sessions, they were to count backwards in multiples of 7 starting from 999.

All the participants re-convened in one room where they were shown the first part of the juggling skills training on the training video tape. In their separate groups and group rooms, each experimenter gave a relaxation procedure (the two control groups played their tapes which contained the relaxation procedure, the experimental group had their relaxation read out to them following exactly the same script as the tape). Thereafter the experimenters gave instructions pertaining to their particular training. After this mental stage each participant was given a beanbag to practise the first step which they did for two minutes in separate individual cubicles. It was thought important to keep the participants separate at this stage in order that they would not become self-conscious. The procedure, from watching the video tape until they finished their physical practice, can be thought of as one cycle. There were another two cycles, similar in sequence except that they learned a new step each time. In the second cycle they learnt to throw with two beanbags and in the third cycle with three beanbags — for both the last two cycles they were given five minutes each for physical practice.

They were then videoed once again to attempt to juggle three times for as long as possible. A debriefing was given collectively as to the nature of the experiment and to the hypotheses that were being tested. After the results were analysed the participants were given a brief written description of the experiment and the results.

Scoring

No literature was found pertaining to how a person's juggling ability could be judged. Therefore, for novice jugglers, it was decided that an appropriate measure would be to count the number of times that they successfully threw and caught the beanbags in a 'cascade' fashion. From the videos the juggling ability was scored using the following criteria. If the beanbag was successfully thrown from one hand and caught in the other, then that counted as one point. To score another point the participant had to throw another beanbag from the second hand and catch it in the first. Hence a participant who theoretically continually threw one bag from the same hand and always caught the bag in the other hand, would only score one point. If a participant dropped one bag but successfully threw and caught a second bag starting from the other hand then this second bag also counted as an additional point. The dropped bag did not count. Aside from this special example above, the attempt was deemed to be finished as soon as the participant dropped a bag. Theoretically if a participant picked up the dropped bag and continued to throw the bags in the correct sequence then scoring would restart, however, in practice none of the participants did this. The number of points for each attempt was summed to give a single measure of a participant's ability to juggle.

Design

The participants were matched for sex but split into three unequal size groups. Because of cancellations the actual proportions of the participants for the imagery (experimental), ***subliminal*** (control 1) and 'as if' (control 2) was, 10 : 6 : 6.

The main analysis was to be a mixed factor (repeated measure) ANOVA. The between group factor was the experimental training group (imagery, ***subliminal***, 'as if') and the between factor was the pre- and post- training measure of juggling ability.

The hypotheses from this analysis are given below.

① Over the experiment participants would show a significant gain in juggling ability.
② The imagery group would show a higher gain than the two control groups.

The difference between the post-training measure of juggling and the pre-training measure was calculated as a separate measure of the **Gain in Juggling Ability** (GJA). This measure was then correlated using a Spearman rank correlation on the MIQ and its sub-test scores.

The hypotheses regarding these correlations are given below.

③ A negative correlation was predicted between the overall MIQ score and the GJA (lower MIQ score indicates higher self-perceived imagery ability).
④ A negative correlation was predicted between the visual sub-scale score of the MIQ and the GJA.
⑤ A negative correlation was predicted between the kinesthetic sub-scale score of the MIQ and the GJA.

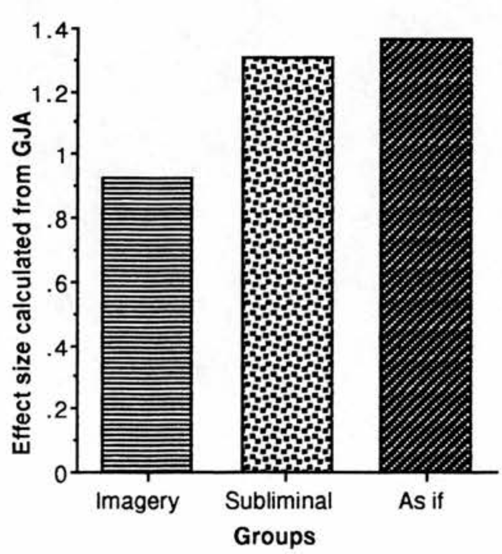
⑥ A Wilcoxon signed-rank test between the two imagery modalities on the MIQ was predicted to show that kinesthetic imagery was harder to image than visual imagery.

Exploratory analyses were planned on differences in learning between the sexes and between the morning or afternoon sessions. There was no prediction as to the direction this difference might take (ie two- tailed). An exploratory correlation was also made for the SSQ although no correlation was expected to occur.

Results

Two of the participants were deleted from the analysis. One because she professed that she could already juggle. Another participant had to be videoed twice for the post-training measure as the video was not switched on to record. Although in the first endeavour to video he had juggled well, in his second videoing his score was so greatly improved that maybe he had an unfair advantage.

The mixed (repeated measure) ANOVA indicated a significant effect for the groups (F = 4.163, p<0.05). The ***subliminal*** group showed the highest overall juggling ability followed by the 'as if' group and then the imagery group. These results suggest that the ***subliminal*** group were better overall (that is even including the juggling ability before the training) than either the 'as if' group or the imagery group. The repeated measure factor was highly significant (F= 33.488, p=0.0001) which suggests that the experiment was highly successful in teaching all the participants how to juggle. Hypothesis ① is significantly supported. However, the interaction was not significant (F=0.394, p=0.68) which suggests that there was not a significant learning difference between the groups. The effect size (d) of the GJAs was calculated by dividing the GJA for each training group by the standard deviation for the GJA across all the groups. A closer look at the mean GJA effect sizes shows the ***subliminal*** group and the 'as if' group to be larger than the imagery group (1.55: 1.45: 1.09). The results are totally contrary to hypothesis ②. A graph of the effect sizes as they relate to each of the experimental groups is shown below.



Graph 5.1: Shows the GJA effect sizes associated for each of the training groups

The Spearman rank correlation between the MIQ and the GJA was not significant mainly because the correlations of the sub-scales were almost completely opposite to each other. Hypothesis ③ is not supported. For the visual sub-scale there was a negative (and non-significant) correlation (r= –0.32, p=0.17). Hypothesis ④ is supported but not significantly. For the kinesthetic sub-scale there was a positive correlation (r= 0.37, p= 0.11) these results are contrary in effect to hypothesis ⑤.

The *post hoc* 2- factor ANOVA on the GJA showed a significant effect for the session (F = 4.468, p=0.05), the afternoon session learning better than the morning session. This was surprising because all the experimenters had agreed anecdotally that, if anything, participants in the morning session were better than participants in the afternoon session. The females appeared to be better learners than the males but not significantly (F=2.363, p=0.14). There was an almost significant interaction (F= 3.692, p= 0.07) the females not showing much difference between the sessions but the males in the morning not learning to throw any more beanbags whereas the afternoon males learned to throw an extra three bags. These results should be tempered by the fact that there were only three morning males and three afternoon males, and as such the above results are probably trivial. It appears that it is the morning males that are causing the main effect of session as all the other cells (afternoon males, morning and afternoon females) GJA are roughly the same.

A Spearman rank correlation between the GJA and the SSQ showed a positive significant correlation (r= 0.456, p= 0.05). This was not expected as the SSQ was never designed as a serious questionnaire. Its function was to control against priming that might occur after the MIQ had been administered (ie participants would guess that imagery was important).

A Wilcoxon signed-rank test between the two imagery modalities on the MIQ gave a corrected Z of –4.11 (p<0.0001), which showed significant support for hypothesis ⑥.

Discussion

Almost all the participants learnt to juggle in that they could throw over 5 beanbags in sequence by the end of the training. Apart from that, none of the results was significant which might suggest that the results were due to chance. However, the power of the experiments was very low (c 0.15) and the following arguments are conjectured as if the results were not due to chance but some systematic variation. It is not clear why the ***subliminal*** group should show the highest GJA and more specifically why the imagery group should show the lowest GJA. This would suggest that there is another factor that accounts for the data other than imagery. The ***subliminal*** group was designed specifically to control against expectancy. It may be that high expectancy has stronger beneficial effects than giving imagery instructions. The experimenters were kept the same for each of the groups so the experimenter for the ***subliminal*** group may have been better at giving higher expectancies than the other two experimenters. A future study would try to counter this effect by rotating the experimenters through the different groups and by keeping them 'blind' to the experimental hypothesis. There appears to be a difference as to what type of imagery facilitates learning best. The kinesthetic scale shows a positive (and therefore in the non-predicted direction) correlation whereas the visual sub-scale is in the predicted direction (better visual imagers learn better). This finding supports the symbolic learning theory which is that, especially for new tasks, an external visual image is better for coding novel movements. The *post hoc* results for the session and the non-significant sexual differences are probably due to all three morning males, by chance, being slow learners and I do not think this is a real effect unless further experimentation showed the same result.

The SSQ, although not meant as a serious questionnaire, was designed to give participants the idea that susceptibility to subliminal suggestions was of experimental interest. Assuming that the questionnaire has face validity, then the positive correlation is counter intuitive (lower SSQ score denotes higher susceptibility).

The differences between imagery modalities again points to the fact that participants find kinesthetic imagery harder to image than visual imagery. This could be a population trend because most people tend to rely on visual perception to give them information about their environment. We very rarely rely on kinesthetic information except in special circumstances such as in sport, especially those where kinesthetic information is crucial to successful performance such as gymnastics or diving. The mean difference in ratings between the visual and kinesthetic scales was almost twenty points. In comparison the difference was only about eight points for the gymnasts, which might suggest that gymnasts, having had to rely on kinesthetic information, find it easier to image than non-athletes such as the novice jugglers from this experiment.

Experiment 3: Learning to Juggle (2)

Introduction

It was decided to replicate this study to see if similar effects could be found to the first juggling study. The hypothesis for this experiment would be that the two control groups (***subliminal*** training and the 'as if' group), would do better than the imagery group. Unfortunately, the recommendations of changing the experimenters in rotation was not feasible because of the large numbers of participants that would be required. Strictly there would have to be four sets of rotations, with each experimenter doing each one of the steps for each of the groups. This was deemed unreasonable as the experiment only takes place in one day in order to hinder cross-talk amongst the experimental participants, which would ruin the experimental design. Also it was not feasible to recruit 'blind' experimenters, hence two of the experimenters were the same as in the previous study (Richard Wiseman and myself) and another experimenter, Chris Roe, was recruited to take the place of the previous experimenter, Anthony Taylor.

Participants

Thirty-one first year university undergraduates (16 females, 15 males) were recruited from a variety of academic topics. The only requirement was that they could not juggle before the study started.

Materials

The same materials were used as in the first experiment, except that a special audio tape was made with the imagery instructions. It was felt that in the previous experiment where the imagery instructions were read out, variations in delivery could influence results artefactually. Hence Audrey van der Meer recorded another set of instructions to complement the relaxation tapes that the other two groups had (appendix II).

Procedure

There were two sessions during the day: one in the morning and one in the afternoon. They both followed the same procedure, which was the same as that of the previous juggling experiment, except that the participants had six attempts to juggle for as long as possible in both pre- and post- training video sessions (instead of three attempts); and the sessions were extended to three hours instead of two.

Analysis

Again the analysis followed the same scoring protocol as in the first experiment.

Design

The participants were matched for sex but split into three almost equal size groups. The actual proportions of the participants for the imagery, ***subliminal*** and 'as if' groups was, 11 : 10: 10.

The main analysis was again to be a two-way mixed factor (repeated measure) ANOVA. The between group factor was the experimental training group (imagery, ***subliminal***, 'as if') and the within participant factor was the pre- and post- training measure of juggling ability.

The hypotheses for this experiment are given below.

① Over the experiment participants would show a significant gain in juggling ability.

② The two control groups would show a higher gain than the imagery group .

③ The magnitude of the effect sizes was to be approximately the same as that of the previous juggling experiment.

The difference between the post-training measure to juggle and the pre-training measure was again calculated as a separate measure the GJA. This measure was then correlated using a Spearman rank correlation on the MIQ and its sub-test scores. The hypotheses regarding these correlations are given below.

④ A negative correlation was predicted between the visual sub-scale score of the MIQ and the GJA.

⑤ A positive correlation was predicted between the kinesthetic sub-scale score of the MIQ and the GJA.

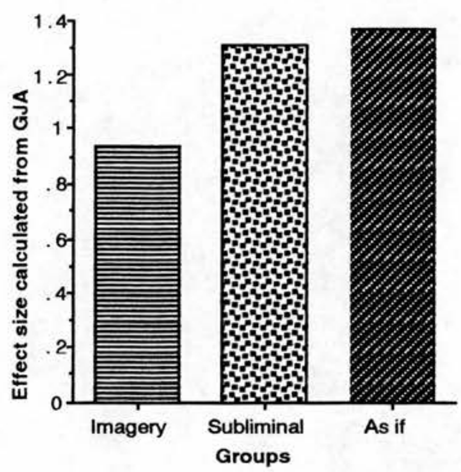
The difference between the sub-scales on the MIQ was to be studied and the hypothesis was:

⑥ Participants would find it harder to image kinesthetically rather than visually.

Results

Five participants were deleted from the analysis because of a procedural mistake which allowed these five to practise their final step much longer than five minutes. They were all from the 'as if' group.

The mixed (repeated measure) ANOVA showed a strong learning effect (F = 33.862, P<0.0001), thus replicating the effect from the previous experiment and significantly supporting hypothesis ①. There was no significant group effect (F = 0.570, p = 0.57) which means that there was no overall difference in juggling ability between the groups. Unfortunately there was no interaction effect (F = 0.514, p = 0.60) indicating that there was no differential learning effect between the groups. Again the mean GJA effect sizes were calculated in a similar fashion to the first juggling experiment and showed that the two control groups were again higher than the imagery group (1.37 for 'as if' group: 1.31 for the ***subliminal*** group: 0.93 for the imagery group). The experiment supports hypothesis ② albeit not significantly. The effect sizes for each group are shown in the graph below.



Graph 5.2: To show the relationship of the effect sizes to each of the experimental groups

The Spearman correlation between the participants' GJA and the the visual sub-scale of the MIQ was r = –0.12 which supports hypothesis ④ but not significantly. The correlation between the participants' GJA and the the kinesthetic sub-scale of the MIQ was r = 0.12 which supports hypothesis ⑤ but not significantly. The correlation between the participants' GJA and the the overall MIQ score was r = 0.03. None of them was significant at the p = 0.05 level with 26 degrees of freedom. Although both correlations were about half those of the previous study, they are both in the same direction which partially replicates the previous findings.

A Wilcoxon signed-rank test between the two sub-scales of the MIQ gave a corrected Z of –4.121 (p<0.0001), which shows significant support for hypothesis ⑥.

Discussion

This study did not show any statistically significant results showing a differential learning effect between the three treatment groups. However, the effect sizes showed once again that the imagery group scored lowest of the three strategies employed. A chance remark from one of the other experimenters led me to question them all about the degree of conviction with which they had carried out their training. Richard (the experimenter for the ***subliminal*** group on both occasions) told me that he had to explain more about subliminal perception than the experimental protocol required, as the participants had asked for more information about it. He told me afterwards that he had really got into the role and told some anecdotes to back up the rationale for using the subliminal training. Anthony (the experimenter for the 'as if' group in the first experiment) had just read out the instructions as he was required and did not elaborate in the way that Richard had done. I for my part (experimenter for the imagery training for both experiments) had tried to play down any enthusiasm for imagery, thinking that the other experimenters would just follow the experimental protocol. Chris ('as if' second experiment) confirmed that he had 'laid it on thick' with encouragement such as "Don't let these other guys beat you" and "This mental training thing is all a bit of a scam anyway". If this is an accurate state of the enthusiasm put in by the experimenters then it is obviously a design flaw in not making the instructions to the experimenters explicit enough. Experimenter enthusiasm appears to have been less so for the initial juggling experiment and very much more so for the second experiment, however, the effect size difference is more or less the same when compared to the respective imagery group of the two experiments. Although this was not strictly controlled as an experimental variable, if it were true then it would suggest that experimenter enthusiasm is not contributing much to the overall effect. What is clear is that these procedures which were designed to be high in expectancy, are better than an imagery strategy. It should be borne in mind, however, that the participants were all athletically inexperienced (in terms of juggling) and probably did not have enough time to develop enough imagery skills to be of practical value. The previous gymnastic training study showed marginal support for the highest gain for the MR protocol was with the advanced gymnasts. A future experiment should try to ascertain whether this expectancy effect is confined to athletically inexperienced athletes only.

A look at the meta-analysis of Feltz & Landers (1983), shows that the majority of the MR studies are conducted with novices (approximately 84% of the recalculated 86 effect sizes from chapter 3, are categorised as using novice subjects). Given that such a large proportion of the meta-analysis were using novices, the results from these two experiments lay serious doubt on the conclusions reached by reviewers of the MR strategy literature, especially for the novice athletes. Further work should be conducted with more experienced athletes to see if the expectancy effect still occurs at higher levels of expertise.

The MIQ has two measures of imagery modality, visual and kinesthetic imagery. There is some case to be made that kinesthetic imagery is very closely related to an internal visual imagery perspective (Mahoney and Avener 1977). A purely visual imagery mode without associated kinesthetic imagery is also believed to be easier to image from an external visual perspective. If that is the case then the correlations of the MIQ sub-scales although ostensibly measuring imagery mode, might also be strongly associated with imagery perspective. The results from both sets of experiments suggest that, at least for novices, having a higher ability to generate an external imagery perspective is more beneficial. This is not an elegant suggestion because if it were true then it would suggest that the control groups, although not specifically asked to use imagery, were in fact using it to facilitate their learning. One would therefore posit that the training script using MR just before the participants actually practised physically, was in someway hindering the natural imagery strategy of participants who were not using the script.

The difference in effect between the two imagery modalities on the MIQ was about eleven points and although highly significant it was not so large as the previous juggling experiment. However, it is still larger in magnitude than the gymnasts in the first experiment, which still supports the idea that experience in a particular perceptual mode makes it easier to image in the corresponding imagery mode.

Combining the Results of the Two Juggling Experiments

Both juggling experiments although not showing significant results in an of themselves, did appear to replicate each other. It was decided to combine the results of the two studies and to conduct significance testing on the larger data set. A look at the effect sizes for the respective groups in both experiments appeared to show that the ***subliminal*** and the 'as if' groups were approximately the same in both experiments. Therefore it was decided to combine the results of both these groups from both experiments into one 'super control group' and to compare this against the combined scores of the imagery groups. The hypothesis was that the super control group would show a significantly higher learning score than the imagery group. A Mann-Whitney test gave a corrected Z of 1.673, p=0.05 (one tailed), thus just managing to significantly support the hypothesis.

Discussion

In one sense the results would be far neater to explain if there were no difference between the groups. Then one could simply infer that the real MR effect as seen in motor performance for novice athletes, was merely an experimental artefact (an expectancy or conformancy effect). However, the fact remains that the control group(s) appear to actually perform better than the imagery group. One might argue that the differential enthusiasm put in by the individual experimenters, is somehow causing the effect. However, as was previously argued this does not bear up to close scrutiny if one looks at the effect size difference between the two control groups and the difference between either of the control groups and the imagery group (see Graphs 5.1 & 5.2). One can see that the difference between the two control groups in both experiments, is approximately an order of magnitude smaller than comparisons of either control group to the imagery group in each experiment. I have previously argued that if experimenter enthusiasm is the main effect then the effect sizes of the imagery group and the 'as if' group from the first experiment ought to be more similar than the actual results (where in actual fact the 'as if' and the ***subliminal*** group are more similar).

Another explanation would be that, by accident, the control groups both had a higher expectation than the imagery group. Realising this problem the procedures were at the outset, designed specifically to be as close to each other as possible in terms of: plausibility of the training, manner and duration of each procedure's presentation. During the design of the procedures, I asked for colleagues' opinions to help me match expectation across the procedures. However, it would be more desirable to assess the claim that expectancy was matched experimentally, given sufficient time and resources. To check to see if the training procedures were equal in their expectation one could, for instance, administer a self report questionnaire to the participants before they received the feedback from the experiment (or a separate matched population not taking part in the experiment), asking them to rate each of the training procedures according to their expectation.of success. However, this is fraught with demand characteristic problems, in the presentation of the training procedures. Tailoring the presentations until the hypothetical ratings are equal is not valid to the actual training (one can never be sure that the presentation of the experiment actually matches the experience of taking part in the experiment). However, future replications of this work would certainly benefit from making some effort in trying to assess the actual expectancy of the training procedures.

Whilst I recognise that differential experimenter enthusiasm and / or an intrinsic unequal expectation of the procedures, could be a real confounding variable(s), I have shown above why I do not believe that either of these explanations is the real one. As I have already stated, the most parsimonious explanation for me, is that the request of the imagery group to use a pre-scripted imagery instructional set, was in someway actually hindering normal learning performance (certainly with respect to high expectancy). This might actually suggest that imagery does have a real role to play in motor performance other than purely as a good motivational device (in this case it was detrimental to the possibly enhanced performance of high expectancy). I would like to suggest that what is being observed in the data, is an example of participants' limited attentional capacity. The ability to do several things at once is limited in people, such that if that capacity is overloaded then the performance of the attempted tasks will decrease (Welford 1962, Kahnemen 1973). Imagery as a real cognitive ability could take up attentional resources that would otherwise be gainfully employed in learning the novel task of learning to juggle. If this were the case then it might be expected that if imagery is to have a real benefit for athletes using MR, then it should not incur such a high attentional demand that it detracts from the athletic performance. There are two ways that this could be achieved. The first is to make the physical task a relatively automatic movement so that attentional demand of the imagery task can be 'afforded'. Wrisberg & Shea (1978) showed that attentional demands of motor performance decreases as the skill becomes more learnt (more automatic). Cox (1990) illustrates this point with an example of a novice basketball player who in learning to dribble the ball on court, cannot attend to the rest of the game such as what the coach is indicating, where her of his team mates are or what the opposition are doing. As she or he become more skilled in dribbling, then these other facets of the game can be successfully attended to without adverse affects on dribbling performance. In these two sets of experiments the athletic task was not by any means automatic. In fact the participant selection requirement was specifically that they could not juggle (ie their juggling skills by definition could not be automatic). The decision to use novice jugglers was made because it made the scoring of the juggling procedure considerably easier. If experienced jugglers had been used then the scoring of the juggling, as used in the experiments, would have become effectively useless. The length of juggling would have probably been a measure of physical or mental stamina rather than the motor performance of juggling ability. A different measure would have probably meant scoring the juggling along some guidelines of aesthetic shape of the beanbags' flight. I have never heard of such guidelines being used and would not know myself which ones would be appropriate. Therefore it seemed logical to confine the study to novice jugglers. The gymnasts in contrast, were relatively used to the athletic task that they were doing and in this respect were different from the novice jugglers. A second way to reduce the attentional demands of the overall task so that MR would give beneficial gains to motor performance, would be to make the imagery used in MR relatively automatic. The way to achieve this would be to practice MR as often as possible. The imagery training in the gymnastic study may have fulfilled this requirement.

CHAPTER 6
Imagery Training and its Use in Mental Rehearsal Revisited

Experiment 4: Shooting and Mental Rehearsal

Introduction

The juggling experiments seem to show that imagery was not giving the beneficial effects of using imagery in mental rehearsal (MR) that has been previously found in the literature (Feltz & Landers 1983). It was thought that another experiment should be run with experienced athletes to try and replicate the effect seen in the first experiment with the gymnasts to see if the effect of imagery training gives a higher benefit than expectancy in any MR protocol. It was thought that smallbore rifle shooting would also be a suitable sport to try and recruit athletes from. Again I had previous experience of the sport and felt comfortable with using or re-acquainting myself with the specialised language. I made contact with the secretary of the Scottish Smallbore Rifle Association, Anne Hamilton. Anne was at one time a British squad member and was very sympathetic to what I was trying to achieve as she had 'dabbled' in various psychological techniques. With much help from her, I set up a training course for the shooters that was similar to the gymnastic and trampolining training course in structure but did not emphasise differences in perspectives as had been done in the other training courses (see appendix II). Instead it made more sense to think in terms of a mainly internal and kinesthetic perspective — the external perspective did not feel intuitively 'right' for a shooting task to either Anne or myself. We also identified that the most suitable club to work with was the University's Alumni club. This is a very high 'calibre' club with many of the members having shot at both national and international standard. This experiment was designed to look again at the role of imagery training and its hypothesised beneficial effect on using an MR protocol for shooting performance. Once again the effect of expectancy was going to be controlled for and the placebo ***subliminal*** suggestion training was used as a control group. The juggling experiments may have shown a greater learning effect for the control groups because they were using inexperienced athletes (with respect to juggling) who had little chance to acquaint themselves with using imagery to improve their performance using MR. Imagery training may have had a detrimental effect on the actual juggling improvement during training the attentional demand of doing two relatively new tasks was too high. Using athletes experienced in the athletic task might get around this problem and a real benefit from the training, as seen in the gymnasts' vaulting, would be observed.

Participants:

Thirteen members of the Edinburgh University's Alumni Club were recruited into the study, nine males and four females, though one of the latter dropped out of the study through reasons other than involvement in this study.

Materials:

Movement Imagery Questionnaire (MIQ) and answer sheets.

Subliminal Susceptibility Questionnaire (SSQ) and answer sheets.

Cassette-based imagery training modules exercises 1–3 were identical to the exercises used in the vault study (experiment 1). Exercises 4, 5 and 6 formed a progression of exercises specifically for shooting that did not stress a particular perspective. Instead, it took a Zen-like approach: extending a tube from the end of the rifle up to the target (exercise 4), the shooter becoming one with the rifle/firing point (exercise 5), and time ceasing to flow (exercise 6).

Cassette-based placebo training modules as used in experiment 1.

Explanation sheet of how the training was believed to occur.

Procedure:

An introductory talk to potential participants, explained that the purpose of the experiment was to assess the worth of two psychological methods to enhance performance. Participants were told that both methods had been shown to work in the laboratory but no one had ever done a comparison of the two. It was explained that all participants would derive a psychological benefit from taking part. It was stressed that although the exercises were easy and quick, it would not be worth while for the shooters or for myself, if volunteers could not devote at least four occasions a week to the training. Those who volunteered were given a copy of the MIQ and the SSQ to take home, complete and bring back to me in the following week. On the third occasion on which I saw them, they were randomly split into two groups — an imagery training group and a ***subliminal*** training group. Each participant received a relevant training pack which consisted of the cassette with the training on it and an explanatory sheet explaining how the training was believed to occur. All participants were told that the data would be collected over six weeks. However, the actual training took place over twelve weeks with the data collection in the last six. Like the gymnastic study and the pilot gymnastic study, a multiple baseline methodology was employed so that all shooters would eventually receive the imagery training. The change-over for the control group occurred just before their final three-weeks training.

During the last three weeks of collecting data, the shooters were asked to do their particular training as an MR strategy just before they were about to shoot a card. For those who had ostensibly listened to subliminal suggestions, they were asked to follow the relaxation procedure as used on the tape and it was explained to them that all the benefits of their home training (ie the ***subliminal*** training) would come to the fore by association with the relaxation procedure. The members of the imagery group were asked to use their imagery to mentally rehearse for their shooting. All the shooters' scores that they had shot during the week were collected. It was noted in which position they had shot their target: prone, kneeling or standing. It was not clear at first which of the scores would be amenable to statistical analysis, however, it soon became apparent that all the participants shot in the 'prone' position whereas the 'standing' and 'kneeling' were shot by approximately half the shooters and even this was an infrequent occurrence. It was decided to do all the analyses on the mean scores for each participant in the prone position. All the scores came from competition targets.

Design

Of the 13 participants, 11 were considered to be of an advanced standard and only 2 were considered to be of an intermediate standard. It was one of the intermediates who dropped out, so it did not appear to be productive to look at ability differences.

The hypotheses for the MIQ scores over the course of the experiment were as follows.

① A Wilcoxon signed-rank test was expected to show a significant learning effect on the participants MIQ scores.

② The change in MIQ scores for the imagery group, would be greater than the change in the subliminal group.

③ The participants would find it harder to image kinesthetically as opposed to visually both before and after training.

The mean scores for each participant were calculated for the first three-weeks and the last three-weeks of the experiment. The main analysis was to be a two-way (mixed) ANOVA. The between-factor being the training groups and the within-factor being the scores from the first three-weeks and the last three-weeks. The hypothesis was:

④ There would be an interaction effect showing that the imagery group had a higher gain in shooting ability than the ***subliminal*** group.

A separate measure the **Gain in Shooting Ability** (GSA) was calculated by subtracting the average shooting score of the first three weeks from the average of the last three. This gave a separate measure which could then be used in correlational analyses. A number of correlations would be computed from the experimental data. The hypotheses regarding these correlations are given below.

⑤ A positive correlation was predicted between the change in perceived visual imagery ability and the GSA.

⑥ A positive correlation was predicted between the change in perceived kinesthetic imagery ability and the GSA.

⑦ A positive correlation was predicted between the change in perceived overall imagery ability and the GSA.

⑧ The self-perceived kinesthetic imagery ability at the end of training, would correlate negatively with the GSA (lower score means higher imagery ability). No prediction was made for the visual sub-scale.

Results

MIQ Results

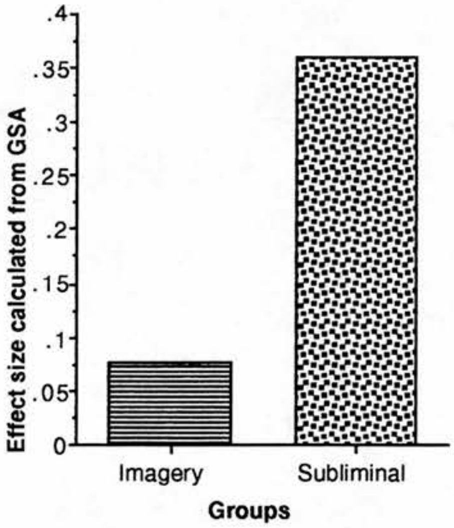
A Wilcoxon signed- rank test between the MIQ scores pre- and post- training was not significant ($Z=1.43$, $p=0.15$), however, it was in the predicted direction. The effect size (d) is 0.52. Therefore there is non-significant support for hypothesis ①.

A Mann–Whitney test between the groups on their respective change in MIQ scores over the training period, was not significant for either the main test, the visual sub-scale, or the kinesthetic sub-scale ($Z=0.000$ $p=1.00$ $Z=-0.214$, $p=0.83$, $Z=-0.214$, $p= 0.83$ respectively). The direction for the sub-scales is marginally in the correct direction. Hypothesis ② is not significantly supported.

A Wilcoxon signed-rank test gave a corrected Z of –1.782 (p=0.08) before the imagery training and –2.705 (p=0.007) after the training. Both results support hypothesis ③, however, it is only the second result that gives significant support.

Shooting Ability Results

The two-way mixed ANOVA showed no significant results for the group factor (F=1.059, p=0.33) nor for the repeated factor (F=1.058, p=0.33) and nor for an interaction between the group and repeated factor (F=0.44, p=0.52). Effect sizes were computed to look at the differences within the groups over time and the differences between the groups. The difference between the imagery group and the ***subliminal*** group for the first three weeks was –0.34, and –0.83 for the last three weeks.The effect sizes tell us that the ***subliminal*** group were better than the imagery group even before they tried consciously to use a MR. However, this difference increased when the ***subliminal*** group was asked to use an MR in the last three weeks. If the effect sizes are computed for the GSA then this would take account of the initial discrepancy on performance levels between the two groups. In other words, one would look instead for a change in performance as opposed to absolute levels of performance. The effect size for the change in performance was still higher for the ***subliminal*** group (0.36) compared to the imagery group (0.08). Hypothesis ④ is not supported, the direction of the effect is totally in the opposite direction to that predicted. The effect sizes of the GSA for the two groups is shown below.



Graph 6.1: To show the effect sizes of the two groups in their gain in shooting ability over the experimental period

Spearman correlations between the change in MIQ scores and its sub-scales over the experiment, showed no significant results (r= 0.05, p=0.87 for the MIQ: r=0.23, p=0.50 for the visual sub-scale: r=–0.08, p=0.81 for the kinesthetic sub-scale). There is no support for hypothesis ⑥ and very little support for hypothesis ⑦. The visual sub-scale shows a small effect in the predicted direction which gives non- significant support for hypothesis ⑤. The correlation for the kinesthetic sub-scale score and the GSA was in the predicted direction (r=–0.25, p=0.46) and gives non-significant support for hypothesis ⑧.

The correlation with the SSQ and the GSA was positive (r=0.577, p=0.05) which is of a similar magnitude and in the same direction as in the first juggle study. It suggests that participants who were more familiar with the concept of subliminal suggestions did worse than those who were not familiar with it.

Discussion

The number of participants was smaller than that of the gymnastic study so it was highly unlikely to see significant results. However, it is surprising that the results (although not significant) were exactly opposite to the hypothesis. Instead they reflected the trend seen in the two juggling studies; that is the 'cover story' of listening to subliminal suggestions, that would ultimately improve their imagery training, appeared to have a more beneficial effect on their shooting performance scores than actual imagery training over an equivalent period. The ***subliminal*** training was designed to control against expectancy. If expectancy was controlled for properly and it is the important factor in any MR protocol, then we should observe no difference between the groups. Although the results are not significant this is, as previously mentioned, hardly surprising given the low power of the experiment, however, the difference between the two groups is seen as a medium size effect. Assuming that this is not a chance artefact and that the difference is a real one, it is difficult to conjecture why the ***subliminal*** training should have had a more beneficial effect than the real imagery training. One alternative is that the ***subliminal*** condition actually gave a higher expectancy than the imagery group.

The initial formulation of the experiment was to use experienced athletes who would not have to learn the athletic task as well as the imagery training and in this sense have less attentional demands placed on them by the experimental protocol. These shooters are almost all of international standard, however, anecdotally I was told that they had not heard of or practised using an MR strategy just prior to performance. At best most of them used or had read about relaxation strategies or concentration exercises. In contrast, most of the gymnasts had heard of MR strategies and to a certain extent had been using some MR techniques under the guidance of their coach. It might be that the ***subliminal*** training for the shooters did not make the cognitive attentional demands on the relatively foreign concept of using MR, as opposed to the imagery training. An alternative suggestion is that ***subliminal training*** took away the the responsibility of consciously acquiring imagery as a mental skill because it was perceived as being 'unconscious' and therefore out of participants' control.

These results, if they are taken to be indicative of the real state of affairs, would suggest that role that imagery has to play is not as large a contribution as expectancy. Should one not take imagery training seriously? The efficacy of the imagery exercises was rated anecdotally by the shooters themselves very highly. Some reported using the strategy successfully in between every shot and not just prior to shooting a card (10 shots). If this is the case then one might conjecture that in the initial phases of being introduced to using MR prior to performance, a method that is high in expectancy but places no attentional demands on the athlete, will work better than one that does (such as MR). As the athlete becomes more experienced with using MR and the whole process becomes more automatic, then the relative contribution of using imagery in MR begins to make a larger contribution than expectancy. A future experiment which allowed athletes to become more familiar with using MR just prior to performance, might show that imagery has a larger contribution to make than expectancy.

The correlations of the MIQ and its sub-scales probably reflect chance and do not map onto real effects that are occurring. If one was however to accept the results as real then it would indicate that an increase in visual imagery ability is a small indication of successful shooting performance. As the shooting imagery exercise was mainly from an internal perspective and had many kinesthetic elements in it, one would have expected a similar relationship for the change in kinesthetic ability.

The positive correlation of the SSQ to the GSA is similar to the first juggling experiment. The direction of the correlation is counter intuitive if one accepts the face validity of the questionnaire. As explained in the juggling experiment, the questionnaire was never meant to be a serious one. However, the questions on the face of it relate to the self-perceived ability of people to be influenced by subliminal perceptions. Like the MIQ, the SSQ uses rating scales from 1 to 7 where 1 denotes higher self -perceived ability. Hence the correlation (accepting face validity) ought to be negative. No explanation can be offered as to why the correlation is positive.

The difference between the imagery modalities again point to the fact that participants find it harder to image kinesthetically rather than visually. The difference in scale points is lower before the experiment (seven points) than later in the experiment (twelve points) which might suggest that this particular set of participants responded more to the visual imagery training than the kinesthetic training. This is not an obvious result as there are many kinesthetic elements to a successful shot. Some parts of the body should be relaxed so as not to cause undue tension which invariably leads to wobbling of the rifle barrel. However, tension must be maintained in other parts of the body such as keeping the rifle butt firmly in place in the shoulder.

Conclusions and Summary of Chapters 4, 5 and 6

Two pilots and four experiments were conducted to look at the role of imagery in a mental rehearsal (MR) protocol. Expectancy was controlled for in control groups. Only one of the experiments supported the main experimental hypothesis which was that the experimental group utilized MR to greater advantage than the control groups as indicated by their athletic scores. The other three experiments showed the reverse trend. None of the experiments were significant, however, this is not surprising due to the low power of each of the experiments (the power was less than 0.15 for all the experiments).

The gymnastic study, whose results supported the MR hypothesis, may have differed from the other three in that the athletes (gymnasts) had, albeit to a limited degree, used some sort of MR prior to performance. That is, they were used to taking a bit of time to prepare themselves mentally for the athletic performance they were just about to perform. The other experiments used athletes who had either never used MR prior to performance (the novice jugglers) or had only applied the loosest of MR protocols such as relaxation, at some unspecified and diffuse point in time before their performance (rifle shooters). For these athletes MR just prior to performance was a novel experience. It maybe that the attentional demand on these athletes was too great for them to benefit from any beneficial effects of imagery in MR. Consider a participant from the imagery group of either the shooters or the jugglers, who has to learn not only new mental skills in the context of imagery, but also has to learn to use it just prior to performance. In contrast the participant of a ***subliminal*** group is led to believe that he/she will not have to consciously learn anything. Their expectations of improving may have been of more benefit to actual performance than was the case in the imagery group the members of which were hindered by too much novel processing which overloaded their attentional capacity. Future research might look at this explanation by, for instance, making sure that participants feel comfortable with using MR just prior to performance. It might also suggest that quicker gains are to be had for using MR for certain types of sport. For instance gymnastics is a sport which tends to occur in short spurts and there is perhaps more opportunity for a coach to say something even as simple as "Before you do your routine just take a bit of time to think about it". This may be enough exposure to MR to not make it such a novel concept. One would expect the same for other acrobatic sports such as trampolining or springboard diving.

All the experiments showed a consistent difference in ability in imagery modality. Kinesthetic imagery appears to be harder to image than visual imagery. A possible explanation for this is that people habitually rely on visual perception in order to gain information about the world they live in. If imagery modality is important in order to receive the benefits of imagery in MR then this result would be important if kinesthetic imagery were thought to be more beneficial than visual imagery. Clearly sport psychologists would, in this case, have to focus imagery training programmes on teaching kinesthetic imagery in preference to visual imagery or bringing kinesthetic imagery competence up to some as yet unknown criteria.

From two of the experiments which taught imagery as a skill (vault and shooting) it appeared that the imagery training was successful, although this was only significant for the vault experiment. A look at the effect sizes in terms of imagery gain showed that the learning effect for the gymnasts was over twice the effect size than that of the shooters (1.24 compared to 0.52). No definitive statements can be made on such small samples, but one might speculate that the shooters were intrinsically different from the gymnasts which led to the difference in learning ability. For instance, all the shooters were of a very high standard (all bar one were national or international shooters). Clearly this is something for future research to replicate and resolve the finer details of such an effect.

CHAPTER 7
Differences in Imagery Perspective in Mental Rehearsal

Introduction

As was briefly mentioned in chapter 2, there is some interest in what type of imagery mode or perspective is used in mental rehearsal (MR). Mahoney and Avener (1977) found that qualifying gymnasts of the 1976 US Olympic team, reported using internal imagery more frequently than those who just failed to qualify. Doyle and Landers (1980) found a similar result with elite and sub-elite rifle and pistol shooters. Hale (1982) found that an internal perspective gave greater bicep muscular activity, as measured by an electromyograph (EMG), when subjects were asked to image a bicep curl, from either an internal or external perspective. However, there have been a number of studies that have not found this relationship (Highlen and Bennett 1979, Meyers Cooke, Cullen and Liles 1979, Rotella, Gansneder, Ojala and Billing 1980, and McFadden 1982). These conflicting findings, it is suggested by Bird and Cripe (1986), could be due to different perspectives giving different benefits for any particular type of sport. Specifically they suggest that an internal perspective may be more beneficial for closed skill sports (ie where the whole sporting environment is under the athlete's control) such as gymnastics, and an external perspective would be more beneficial to an open skilled sport (where the environment is not under the athlete's control) such as country terrain or other athletes in team sports, for instance cross country running or rugby. Smith (1987) details some reasons why an internal perspective appears overall to be better than an external one:

- athletes rarely see themselves externally unless they are filmed or videoed;
- external imagery does not contain all information that an internal perspective would; and
- athletes might be less nervous using an internal perspective, as in an external perspective they may take on the role of a judge and become too self-critical.

However, Smith goes onto say that the evidence does not suggest that internal imagery is a pre-requisite for any beneficial gain. He suggests that external imagery could also be of benefit because it is a good motivational device that aids concentration and reduction of anxiety. Some tasks he writes, 'may be more receptive to external imagery' [p.243] and asks for more research to be done in this area.

Despite this, the British Association of Sports Sciences and the National Coaching Foundation advocate that imagery will be most effective when it:

> ... is done from an internal perspective (although there may be specific occasions when an external perspective is suitable) [Morris and Bull 1991, p.17].

This statement does not really give interested coaches or athletes useful advice, because it does not tell them when an internal perspective is 'suitable' or which 'specific occasions' make an external perspective 'suitable'. The statement also gives the impression that on the whole an internal perspective is more effective. This does not appear to be appropriate advice to give, as Hardy (1989) suggests that we cannot say when an imagery perspective is appropriate because:

> ... although there is a considerable body of evidence showing that imagery does work, there is still considerable disagreement on exactly how it works [p. 225].

The sport psychological theories have different predictions as to which perspective should give superior performance. Psychoneuromuscular theory dictates that the imagery should be as similar to the real experience, so as to 'prime' the exact muscle groups that are used, which gives support for an internal perspective. Symbolic learning theory does not require any particular perspective, as imagery only serves to help code the relevant movements. Presumably, in symbolic learning theory, the perspective that helps an individual achieve this coding (say because they find a particular perspective, easy to image) is the one that will give more benefit to the individual. Harris (1986) notes that research should be addressing the question of individual preferences rather than concentrating only on the proof of whether an internal or an external perspective would be better. Triple code theory (ISM) and Bio-informational theory suggests that an internal perspective ought to provide more benefit, as the perspective should give equivalent somatic responses and more meaning because of prior associations — real life perception of the sport is rarely if ever perceived from an external perspective.

Wiltshier (1991) administered a questionnaire in order to compare the differences between national athletes from open (rugby) and closed skill (downhill skiing—this is considered a closed skill sport as the skiers have often been over the course that they are racing and so the environmental factors are known — field athletics and weight lifting) sports, in their use of internal and external imagery. She found a significant difference between the two types of sport, the open skill sports preferring to use external imagery, and the closed skill sports preferring internal imagery. This is in accord with Bird and Cripe's (1986) suggestions. One could rationalise why this might be so. Closed skill sports typically tend to rely on precise body movements in order for them to score highly in their sport. For these athletes an internal perspective, which included kinesthetic imagery, would help to achieve those body positions, because of appropriate visual feedback and integrated muscular innervation. Open skill sports on the other hand, (especially team sports), tend to rely on strategic manoeuvres which are not dependent on exact body movements to bring the manoeuvre into position. An external perspective may give a higher benefit for helping the athlete to understand how a manoeuvre is brought into play. However, Highlen and Bennett (1983) did not find Wiltshier's findings between springboard & tower divers and Olympic wrestlers.

Kinesthetic imagery is often reported along with taking an internal perspective (Denis 1985, Hall 1985, Hardy 1989). Mumford and Hall (1985) report that the percentage of athletes reporting this phenomenon was small. However, my impression from my participants was that most of them reported being unable to generate solely kinesthetic imagery without an associated internal visual perspective and vice versa. Although this has yet to be validated, one is tempted to suggest that for most athletes the two modes are very closely coupled. Mahoney and Avener's (1979) original classification of internal imagery specifically included both the visual and kinesthetic mode of imagery. Therefore it may not be the visual perspective per se that might confer the advantage, but also the role of kinesthetic imagery, either as a supplement to the internal perspective or instead of it. Start and Richardson (1964) may have partially shown this relationship by noting that kinesthetic imagery correlated more highly on the performance of a gymnastic manoeuvre, rather than visual imagery.

Given that an internal visual perspective and kinesthetic imagery are probably closely coupled, one could also suggest that internal/kinesthetic imagery is more difficult to generate, because two modalities are required to be generated simultaneously. Therefore one might suppose that an internal/kinesthetic imagery perspective may only be more successful than an external one, if the athlete can successfully image the scene in the two modalities. If this were the case then even in closed skill sports one would expect to see the largest advantage of using an internal/kinesthetic imagery in the more experienced athletes. Less experienced athletes may simply not be generating any or enough internal imagery when asked to generate an internal visual/kinesthetic scene. External imagery on the other hand may be easier to image because it works in one modality. Athletes who cannot successfully generate an internal perspective, may still derive some benefit from an external perspective, because it is a 'good motivational device'. Feltz & Landers' meta-analysis did report a larger effect size for the experienced athletes ($d = 0.77$) as opposed to novices ($d = 0.33$) and although the question of perspective was not addressed here it would have been interesting to have known if the experienced athletes were using more internal imagery than their novice counterparts. Wiltshier (1991) did find a significant positive correlation ($r = 0.36$) with regard to athletic experience and use of internal perspectives.

Experimental Studies

Given the results from the experiments from chapter 4 one might be tempted to ask why bother making an experiment testing the perspective that an athlete adopts. Firstly, the experiments as they are presented in the thesis did not occur in the same chronological order. Rather, as soon as the training study was finished the perspective study would start (within a few months) so that initial impetus was not lost and the imagery skills were still more or less fresh. Thus all the results from chapter 4 were not known until after most of the perspective experiments had been completed. Secondly, it was recognised at the time that the results from the various training studies might not come out according to the hypotheses but that in principle that did not mean that differences in imagery perspective were unimportant. If a consistent or explainable difference was found then it might point to the fact that imagery does have an important role to play, albeit a minor one, with expectation being a major one. It was hypothesised that there would be a difference in the effectiveness in using an internal visual and kinesthetic mode of imagery, compared to a purely visual external mode, when employing an imagery strategy to affect performance in an athletic context. It was planned only to conduct perspective experiments on the acrobatic sports as it did not seem to make much sense to look at an external perspective for the shooters and there was never enough time to explore the question of perspective differences with the novice jugglers.

Experiment 5: Imagery Perspective Differences for Trampolinists

Introduction

From the initial pilot studies which used trampoline participants, an experiment was devised to tap into possible differences in imagery perspective. Bearing in mind the above literature one would hypothesize that there would be an advantage in using an internal perspective because it is a closed skill sport. There is a confounding variable in that the few participants were not particularly advanced trampolinists in that none of the team members had competed at national level or above. However, the degree of tricks (which were not fully mastered) that they had shown in the pilot studies led me to assume that they were at least of an intermediate standard.

Materials

Video recording equipment.

Cassette-based imagery training course similar to the course used in experiment 1 but with exercises 4 and 5 adapted to emphasize an internal (ex. 4) and external (ex. 5) perspectives for trampolinists trying to obtain as much height as they could off the trampoline bed.

Participants

Having used the trampoline participants from the same club in the two pilot studies (reported in chapter 4) and had such a disastrous attendance record, it was felt more productive to use only committed participants despite the corresponding decrease in statistical power, and accordingly only eight undergraduate participants were recruited.

Methodology

Two of the participants had not taken part in the pilot studies and were thus given the cassette-based training programme to try and bring them up to the same imagery ability standard as the rest of the participants. Over the five-week period of the experiment one participant had to pull out of the study due to injury (not connected with the study). Attendance was considerably better than the pilot studies but again only one participant attended each of the five sessions. Participants were instructed to do two routines for each of the sessions. The first one was to do a perfectly normal routine without any conscious preparation and the second was to mentally rehearse their routine from a pre-scribed perspective. The following week the instructions were the same but the perspective was changed. Both routines were videoed from a side and slightly elevated point of view.

Scoring and Analysis

The complete videoed sessions were catalogued and edited in a random order on to separate video tapes which were sent off to two Scottish national judges, with brief explanations and instructions.

Design and Hypothesis

Participants were randomly split into two groups to counterbalance the order that each participant tried to use a different imagery perspective. The main analyses were to be independent t-tests of the difference of the judged scores of the MR routine and the normal, non MR routine. The hypothesis was that the internal imagery rehearsal would give larger gains than the external perspective. No difference was predicted between the random groups which differed only in the order of perspective attempted each week. Due to the small number of participants finally contributing to the analyses a power analysis was planned and effect sizes were calculated.

Results

A Pearson product correlation between the two judges yielded a positive correlation of $r=0.59$ for the non-mental rehearsal conditions and $r=0.74$ for the mental rehearsal conditions. Both correlations were significant and hereafter the two judges' scores were combined. The mean of the MR was higher than the non-MR condition. This is more than likely due to an order effect as the MR rehearsal always followed the non-MR condition. Therefore no further analyses were carried out between these two scores. Instead the difference of the judged scores between the MR routine and the non-MR routine was calculated. This difference was the measure that was computed in the statistical analyses. The scores were averaged so that each participant had an average measure for each of the imagery conditions. As previously mentioned very few of the participants attended all the sessions so that the score averages are not strictly compatible. A paired t-test was run between the difference measures of the internal and the external imagery MR routines which was non-significant ($t = 0.739$, $df = 6$, $p > 0.24$ (one-tailed). The mean difference between internal and external difference measures was –0.22, ie external imagery yielded a larger effect than internal imagery. Translated into effect sizes this is an effect size (d) of 0.28 which can be interpreted as a competitor moving upwards from 50th rank to 39th rank, out of a competition of 100 competitors if an external as opposed to an internal perspective was used. A power analysis (computed for two independent means, same group size) yielded a power coefficient of about 0.17 (ie a 17% chance of correctly rejecting the null hypothesis at the $p = 0.05$). A correlation between the advantage scores of both the internal and external perspective, yielded a Pearson product correlation of $r = -0.704$ (2-tailed, $p > 0.05$). The correlation is very high, though it actually just failed to reach significance. The power coefficient for the correlation was 0.4 (ie there was a 40% chance of correctly rejecting the null hypothesis, even with this few participants).

Discussion

Surprisingly, external imagery appeared to be better for the trampolinists than internal imagery. Although the difference is not significant, it is clear that the power in this experiment is very weak and therefore not surprising that significance was not achieved. Trampolinists routines consist of ten bounces and each bounce consists of an acrobatic movement such as a somersault. Especially before a judged routine (but even in training), a trampolinist's biggest concern, at this skill level, is remembering the sequence of acrobatic movements. It could be argued therefore that to image the routine externally would provide more benefit to the trampolinist, as it is difficult to recognise a trick from an internal point of view let alone generate the image. This ties in a bit better with the symbolic learning theory and not so much with the psychoneuromuscular theory. It is thought that the human perceptual system perceives the environment as a static backdrop onto which foreground figures are moving (Gregory 1966). Whether this is the preferred mode of observation is debatable. However, if this was the case then it would not be all together surprising that external imagery is easier to image. I would hypothesize that internal imagery should still be superior when it can be generated in a controlled and vivid manner, than external imagery. However, assuming that external imagery is usually easier to image than internal imagery then as the task to be imaged becomes progressively harder there might be a trade-off between doing the MR internally (more benefit but harder to do) and externally (less benefit but easier to do), such that for hard tasks to be imaged, it would be better for an athlete to mentally rehearse from an external point of view. The trampolinists used in this study would be classified as intermediate and it could be that they did not have enough athletic experience to draw on to be able to generate an internal/kinesthetic perspective.

The negative correlation between the benefits received from either taking an internal or external perspective suggests that participants appear to do far better at one perspective, at the sacrifice of another. This only serves to confound the picture being built up, ie not only is there benefit/difficulty trade-off between the perspectives, but also there is an initial preference or ease for every participant which may be just as or even more important in terms of the gain experienced by using a particular perspective.

A replication of the experiment might counterbalance the order of MR (regardless of perspective) with the non-MR conditions. A better design still, would be to have the same participant do two routines both with MR alternating between internal and external perspectives, the order of which is alternated each week (to counterbalance the order). However, this modified design does not allow us to further explore the negative correlation between the gains from either perspective (since they are not compared to a non-MR condition rather to each other). This would be interesting for future research to explore further, for instance, is knowledge of individual preference a better predictor of more beneficial gain than simply that a single perspective is better in a particular task. If this was the case then we might still argue that if there was no individual preference for a perspective then the complexity of the task to be imaged might dictate which of the two perspectives should give more benefit in MR.

Experiment 6: Imagery Perspectives in Vaulting

Introduction

A second study was undertaken with the gymnasts from the gymnastic training study, to look at differences in imagery perspective. Mahoney and Avener (1977) had reported that an internal perspective was better for elite gymnasts. The idea was to use the same experimental set up that I had employed for the first gymnastic study (chapter 4). That is the gymnasts would be vaulting over the horse and being filmed from the same angle as in the previous study. Hopefully, I would be able to use the majority of the same participants that I had before. As previously, I would send off the video tapes to be judged independently by two judges, and their scores would be used in the analysis.

Participants

Twenty female participants from the Meadowbank Ladies Olympic Gymnastic Club were recruited. As it turned out I could not use all the same participants as before but about 60% of the participants had taken part in the previous study. The age range was from 9 to 17 years old and the skill level ranged from about a year's experience (novice) to national squad level (advanced).

Materials

Video recording equipment.

Cassette-based imagery training modules, the same ones that were used in experiment 1.

Mental Training Program for Gymnasts: Over the summer of 1991 a booklet was produced that implemented a mental training program that taught relaxation, concentration and imagery skills (appendix III). Imagery was also used in novel ways apart from being purely a mental rehearsal strategy, such as injury prevention and recovery. The booklet was designed to be used by the coaches and the advanced gymnasts and contained cartoons and illustrations to make the points clearer and the text a bit more fun to read.

Procedure

The study took place during the club's normal training hours. There were five sessions during which measurements were taken. All those participants who had not taken part in the first gymnastic study were given a copy of the cassette-based imagery training (which I had used in the first study), two weeks prior to the first data recording session. In addition I had spent the in-between time continuing to go to the club to give a more general mental training programme using imagery (see appendix III). This turned out to be about three to four months over the summer holidays. The training course was specially designed to give psychological tools to be used by the gymnast which included relaxation, imagery from different perspectives and modalities and the use of imagery to recover from injuries. In short, I felt confident that all the participants understood what was meant by imagery and also what each of the different perspectives implied. A verbal explanation was given to all the participants prior to the first session, of the experimental hypothesis. It was stressed that I did not know which perspective would yield larger results and that there was no hidden agenda (some of the participants had received the ***subliminal*** training from the first experiment reported in chapter 4, and it was felt important to emphasize that there was no deception in this present experiment). It was stressed that I was not sure which perspective was better and that was why I was doing the experiment. Participants were tested in their ability groups. Previous experience had shown that it was more productive to set the camera recording for each group and then to leave it running whilst I went up to where the gymnasts sat mentally rehearsing. This enabled me, if they needed it, to remind each participant which perspective they should be rehearsing. Also the youngest group kept thinking that the experiment was a sort of race, and I found it necessary to keep reminding them that this was not the case.

Scoring

The video tape was judged independently by two national judges. They were different judges from the previous study. Both judges were present in the gym hall on some of the occasions but both were 'blind' to the ordering both at the time and after the tape was edited (the session order was changed). Both judges were informed of this which meant they would have no idea as to which participant was doing which condition and when the participant was doing it — this was done to eliminate any systematic bias.

Design

The participants were matched for ability and then split randomly into two groups. Each group did four vaults preceded by MR but alternating their perspective with each vault. The perspective order was counterbalanced between the groups. Each week the group order was reversed (ie the counterbalancing of the groups remained the same). This procedure would allow me also to eliminate ordering effects during the session, which I presumed would overshadow any MR effects. The hypotheses are given below.

① It was hypothesised that a t-test between the two perspectives would favour an internal perspective.

② The more experienced gymnasts would show a stronger beneficial effect from using an internal perspective.

Results

The judges showed a correlation of $r = 0.80$, $p<0.001$ and thereafter their results were combined and treated as one data set. The weekly sessions were averaged into an internal and an external score for each participant. A paired t-test between the vault scores from each perspective, just failed to achieve statistical significance ($t = 1.574$, $p=0.067$). More traditional calculations of an effect size would not be appropriate in this instance because the scores are dependent on the degree of difficulty of the vault. As there was a range of vaults done this would inflate the standard deviation and thus artefactually deflate the effect size. Instead an effect size was computed from the t value (Rosenthal and Rosnow 1991). The effect size ($d=0.36$) was in the predicted direction, that is an internal perspective appeared to give more benefit to the gymnasts. Hypothesis ① is almost significantly supported.

Inspection of the results showed that the effect size for the novice group (0.51) was higher than the advanced group (0.42) and the intermediate group (0.17). This is not what is expected according to the literature, where one would expect the effect size to be higher for the more experienced group. Hypothesis ② is not supported.

Discussion

The results are almost significant and do support the notion that an internal perspective in mental rehearsal (MR) is better than an external one for vaulting in ladies gymnastics. Notice that the experiment does not make any claims about how good MR is for performance increment, as there was no control group using no imagery with which to compare the internal or external perspective results. The effect size is medium sized and is the equivalent of changing a mid placed competitor upwards from 50th to 36th rank in a competition of one hundred. Again because of the low power of the experiment, any conclusion drawn is tenuous. It is surprising that the gain in perspective for the intermediates was considerably lower than the novices. The novices and intermediates were composed or about 50 % of the participants from the previous training study. There too, the novices appeared to show a stronger benefit from employing MR. In the training study, I argued that it could be that the commitment shown by the intermediate ability levels may not be as high as either the advanced or novice levels because they are at an age where they are learning not to be intimidated by adults but have not acquired the wisdom to realise that the training that they are doing is for their own benefit. Thus, there may be a temptation to think of the experiment (indeed the whole physical training session) as another extension of school. Future studies would have to take this as a serious fact to contend with and to try and eliminate the 'mind set' that the experiment is to be taken lightly whenever possible. Whilst one might have expected the novice gymnasts to have benefited more from an external perspective because they would find the internal perspective difficult to generate, one must remember that these gymnasts had undergone a significant amount of training, learning how to use imagery. Therefore, it could be that their imagery skills were sufficient to successfully generate an internal perspective. It was an unfortunate time to run the experiment to try and use the advanced level gymnasts as injury and competition made most of the advanced gymnasts unavailable for the experiment.

Although the results are in accord with Mahoney and Avener (1977), they go against the results of the trampoline study. The difference between the trampoline study skills and the vaulting skills is that the trampolinists had to learn a complete routine which consisted of many acrobatic movements. The gymnasts, on the other hand, only had to concentrate on the one movement, namely the vault. I have argued previously that internal imagery may be more beneficial in terms of psychoneuromuscular theory, but only if the internal images can be successfully generated. Otherwise in terms of trying to remember routines, an external image (which it is claimed is easier to generate) will provide more benefit (as predicted by symbolic learning theory). In gymnastics there are various disciplines which vary from executing a single movement to others which require a variety of acrobatic movements to be placed into a routine. A future experiment of this kind would make several predictions. If the task to be learnt was a routine (sequence of movements), then for gymnasts learning the routine and especially if they are relatively inexperienced in gymnastics, an external perspective would be of more benefit. In contrast, if the sequence is already learnt or if the gymnasts are very experienced then an internal perspective will provide more benefit, so long as an internal perspective can be generated successfully.

Experiment 7: Perspective Differences in Beam

Introduction

Following on from the conclusion of the vaulting results it was decided to try and do an experiment similar to the vault except to try and use a gymnastic skill that required the use of a routine. Consultation with Maggie Bisset, the coach, resulted in setting up a training procedure for the beam routine. For the beam routines, the gymnasts perform gymnastic skills along the length of a 10 cm wide beam that is raised about 1.5m off the floor and is about 2.5m long. The gymnasts show dance skills as well as acrobatic moves on the beam and typically dismount from the beam with some sort of somersault move. As the routine consists of many elements it was thought that this would be very similar in nature to the trampoline routines.

Hence it was thought that mental rehearsal (MR) using an external perspective would give more beneficial effects than an internal perspective especially for novices. However, for advanced gymnasts the reverse trend would be seen. Although I had previously set up the general mental training course, it was decided to give a more intensive home-based exercise, similar to the first training experiment, because the gymnasts had not been specifically primed to use MR in the beam routines (appendix II). In addition to the usual cassette, I included a transcript of the training so that the gymnasts could make their own recording of the training. In the event, none of the gymnasts did so, saying they much preferred listening to the pre-recorded tapes.

Materials:

Modified cassette-based training. Exercises 4 & 5 being recorded specifically for the beam routine.

Transcript of the imagery training scripts used on the tapes.

Video recording equipment.

Participants:

Fourteen participants were recruited from the Meadowbank Ladies Gymnastic Club. They were categorised into advanced, intermediate and novice gymnasts. The novices in this experiment were not the same novices as in the previous study but were much closer to the intermediates. The label of novice is for convenience only and perhaps should be interpreted more strictly as intermediate level–2, however, for ease of language they will be continued to be referred to as the 'novices'.

Procedure:

After the participants were recruited, a short introductory talk explained that the purpose of the experiment was once again to see which perspective was better when employed in MR. They were not told which perspective I believed would be better for their beam routine. At this stage they had not had their feedback from the vault perspective experiment (experiment 6), so they did not know the results of the last study and therefore were not biased to conform to expectations. The following week they were given a training pack which included the modified cassette-based training for their beam routine (appendix II) which was developed in close co-operation with Maggie Bisset and some other coaches in the club and a transcript of the cassette training. The gymnasts were asked to try and do the exercises at least four times a week and to record the number of times they did an exercise in a small diary that they had received. Some preliminary work showed that in practice I could only ask each gymnast to do two routines (unlike the vault whereby the participants always did four vaults). In order to try and eliminate warm-up effects, I strongly emphasised to the gymnasts to pretend that each of their routines was as if they were doing it in a competition and any particular skills that they wanted to warm up for, they were to do before their actual routine. The gymnasts were matched for ability and split randomly into two groups which differed in their order of MR perspective taken in any week. The perspective order for each gymnast was also alternated each week to avoid ordering effects. Many of the gymnasts were either doing the routine for the first time or they were doing a particular skill for the first time. Often they requested help such as a coach standing in to support a new manoeuvre or they missed out the manoeuvre altogether. The gymnasts were asked to do their MR just before they went and did their actual routine. After each session, each gymnast was asked which perspective they had preferred irrespective of how their routine had gone and any explanation that they offered for their preference was also noted.

Scoring

The videoed sessions were edited and sent off in the same manner to the judges of the previous study.

Design:

The same counterbalancing procedure was used in this experiment as in the last experiment. The hypotheses for this experiment were as follows.

① The overall difference in performance scores between the two perspectives would favour the internal perspective.

② The effect size would be smaller than the vault study because a number of gymnasts were learning new routines and/or new skills.

Results

A paired t-test between the average internal and external score was not significant ($t=1.013$, $p=0.16$) but in the expected direction. Hypothesis ① is supported but not significantly. The effect size was calculated from the t value for the same reasons as in the previous study. It was smaller (0.26) than the vault study (0.36) and is the equivalent of moving a competitor from 50th to 40th rank in a competition of one hundred competitors. This supports hypothesis ②.

The effect sizes (d) of the advanced, intermediate and novice group were 0.15, 0.56 and 0.58 respectively.

Discussion

Although the results are not significant due to the low power of the experiment the following comments are made on the assumption that the effects seen in the data are a reflection of the real state of affairs. The results still support the notion that for gymnasts, an internal imagery perspective is better for use in MR although the effect is not quite so large as in the vaulting study. This, it is argued, is because the beam routine is a sequence of movements and thus more like the trampolining situation. However, unlike the trampolinists, there is still evidence to suggest that an internal perspective is still better for MR than an external perspective. Many of the gymnasts had been working with MR under my guidance for over 18 months and I could feel reasonably sure that the gymnasts were comfortable with using MR and knew what they were expected to do. For this reason it may be that all the gymnasts could successfully generate internal imagery and that this was not the case for the trampolinists.

The results between the ability levels is surprising as the advanced gymnasts scored the lowest effect size. However, three of the six advanced gymnasts had joined the club for training relatively recently and had not had the extensive training that the others had. The results showed that these newer gymnasts appeared to show a higher benefit from using an external perspective as reflected by their scores. The gymnasts themselves though, all reported that they preferred using an internal perspective. Their performance results are not reflected in their favoured perspective. This observation again falls in with the notion that a beneficial effect only occurs when a sufficient ability for an internal perspective is achieved. If this is the case then the effect size has probably been artefactually lowered which would go against the second hypothesis. For the novice and intermediate group the effect size was substantially larger than the vault study. This would suggest that even for new routines, if an internal perspective can be imaged then this will provide more benefit than an external perspective. The intermediates from this group were the same intermediates from the previous vaulting study, who I thought had not been as motivated to take the previous experiment seriously enough. In this experiment, I took great pains to provide motivation by spending some time explaining that this experiment was of benefit to them if they were to take it seriously and that this was not like a school situation. Their results from this experiment may reflect a greater commitment to the experiment.

Summary of Experiments 5, 6 & 7

Three experiments were conducted that looked at the qualitative difference in imagery perspective in mental rehearsal (MR) just prior to performance. The results were equivocal in that one of the experiments (trampolining) showed an effect that supported an external perspective, whilst the other two showed an effect supporting an internal perspective (vault and beam in ladies gymnastics). However, these results can be reconciled if one looks at what aspects of the performance is crucial to the athlete. In the case of the trampolinists, the case is argued that for the level of athletes worked with, concern was more for remembering the complete routine and concern for body shape was deemed not to be so important. If this is the case then the task is more of a learning one in which an external perspective lends itself better. There was support for an internal perspective for the vault study. The beam study too showed an effect supporting an internal imagery perspective however this was smaller than the vault results. This maybe because the beam is more like the trampolining skills where a routine of acrobatic movements is performed. However they still may have shown superior performance using an internal perspective because the gymnasts differed from the trampolinists in several respects. Firstly, considerably more time was spent with them teaching imagery skills that could be employed with MR (I had worked with the club for just over two years). Secondly, concern with movement sequences was not so high as many had already learnt them or individual elements of the sequence had been learnt in other sequence variations. They therefore had more opportunity to attend to body elements such as body shape and alignment. Although the experiments were of low power and statistical significance was often not achieved, a picture in conjunction with the previous literature appears to be emerging. In line with some sport psychologists, it appears that imagery perspective may confer different gains when employed in MR (Feltz & Landers, Bird & Cripe 1986, Smith 1987). However, Hardy (1989) has suggested that we do not yet know when each perspective would be appropriate. The two most popular theories that are proposed to account for the effects of MR (psychoneuromuscular theory and symbolic learning theory) are usually billed as being incompatible with each other, although as Savoyant (1988) has said this need not be so. The results of the experiment point to there being several factors that will dictate the efficacy of using a particular imagery perspective. Chiefly amongst these are three factors: the ability to actually generate the appropriate imagery perspective; how experienced the athlete is in their respective sport; and finally whether the sport is more concerned with precise body orientation or more concerned with a sequence of movements. Accordingly a schematic diagram is shown below which illustrates these three points.

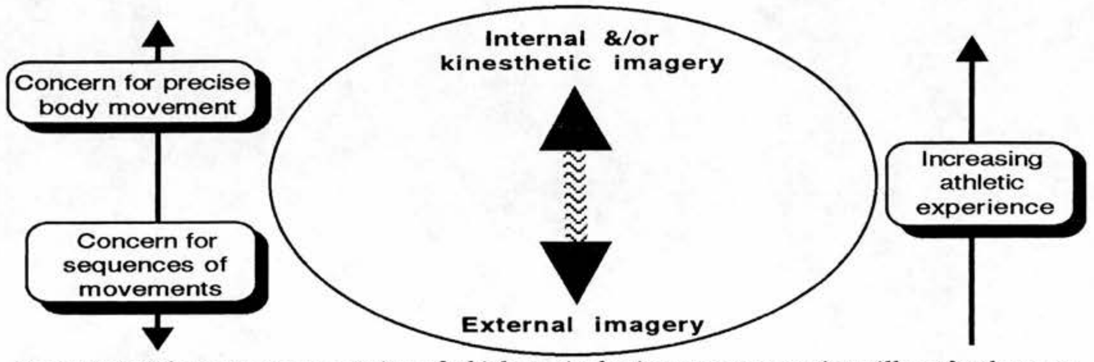


Figure 7.1: Schematic representation of which particular imagery perspective will confer the most advantage for MR.

Sports which contain sequences of movements usually suffer more from not achieving the sequence of moves, as opposed to not attaining a good body shape. For instance in the case of both trampolining and the women's beam routine in gymnastics, more points will be deducted if a movement is missed out of a routine, rather than if a particular movement is not being executed with pointed toes, or with enough height gain. An external imagery perspective will help athletes more to remember the sequence of movements according to the principles of symbolic learning theory. If good body shape becomes a higher priority (either because there is only one movement to do [as in vaulting], or because the athletes are experienced enough to be able to easily remember the sequence), then an internal/kinesthetic imagery perspective will be better (on the basis of psychoneuromuscular theory principles).

Athletic experience of the athlete plays a part in the effectiveness of being able to generate the appropriate internal/kinesthetic imagery, as experienced athletes will have a better idea of which internal and kinesthetic components contribute to successful athletic performance. An inexperienced athlete will not have this knowledge and therefore be unable to generate the appropriate internal/kinesthetic image. No benefit according to psychoneuromuscular principles will be conferred. One possible way around this would be to build a guided imagery script which was written by an experienced athlete that would give the correct images for successful performance. Further research to test the worth of the model was required.

Experiment 8: A Survey of Perspective Differences in Open and Closed Skill Sports

Introduction

One approach to explore the model further was to look at what the top athletes from open or closed skill sports employ in their mental rehearsal (MR) in terms of imagery perspective. Open skill sports are typically those which have open elements which are not under the direct influence of an individual athlete. This might be the weather, the terrain or other competitors (either team mates or opponents). Closed skill sports refer to the sport being relatively closed to these influences and that the elements of the sport are more or less all under the direct control of the individual athlete (gymnastics and trampolining are examples of closed skills sports). Highlen and Bennett (1983) compared the use of imagery perspectives for both Olympic wrestlers and Pan American divers. They found no difference in the use of imagery perspective between the two sport types. Wiltshier (1991) tried to replicate this finding with other open and closed skill sports from athletes at or near the top of Edinburgh University's sports clubs. Wiltshier in contrast to Highlen and Bennett (1983), found statistically significant support that closed skill athletes used more internal than external imagery. She also found that as experience in the sport increased, so the use of imagery increased and that attributes of imagery in dreaming tended to correlate with the same attributes in mental imagery. The study's conclusion seemed to suggest that imagery perspective tends to have a benefit depending on experience in the sport and to a certain extent the type of sport studied. These conclusions tie in very well to the model proposed above, if one were to elaborate the concern for body movement as occurring more often in closed skill sports, and that the concern for a sequence of movements occurs more frequently in open skill sports. In the last case this would be most obvious in team sports which rely on tactics, such as soccer or rugby. Sport psychologists such as Feltz & Landers (1983), Hardy (1989) and Cox (1990), have suggested that the two imagery perspectives may both be effective for different reasons.

It was decided to try and replicate Wiltshier's findings by analysing what it was that athletes from open and closed skill sports actually did. By using top international athletes, I was almost by definition, going to find out what really worked (otherwise they would not be internationals) as opposed to lower performance athletes from the relevant sports possibly using inappropriate imagery perspectives (if they used imagery in MR at all!). The model makes the prediction that closed skill athletes should prefer to use an internal perspective if they were only concentrating on one movement and provided that they were experienced enough to be able to generate the appropriate imagery. The open skill sports, if they were a team sport that relied on tactics for the game, would prefer an external perspective. It is not clear in the last case, what the effect of athletic experience has on the preferred imagery perspective. I had the opportunity to distribute a questionnaire that asked about the use of imagery perspective for athletes' MR, amongst international divers (closed skill athletes) and international rugby players (open skilled athletes).

Participants

Twenty-three mixed sex international divers from an international meet at Amersfoort in Holland and thirteen international male Scottish rugby players from the 1991/1992 season.

Matérials

The Use of Imagery in Sports Questionnaire (UISQ) was taken from Wiltshier's (1991) original questionnaire and considerably adapted and revised (appendix I). It was designed to try and measure the frequency of use of imagery perspectives and imagery modes as well as explore frequency, controllability and vividness of their dream imagery. It included seventeen questions such as:

- How often do you use external imagery?
- Do you find your kinesthetic imagery is frequently vivid?
- Are your dreams often controllable?

All these questions asked for an answer on a scale from 1 (very often) to 7 (never). For the purposes of this questionnaire there was a distinction made between internal imagery and kinesthetic imagery. Internal imagery in this case refers to the purely visual perspective and not inclusive of the kinesthetic imagery as was used in the experimental studies. This was done to see if any effects between the two imagery modes could be teased out. Questions about their dream imagery were asked because Wiltshier's findings seemed to be interesting. However, in the interest of keeping the questionnaire concise (in order to make it more attractive to complete) there were only three dream questions relating to the frequency, controllability and vividness of the overall dream imagery. There were some ancillary questions of a free form answer format such as had they ever had mental training and if so what type. Some personal details were taken such as their age and how long they had been practising the sport.

Procedure

Questionnaires were handed out to the divers whilst in Amersfoort, Holland, which divers filled out over the course of the international diving meet. The questionnaire was in English and as most of the divers were not native English speakers I was on hand to try and answer and translate any of the terms used in the questionnaire. Fortunately some of the divers, particularly the Dutch, helped with the translation aspect. One of the Scottish rugby squad team members distributed the questionnaires amongst the squad and handed the answers back several weeks later. For the rugby players, not only were specialised terms defined on the questionnaire, but also the players were familiar with these terms as they had been doing some squad training with a sport psychologist. Therefore it was felt unnecessary to be on hand as I had been for the divers.

Hypotheses

On the basis of Wiltshier's results and the results of the perspective studies earlier in this chapter, several hypotheses were formulated which are given below.

① The ratio of the frequency of internal to external imagery use would be significantly different between the sports. The divers using more internal than external imagery than the rugby players.

② Divers would use internal imagery more frequently than rugby players.

③ Rugby players would use external imagery more frequently than divers.

④ Divers would use kinesthetic imagery more frequently than rugby players.

⑤ The preferred imagery perspective or mode would differ between the two sports. Specifically rugby players would prefer external imagery and divers would prefer internal or kinesthetic imagery.

⑥ The frequency of use of imagery in each perspective or mode would be positively correlated with the frequency of dreams.

⑦ The vividness of imagery in each perspective or mode would be positively correlated with the vividness of dream imagery.

⑧ Years of experience would correlate negatively with the use of an internal perspective (a low internal score indicated frequent use).

⑨ Years of experience would correlate positively with an external perspective which would indicate that as the athletes became more skilled they would tend to rely less and less on external imagery (a low external score indicated frequent use).

⑩ Years of experience would correlate negatively with a kinesthetic perspective, indicating that as they became more experienced they would come to use kinesthetic imagery more and more (a low kinesthetic score indicated frequent use).

Post hoc analyses would be explored as would the general comments, although no hypotheses were made.

Results

The ratio of the frequency of use for the internal to external imagery perspective was calculated and a Mann-Whitney test was performed between the two sports. The result was not significant (corrected $Z = -0.481$, $p=0.63$). Hypothesis ① is not supported.

The frequency of internal imagery use was tested between the sports and not found to be significant but suggests that divers use more internal imagery than rugby players (corrected $Z= -1.40$, $p=0.16$). Hypothesis ② is supported but not significantly.

The difference between the sports for the frequency of external imagery was just significant (corrected $Z= -1.95$, $p=0.05$), suggesting that divers also use more external imagery than their rugby counterparts. Hypothesis ③ is not supported in fact the results are totally contrary to it.

The frequency of kinesthetic imagery use was significantly different between the sports (corrected $Z=-3.66$, $p=0.0002$) suggesting that divers also use more kinesthetic imagery than the rugby players. Hypothesis ④ is significantly supported.

Post hoc Mann–Whitney analyses showed a significant relationship between the vividness of dream imagery and the sporting type (corrected $Z = -1.93$, $p=0.05$) with divers reporting more vivid dream imagery than rugby players. Divers tended to dream more (corrected Z = –1.33, p=0.19) and have more controlled dreams (corrected Z = –1.31, p=0.19) although these relationships are not significant. Divers also had significantly more vivid external and kinesthetic imagery (corrected Z = –2.00, p=0.04; Corrected Z = –3.68, p=0.0002) as well as more controlled kinesthetic imagery (corrected Z = –3.11, p= 0.002) than rugby players.

A chi-squared analysis between athletes preferred imagery mode or perspective and sport was significant (χ^2=6.171, p=0.05), which gave significant support for hypothesis ⑤. The percentage column totals are displayed in the table below.

	Diving	Rugby	Totals
External	34.8	76.9	50.0%
Internal	56.5	23.0	44.4%
Kinesthetic	8.7	0	5.6%
Totals	100%	100%	100%

Table 7.1 Table of the chi-squared analysis of the types of imagery used in MR by both divers and rugby players.

The table suggests that divers prefer both an internal perspective and kinesthetic mode more than rugby players. However, it was only a minority of divers that preferred kinesthetic imagery. In comparison to divers, rugby players preferred an external perspective as opposed to internal or kinesthetic imagery.

The frequency of dreams was correlated (Spearman rank correlation) with the frequency of use of internal, external and kinesthetic imagery. The corresponding correlations were –0.29 (p=0.09), 0.489 (p=0.004) and 0.094 (p=0.58). The strongest positive correlations were between the frequency of dreams and the frequency of external imagery use. The negative correlation of the frequency of internal imagery use and dream imagery suggests that the more people dream the more likely they are to use imagery from an external perspective. A causal relationship can, of course, not be inferred. There is little significant support for hypothesis ⑥.

The vividness of dream imagery was correlated (Spearman rank correlation) with the vividness of internal, external and kinesthetic imagery. The corresponding correlations were 0.322 (p=0.05), 0.431 (p=0.01) and 0.176 (p=0.20). The strongest correlations are between the vividness of dream imagery and the vividness of both internal and external imagery. There is partial significant support for hypothesis ⑦.

The correlations between the years of experience and imagery use for internal, external and kinesthetic were –0.19 (p=0.308), 0.378 (p=0.04) and 0.158 (p=0.40) respectively. Both the correlations for the internal and external imagery use are in the expected direction although only the external imagery use is significant. Hypothesis ⑨ is significantly supported, hypothesis ⑧ is supported but not significantly, and hypothesis ⑩ is not supported. Eyeballing the data showed that the rugby players almost exclusively relied on external imagery. The average number of years experience was higher for the rugby players and this may have clouded any relationship that might have been seen in the divers. Correlations were run only on the divers and for frequency of use for the internal, external and kinesthetic imagery, they were –0.60 ($p=0.009$), 0.16 ($p=0.49$) and –0.341 ($p=0.14$) respectively. The correlations from this selected sample all support hypotheses ⑧, ⑨ and ⑩; hypothesis ⑧ is supported significantly.

Discussion

These results generally support Wiltshier's (1991). This suggests that there is a qualitative difference between imagery perspective and mode as used by athletes of open and closed skill sports for mental rehearsal (MR). It also suggests that there is a quantitative difference between the two sports in the amount of MR employed. Generally divers appeared to use MR more often than rugby players; internal, external and kinesthetic imagery were all more frequently used by the divers; divers rated their kinesthetic imagery as being more vivid and controlled than the rugby players. These results generally back up the model that was proposed earlier in this chapter with some elaborations. That is that there is a differential gain to be had from different perspectives. Most of the rugby players (regardless of experience) preferred using external imagery, whereas the majority of the divers preferred using internal imagery. Although there were some divers who preferred to use kinesthetic imagery, they were in the minority. Furthermore as experience in diving increased so the frequency of internal and kinesthetic imagery increased. This supports the notion that initially external imagery is easier to image and it is not until experience in the sport is gained that an internal perspective or kinesthetic mode of imagery is used.

Diving as a closed skill sport tends to rely on precise body movements to execute a dive safely and well to score high points. There is little room for error because the movement is ballistic. There is little the diver can do to alter either the flight trajectory or the angular momentum whilst in the air. Therefore any technique that helps the diver to achieve correct body positions will be an invaluable aid. For this reason, divers can derive benefit from MR using imagery. Furthermore, the imagery theories such as psychoneuromuscular, ISM or Bio-informational theory, would suggest that an internal perspective would be best, especially if combined with a kinesthetic mode of imagery, for any sport like diving that was concerned with body form. Rugby as an open skill sport is, by definition, unpredictable and cannot be subjected to MR of most permutations of the game since the latter would be too many to remember. The potential to rehearse set moves is limited by the nature of the game to states of play such as penalties, scrummages and line- outs. These set moves are of a tactical nature and as it cannot be appreciated from the perspective of an individual in the manoeuvre (they do not see the 'big picture') MR from an external perspective is likely to confer the best advantage in learning and understanding the tactical manoeuvre (this is regardless of the experience of the player). The benefits, according to symbolic learning theory, are likely to be best during the learning phase of a new set manoeuvre. An internal point of view would probably not be of benefit because the manoeuvres are not so concerned with body form as long as the manoeuvre is effected properly.

Whilst the results of the questionnaire certainly backs up this point of view, it also suggest avenues to be pursued where MR might be more fruitfully employed in both sports than at present. It can be argued that for diving, kinesthetic awareness is probably at least as important to a diver as visual awareness. Some of the multiple somersaulting and twisting dives do not allow time for the diver to visually perceive the environment. If this is the case then it would appear that a higher ability in kinesthetic awareness would be more desirable than an internal visual perspective. Clearly this is not reflected in reality because most divers preferred an internal visual mode over a kinesthetic mode. Imagery training could concentrate on trying to re-address the imbalance. Rugby players clearly show that they do not rely on MR as much as the divers. However, there are probably areas in their game where they could benefit from MR. Specifically an increase in external imagery ability would probably aid in acquisition of new tactical manoeuvres. An increase in internal visual and kinesthetic imagery could probably be used to affect performance of set manoeuvres for which body form is important. Two such examples, include kicks (eg. penalties and try kicks) and scrummages where not only is the body shape important but also the environment is under tolerable control of the individual athlete compared to the rest of the game.

The dreaming results are not significant but do suggest that a relationship exists between the sporting type and the frequency, vividness and controllability of dreams. This relationship could exist because divers tend to make more use of imagery which can be subsequently incorporated into their dreams than the rugby players; this is indeed reflected in the strong correlations between the frequency of external imagery use and the frequency of dreaming; and the vividness of both internal and external imagery and the vividness of dreaming. These results may however be due to experimental demand characteristics. Why there should be a negative correlation between the use of internal imagery and dream frequency is not clear.

Conclusions of Chapter 7

Three experiments looking at performance differences in the use of different imagery perspectives for MR, appear to show that which perspective is more beneficial depends on several factors such as the type of sport the athlete is involved in and the experience of the athlete. A simple model was proposed and results from a self-report questionnaire on the qualitative differences in imagery between open and closed skill sports (rugby and diving respectively) appear to back it up and offer further elaborations to the model. Predictable differences between which perspective confers the most benefit to athletic performance, back up the assertions of some sport psychologists (Feltz & Landers 1983, Hardy 1987, Cox 1990), that each imagery perspective is conferring benefits to athletic performance through different cognitive mechanisms.

CHAPTER 8 Conclusions on the Role of Imagery in Mental Rehearsal and Recommendations

The Contribution of Imagery in MR is Initially Small

This section started by examining the evidence pertaining to mental rehearsal (MR) effects in the sport psychological literature. Anecdotes of so called 'elite' athletes appeared to show that superior athletic performance was often associated with an athlete mentally rehearsing the athletic performance using imagery, just prior to the actual performance. Sport psychologists have further found some evidence suggesting that elite athletes tend to practise imagery of their sport more frequently, in a more controlled fashion and more vividly. The relationship in the experimental literature is, due to some null results, equivocal. Furthermore, this work is only correlational and thus the cause of the superior performance cannot be said to stem from the use of imagery in MR.

Experimental researchers have tried to experimentally manipulate conditions to isolate the effects of MR on athletic performance. A quantitative review of this literature used a statistical technique called meta-analysis (Feltz & Landers 1983). The effect can be translated into the equivalent of changing a competitors placing, in a one hundred competitor competition, from 50th to 30 place.

Despite this medium effect, a closer examination of a selection of the original reports from the meta-analysis, showed scant attention was given to the effect of controlling against conformancy in these experiments. It is argued that it must be obvious to experimental participants (subjects) that the MR group is expected by the experimenter to do better, than the control group members who often either did nothing, or did a trivial task not involving imagery. It is argued that the results may be due to the participants from these experiments conforming to behave to the experimental expectation of the imagery group doing better on the experimental task.

Four experiments conducted using a variety of athletes (gymnasts, rifle shooters and inexperienced jugglers learning to juggle for the first time) were conducted to assess the effect that MR would have compared to a control group given a bogus protocol that was high in expectancy but contained nothing that was expected to help the athletes. Of the four experiments conducted, only one of them showed support for the superior benefit of MR. The other three, surprisingly, showed higher benefits from using the bogus MR. These latter three experiments used athletes for whom the concept of MR was relatively novel. At the very least these experiments call into doubt the results of the meta-analysis already mentioned because the vast majority used inexperienced athletes. It would appear that expectation is a major contributor, and not imagery, of the beneficial effects seen in the MR literature. Below is a summary table of the experiments conducted to explore the role of MR in increased athletic performance.

Experiment	Imagery Training	Novice/ Experienced	Prior use of MR	Imagery/expectancy n for MR (effect size)
Vaulting	Yes	Both	Yes	Imagery (0.28)
Juggle 1	No	Novice	No	Expectancy (0.41)
Juggle 2	No	Novice	No	Expectancy (0.41)
Shooting	Yes	Experienced	No	Expectancy (0.28)

Table 8.1: The combined results of the experiments to look at the effect of MR using imagery compared to a control group that was high in expectancy.

A meta-analysis of these results weighted by the degrees of freedom, gave an mean effect size (d) of 0.17 in favour of the control group, ie opposite the conventional wisdom that MR would confer a beneficial effect to athletes. Although the effect is small, I think it is worth noting for the juggling experiments which most closely replicate the previous literature, that the combined results were quite large and significantly so. If the experimental results were only due to the demand characteristics of the experimental situation then one would not expect a large difference between the imagery trained group and the 'subliminal' group. This suggests that something else is occurring other than participants wanting to comply to the 'good subject effect' (Rosenthal and Rosnow 1991), that is the participants wanting to comply to the experimenter's expectation, in this case that the imagery group would benefit more from imagery training in MR. Far from obviating imagery effects in MR to nothing more than an experimental artefact that can be more parsimoniously explained by expectancy effects, it perhaps points towards imagery being a cognitive process that robs the experimental participant of valuable attentional resources. One could posit that there are two mechanisms occurring to produce the experimental effects. The first is expectation of success and the second is the contribution of imagery. Expectation is a completely different mechanism to increase performance (by increased motivation say) which, unlike imagery lays no demands on attentional resources, the latter of which can be effectively used for that athletic performance. This does not augur well for psychologists that claim that imagery is not a process under cognitive control (Pylyshyn 1985, Haugeland 1982). These propositional theorists would have to explain this effect, by stating that the act of trying to generate imagery was making the participant access and activate propositional codes which are the real cognitive elements that are interfering with attentional resources.

Recommendations

One must remember that these recommendations are made realising that the experimental results are not strong ones. Obviously further research is warranted in this area and the experiments point to various avenues that should still be explored to clear up the question of, for instance, the importance of prior experience using MR before performance. However, rather than leave the questions open ended, tentative recommendations are made with the understanding that they should be continually reviewed in the light of new experimental evidence.

The results as they stand, have practical implications for the athlete that would like to use MR to complement and improve their athletic performance. In order to avoid overloading the attentional capacity of the athlete, they must spend time learning to increase their imagery ability so that it becomes relatively automatic, and time must be spent familiarising themselves to use imagery in MR just prior to performance so that that too is a relatively automatic process. Until this automisation has occurred there is unlikely to be an increase on performance in fact, as often occurs when an athlete is shown a new physical technique to improve his/her performance, it is likely that performance may decrease slightly. The results may also point to the importance of high expectation of success in the initial phases of using a mental technique with little cognitive demand made on the athlete. Mental programs should be designed to give the impression of high success for the athlete if they were to engage in it. Ethically one should not give an outright lie and say that the programme will give tremendous success when there is no evidence for this. However, one can bolster the image of success using various strategies. Some of them used in these studies are mentioned below.

- The training programmes were made to have a 'glossy' feel. Care was taken to present the training in a professional manner which is made considerably easier with the advent of desk top publishing and laser printers giving almost typeset quality finishes.
- Explanations were given both verbally and backed up by written handouts that gave a simplified and easy to understand language of how the training programmes were supposed to work. I do not think that technical language should be used solely to make a programme sound good as it is all too easy for athletes to lose comprehension of what the programmes are supposedly trying to achieve.

Given the experimental results of the imagery training experiments, it is important to remember that the results do not indicate that mental rehearsal gave no benefit to the athlete and I still believe that imagery in mental rehearsal is a valuable aid to increase athletic performance. I do not think that the results warrant abandoning imagery training in favour of constructing placebo training procedures that are high in expectation. There is the possibility that the effects are due to a confounding variable of the attention capacity of the participants, being overloaded for the experimental tasks. Furthermore, discussions and anecdotal written evidence with elite athletes continue to persuade me of the worth of imagery in MR, and data from the first gymnastic study supports this notion. Furthermore in discussions with my participants, long after their respective experiment was finished, they often talked about the perceived benefits that their imagery training appeared to confer on them, when they continued to use it in their sport even after the experiment was finished. This would indicate that future research on this question should allow far more time for the benefits of mental rehearsal to emerge than in my experiments.

A Dilemma for the Coach/Sport Psychologist

A coach or sport psychologist has a dilemma because eventually the benefits in the initial phases of using a mental technique that is high in expectation and low in attentional demand, will be surpassed by the benefits of a 'real' mental technique (MT) such as imagery in MR which has become automated and thus low in attentional demands. The athlete wanting to utilize the 'real' benefit of imagery in MR, has to not only train up imagery ability but also to train her/himself into the habit of using it regularly prior to performance. This will in the initial part of using a programme, place a large cognitive demand on the athlete which will either not contribute to performance or may even make it worse.

When to use a mental technique

- A mental training programme must emphasise the habitual use of a mental technique as an integral part of the athletic movement.

This should be started with any athlete as soon as it is both possible and feasible (ie not immediately before a major competition!). This will help the athlete to become familiar with the concept of applying a MT to affect performance, just as one might have to get used to wearing spikes on one's shoes for sprinting, so one must get used to doing a MT.

Achieving short-term or long-term gains using MTs

- A coach who wants to implement a mental training programme that will give a <u>short-term gain</u>, should concentrate on a programme that will give high expectation of success but place no cognitive demand on the athlete.

Imagery training for a particular sport and using it in MR just prior to performance (especially if this is novel) would not fulfil these requirements. An alternative would be to use a very simple imagery exercise such as just visualising a simple but pleasing object, for instance the sun in a sunset or sunrise. If this was coupled with a plausible explanation as to why this will improve an athlete's sport in order to raise expectation of the technique then this would fulfil the requirements.

- A coach who wants to implement a mental training programme that will give <u>long-term gains</u> might implement a programme that teaches a mental technique that is used in mental rehearsal just prior to performance.

Imagery training would be appropriate in this case; however, the coach should realise that just like any new technique that is learnt, there is likely to be a plateau or even a decrement in performance when initiating such a programme. It is difficult to say how long this training must occur before the benefits begin to show, as this was not a variable studied in the experiments. I can only provide a 'guesstimate' from the experiences of my participants who spontaneously told me about perceived gains of the imagery in MR. I did not make any formal observation of when these comments were made after the training was finished hence these recommendations are tenuous to say the least. If an athlete is used to MR in some form or another, then the imagery training used in the experiments appeared to give beneficial results as soon as ten weeks, provided a definite attempt was made to practise imagery at least four times a week. For athletes not used to MR just prior to performance, twenty weeks appears to be a minimum, again practising at least four times a week.

Imagery perspectives

The role of imagery perspective was examined in the experimental literature. It is mostly believed that an internal perspective is more beneficial when employing imagery in MR just prior to performance. However, the experimental literature is also equivocal on this point. Three experiments in this study observed the effect of imagery perspective on performance. The first one, trampolining, found that an external perspective was more beneficial, the other two experiments (vault and beam in women's gymnastics), found support for an internal perspective. Due to the small number of participants, only tentative conclusions can be drawn from the experiments. Below is a table outlining the experiments that were done to look at the role of imagery perspective in MR.

Experiment	Open / Closed	Seq. of movement	Novice/ Experienced	Prior use of MR	Superior perspective (effect size)
Trampolining	Closed	Yes	Intermediate	No	External (0.28)
Vault	Closed	No	Experienced	Yes	Internal (0.36)
Beam	Closed	Yes	Experienced	Yes	Internal (0.26)

Table 8.2: The results of experiments to look at performance according to which perspective was used in the athlete's MR.

A meta-analysis of the results weighted by the degrees of freedom gave an average effect size (d) of 0.24 in favour of an internal perspective. This is the equivalent of changing a competitors rank from 50th to 41st rank out of a competition of 100.

Psychoneuromuscular, Triple Code and Bio-Informational theories all predict that the benefit of imagery should be largest for an internal perspective because it represents what the athlete would actually experience. This benefit will only be realised if the athlete has sufficient imagery ability to generate an internal perspective (a consistent result seen in the training studies, was that an internal perspective was harder to generate than an external one). However, an external perspective can still provide benefit to an athlete who is learning a new skill especially when it is important to remember a long sequence of distinct athletic moves, (as dictated by the Symbolic Learning theory). Therefore, an external perspective will on the whole be more beneficial to athletes who cannot generate an internal perspective and who are learning a new athletic skill. This will not be the case for athletes who can generate internal imagery easily, for instance if they have had enough experience to have done most of the elements required in a particular sport (a new move in other words is a re-ordering of elements that they have already experienced and will still be easy to generate internal imagery for). This model back up the assertions of various sport psychologists that imagery perspective may provide athletic performance benefits for different reasons (Feltz & Landers 1983, Smith 1987, Hardy 1989) and cannot be incorporated by a single theory. A questionnaire given out to international athletes generally supported this notion.

These results tie in with the results of the first four experiments that suggest that the quasi-sensorial aspect of imagery is important and not an epiphenomenon of underlying cognitive propositions (Pylyshyn 1981). If the epiphenomenal aspect of imagery were true and the actual cognitive processing was solely accountable by amodal propositions being processed, then it is difficult to see how the perspective of imagery should make a difference to the athletic performance, as presumably the task to be imaged would access the same propositions regardless of imagery perspective taken. I would also argue that it cannot be that athletes are responding to their own expectations or the demand characteristics of the experiments, because the results are not consistently in one direction (certainly that was my initial expectation and wish) and the athletes had no idea of which perspective should be better. If ease of doing a particular perspective were important, then again this is not supported by the first four experiments, as most of the athletes found it easier to generate visual imagery (which I have argued is equated with an external perspective) rather than a kinesthetic imagery (which I have equated with an internal perspective).

Generally the results seem to be consistent with the notion that just as motor movements must be trained and relevant muscles strengthened to be used effectively, so too it appears that imagery is an ability that must be trained before it can be used to any effect. The perspective questionnaire for the international divers supported this fact, because the more experienced divers were using the more difficult visual perspective and imagery mode. The fact that there are different types of imagery possible which have different ostensible effects of behaviour makes the role of cognition more important for the athlete and one that cannot be assigned to simple stimulus-response associations or epiphenomenal by-products of central cognitive processes.

Recommendations

These recommendations are made on the same understanding as before that the experimental results are statistically weak and that future research will help to temper the present recommendations.

When to use which imagery?

- If an athlete can successfully and relatively easily generate internal and/or kinesthetic imagery then this should be used in preference to external imagery, in mental rehearsal of closed skill athletic movements.

Although this is a recommendation for closed skill athletes, it is also applicable to open skill athletes at certain 'closed skill junctures' of their sport. For inexperienced athletes it may be necessary to have them follow an imagery script that has been prepared by an experienced one so that the correct details are included in the imagery.

- Priority should be given to training athletes in internal visual and kinesthetic imagery.

Imagery training should be given to athletes to use a variety of imagery modalities and visual perspectives. These are tools that can be used in a number of different situations. Most athletes find it easy to create an external visual image and then find it increasingly difficult to create an internal visual image and finally a kinesthetic image.

- If the athlete finds only an external imagery perspective relatively easy to image then this should be the preferred mode for mental rehearsal of athletic movements.

The actual gain from using an external perspective in a situation other than the one outlined in the next recommendation, is likely to be one of helping concentration and being less susceptible to distraction. If the imagery is controlled enough to see always a successful performance then external imagery may also improve an athlete's confidence. The worth of concentration and confidence should not be overestimated especially in a competition atmosphere. However, time should be spent trying to improve the athlete's internal and kinesthetic imagery abilities to receive the added benefit of imagery in its own right.

- If a sequence of movements could in reality not be properly perceived by an athlete completing the sequence, then an external perspective will provide more benefit than an internal or kinesthetic imagery perspective for mental rehearsal.

This recommendation is of most benefit to the athlete during the learning phases of a new sequence. The imagery aids the athlete to encode the correct sequence of the complete sequence. Typically these sequences will be tactical manoeuvres in a team sport.

Future Considerations

At the end of chapter 2 a list of recommendations for future research were made to help us answer fundamental questions, for instance those posed by Smith (1987) such as why imagery appears to work in some sporting contexts and not in others. The results of these experiments provide us with tentative answers, that need to be further corroborated by future research. For example there is some support that imagery can be trained as an ability, however, the results appear to suggest that the act of MR needs to be trained as an additional ability too before any performance increases are observed. These experiments did not specifically test this hypothesis but it is probably a productive line of research to follow.

The experiments were never really model or theory driven, they stemmed in part out of my own curiosity as a springboard and tower diving coach, to demonstrate an effect empirically. However, I realise that eventually for the empirical facts to be more than just numerical observations of behaviour, theories need to be taken into account . The experimental results provide some tentative support to suggest that imagery is a real cognitive process, however they cannot offer any insight as to which of the clinical or quasi-pictorial theories maybe correct, nor do they add to our knowledge about what the function of imagery is (using it to enhance sports performance is an adaptation of its function [whatever that might be] to modern needs). A refinement of these experiments would be to incorporate some psychophysiological measures that could be taken just prior to performance, to see if they back up the assertions of Bio-Informational or Triple Code theory. Use of modern telemetry units could provide this information whilst still maintaining ecological validity, by allowing the athletes to continue their sport in their usual athletic environment, relatively unencumbered by wires attached to consoles in psychology laboratories.

The results of the experiments suggest that a consideration of the quality of imagery (visual perspective and imagery mode) should be borne in mind when asking a particular athlete to use imagery in MR. Whilst broad outlines have been given as to when and what type of imagery should be used, future research should further refine these broad divisions to be more and more applicable to specialised athletes. For instance, what type of imagery should a slalom canoeist use in her/his mental rehearsal just before a race? It is difficult to define the sport as either open or closed, specialised individual techniques are required to paddle through the 'gates' and yet tactical considerations are required in choosing a 'line' down the course of the river.

As was previously mentioned an internal visual perspective is almost always associated with kinesthetic imagery and vice versa. Research needs to be conducted to ascertain whether it is one of these modalities that is contributing the main MR effect or whether it is a synergistic effect of the two modalities operating together. There are a number of sporting scenarios in which one could imagine that an external visual perspective coupled with kinesthetic imagery may in fact give a higher benefit then any of the other imagery combinations discussed, the slalom canoeist being one of them. There are other scenarios where 'flicking' from one visual perspective to the other may also be more beneficial. These scenarios lend themselves to future research.

SECTION 2:

Mental Imagery in Micro-PK Performance

Chapter 9: PK-RNG Literature

Introduction

In the last section the effect of training imagery and in taking a particular imagery perspective, were studied with respect to sports performance. This section deals with the issue of the effect of imagery training and the use of a goal orientated imagery strategy on 'micro-psychokinetic' performance. Micro-psychokinesis (or micro-PK) in this instance refers to the apparent ability to affect the output of a pseudo random algorithm through mental means alone. The questions concerning the effect of imagery as it relates to micro-PK are just as pertinent in parapsychology as they are in sport psychology. There is a great deal of literature correlating imagery with successful psychic performance (George & Krippner 1984). However, like the sport psychological literature dealing with the effect of imagery on athletic performance, the conclusions are far from neat and no real consensus can be arrived at. This section will try to highlight the correlations of micro-PK performance and imagery, point out the inconsistencies in the literature and report on some studies done to try and further research this phenomenon.

The use of imagery for successful performance both in sports and psychic performance is not the only tie up between these two, what appear to be at first glance, unrelated disciplines. Both sets of performers more often than not have to act in front of a critical audience. In the case of athletes, they perform in front of judges, referees and or spectators. For 'psychics' they often perform in front of audiences who are trying to evaluate their claims of being psychic. This audience might be a paying one, or they may be interested observers such as scientists. Also when both types of performers are 'performing' exceptionally, well the subjective experiences are very similar. They both describe feeling very powerful, awareness of the passage of time is distorted, total awareness of the complete environment and ineffableness.In sports this experiences has been described as a 'peak' or 'optimal performance'. Psychics in similar experiences are described as being in a mystical state (Goleman 1975, Servadio 1986). Csikszentmihalyi (1992) has described these type of experiences as being a subset of experience that he describes as a 'flow' experience. 'Flow' was the word that was commonly heard in descriptions of optimal experiences such as, "I was carried on by the flow [p.40]". Csikszentmihalyi (1992) thinks that flow experiences are ones in which our attention,

> ...can be freely invested to achieve a person's goals..[p.40]

For this reason flow experiences can occur for just about any activity including sport or meditation but also in walking or listening to a concert or admiring a work of art. Murphy and White (1978) have made the connection between sports and mysticism explicit by highlighting athletic experiences that are parapsychological or mystical in nature. Below is an excerpt from their book in which Mike Spino, a long distance runner, describes just such an experience.

> In the winter of 1967, I was training on dirt and asphalt, paced by a friend who was driving a car. I had intended to run six miles at top speed, but after the first mile I was surprised at how easily I could do it. I had run the first mile in four and a half minutes with little sense of pain or exertion, as if I were carried by a huge momentum. The wet pavement and honking horns were no obstacle at all. My body had no weight or resistance. It began to feel like a skeleton — as if the flesh had been blown off of its bones. I felt like the wind. Daydreams and fantasies disappeared. The only negative feeling was a guilt for being able to do this. When the run was over conversation was impossible, because for a while I didn't know who I was. Was I the one who had been running or the ordinary Mike Spino? I sat down by the roadway and wept. Here I was, having run the entire six miles on a muddy roadside at a four-and-a-half mile pace, which was close to the national record, and I was having a crisis deciding who I was [p.114].

Mishlove (1981) in reviewing training procedures for psi abilities across esoteric, occult and parapsychological literature, found that ancient and contemporary tribal shamans use physical exercise as part of their ritual in performing their ostensible paranormal powers. Sufi mystics too use physical exercise in their dervish dances to induce trances and achieve mystical states.

In short there appears to be a number of links between sports and parapsychology which may suggest that athletes could make good experimental participants in parapsychological studies. Not only do both subsets of people have to perform in front of critical audiences, they also share common experiences when performing at their optimum and finally both subsets use mental training regimes to help enhance their performance.The main emphasis in the investigations shortly reported, is in the use of imagery to affect micro-psychokinetic performance. This first chapter introduces some of the parapsychological terms used to describe the experiments. The parapsychological literature on the use of imagery is outlined. From this literature the rational behind the conceptualisation of the experiments is explained. The following chapter describes the experiments that were conducted for this thesis and the results presented. In the final chapter of this section the results are tied into previous research and they are attempted to be reconciled with some of the theoretical models.

What is micro-psychokinesis?

Parapsychology is the study of interaction between an organism and the environment through presently unknown means. Two broad types of ability are examined in parapsychology, extra sensory perception (ESP) and psychokinesis (PK); collectively these abilities are referred to as psi abilities. ESP is the ability to obtain information from the environment by means presently unknown. Psychokinesis is the ability to affect the environment by means presently not known. The ability of psychokinesis is further divided into two types of effects: micro-PK and macro psychokinesis (macro-PK). Macro-PK is when the affect on the environment is large enough to see with the naked eye, such as levitation or metal bending. Micro-PK on the other hand is when the effect on the environment is so small that it needs to be magnified (Palmer 1986). Mostly this means using statistics, although other devices, such as strain gauges (Isaacs 1983), spectral analysis or thermometers (Schmeidler 1973), have also been used.

Micro-PK and RNGs

PK research had, up to the 1930's, mostly been left out of laboratory and most of the investigations concentrated on the PK effects seen either in the seance room (such as the rappings or even the levitation of objects such as the seance table) or in poltergeist studies (Schmeidler 1984). However, the opportunity in this environment for fraud to occur, was too great in these uncontrolled conditions for most scientists to accept the phenomena as real. Rhine set about a program of having subjects try to influence the fall of a dice over many trials (Schmeidler 1987). This made the subsequent analysis subject to statistical techniques so that despite nothing visibly paranormal having occurred, PK could be inferred if a subject's throws gave results beyond that expected by chance. Despite this seemingly elegant introduction of PK research into the laboratory, the possibility of fraud or unconscious mistakes at the time of recording or at the time of analysis, still made this method relatively unacceptable to most 'hard nosed scientists'. This is referred to by Palmer (1986) as the 'Experimenter error (E-error) hypothesis' which postulates that significant results occur because,

> ...their research procedures allow for artifacts or cheating by their subjects, or because they cheat themselves [p.214].

Beloff & Evans (1961) were the first to introduce the idea of a random number generator (RNG) based on a live source of radioactive Uranium. Their results were not promising; however Helmut Schmidt (1969) coupled a source of Strontium^{90} (which is also radioactive) to an electronic display that provided feedback of the internal state of the RNG to the experimental subjects. The results were recorded electronically, hence substantially reducing the possibility of fraud or unconscious mistakes by any party involved in the experiment. Extensive tests were made on the machinery to see that under normal conditions the machines worked as they theoretically should (ie give a random output). The results for the randomness tests revealed normal random properties. Under a precognition paradigm (predicting the future state of the machinery) the results were highly significant in two experiments. Since that time there has been a profusion of RNG experiments and the RNGs and their associated displays have increased in their sophistication and complexity.

Meta-analysis of PK-RNG literature

Rather than go through a traditional literature review of the efficacy of the PK-RNG methodology the reader is referred to the meta-analyses of the literature by Radin and Nelson (1989). The use of meta-analysis in the behavioural sciences has been covered in the previous section (chapter 3). The effect size they used was $z/\sqrt{n}$ where z is the standard deviation away from mean chance expectation (MCE) and n is the number of random decisions made for the experiment. From the period of 1959-1987, they found 832 studies, the mean effect size was 3.2×10^{-4}, which although small is highly significant ($z=4.1$, $p<0.00003$). The 'fail safe N', which is the number of additional unreported studies with a z of 0 that would be required to reduce the effect to non-significance, they calculated to be

585,000 studies. The ratio of reported to hypothetically unreported studies is about 1:90, which Rosenthal (1984) suggests is unreasonable. Radin and Nelson (1989) conclude,

> ... it is difficult to avoid the conclusion that under certain circumstances, consciousness interacts with random physical systems [p.1512].

The meta-analysis does not unfortunately go on to explore moderating variables that might suggest what are the most conducive conditions or strategies for participants to elicit the strongest effects. Instead I shall report a selection of the results that seem to me to stand out as more conducive situations to such effects.

The results from the individual experiments have been impressive enough to warrant many researchers to conduct process orientated research before the results of the meta-analysis were known. More extensive reviews can be found (eg Schmeidler 1984, 1987) but an outline of some of the major findings will be presented here.

Imagery and Psi

Spontaneous cases and interest in imagery

There has been considerable interest in the use of imagery in parapsychology for several reasons. Reviews done on spontaneous cases report the largest proportion occurring in a visual or auditory mode, or even a combination of the two (Green 1960; Rhine 1978; Schouten 1979, 1981, 1982; Kohr 1980). This is as opposed to psychic information being obtained in an 'intuitive' mode, that is without any sort of imagery where the participant just "knows" some sort of information (Rhine 1978). An example of a psychic experience involving imagery is taken from Myers (1903).

> On the 5th of July, 1887, I left my home in Lakewood to go to New York to spend a few days. My wife was not feeling well when I left, and ... at night, before I went to bed, I thought I would try to find out if possible her condition. I had undressed, and was sitting on the edge of my bed, when I covered my face with my hands and willed myself at Lakewood at home to see if I could see her. After a little, I seemed to be standing in her room before the bed, and saw her lying looking much better. I felt satisfied she was better... On Saturday I went home. When she saw me she remarked... "I thought something had happened to you. I saw you standing in front of the bed the night (about 8:30 or before 9) you left, as plain as could be, and I have been worrying myself about you ever since. I sent to the office and to the depot daily to get some message from you." ... She had seen me when I was trying to see her and find out her condition. I thought at the time I was going to see her and make her see me.

White (1964) reported that "gifted" ESP subjects have also stressed the importance of imagery (eg Sinclair 1930). As a result of this anecdotal material there have been numerous attempts to study the relationship between psi and imagery (George and Krippner 1984).

The relationship between imagery and psi scores

There have been quite a few studies that have looked at the correlation between participants imagery ability as measured by self report questionnaire and their psi scores. The most popularly used imagery scale has been Betts Questionnaire upon Mental Imagery (QMI). Initial positive correlations (Palmer & Vassar 1974), were later thought to be an artefact of the design protocol, as the questionnaire was given to the participants after they had completed a clairvoyant psi task. Hence it was argued that the experimental participants may have conformed to the demand characteristics of the experimental situation. The relationship disappeared if the questionnaire was given to the experimental participants before the psi task (Palmer & Lieberman 1975). Honorton (1975) questioned the validity of the QMI with regard to imagery ability because of its lack of correlations with other imagery measures such as visual recall scores and psychophysical measures.

Since that time several other studies with the QMI have revealed differences between high and low imagers (divided via a median split) (Rao, Rao & Rao 1977, Sargent 1978) but again the results are not clear. Rao, Rao & Rao (1977) in a forced choice ESP task found high imagers were significantly hitting. Sargent (1978) in a forced choice ESP tasks did not find this relationship (there was no overall score difference) but found that high imagers had greater score variance. This interacted with the imageability of the target words such that high imagers scored lower in low imageability words. Sargent suggests that high imagers would prefer high imageability words because they can use their imagery (although his results do not agree with this), however they are denied using their high imagery if the words are of low imageability (although why this should produce significant missing is not clear). Gissurarson(1989) in a three pilot series found correlations with the vividness of visual imagery questionnaire (VVIQ - Marks 1973) and PK scores in the predicted direction although they were not significant. On balance there does seem to be a weak link between imagery and psi abilities.

Using imagery strategies

Accordingly there have been a number of attempts to investigate this supposed association in the laboratory. These have been reviewed effectively by George & Krippner (1984) who state that whilst the results are equivocal, imagery in parapsychology should be further researched. For instance with regard to the results being equivocal, they quote some research done on whether the use of an imagery strategy is more beneficial for showing psi in the laboratory than some other strategy. Honorton, Tierney & Torres (1974), Schecter, Solvfin & McCollum (1975) and Morris & Bailey (1979) found no evidence that using an imagery strategy produced higher psi scoring to either guessing in the first two studies or concentration in the final study. In contrast Morris (1980) and Kreiman (1980) both found statistical support that imagery was superior than either of their respective comparison strategies (concentration and 'thought monitoring'). George & Krippner (1984) end their article by stating,

> The mutual interest of imagery researchers and psi researchers have presented each with formidable challenges. Let us hope that these challenges will not be insurmountable [p.82].

Morris (1977) collected seventy popular books that purported to train psychic abilities. These books were not academic publications but more in the style of 'self help' material that one often finds in book stands of airport, train or bus terminals. His 'Airport Project' involving students from two introductory parapsychology classes assessed the advice given in these books. One should be cautious about this advice since it is quite probable that much of it may have come from a common source of literature that the authors have all referenced. Using this literature Morris identified several strategies that appeared to facilitate psi performance - two of them identified were 'goal' and 'process' orientated imagery. Morris, Nanko & Phillips (1982) define a goal directed strategy as,

> ...selecting the final goal or outcome that one wishes to produce, then picturing that outcome vividly in the mind's eye. [p.2]

Goal directed imagery for a PK task in which a light randomly 'walks' around a circle of light bulbs (Placer, Morris & Phillips 1977), would be to image the light 'walking' in a predominantly clockwise or anti-clockwise direction (ie depending on what the intention was). In contrast a process directed strategy,

> ...involves selecting some sort of process or series of happenings that naturally lead up to the desired outcome, then visualizing those processes taking place [p.2].

Process oriented imagery for the circle of lights PK task would be to image energy building up in the body and to let that imagery flow out into the apparatus to 'push' the circle in the desired direction. Experimental data shows support for the most successful strategy being goal directed imagery. (Morris, Nanko & Phillips 1979, 1982, Levi 1979, Morris & Reilly 1980, Nanko 1981).

Imagery training

There are two major reviews of the anecdotal psychic training literature. Morris' (1977) 'Airport Project' has been mentioned above. Mishlove's (1983) review of the training literature is far more extensive because it also looked at anthropological data from cultures outside the western tradition. Most of the training practices from this review pertains more to ESP. It frequently mentions the use of imagery and some of the practice techniques are designed to improve imagery ability. More specifically for PK training, Gissurason (1989) has noted that some of the books that Morris reviewed (1977) gave some general suggestions for training PK. They were:

- the goal or target in a PK task should be meaningful to the person trying to exert the effect,
- the task should be repeatedly visualised,
- visual imagery skills are necessary to the task and have to be acquired.

White (1964), pointed out that the early 'gifted subjects' practised their imagery skills very diligently. Some experimental studies have tried to train imagery abilities to increase the possible effect imagery may have on psi scores. Most of the studies looking at both ESP and PK scoring, found no relationship between the imagery training and the subject's psi scores (Mockenhaupt, Roblee, Neville & Morris 1977 - Morris & Bailey 1979 - Morris, Nanko & Phillips 1979 - Morris & Hornaday 1981). In one of the studies Morris, Roblee, Neville & Bailey (1978) found a significant decline in the scores over time; this is obviously counter to the training hypothesis. In two of Morris's studies an attempt was made to measure the experimental subject's visual imagery ability. Either through an in house developed questionnaire (Morris & Hornaday 1981), or through blind judge's ratings for subjects' mentation reports of their 'imagery abundance' on a 200 point scale (Morris, Nanko & Phillips 1979). No significant relationships were found in either study.

George & Krippner (1984) criticise these experiments because they have not ascertained if the subject's imagery training was effective (ie did the imagery ability increase). If it it had not increased then naturally we would not expect to see an increase in the psi scores. George(1982) gave three psychometric tests to his subjects but did not find a significant increase in either their imagery scores or their psi scores. He did though find that those that practiced their homework exercises more, improved their psi scores, although he does point out that this could be due to a motivational effect. Braud (1983) also did a training study except, unlike George (1982), the psi task was a micro-PK task and not an ESP one. The training programme over six weeks was a slightly modified version of George's imagery enhancement training programme. As well as twenty minute weekly exercises he also asked his subjects to do homework exercises. The imagery exercises stressed and emphasised eliciting colour imagery. The PK task was to keep a red lamp turned on for as long as possible (the decision to turn it on or off was decided by a RNG). The imagery task used to try and affect the PK score, was to image the warm glow of a setting or rising sun. Imagery questionnaires (Paivio's IDQ, Mark's VVIQ and Gordon's control of imagery questionnaire) were filled out by the subjects both before and after the training. All the questionnaires improved over time although due to the low power of the experiment (he only had seven subjects), only the IDQ change was significant. The results showed that the PK scores improved from pre- to post training (d=2.84), the post training score was significantly above mean chance expectation (MCE). However there were no correlations between the improvement of self rated imagery (for any of the questionnaires) and the improvement of the PK scores. However, he did find a large (significantly so) correlation between the amount of time spent on homework and the increase in psi scores (r= 0.84). His main conclusion for successful use of imagery to elicit psi is "practice, practice, practice the visualisation exercises". He also notes that in his opinion the key to success is that the task to be visualised should be as similar as possible to the feedback of the PK task (personal communication 1989). This follows on from his theoretical considerations of lability and inertia of the target and the influencing agent respectively (Braud 1981). Another major study into the effectiveness of imagery training on psi scores was conducted by Gissurarson (1989). He compared imagery strategies in their effectiveness in eliciting PK on various types of RNG's. Gissurarson(1989) also developed a third imagery strategy called 'end orientated imagery' where the imager was to image the actual feedback score of the PK task. Gissurarson points out that this new strategy is actually a subset of goal orientated imagery. There was some *post hoc* evidence for psi but this was not differentiated on the strength of the various imagery strategies (goal-, process- or end- oriented imagery). As previously mentioned he found weak correlations between the imagery ability of his subjects and their PK scores but he only took one imagery questionnaire reading at the beginning of the experiment, so that no correlations could be computed for any change in imagery and psi scores.

In conclusion the experimental literature cannot state whether the imagery training is beneficial for enhancing psi performance. In part this is because correlations have not been reported between a hypothetical imagery ability improvement and a hypothetical psi ability improvement. This for all but two studies (George 1982 and Braud 1982), is because for the majority of the training studies, a post training questionnaire was not administered and hence an improvement in imagery ability was not computed. In both Braud's (1982) and George's (1982) studies a post training measure was taken but the sample size was so small (seven and twelve subjects respectively) that the power of detecting a reasonably accurate correlation was extremely low. The only consistent result (reported in the last two studies) has been a correlation between the amount of time spent on imagery improvement homework exercises and an improvement in psi scores.

Using Games in RNG-PK experiments

One of the biggest problems with working with RNGs is that despite their elegance in terms of experimental design and better control against cheating etc (McCarthy 1981), they have at present no real function in the real world. In an effort to make a neat experimental design that is immune to the subtle but normal biases, that sceptics of parapsychology have pointed out may account for the anomalous results, parapsychologists run the risk of trivialising experimental tasks to demonstrate psi abilities. Williams Cook (1991) makes this point and pleads with the parapsychology community not to go down the same path that psychology has Kline (1988). Williams Cook points out that this point was well appreciated by some of the early psychological and psychical researchers (Myers 1900) but laments that we do not appear to have progressed much since that time. It is not unreasonable to suggest that psi powers, assuming they are real, have probably developed as a method of survival (Broughton 1988) and thus have a biological role to play. There is nothing in our 'survival tool kit' as bipedal, savannah, hunter gatherer primates (albeit very technologically advanced ones) that gives us a need to be able to psychically 'tweak' a radioactive, electronic or pseudo random generator. More simply put, there is no ecological validity in an RNG experiment. Braude (1986) is even more scathing and says

> ...situations that elicit psi functioning are unlikely to be those found in formal experiments, which at best create only artificial or contrived needs. No matter how interesting or attractive the experimental tasks may be (eg, embedded in video games or other visually arresting displays), it is inexcusably naive (especially for a trained psychologist) to suppose that subjects will find the tasks deeply motivating, or more motivating than the experimenter's real investment in success (*or* failure) [p.9].

Arguing from this stand point one can only surmise that if RNG experiments are successful, then it must be because there is some psychic process that does have a biological function that can be used (maybe very crudely) to affect the outcome of an RNG. More to the point the meta-analysis does point to an effect in need of an explanation (Radin & Nelson 1989).

However, as Honorton (1980) has pointed out the success of video arcade games is not in doubt and provides an opportunity to present a psi task in a novel and interesting way. One of the ways to increase the interest in the participant, is if the outcome of the RNG is presented in such a way to have *meaning* to them. Despite what Braude says it might be that a visually arresting display can provide that interest and meaning.

The variety of micro-PK gamesextendfrom a simple display that is interpreted in a game like setting, to fully developed arcade like simulations. For instance in the former category, Weiner (1978) and Broughton (1979) showed a display of ascending lamps; either computer display lamps or real lamps. The task was to make the lights ascend as quickly or as high as possible. In the former case there were four ascending blocks and the task was conceptualised as a horse race. The subject chose one of the columns as their 'horse' and then tried to will the horse to win. For the latter task the single ascending column or lamps was conceptualised as a fair ground 'test your strength' game of using a hammer to hit a pad which launched a weight up a column. A really strong blow makes the weight hit a bell placed at the top of the column. Other games had simple displays that were not interpreted on any special way and yet the task was presented in a game like fashion. Debes & Morris's (1982) game 'Horizon' asked a subject to influence a falling dot from the top centre of the screen to eventually fall to a desired side (left or right). Weiner (1980) and Schecter, Barker & Varvoglis (1983) presented slightly different versions of a game, that had a subject physically try to maintain a graphic element in the centre of a computer screen. The task gradually became harder and the rate of the increase in task difficulty was controlled by a RNG. Honorton (1980) describes a arcade-like game called 'Psi-Trek' which had subjects trying to guess which of four quadrants a computer would choose. Hidden in one of the quadrants was an 'enemy' spaceship. Location of the enemy led to an animation display (there were twenty eight of them to maintain novelty). Cumulative scoring of the game was rewarded by a display depending on whether the scoring was at/below chance or whether it was above chance. Berger & Honorton (1984) designed a game based on the popular arcade game 'Space Invaders'. It was called 'Psi Invaders' and worked in a very similar manner to the real 'Space Invaders', except the 'cannon' used to shoot the 'enemy' was faulty and required psychic force to keep the cannon firing. Schmidt (1989) one of the most successful experimenters with RNG PK experiments, has said that although there ought to be a game like quality to the RNG task, he prefers simple displays as the more sophisticated ones run the danger of detracting from the PK task as the subject becomes too involved in the display and loses concentration.

Games provided engaging visual and audio feedback and this may help to keep the motivation and interest in the PK task higher than say someone who is trying to obtain more '1's than '0's. However, Gissurason (1989) in a review of the PK game literature, feels that there is no evidence that the game like interface gives any stronger PK effects.

Absorption

One of the features of a video arcade game is that the player can on occasions become completely absorbed in the task. Absorption has been formerly stated by Tellegen & Atkinson (1974) as,

> ..a 'total' attention, involving a full commitment of available perceptual, motoric, imaginative and ideational resources to a unified representation of the attentional object [p. 274].

Absorption is of interest to parapsychologists for a variety of reasons. Pekala Wenger & Levine (1985) have identified that trait absorption is associated with more frequent and more vivid imagery. This relationship was replicated with the vividness of imagery and absorption by Campos & Pérez (1988), although the correlations for women were lower than that for men. A more thorough review by Roche & McConky (1990) also came to the same conclusion. Some of the facets of absorption described by Tellegen & Atkinson (1974) relate to optimal or flow experiences (Maslow 1968, Cszikszentmihalyi 1988). From their original paper Tellegen & Atkinson (1974) say that absorption has been,

> ...described and discussed widely in literature on meditation, expanded awareness, peak experiences, mysticism, esthetic experience, regression in the service of the ego, altered states of consciousness, and in the literature on drug effects [p.274].

Which, as was explained above, link both sport and parapsychological performance (Murphy & White 1978). White (1964) described how in the "waiting technique" a person had to absorb their mind and then build a mental tension and wait for an answer, that was more than just a guess, to appear in their conscious thoughts. An absorbing task in this instance could be imagery (Sinclair 1930; Cook & Irwin 1983), but it could equally well be some other practice such as meditation (Owens 1975; Goleman 1975). Nadon & Kihlstrom ((1987) reported that self perceived reports of paranormal experiences correlated strongly with imaginative involvement in sensory and aesthetic experiences from Tellegen's 1981 Absorption scale. They use this argument to suggest that high absorbers are self deluding themselves into thinking that they have had a paranormal experience. Irwin (1985, 1989) has reported that a subject's need for absorption (ie engaging in absorbing tasks) correlates highly with perceived ESP experiences.

Unfortunately there exists but a few trait measures of absorption (for instance Tellegen and Atkinson 1974) and even fewer state measures of absorption. Pekala, Wenger & Levine (1985) tried to assess a subjects absorption state by using a technique that basically asks subjects to retrospectively assess their subjective absorption experience whilst doing a particular task. However, this technique is obviously prone to demand characteristics. St. Jean & MacLeod (1983) report that time is typically underestimated when in an absorbed state, although this relationship was purportedly not replicated in a later study (St. Jean & Robertson 1986). Absorption is discussed in more detail in the final experiment reported in chapter 10.

Increasing the PK Effect – Majority Vote Techniques

If one considers the psi process to be one of information transfer then the signal that is being transferred is a very noisy one to give us such small effects (Radin & Nelson 1989). However the problem of 'cleaning up' a noisy signal has been known for some time for instance in the communications industry and they usually involve averaging, or majority vote procedures. For instance, if asked to influence an RNG into one of two states (0 or 1), one could arrange for a computer to average 11 samples of an attempt to influence the RNG. Whichever state is more prevalent is the one that is carried forward as the actual response. By example, if there were seven '0's and four '1's then the computer would carry the majority vote to being a '0'. One can see in this example one of the problems with majority vote techniques, namely redundancy (so in my example it took 11 trials to actually come to one decision). Fortunately computers can work so fast that this is not an immediate problem when we look at RNG work.

Puthoff, May & Thompson (1986) used a techniques described as 'sequential sampling' which meant that there was a variable length majority vote code. This means that unlike my previous example which has a fixed length majority vote code (ie eleven trials are always sampled before a decision is reached), the number of trials used to come to a decision varies from one decision to the next. The parameters that decide how long it takes to come to a decision are statistical in nature and basically look for trial lengths that do not look especially 'normal' (in the statistical sense). For instance the statistics would come to a decision if there were sixteen '1's and five '0's, but not if there were six '0's and five '1's - the last example is too close to normal chance results. This technique on a binary decision process can come to three decisions: decide a '0', decide a '1' or cannot decide so disregard the collected samples and start again. A more detailed explanation is given in Puthoff *et al*'s (1986) or Radin's (1990) respective papers. Using this technique Puthoff *et al* (1986) found, out of two subjects, one performed at chance and the other got a significant result (an effect size of 5.6 % in the desired direction - up from a 1.5% effect size when just looking at the raw bits of data). They also noted *post hoc* that the longer the decision process went on (ie the more trials it took to come to a decision) the more accurate both percipients were in getting a 'hit'.

Radin (1990) replicated Puthoff *et al*'s results using the same sequential sampling function but in an attempt to decrease the 'effort-to-decision-ratio' he added a few refinements. This ratio is the number of 'button presses' an operator must press in order for the program and RNG to reach a decision. The main way this was achieved was to build upon Puthoff *et al's* finding that the longer the majority vote length was the more successful the decision was. Thus Radin incorporated a weighting scheme which placed more weight on those decisions which took longer to be decided. Using this technique Radin managed to obtain a highly significant effect size of 16% (ie changing the hit rate from about 50% (expected by chance) to 66%). Furthermore his 'effort-to-decision-ratio' was only 2:1 compared to Puthoff et al's 15:1. Radin & Bisaga (1991) have subsequently incorporated this technique into a 'Gedanken device' which they define as "a system that can detect and act upon human mental intention". This is their commercial language way of saying a "switch that can be activated by psychic means".

Conclusions and Recommendations

Trying to study PK in the laboratory, has gradually evolved into using random number generators (RNGs) usually coupled to modern computer equipment. The PK task is to alter the probability distribution of the RNG. The RNG is often yoked to a form of feedback to inform the participant whether they 'hit' or 'missed' their pre-assigned intention. This procedure is favoured for experimental design purposes because it makes participant fraud very difficult. In addition if the results are automatically recorded onto electronic media then this makes the chances of experimenter recording error or fraud considerably smaller. A meta-analysis of the RNG-PK data (Radin & Nelson 1989) points to a small but highly significant effect. This effect was not related to a flaw analysis (ie where one could argue that the effect comes mainly from poor experimental procedure).

Anecdotal and non-experimental literature, recommends using visual imagery as a mental technique to obtain PK effects. Although the previous experimental literature of the effectiveness of using an imagery strategy is equivocal, the results from some of the experiments support the notion that goal orientated imagery (as opposed to process orientated imagery) is an effective strategy to enhance micro-PK performance. It would seem that there are a number of ways that the experimental studies on micro-PK could be improved in future experiments that might address the inconsistencies found in the experimental literature.

Specifically it is perplexing that the experimental literature does not bear out the strong relationship between imagery and the spontaneous case literature. However, in part this may be due to the experimental design not being sensitive enough to show this relationship; for instance by not taking imagery measures, or in the case of imagery training, not taking both a pre- and post-training imagery measure to check to see if the training actually increased the experimental participant's imagery ability. Or it may be that the relevant facet of imagery was not trained such as a subject's imagery vividness or imagery controllability. Another reason why the effects may not have manifested is that the micro-PK task may seem too far removed from what the experimental participants would do in everyday life (ie it is not meaningful or ecologically valid to the participant). Various explanations offered by George & Krippner (1984) to explain the inconsistency found in the literature relating to imagery and psi are: the measures of imagery are not the same over the various studies, imagery is only tangentially related to psi, and

> Controversy surrounds whether to view imagery as a trait, a state, a way of speaking etc [p.81].

Thus the studies research in the relationship between imagery and psi may be mixed because they are not focussing on the same aspects of imagery.

As in the sport psychological studies none of the studies either in using imagery strategies or in imagery training protocols in parapsychology, have specifically attempted to control for expectancy effects (Rosenthal 1980) which may increase the motivation of their trained subjects (Greenhouse 1991). It seemed prudent to try and control for expectancy in these training studies as well. George (1982) made this point and illustrated how this has been achieved by studies done by Morris and his associates (such as Morris & Bailey 1979) where the motivation is controlled in part by including an alternative strategy instead of imagery that subjects use, such as concentration exercises. Morris and Bailey (1979) did not include the concentration group as a strict control as they were not sure which would provide the largest effect. In that sense the design was a comparison between the two strategies.

Addressing both these problems led to the following recommendations that were implemented in the thesis' research. Where there was an imagery training element, both a pre- and post imagery training score would be taken. The task would also be made as ecologically valid as possible. In as much that this is almost impossible with a micro-PK task (there is nothing 'normal' about trying to affect the statistical probabilities of electronic equipment), one of the easiest ways thought to achieve this was via visual feedback that the participants would receive. Accordingly it was decided to make the PK task a visual representation of an athlete's real athletic task. This had the double advantage of the task not only being relevant and meaningful to the athlete, but also the imagery training that they had received to improve their athletic performance could be used directly as the imagery strategy in the PK task. This would then follow up on Braud's recommendation to make the imagery strategy as close to the visual display as possible.

A final study would use a slightly modified version of the game to assess the importance of absorption as a state measure that might correlate with PK performance, and whether a special majority vote technique could produce larger PK score effects.

Chapter 10: Experiments with Athletes Using Micro-PK

Introduction

The last chapter highlighted the link between sports performance, psi performance and imagery. Anecdotal reports stress that visual imagery should be acquired as a skill to be used in PK performance, although there is no recommendation to what level of imagery ability the training should take a prospective psychic. Experimental evidence however, suggests tentatively that a goal-orientated imagery mental strategy is a successful way to produce psi hitting. The role of imagery ability and PK performance could be further researched by replicating the previous experimental results and when appropriate to correlate any change in imagery ability with a hypothetical change in PK ability. The following experiments described were designed with the above points in mind. The main hypotheses were:

- Participants with higher initial vivid imagery ability would score higher in the micro-PK tasks.
- Participants with more imagery training in vividness would score higher in the micro-PK tasks.
- Participant's change in imagery ability (where appropriate) would correlate positively with an increase in their micro-PK scores.

This chapter mainly describes four sets of experiments exploring these hypotheses. Unlike previous training experiments the effect of expectancy in training procedures was controlled for in the training protocol. This is exactly comparable to the expectancy effects described in the previous section on athletic performance enhancement. The final experiment was run to explore the role that an imagery perspective and 'sequential sampling' (a majority vote technique), plays on the PK effect size and to what extent an individual's state of absorption correlates with their PK score.

Computer RNG - PK test, brief overview

A brief overview of the equipment and software used and how the programs run in essence is presented here, whereas more detailed explanations of how the program looks and feels is presented for each of the experimental write ups. The main advantage of using a computer was dealt with in the last chapter but briefly stated: they can be used to generate pseudo random numbers; they are very hard to inadvertently or deliberately alter through normal physical means; the computer can provide interesting visual displays that may allow the experimental participants to become absorbed in the game; the visual displays can be tailored specifically to participants to provide contextual meaning; and results can be recorded automatically by the computer. The games were constructed with pieces of animation specifically of a participant's particular sport. Particular attention was paid to try and make the animation sequences as close to the scenes that the participants would be imaging as possible (ie the imagery that the athletes would use in their mental rehearsal (MR) prior to their athletic performance).

The general plan of the program can be described thus:

- Instructions in the program ask the subject for relevant details such as their name etc.
- Having started the program the computer displayed a short starting sequence of animation.
- At the end of this piece of animation it chose a random number (normally one of two numbers).
- The result of this determined which animation, from a number of alternative second sequences, should be displayed. In principle the observer would be unaware of this decision process and the two sequences should appear as one uninterrupted sequence. In practice however, hardware speed restrictions meant invariable a pause would ensue whilst the next animation was chosen.
- More than one of these steps was commonly used to make a complete animation sequence (ie several random numbers would be generated for one ostensible trial).
- At the end of the participant's session the random numbers were recorded to the hard disk (only for some of the games) and a floppy back up disk.

This rather elaborate procedure was taken for several reasons. Firstly it allowed a real time aspect to be incorporated into the display; an alternative would be to have a precognitive set up where as the trial was initiated the required random numbers were all generated and from this an appropriate complete animation is selected. Secondly more RNG trials could be sampled in the one trial. More details of the games' construction are given in Appendix V.

Describing the task to the athletes

I initially recruited the athletes to take part in sport psychology experiments but asked in return for all the 'free' mental training they were getting, that they also had to agree to take part in a parallel PK experiment. Although this sounds (correctly) as if I was putting pressure on the athletes to become involved in the PK task, none of the athletes ever asked to be included in the sport psychology experiments only and excluded from the PK experiments. I took this stance because I thought it would become too complicated to explain the two experimental procedures in the recruiting stage (ie the rationale behind doing the MR experiments was already too much to assimilate without in addition trying to justify why I was doing the PK task experiments). I described the task in as non-committal way as possible in order not to give the participants preconceived ideas. The PK task was designed to show animations specific to each of the athlete's particular sport: a girl doing a selection of vaults over a vaulting 'horse', a manikin trying to juggle three balls in a cascade fashion and a bullet making its way down to a target. I would ask the athletes to immerse themselves into the PK task as they might do for their actual athletic performance. For all but the shooting game the animations had a named character whom I asked the athletes to identify with and 'help' them in her or his task. If the athletes asked for a more complete explanation of how the game worked I explained that the animation was chosen on the basis of an electronic coin that flipped 'heads' or 'tails', if it flipped heads it would play one animation, tails and it would choose another. I also explained to all the athletes that the overall effect would not be startling, so that they would not become disenchanted with the game because they were expecting more control than they would probably have.

Despite the explanation of the task before they actually did it, many of the participants (irrespective of age or ability), were surprised at what they were actually being asked to do and did not realise this until they found that there were no keyboard, mouse or paddle controls to the game. I deliberately played down the 'fantastic' aspect of the task by explaining that PK was believed to be a perfectly natural, albeit weak ability. For those participants that expressed a sceptical attitude, I would explain that they were correct in thinking that the 'conventional wisdom' did not expect any effects to occur, and that was why it was important to follow up on the previous research that claimed that there was an effect. This, I reasoned, would have the effect on these athletes of looking on the task in a favourable light, and not as a waste of their time. I did however, ask them to suspend their disbelief for the duration of the experiment as the previous research appeared to show that this was a necessary condition for the effect to occur. I encouraged them that there was plenty of opportunity to talk about the research and 'voice their scepticism' after the experiment was finished. I specifically asked the participants not to actively strive or strain to try and affect the game. Rather I encouraged them all (ie regardless of the experimental group they were in), to have a 'casual wish' to help the character in the game to achieve a good athletic result. They were to be pleasantly surprised if they achieved a good result, but not overly disappointed if they did not succeed. In a way this is slightly out of character for the athletes (who typically invest much effort in succeeding), however I explained this was a strategy to help them achieve a high 'score' and that they were more likely to get one if they followed it.

To sum up, three micro-PK games were constructed for athletes to use to explore the effect of imagery training on the hypothesised PK effect. The games were constructed to give real time animations specific to the athlete's sport as a form of feedback. The animations were constructed to reflect what the athletes might be imaging if they were using mental rehearsal.

PK-RNG Vaulting

Introduction

The first imagery training experiment with the gymnasts (see the last section) provided an ideal opportunity to instigate the PK study. Using the same rationale as the MR study, the same experimental and control group could be used. The athletes were all using cassette based mental training procedures. One of the groups was receiving imagery training, whilst the other was receiving a bogus 'subliminal suggestion' training course. It was decided to try and run the two experiments almost concurrently, alternating each week as to whether I took data for the mental rehearsal experiment or for the PK experiment. Like the mental rehearsal experiment, the PK experiment was run in the gymnastic hall, making it easier to get the athlete and the computer together in one place. The alternative would have been to ferry the gymnasts to the psychology department. This was thought to be an impractical use of time and maybe even slightly intimidating for the athletes (who initially volunteered for training for their sports performance and not to work with computers in academic buildings). There were in essence two groups of athletes, one of which received imagery training, the other which received a placebo ***subliminal*** training procedure for the first half of the experiment, and for the last half they too received the same imagery training as the first group. For the first half of the experiment both groups of participants were asked just to use any mental strategy that they felt comfortable with. For the last half of the experiment when all the participants had been trained in imagery, they were all asked to use an imagery strategy specific to vaulting, that they had learnt in their imagery training exercises. The game (explained below), took about five minutes to complete which was what I guessed would be the longest that the athletes would be able to spend on the game, on order to allow me to test all the participants in a single normal training session.

Materials

The Movement Imagery Questionnaire (MIQ) which consisting of two sub-scales on the vividness of visual and kinesthetic imagery, as described in the previous sports section (chapter 4).

Apple™ Macintosh SE, 1 MB RAM, 40 MB Formac™ hard disc and a 'mouse'. Random numbers came from the computer's own pseudo random number generator, since a live source of randomness was not easily available for this particular computing system. The random function of the computer was a pseudo random algorithm that obtained a seed number from the computers internal clock, usually by an interrupt procedure such as a mouse or keyboard press. This arrangement is seen to be more preferable than a procedure which only calls up the seed number once (for instance when the computer is first switched on).

An Aries™ spike protector extension cable.

Small diaries for participants to record the frequency of use of the imagery exercises.

A mini-lab was constructed using two trampoline beds which when folded formed effective vertical barriers. This allowed some degree of privacy and allowed the gymnast to concentrate on the task and not to become distracted. A padded mat allowed participants to sit in front of the computer without getting too cold or uncomfortable. A chair was used to place the computer on, so that the screen was at eye level. A diagrammatic representation is shown as follows:

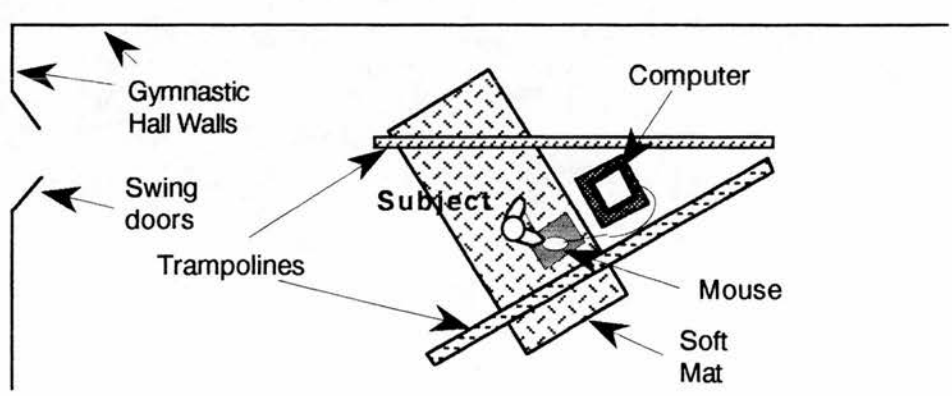


Figure 10.1: Diagrammatic representation of the 'mini-lab' which was used to run the PK game

Micro-PK game "Jessie": The game tried to simulate a fictitious girl gymnast "Jessie" vaulting over a 'horse' (a piece of gymnastic apparatus). There were seven stages at which the program required an RNG to complete the animation. Six of these closely correspond to real decision points in the actual physical movement. They are: running towards the horse 1 (fast/slow), running towards the horse 2 (fast/slow), jumping onto the springboard (low/high), jumping off the springboard (low/high), leaving the horse (high/flat) and the amount of rotation (on her back/ with a step back/ perfect landing/ with a step forward/ on her face).The figure below shows various clips from the animation. The end of the animation shows three possible outcomes: Jessie lands on her back ①, lands on her feet ②, or she falls on her face ③.

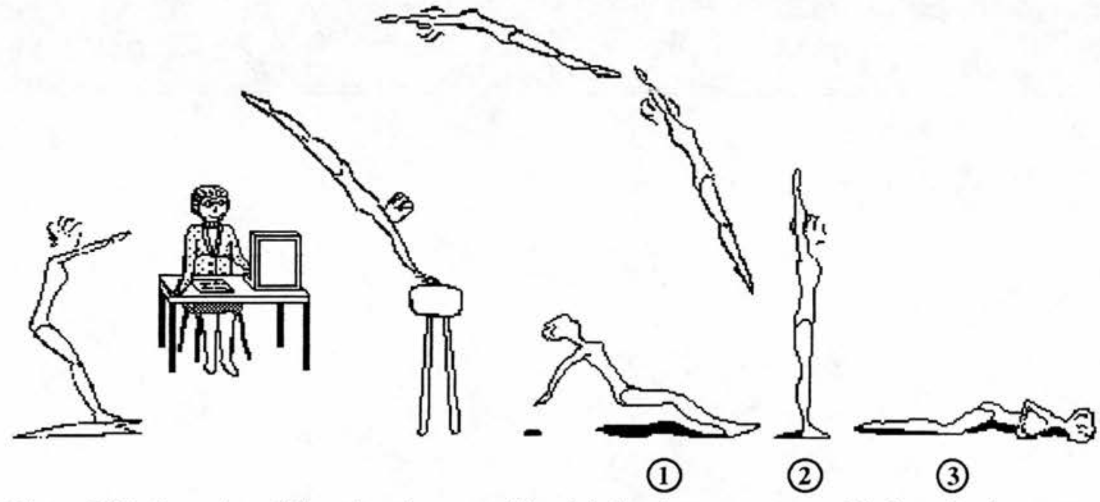


Figure 10.2: Out takes of the animation game "Jessie" showing a sequence with three final outcomes ①, ② or ③.

The choices were independent of each other. There was in addition feedback given for the whole of the vault by a score given as a judge would score the vault. The scoring was worked out using FINA regulations (this is the international body that works out the scoring system for Olympic and world championships). The final score was also upped or downed by 0.05 points or remained the same, randomly to simulate judging subjectivity.

The program was developed in conjunction with Maggie Bisset, the coach, which allowed an experts eye to tweak the animation to make the simulation as realistic as possible in terms of flight, angles of take off and speed of rotation. The random adding or subtracting to the 'judge's' score, was not added until the last two data gathering sessions. For the gymnast it did not alter the display in any way that they would see whilst playing the game. Each participant tried to influence ten vaults which meant that for each session 60 (6 x 10) ostensible RNG decisions were to be modified (the final RNG which altered the final score by 0.05 was not used in the final analysis). Results were stored automatically to both the hard disc and a floppy disc. On line help was built into the program to help the participant to enter their name and the vault category (there was a choice of doing a handspring, squat through or a tsukuhara) that they were going to see. No keyboard was present and the whole program was initiated and driven by a 'mouse'. Most of the participants had worked with computers either at home or at school. None of the participants expressed a fear or concern to work with a computer. However, only one of the participants had any experience with a Macintosh computer, and she claimed not to have had any experience of the programs used in the game construction. Hence, despite participants familiarity and ease of working with computers, it was exceedingly unlikely that any of them would be able to alter the program or modify the results without my knowing it (the only feasible way for any of the participants to break out of the program would be to deliberately crash the computer in which case I would become aware of the event).

Participants:

Twenty two female participants from the ages of 8 to 16 years old were recruited from the Meadowbank Ladies Olympic Gymnastic Club. They were all at the time involved in another experiment to assess the role of imagery training for MR (see previous section). Their ability ranged from almost novice to junior international standard.

Methodology

The equipment was set up at the beginning of the session in a way that was as consistent from session to session as I could make it. Participants were matched for gymnastic ability but otherwise randomly split into the two groups (experimental and placebo/control). The treatment procedure over the 10 week period was a **multiple baseline** method was employed whereby both groups received the imagery training and differed only in their time of starting the training. This was done for ethical reasons in that every participant would receive the training that was believed to be beneficial. This procedure would ensure that those participants in the control condition would not feel that the experiment had been a waste of time for them, once they found out the experimental design. The general multiple baseline design is shown in the table below.

	1st half of training	2nd half of training
Experimental	Imagery training	Imagery training
Control	Placebo training	Imagery training

Table 10.1: The design of the multiple base line experiment

During the sessions when the PK game data was being collected, the gymnasts took time out of their normal training routine to play the game. They were instructed to put on extra clothing to stay warm and therefore reduce the risk of injury when recommencing with their normal physical training after a period of inactivity doing this experiment. For the first session I sat for a while with the gymnasts to explain what the program was about and to help them set up the program correctly and run it properly. Thereafter I left them to finish their session in their own time. For the remaining 5 sessions they were able to proceed on their own with the set up and running of the program although I was on hand to answer any queries they might have had whilst playing it. For the final session I had to recruit Sheila Matthew, a friend, to become the experimenter as I was concurrently running the mental rehearsal study (ie the two studies overlapped on this last occasion). This should not have unduly influenced the participants as they already knew how to set the program up and run it for themselves. Sheila's task was more to oversee the equipment and ensure that all the participants had their go on the game during the course of the session.

In terms of actually trying to alter the performance of the pseudo RNG, I explained to the gymnast to just try and will the girl on the screen to do the correct movements. Initially the instructions as to what mental strategy they might use, were deliberately left as vague as possible in order not to bias their preconceptions about how they might try to exert their 'will'. In the latter half of the experiment all the participants were asked to use their imagery as they would do in their real athletic performance (ie using imagery in a MR paradigm).

Scoring

The scoring used for the statistical analysis was different from that used in the feedback actually given in the game (ie the scoring was not FINA regulations scoring). If the animation showing a better movement was played at any particular step (eg "Jessie" landed straight on her feet) a single point was scored. Any one trial had six steps in it, the maximum that a participant could score therefore on one trial, was six points.

Design

Analyses could be conducted between two, matched for gymnastic ability, sample groups. The experimental group received imagery training right throughout the experiment, the control group received a bogus training protocol (where they believed that they had received subliminal suggestions) for the first half of the experiment, but for the last half they too received imagery training. For group testing, matched unpaired t-test were to be calculated. Effect sizes (Cohen's d) were also calculated.

The hypotheses were as follows:

① The group that received more imagery training would score significantly higher than the group receiving less imagery training.

② Participants with higher self rated visual imagery at the start of the experiment, would achieve higher PK scores.

③ A positive correlation would exist between the difference of imagery ability over the training period and the change in PK scores over the same period.

④ A positive correlation would be found between the PK scores and the frequency of use of the imagery exercises.

Results

The PK scores were averaged across the last four sessions that the game was played. The first session was not included in the analysis because there were only half the number of participants that contributed their scores, in this session. All p values shown are one tailed.

An unpaired t-test between the two groups just failed to reach significance at the $p=0.05$ level in the predicted direction ($t=1.621$, $df=20$, $p=0.06$) , that is the imagery group scored higher than the 'subliminal group. The effect size (Cohen's d) between the two groups was 0.68. Hypothesis ① is supported and just failed to reach significance.

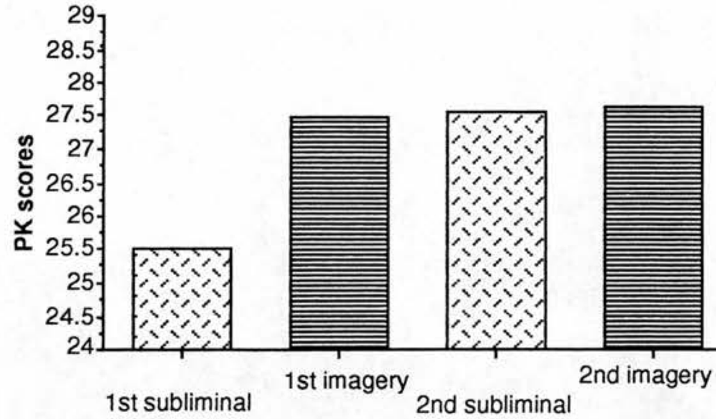
Mean chance expectation (MCE) for the game score was 27 (ie the sum of the trials in one session). A participant's game score was averaged over all the sessions. A one group t-test of the PK scores of both groups compared to the MCE was not significant (t = 0.726, df=21,p=0.24). The average was higher than the MCE which was predicted; the effect size (Cohen's d) was 0.18. The subliminal groups mean score was below MCE but not significant (t=–0.634, df=8, p=0.27), whilst the imagery groups mean score was above MCE and significantly so (t=1.931 df=12, p=0.03).

Correlations between the MIQ (including its sub-scales) and the PK scores were computed for the MIQ taken at the beginning of the training experiment and at the end. All correlations were in the correct direction although only the visual sub-scale in the first MIQ was close to significance (N=20, r=0.37). Hypothesis ② is supported but not significantly. A table of the correlations is given below.

Imagery Measure	Correlation
1st MIQ total	0.15
1st Visual sub-scale of MIQ	0.37
1st kinesthetic scale of MIQ	0.02
2nd MIQ total	0.06
2nd Visual sub-scale of MIQ	0.19
2nd kinesthetic scale of MIQ	0.007

Table 10.2: Showing the correlations between participants imagery ability and their PK scores.

A paired t-test between the last two sessions mean game scores and the mean game scores of sessions 2 and 3, was not significant but in the predicted direction (t= 1.304, df =18, p=0.10). That is, the PK scores towards the end of the training were higher than at the beginning. However, a *post hoc* look at this change between the groups, shows that the change is larger for the subliminal group than the imagery group. The graph below illustrates that it looks as if the the main change is from the PK scores of the subliminal group in the first sessions to the second sessions. The magnitude of the PK scores of the subliminal group appears to have caught up with the imagery group, the latter whose scores have remained relatively stable.



Graph 10.1: Showing the change of PK scores over time for the subliminal and the imagery groups. For the first half of the experiment neither group has been asked to use any particular strategy. In the last half, all participants were asked to use imagery. MCE for this set of results is 27.

Correlation between the change in self rated imagery and in the change of PK scores were all not significant and was largest for the change in kinesthetic imagery. Hypothesis ③ is supported but not significantly so. The correlations are outlined below (N=12).

Imagery Measure	Correlation
Change in overall MIQ score	0.13
Change in visual imagery	0.04
Change in kinesthetic imagery	0.20

Table 10.3: The correlations between the change in imagery ability over the training period and participants PK scores.

The correlations between mean PK game scores and frequency of homework exercise use (from their diaries) showed a significant correlation in the predicted direction ($r=0.63$, $N=15$, $p<0.01$). The diary recorded the frequency of homework exercises done regardless of the type of exercise done (imagery or 'subliminal'). A correlation was also calculated that recorded the use of exercises that were specific to imagery. It was marginally higher and also significant ($r=0.64$, $N=15$, $p<0.005$) than the overall correlation. Hypothesis ④ is significantly supported. The correlation was also computed *post hoc* on pre- to post- training improvement in PK scores and the use of the diaries. It was significant for the overall use of the exercises ($r=0.55$, $N=14$, $p<0.025$) but not so for the imagery specific exercise, although it was still positive ($r=0.31$, $df=14$). The results would therefore suggest that the main contribution from the homework exercises with regard to increasing PK ability may not necessarily be solely from learning imagery specific exercises. Instead it may also relate to some unmeasured variable such as motivation.

Discussion

The results of the experiment seem to support the results that Morris (1980) and Kreiman (1980) obtained, that is that an imagery strategy seems to give a better PK score than a non imagery strategy. However, it is important to note that this assertion was not tested directly, rather the participants with the highest imagery training appeared to do better than the participants who ultimately had less training. The instructions to the participants was left vague, although they were all told that they should use an imagery strategy in the last two sessions of the PK game. There was some non-significant indication that the PK scores increased over time, however this change was not correlated with a change in imagery ability which is what was predicted. There was some non-significant correlations that were positive for the change in imagery ability and the change in PK scores. However, this was largest for the kinesthetic scale and not for the visual scale. The correlations between the PK scores and the imagery questionnaire (and its sub-scales) were all in the predicted direction although the main correlation seems to be with the visual sub-scale. This would suggest that a visual imagery may be more beneficial in using an imagery strategy. Despite this it does not seem that changing a participant's visual imagery ability has an effect on being able to change their PK scores. One possible reason for this rather discrepant result is that despite the results, the participant's real imagery ability did not change that much over the course of the training and that the reasons for the results of the change were because the participants were responding to the demand characteristics of the experiment. One might postulate that the training either did not or cannot change that part of the imagery mental strategy that has an effect on PK performance.

More surprisingly however is that when the change for each group is compared, it appears (not significantly) that the subliminal group actually increased their PK scores more than the imagery group (see graph 10.1). This might suggest that a real PK training effect is not due to an increase in imagery ability, rather what we see in the data is the transition of the subliminal group from not using imagery as a mental strategy, in the first sessions, to one where they do use it. One would postulate that the imagery group must, without prompting from me, have used an imagery strategy, which is possible if they were primed to use imagery due to their imagery training. However, if this is the real explanation then it would be difficult to explain the high correlation between the frequency of doing the homework exercises and the PK scores. The latter replicates the results of both George (1982) and Braud (1982). However, the correlation for the imagery specific imagery exercises is not that much higher than the exercises that included the subliminal suggestion exercises. Whilst realising that caution should be exercised for such a low powered test, it could be that the correlations indicate general motivation or enthusiasm for developing a mental skill is an important indicator of PK success.

PK-RNG Juggling

Introduction

Following on from the gymnastic study it seemed appropriate to try and replicate the PK results in using the participants from the studies that were reported in the previous section to teach juggling skills to novice jugglers. Unlike the gymnastic study, the participants were split into three groups — one imagery group and two controls. One of the latter two groups was told that they were receiving subliminal perception instructions to help their performance. The other was told that they were not receiving any mental training but were asked to pretend 'as if' they had received some (in other words to deliberately try and be as motivated as possible). This was done due to the design of the juggling improvement experiment that they took part in at the same time as this PK experiment (see previous section). However, for the PK analysis the imagery group would still be compared to the other two groups whose data would be combined (this was done to increase the statistical power of the experiment). Also unlike the gymnastic study, the whole experiment took place in one session and not spaced over several weeks. Only one questionnaire was taken at the beginning of the experiment and none was taken at the end. A new PK game was built to simulate the task that they were trying to do in their actual juggling task — namely to juggle for as long as possible.

Participants

Twenty two participants of both sexes took part in the PK experiment, recruited from undergraduate lectures from a variety of academic subjects.

Materials

Four Apple™ Macintosh SE computers that belonged to the psychology department with 1MB of RAM. The program ran off two floppy discs.

The game constructed was of a cartoon character called "Jeffrey", who was trying to juggle three balls in a cascade fashion for as long as possible. There were basically two animation segments: one where Jeffrey would juggle successfully, and one where he would drop all the balls and shrug his shoulders with a wry grin. An extract from the animation is shown below.

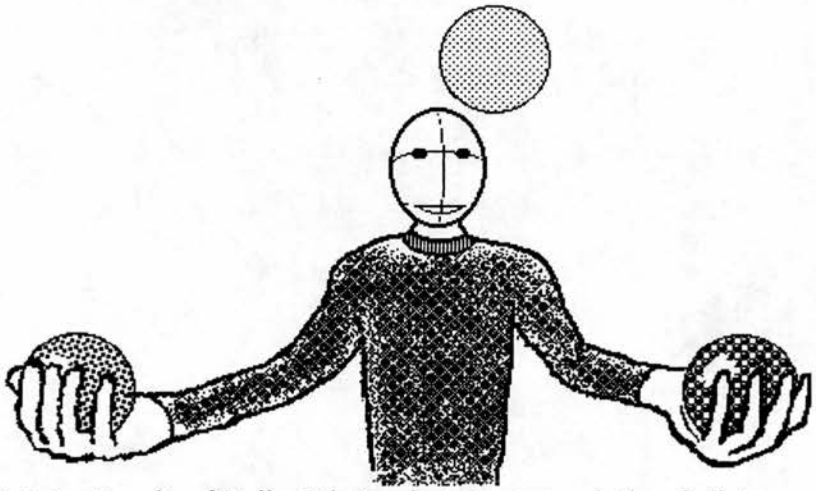


Figure 10.3: Animation clip of "Jeffrey" the juggler trying to juggle three balls in a cascade fashion.

In order to make the task more than just a binary task that would become frustrating since half the time the number of possible juggles would only be one, the probabilities of either continuing or dropping were altered by the program as the trial proceeded. The probability of dropping the ball on the first trial was only 0.05, for the next trial it was 0.10, then 0.15 etc. Thus Jeffrey eventually had to drop the balls by the 20th cycle. Mean chance expectation (MCE) was 5.29 'juggles'.The task for the experimental participants was to associate with Jeffrey and try to 'will' Jeffrey to keep juggling for as long as possible. Each participant had ten attempts to keep him juggling for as long as possible.

Procedure

Participants had just finished doing another study to learn how to juggle themselves in a cascade fashion (see previous section). This had taken them almost 1 ¾ of an hour. The testing for this experiment took part in the psychology department's Macintosh computer room, which was adjacent to where the participants had just been conducting the juggling study. The layout of the room and the computers is shown below.

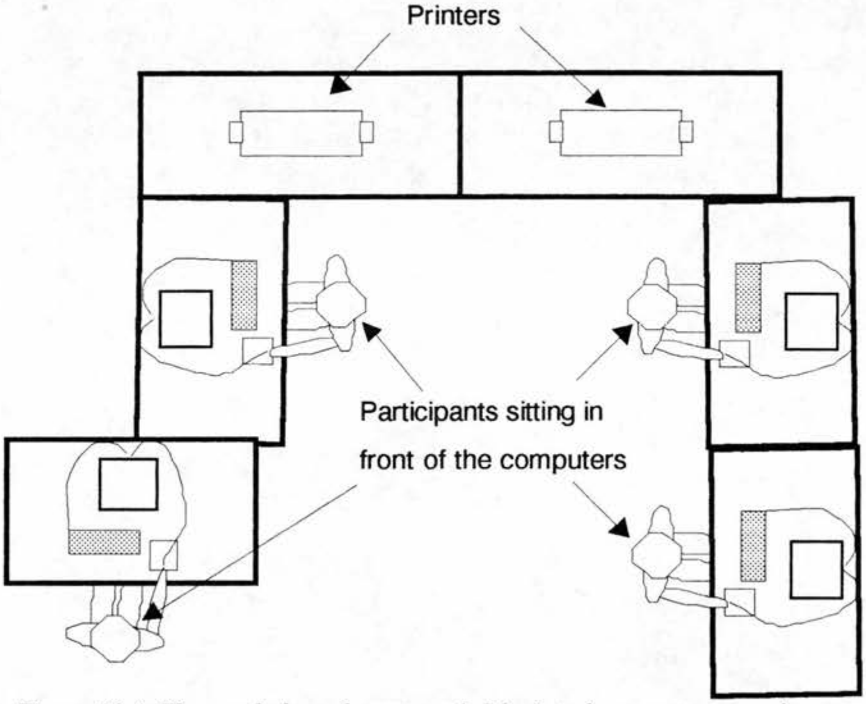


Figure 10.4: The psychology department's Macintosh computer room layout.

All participants were given a demonstration *en masse* of the PK game showing how to start the game and enter in their name. Since there were only four computers, that could be used at any one time, the rest of the participants practised their new juggling skills and received individual tuition from any of the experimenters from the previous sports experiment (all of whom were proficient cascade jugglers). Participants were asked to use the special mental techniques that they had been using to help their real juggling skills (ie the mental techniques they used in the previous experiment - see last section). When every one had finished playing the computer game, all the participants were given a debriefing as to the nature of the experiment and the hypotheses being tested. After the results were analysed the subjects were given a brief written description of the experiment and the results (about 3 weeks after the experiment was finished).

Scoring

The number of times that "Jeffrey" juggled, was automatically recorded on floppy disk and used as the PK score. The longer Jeffrey juggled the more positive a PK score was seen to be. Don McCarthy a parapsychologist and mathematician (at St. Johns University) had worded out the probability distribution for this method of scoring so that mean chance expectation could be calculated (see appendix v).

Design

The data from the 'subliminal' and the 'as if' groups were combined into one large control group for statistical power considerations. Subsequent analyses were between the imagery group and the control group. The hypotheses for the experiment were as follows:

① The imagery group would score more positively than the control group.

② Correlations of the MIQ and its sub-scales with the PK scores would be positive. The correlation would be largest for the visual sub-scale.

③ The results of all the participants would be higher than MCE.

Results

An unpaired t-test between the experimental and the control group, was not significant but in the predicted direction (t=0.184, df= 20, p=0.43). The imagery group scoring higher than the control group. The effect size between the groups was small (d=0.08). Hypothesis ① is supported but not significantly.

The Spearman rank correlation between the PK scores and the MIQ scores were not significant but in the predicted direction. However, the visual sub-scale was very small (r=0.02, n=22, p>0.05), in contrast the kinesthetic sub-scale was considerable larger and significant (r=0.40, n=22, p<0.05). There is only partial significant support for hypothesis ②.

A one group t-test of the average PK game scores of all the participants compared to MCE, was also not significant and in the wrong direction (t= –0.586,df=21, p=0.28). That is overall the scores were below MCE, the effect size (d) was –0.12. Hypothesis ③ is not supported.

Discussion

The difference of the PK scores between the imagery group and the control group although small and not significant, was in the expected direction. The direction backs up the assertion that an imagery strategy appears to give higher performance than either of the strategies used in this experiment ('subliminal' or 'as if') for a micro-PK task. One might state that the scores of the control group show a higher PK effect because they are further away from MCE than the imagery group, albeit in the wrong direction (ie the score was more negative). However, since the task was to keep 'Jeffrey' juggling for as long as possible, I conceptually perceive the more positive (or less negative) score to be the higher PK score. Palmer (1975) has dealt extensively with this problem and suggests that we should be wary of conducting research that makes assumptions based on whatever suits the results best. He proposed three models that researchers adopt when interpreting their psi results. The first postulates that psi is any deviation away from MCE either in the intended or non-intended direction. The second is that anything above an absolute zero value is in the intended direction (even if it is below MCE) and that results such as the one outlined in the above experiment (where both groups are below MCE, but the difference between the groups is in the predicted direction), should be used to elucidate relationships in process oriented research. Strictly the second model, Palmer explains, has no place for MCE. The third model tries to combine the benefit of both worlds by stating that there are two factors operating. The first sets the overall scoring rate to be above, at or below MCE. What this factor is, is unknown but maybe due to the environmental setting, or the interpersonal atmosphere of the experimental setting it makes the environment either psi positive or negative. Other factors can operates on top of this overall environmental psi influence. In this case one would postulate that the use of imagery is one such factor. One might say that the imagery group showed more 'successful' psi in an overall low psi environment. Why this environment should be 'low' is not known, however, unlike the gymnastic study the testing was conducted in the department's computer laboratory. There were four participants being tested at any one time. The testing did not occur at the same rate so that there was a certain degree of movement from the other participants as one would finish and another would take her/his place. In addition there was a slight 'confrontation' with two members of staff who despite booking and posting notices outside the room well ahead of the experiment, insisted on using the computers for their work. I asked them politely if they could postpone their work until later, which they duly did but not too willingly and with a small verbal protest. It cannot have escaped the attention of those that were present (especially those waiting to get onto the computer) that this had occurred and may have distracted them from their task. Unfortunately, I did not make a note of which participants were present during this incident so that I could not conclude whether these participants had particularly low scores. There is little that I could have done to avoid this sort of thing happening as the computer room is the department's common resource and I had taken all the necessary steps to try and keep the room free for the testing period.

The correlation between the PK scores and the MIQ sub-scales, was in the predicted direction for the kinesthetic sub-scale. This was also the case for the visual sub-scale, but for all intents and purposes was so small as to be negligible. The implication of this result is that there may have been a tendency to use a strategy incorporating kinesthetic components in their mental effort to affect the display. Of course without further investigation this is a very tenuous link as we have no guarantee that the subjects were using any systematic (eg kinesthetic imagery) type of mental strategy. In the previous literature, Honorton &Barksdale (1972) found positive results for an RNG task when using muscular tension - but only when the testing was done in a group. The psychoneuromuscular theory of imagery is that imagery can lead to tiny muscular innervations (Jacobsen 1931), this effect is greater when using an internal image (Hale 1981). My own athletes have told me that they find it very difficult to take an internal image without using kinesthetic imagery and visa versa. This suggests that if a subject uses kinesthetic/internal imagery they are more muscularly tense than someone taking an external image.

PK-RNG Juggling 2

Introduction

A second juggling study was undertaken and the same PK task was used to try and replicate the findings of the first experiment. That is the imagery group compared to the control group would show higher game scores (regardless of the deviation away from MCE). It was still hypothesised that the overall deviation away from MCE would be in the positive direction (ie higher). The correlations of PK performance would show a positive relationship with the kinesthetic sub-scale of the MIQ and to a lesser extent with the visual sub-scale of the MIQ.

Participants

Twenty six participants, were recruited from undergraduate lectures, from a variety of academic subjects, for both this study and another study that looked at learning rates of juggling (see previous section). Their only requirement was that they could not already juggle.

Materials

The same materials were used as in the previous experiment.

Procedure

The procedure was exactly the same as the first juggling PK experiment. Except that the experimenter, Anthony Taylor, was replaced by Chris Roe.

Scoring

The scoring for this game was exactly the same as in the first juggling PK experiment.

Design

Again to increase the statistical power of the experiment, the scores of the ***subliminal*** and the 'as if' groups were combined into one control group. These were compared with the imagery group. The hypotheses were the same as the first experiment:

① The imagery group would score more positively than the control group.

② Correlations of the MIQ and its sub-scales with the PK scores would be positive. The correlation would be largest for the visual sub-scale.

③ The results of all the participants would be higher than MCE.

Results

An unpaired t-test between the experimental and the control group, was again not significant but in the expected direction ($t=0.374$, $df=19$, $p=0.36$). That is the imagery scored more positively than the control group, the effect size (Cohen's d) was 0.16. Hypothesis ① is supported but not significantly.

The correlations were not all in the predicted direction. The kinesthetic scale was small but in the wrong direction ($r=-0.09$, $n=26$, $p>0.05$). The visual sub-scale was significantly in the predicted direction ($r=0.39$, $n=25$, $p<0.05$). There was only partial significant support for hypothesis ②.

A one group t-test of the average data of all participants compared to MCE, was almost significant and in the predicted direction ($t=1.471$, $df=24$, $p=0.08$). That is the overall mean was above MCE, the effect size was (d) 0.29. Hypothesis ③ was supported almost to a significant degree.

Discussion

The results between the control group and the imagery group in terms of the number of times that 'Jeffrey;' juggled, replicated (albeit not significantly) the results of both the vault study and the first juggling study. That is it appears that an imagery strategy is better than either the ***subliminal*** or the 'as if' strategy. Furthermore the combined results were almost significantly above MCE. Both groups scored above MCE although none of them independently so. It would seem that the the overall environment was more psi conducive than the previous experiment. Again though a member of staff insisted on using the one of the computers. I did not on this occasion make such a 'song and dance' about it, instead I just asked that if it was convenient could they come back after the experiment. The member of staff left after about 15 minutes. Again all precautions were taken to ensure that the room would be free to use for the experiment. It may have been that the encounter this time was not so 'charged' as the last one and that this may have prevented an overall psi missing environment (overall below MCE scoring) from occurring.

The correlations do not replicate the first juggling experiment but the visual sub-scale was significantly in the predicted direction, and replicates the correlation of the vaulting study. Quite why the correlations should be almost exactly opposite to the first juggling study, is not clear. The participants were not overtly different from the participants of the first experiment. They were recruited in an almost identical manner as the first experiment. Also the change of one of the experimenters did not 'feel' as if there were a different 'atmosphere' to the experiment.

Combining the Juggle studies

Looking at the combined studies is problematical for several reasons. For the differences between the groups the overall means for each experiment were below MCE for the first experiment and above MCE for the second experiment. However, both studies show a consistent relationship between the imagery group and the control group. The effect size for the second experiment is almost twice that of the first experiment. The table below summarizes the mean game scores for both experiments for the imagery and the control conditions in each (the number of subjects is in brackets and MCE = 5.29).

	1st expt.	2nd expt.	totals:
imagery	5.22 (10)	5.61 (9)	5.41 (19)
control	5.15 (12)	5.48 (17)	5.35 (29)
totals:	5.18 (22)	5.53 (26)	5.37 (48)

Table 10.4: Total PK scores of both juggling experiments.

In order to try and show an experimental effect a 2 factor ANOVA was computed for the results with experimental condition as one factor and the experiment as another. It was hoped that the experimental factor would come out as significant, however this was not the case ($F=0.152$, $p=0.70$).

PK-RNG Shooting: the effect of imagery training

Introduction

Another experiment was conducted with the University's Alumni small bore shooting club to explore training their imagery ability for use in mental rehearsal. The club is of a very high standard with many of the team shooting in national and international meetings. A PK study was planned to run immediately after the sports improvement study (see previous section), and before they received any feedback for the sports improvement study. Unlike the vaulting study, the PK game could not be conducted synonomously with the actual sports improvement study because of the timetable restrictions with the booking of the room where the PK study was conducted. The use of other rooms was considered but deemed inpractical in terms of the logistics and cost of getting the shooters to the computer. Again, as in the gymnastic study, half of the experimental participants would be have had approximately twice as much imagery training as the control group. A new PK game was constructed to be meaningful for shooters.

Participants

Twelve participants were recruited from the University's Alumni club, although one dropped out for reasons unrelated to this study. The ability level ranged from national to international standard.

Materials

The Movement Imagery Questionnaire (MIQ).

Apple™ Macintosh SE, 2.5 MB RAM (upgraded from 1 MB RAM), and a 40 MB Formac™ hard disc.

An Aries™ spike protector extension cable.

The game was constructed with the following elements. At the start of the game the shooters had to influence a fictitious shooter shooting in the computer environment's 'shooting range', to lower their breathing and heart rate. This was depicted by trying to get two column indicators representing the breathing and heart rate, to fall below a highlighted threshold, the rate of falling was determined by a RNG. The intention, as in real life for shooters, was to make the rate fall as quickly as possible. The game would not proceed until this had been achieved. In the game proper, the participants pressed the mouse to indicate that they were ready to 'fire' a shot. A picture of a trigger and trigger finger could either 'squeeze' or 'snatch' the trigger. Their goal, as in real life, was to try and show the trigger being squeezed. They would subsequently see the tail end of a bullet spinning towards a target. It would 'wobble' towards the target to finally hit it and the participant would be given the score that they got on that 'shot'. The participants goal was to try and get a good final score. Theoretically they could achieve this through a variety of methods, either by having the shot make large deviations away from the centre only to return towards the centre before it hit the target, or to have little deviation away from the centre during the course of the bullets 'flight' (ie it made not difference to the final score). After the score for that shot was given the scene would change back to the trigger and trigger finger for a further seven 'shots' (ie eight in total per session). The view of the target and the rear of the bullet is shown below.

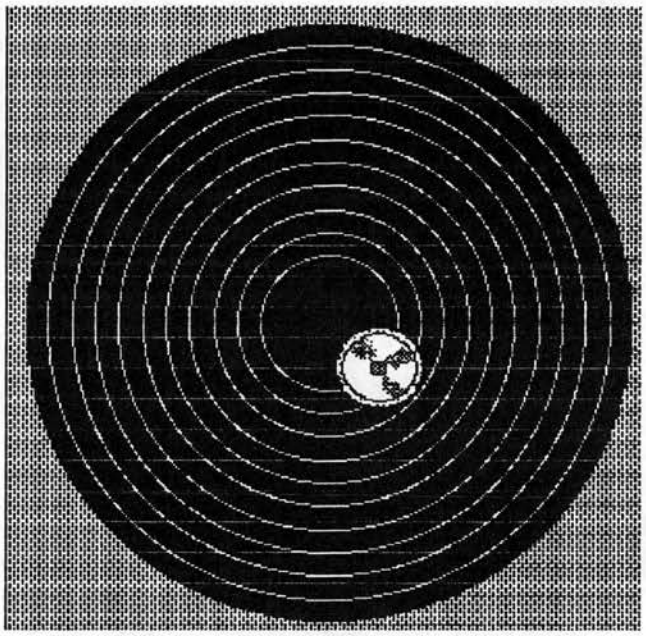


Figure 10.5: The scene that the shooters would see. The tail end of the bullet can be seen (straddling the bullseye) which in the animation would be spinning.

Procedure

The MIQ was handed out before the session for the participants to fill out in their own time at home sometime before the experiment started and before they received their imagery training. The MIQ was also handed out a second time after their imagery training but before the PK experiment. They were not all returned however, before the PK experiment started.

At the start of a PK session a 'mini-lab' would be set up in a conference room in the University's sports complex. The room was quiet but for muffled thumping and banging from a basketball club playing directly above the room. None of the participants complained or commented that this disturbed them. The computer was set up in a corner of the room the overhead light for the half which had the computer set up was left off. The curtain was drawn across the room's window (it was always dark at the time of testing). The aim was to make the setting as comfortable as possible. The setup is represented diagrammatically below.

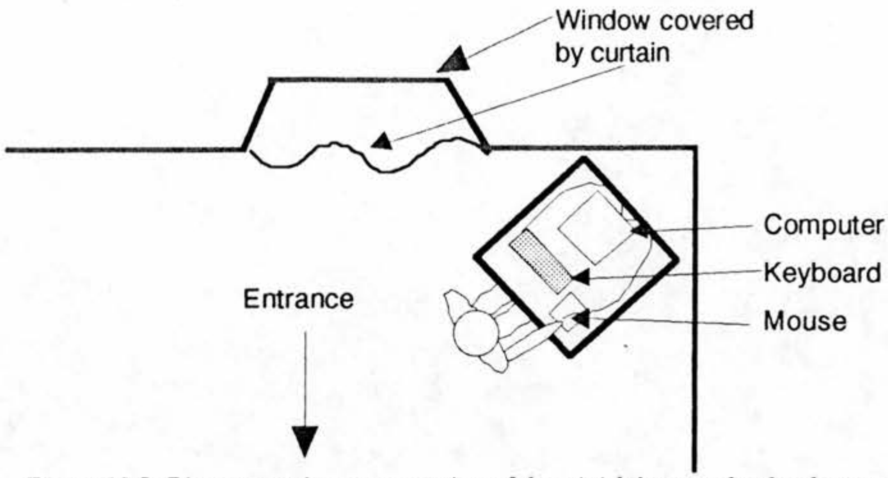


Figure 10.5: Diagrammatic representation of the mini-lab set up for the shooters.

I decided to run everyone on the game for three sessions. It was felt the game was quite complex to understand and judging by the previous games there was a danger that the participants might not understand exactly what I was asking them to do. To try and obviate this problem all of the participants played a simple PK game before they attempted to use the shooting PK game. The simple game was the computer equivalent of the apparatus described by Pacer, Morris & Phillips (1977), which was a display of a circle of lamps, one of which would light up in a random walk around the circle. Anecdotally, I think that this strategy paid off because, despite my trying to tell the participants what it was they were trying to do, many (about half) did not fully appreciate the task until they realised that they could not play the game using physical means such as manipulating the keyboard or mouse.

The following sessions after their introduction to micro-PK tasks, saw them play the PK shooting game proper. For their first shooting PK game I would sit in and show them how to start up the game and give them a brief introduction of what to expect in it. I then left them alone to play the game. In the following sessions they would start up and play the game by themselves. Not everyone managed to play their game in the same weeks as most of the other participants. Thus the testing period lasted over five sessions whilst those that could not attend the initial sessions, played their final games.

Scoring

Not all the participants due to other commitments (ie not related to dissatisfaction of the experiment) managed to play three games. It was decided before the analysis to only take data from the participants that played at least two games. The method of calculating the PK score was as follows: the number of steps that it took for the breathing and heart meters to fall below the threshold level was summed and added to the horizontal and vertical units away from the centre of the target. The smaller the final number, the higher the PK score. A lower final number meant that they had made the computer's depiction of heart and breathing rates fall quicker, and the computer's target scores were closer to the centre.

Design

The hypotheses were as follows:

① The imagery group would score more positively than the control group.

② Correlations of the MIQ and its sub-scales with the PK scores would be positive. The correlation would be largest for the visual sub-scale.

③ Changes in MIQ ability would correlate with higher PK game scores.

Results

An unpaired t-test between the imagery and the 'subliminal' group was not significant but revealed that the imagery group scored in the predicted direction (t=0.122, df=8, p=0.45), the effect size was 0.08. Hypothesis ① is supported but not significantly. The magnitude is small and similar to that of the first juggling study.

The correlations were not significant but in the wrong direction for the first MIQ but in the correct direction for the second MIQ (visual sub-scale, r=0.36, n=8, p>0.05; kinesthetic sub-scale, r=0.34, n=8, p>0.05). Hypothesis ② shows support only in the second MIQ scores and not to a significant degree. A table of the correlations is shown below.

Imagery Measure	Correlation
1st MIQ total (n=10)	–0.28
1st Visual sub-scale of MIQ	–0.46
1st kinesthetic scale of MIQ	–0.11
2nd MIQ total (n=9)	0.47
2nd Visual sub-scale of MIQ	0.36
2nd kinesthetic scale of MIQ	0.34

Table 10.5: The correlations between participant's imagery ability and mean PK score.

The change in direction over time is a reversal of the pattern seen in the gymnastic study, it is however what we would predict for the learning hypothesis (although we would not predict the initial negative correlations).

The change in self rated imagery and its sub-scales over the training time and the mean game score were in the right direction and for the total change in the MIQ and for the visual sub-scale significantly so (r=0.69, n=9, p<0.05 and r=0.65, n=8, p<0.05 respectively). Hypothesis ③ is significantly supported. The correlations are mapped out in the table below.

Imagery Measure	Correlation
Total MIQ change	0.69
Visual sub-scale change	0.65
Kinesthetic scale change	0.58

Table 10.6: Correlations between the change in imagery ability and participant's PK scores.

Unlike the gymnastic study, no PK game was played before or near the beginning of the imagery training so that no correlation could be calculated between the change in PK game scores and the change in imagery ability.

Discussion

The difference between the imagery and the control group was once again in the predicted direction, although the effect (0.08) was not nearly so large as the first training study with the gymnasts (0.68). One obvious reason as to why the effect size should be so different from this study is terms of the power of the experiment making the effect size estimation unreliable. In this final analysis there were only ten participants compared to twenty two in the gymnastic study. Previous experience had shown that it was better to recruit small numbers of committed participants than larger numbers that perhaps could not spare the time or effort to take part in the experiment. Another crucial difference between the two experiments was in the timing of when the imagery training took place and when the PK game was played. In the gymnastic training study for the early PK sessions none of the gymnasts were told to use any particular strategy. Only after the subliminal group were also asked to change to their imagery training regime, did I ask all participants to use an imagery strategy. In contrast the change to imagery training for the subliminal group had already occurred by the time that the shooters starting playing the PK game. Thus I asked all the shooters to use an imagery strategy for all the games they played. The situation is more analogous to the second half of the vault PK game (see graph 10.1) when both imagery and subliminal group were all using imagery. The results in this second half of the vault study showed only a very small difference between the imagery and subliminal group. It looks as if this experiment replicated the situation of the last part of the vault PK study. This lends further support to the assertion that I made in the discussion of the gymnastic training study, that the imagery training did not really increase the PK ability of the athletes by a significant amount. Instead it is the use of an imagery strategy itself that seems to contribute the largest PK effect to these sets of studies.

The correlations did not replicate those of the gymnastic study but were in the predicted direction. Although the correlations are not significant, they are quite large and perhaps do not show significance because of the low number of participants in the study. Particularly noteworthy is the large correlations of the PK score with the change in imagery ability over time, which replicates a similar finding by Braud (1982).

Exploring other facets of micro-PK games

Introduction

As a follow up to the first PK game with the gymnasts, it was decided to run another experiment with the same gymnasts using their now trained up imagery skills. Its purpose would be to explore several facets of micro-PK games which might either show a differential effect (imagery perspective) or increase the PK effect (a majority vote technique) or correlate with a psychological state (absorption). These facets are explored in more detail below.

Imagery perspective and micro-PK performance

In some of the previous experiments (the gymnastic game and the second juggling study) there was some support for visual imagery being positively correlated with the PK scores of the previous games. In the previous section dealing with sports improvement, I argued that there is some ground to equate the visual sub-scale of the MIQ with external imagery and the kinesthetic sub-scale with internal imagery. The visual display that the participants see on the vault game is external in nature. According to Braud (1981, personal communication 1989) using an imagery strategy will be most effective on a labile system when the image corresponds to the desired state of the system. In this case the system is coupled to a visual display which is external in nature, hence an external perspective may achieve higher PK game scores than an internal one.

Majority vote techniques

The use of majority vote techniques to increase the signal to noise ratio was discussed in Chapter 1 of this section. The program was modified internally to try and replicate the findings of Puthoff, May & Thompson (1985) and of Radin (1989) using the 'sequential sampling' in order to increase the signal to noise ratio. To the gymnast the program did not appear any different apart from a slight delay when the program was making a decision of which animation to play.

Absorption

Absorption may be a state variable that correlates with the ability to generate psi data (Irwin 1985, 1989, Nadon & Kihlstrom 1987). The commonly used absorption scale is that of Tellegen & Atkinson (1974) which is a questionnaire measuring a person's absorption trait. The literature tying parapsychological experiences with absorption suggest that a person is actually in an absorbed state whilst the parapsychological experience is happening. I therefore specifically wanted to asses the correlation of a person's state of absorption with their PK scores. Following the adage that "time flies when you are enjoying yourself", I reasoned that if a person is absorbed in a task then the subjective measure of time passage will be an underestimate of the actual time passage (time 'flies'). In contrast, someone who is not absorbed will overestimate the passage of time compared to the real time (time 'drags by' for these people). Work by St. Jean & MacLeod (1983) supports this notion. They asked subjects to rate how long an interesting and a relatively boring passage of text took to listen to; the former was underestimated in time whilst the later was overestimated. St Jean &

Robertson (1986) claim not to have replicated this effect in a further experiment. However, a close look at their protocol makes this interpretation dubious. Subjects in two conditions were asked to listen to the same passage. In one condition they were told to listen to the passage in a relaxed state, in the other they were asked to try and remember how many sentences there were or how many times the name "Charles" was mentioned in the passage. They claimed that the first relaxed condition was the absorbed condition and the latter condition they argued was an 'active attentional set' condition. I would argue that the concrete task of the 'active attentional set' is likely to produce a more absorbed state than the relaxed condition. This, I reason, is because the subjects will have to devote much of their attentional resources to complete the task. Complete attention to some object or task is a function of absorption (Tellegen & Atkinson 1974). Thus I would argue that the results of St. Jean and Robertson (1986) actually does successfully replicate the earlier work by St. Jean & MacLeod (1983). That is people in an absorbed state will underestimate the passage of time.

To gain a state measure of absorption I asked the gymnasts to estimate how long they took to complete the game. A timer in the computer logged how much time they actually spent on the game. The absorption measure was the estimated time subtracted from the actual time it took to complete the game; therefore it did not matter how long the actual game took to complete, the absorption measure gave a score that indicated an over- or under- estimation of the time it took to play the game. The suggestion is that the more absorbed the game player is the higher their PK score will be (Irwin 1985 1989). I would also expect that as time progresses the players would become less and less absorbed in the game because the animation elements would become less novel. In addition the more random nature of the game would mean that without the *possibility* of complete control that participants normally experience in games, they would feel less motivation to continue the game. This could in part explain the decline effect that is commonly seen in the PK literature (Rush 1986).

The modifications to the experimental set up were designed to explore the avenues of imagery perspective, sequential sampling and absorption traits on the effect on PK scores. Using participants that had imagery training and were used to the concept of trying to play a micro-PK game, the experiment was designed to be more exploratory in nature. It was appreciated that the risk of trying to research too many variables might only serve to confuse the picture. However, the gymnasts that were used in the previous PK study, precisely because they had had imagery training and were already used to the idea of using a micro-PK device, I thought was "too good an opportunity to be missed".

Participants

Fourteen participants from the Meadowbank Ladies Olympic Gymnastic Club, volunteered to take part in the experiment. All of them had had imagery training, although not all of them had taken part in the first experiment, so these participants the PK game was new. These participants were newer recruits to the gymnastic club (ie they were not excluded from the previous experiment on some *a priori* reason).

Materials

An Apple Macintosh SE with 2.5 MB RAM and a 40 MB hard disc.

Computer PK game "Jessie" from the first vaulting PK experiment with some slight modifications. The entering in of subjects' names and which perspective they were to take was done by the subject, with the help of the experimenter if necessary. Unlike the last experiment there was a 'mouse' and a keyboard present to enter in the data (previously there had only been a 'mouse'. Also the participants did not have a choice of vaults as in the last game. They were all displayed a single vault type (handspring) that they could all do.

The trampolines were not present in the hall as last time so the "mini-lab" was not constructed in exactly the same manner. However, using mobile parallel bars and floor mats propped up against the bars, a similar mini-lab was constructed shown below.

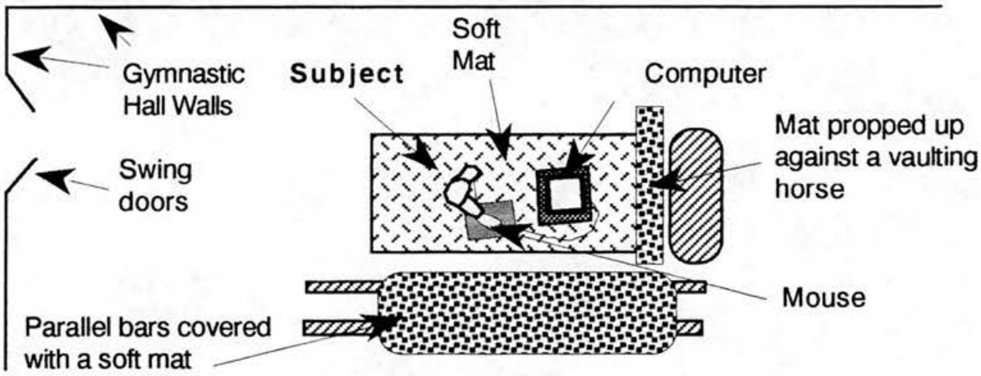


Figure 10.6: Diagrammatic representation of the second "Mini-lab" constructed without the trampolines. The mats were high enough to effectively hide the participants from general view from the rest of the gym.

Procedure

Having set up the mini-lab, participants were asked to take time out of their normal training routine to come and play the game. In order to help participants enter in their names and perspective they were imaging I, as the experimenter, sat in at the beginning of their first session and guided them through the program. I explained that they were to try and use imagery from a particular perspective in order to influence "Jessie". I also explained that the internal workings of the program had been slightly modified so that whilst "Jessie" was making a decision, she would appear to take longer to make it than previously. Rather than get frustrated with the computer, I explained that this was "Jessie's" way of giving them (the participants) more time to influence her — the longer she took, the more influence they were having. At the end of the program they were asked to key in how long they thought it took them to complete the game. The time was entered in minutes and seconds.

Design

Participants were matched for ability but otherwise randomly split into two groups. The first group started to use an internal perspective one week and alternate their perspective in the following weeks. The other group did exactly the opposite, that is they started the first week to use an external perspective and then alternated their perspective (ie the design was counter balanced). The whole experiment ran over five weeks. The hypotheses were as follows:

① The external perspective would score higher than an internal perspective on the PK scores.

② The overall PK scores would be higher than mean chance expectation (MCE).

③ There would be a positive correlation between the PK score and the number of sub- trials that it took to generate a random number, showing evidence for the sequential sampling effect.

④ The PK score would be positively correlated with the absorption measure.

⑤ Absorption in the game would decrease over time.

Results

Some of the scores were lost from the analysis due to a hardware failure in one of the weeks (see appendix V).

The results for each perspective were averaged for each participant. A paired t-test between the perspectives was not significant but showed that an external perspective was superior in getting results higher than MCE ($t=0.971$, $df=13$, $p=0.17$). The effect size (d) was 0.25. Hypothesis ① is supported that a external perspective would be better than an internal one, although this support was not significant.

The overall scores were not significantly away from mean chance expectation (MCE) and in the wrong direction ($t=-1.17$, $df=13$, $p=0.13$). The effect size (d) is –0.21. This does not support hypothesis ②.

A Pearson Product correlation between the sequentially sampled PK scores and the total of the sequentially sampled steps required to make the PK score was non-significant and in the wrong direction ($r=-0.15$, $df=59$). There was no support for hypothesis ③.

A Pearson Product correlation between the PK scores and the absorption scale was not significant but in the predicted direction ($r=0.12$, $df=59$). There was support for hypothesis ④ but not significantly.

A Spearman correlation between the sessions and the absorption measure was not significant but in the predicted direction ($r=-0.18$, $N=59$). There was non significant support for hypothesis ⑤ that participants become less absorbed (or more bored) with each playing of the game.

Discussion

None of the results were significant which would suggest that either the effects are very small or that the effects are not there. It is worth bearing in mind that the power of the experiment is still very low. The difference between the perspectives was in the predicted direction in favour of the external perspective. Anecdotally most of the participants did not like the idea of trying to generate an internal perspective whilst looking at an animation that was external in character. We tried to combat this by getting the participant to turn slightly side on to the computer so that they were facing the same orientation that the computer figure was running to. In addition I asked the participants not to focus too intently onthe animation but rather to use it as a marker of where their imagery should be in relation to the computer vault. However, one could argue that in relation to MCE it was actually the internal perspective that showed more psi (albeit in a negative direction d= –0.20). The external perspective scores although more positive than the internal ones are actually closer to MCE (d= 0.02). However like the previous studies it was decided to consider indications of psi as those that were in the positive direction as this equated with the goal of the participants playing the game (ie the external perspective showed more 'successful' psi).

While the results support Braud's (1981) Lability hypothesis, there are a number of alternative explanations of the results. The first gymnastic study (which used the same game), showed that the highest correlation of the PK scores and the MIQ was with the visual scale. I have argued previously that visual imagery can be equated with an external perspective and kinesthetic imagery with an internal perspective. If this were the case then the correlations would suggest the largest effect would be for the external perspective. In the sports section it was noticed that participants generally find kinesthetic (internal) imagery harder to generate than visual (external) imagery. The two points do not in themselves detract from the Lability hypothesis, they merely point to a possible confounding variable. That is it may be just the strength of the imagery ability that is contributing to the higher PK scoring, rather than the imagery that corresponds closest to the RNG tasks, that is providing the effect.

There was no evidence of the sequential sampling technique, being able to show larger psi effects. Not only was the correlation small and not significant but it was in the wrong direction. One possible explanation is that the overall successful psi scoring in this experiment was poor (ie below MCE). There may have been too little successful psi for majority vote procedures to amplify an effect. Future work could check this point out by finding larger positive effects for when the overall psi scores are positive.

The correlation with the absorption scale suggests tentatively that the more absorbed one is the better the chance of getting a higher PK score. The correlation is small and not significant and therefore awaits further confirmation. The absorption measure to some extent appears to be a reasonable measure as over the sessions the participants became less and less absorbed in the game. This was to be expected as the game became less and less novel. In order to keep absorption high, one would need to include more novel elements for each subsequent session. The arcade game industry uses this technique to retain their custom for as long as possible. As experience progress so the player moves onto higher levels where novel elements are added. However, there is a trade off to be had as when the game becomes too novel so that much mental effort is expended in just trying to understand the game's feedback. One might therefore, like the arcade games, possibly construct PK games so that as the participant exceeded some performance measure (it might be PK performance, or the number of sessions that a participant had already played the game) that the game would progress on to introducing more novel elements. In this way one would hope to maintain absorption over the course of several sessions.

Chapter 11:Overall Summary of Micro-PK Experiments

Introduction

This section of the thesis has dealt with questions relating to micro-PK performance. The first chapter dealt with describing what micro-PK was and what some of the important variables were that appear to predict whether micro-PK was successful or not. Chiefly amongst these, was the use of a goal orientated imagery strategy. Furthermore there was some indication that the participants with higher vivid visual imagery obtained better micro-PK scores. The second chapter described five micro-PK experiments, four of which looked at replicating the goal orientated imagery strategy. A single experiment explored the role that an imagery perspective had on PK performance, whether a majority vote technique replicated an increase in PK effects, and whether a state measure of absorption correlated with PK performance. This chapter will deal with trying to draw all these elements together to present an overall picture along with discussion of the results relevant to the parapsychological literature.

Comparing Imagery Strategies Over-Non Imagery Strategies

The first four experiments all looked for and reported a positive effect for the use of an imagery strategy to try and help influence micro-PK performance. The table below summarizes the results of the four experiments.

Experiment	N	Effect size (d)	t-value grps	p(1t)
Vault PK game	22	0.68	1.621	0.06
Juggle PK game (1)	22	0.08	0.184	0.28
Juggle PK game (2)	26	0.16	0.374	0.36
Shooting	11	0.08	0.122	0.45

Table 11.1: Results of four experiments assessing an imagery strategy and a control strategy to affect PK performance. Positive results for effect sizes and t-values indicate that the imagery groups had superior scores.

A meta-analysis of the results weighted by degrees of freedom gave an overall effect size (d) of 0.27 with an associated combined p value of 0.09. Although the combined effect size is not significant is is never the less an encouraging result. The effect size is small and therefore would require more participants to achieve statistical significance at an alpha level of 0.05. The results are similar to those seen by Morris (1980) and Kreiman (1980). Unlike these studies a control against the demand characteristics of the experimental situation was included. Despite that the results still suggest the imagery strategy to be superior to the control strategies.

Correlating Imagery Ability with PK Performance

Correlations of participants imagery ability is not so clear cut as the use of an imagery strategy. If there is something unique about the imagery ability itself then one would expect that the higher a participants imagery ability the higher their psychic functioning. If no correlations were found then one would postulate that the imagery was not important *per se* rather that just mentally engaging in any cognitive strategy (such as imagery) somehow helps the psychic functioning to occur. Below is a table giving the correlations of the self rated imagery scores.

Experiment	N	Visual scale	Kinesthetic	Total
Vault PK game	20	0.37	0.02	0.15
Juggle PK game (1)	22	0.02	0.40	0.34
Juggle PK game (2)	26	0.39	−0.09	0.15
Shooting	10	−0.46	−0.11	-0.28

Table 11.2: Results of the correlations of the MIQ (imagery questionnaire) and the PK scores. For the shooting and the vaulting study the correlations are those taken before the imagery training.

A meta-analysis of the correlations, weighted by degrees of freedom, gave the following mean correlations for the visual, kinesthetic sub-scales and total scale of the MIQ respectively: r=0.18, r=0.08 and r=0.16. They are all small correlations, but all are in the predicted direction. It would appear from the results that visual imagery is a more important predictor of micro-PK performance. However, from the previous sports section, we saw that generally people found visual imagery easier to generate than kinesthetic imagery. It may be that the low correlation of the kinesthetic imagery and the PK score, is confounded by a general low level of kinesthetic imagery that may fall below some threshold that would need to be acquired before it could be used in a PK task.

For two of the studies, long term imagery training was given to see if the hypothetical increase in imagery would correspond with a higher mean PK score. The correlations of athlete's change in imagery ability and mean PK score is shown in the table below.

Experiment	N	Visual scale	Kinesthetic	Total
Vault PK game	14	−0.23	0.02	-0.12
Shooting	9	0.65	0.58	0.69

Table 3.3: The correlations of the change in imagery ability over the training period time and the mean PK game score.

A meta-analysis of the correlations weighted by their respective degrees of freedom for the visual, kinesthetic and total scales are r=0.09, r= 0.23 and r=0.18 respectively. While there are problems from making too much of the data with such few sample numbers, and the results appearing not very homogenous, the following discussion is conjectured as if there was a real effect occurring in the experiments. There are several points to be made from these results. The first is that they generally support the notion that increasing a participant's imagery does affect their mean PK game score. Furthermore, the biggest predictor is the kinesthetic scale and not the visual scale. Backing up the point of the previous paragraph, it is possible that the previous low correlation of the kinesthetic imagery scores is not due to kinesthetic imagery not being able to be used as effectively in a micro-PK task compared to visual imagery. Rather, it may be that the overall level of kinesthetic imagery is lower than the visual imagery and possibly did not reach some operational threshold. Increasing the imagery kinesthetic ability possibly in this instance brought the participants above that threshold. The increase may not have been so large for the visual scale because the increase in this ability was not as large as that of the kinesthetic scale (see previous section). However, these conclusions should be treated with caution because a look at the above table shows quite dramatically for the visual sub-scale that the two groups of athletes appear to be behaving differently. The gymnasts actually showed a negative correlation, that is the better the gymnasts imagery became the worse overall PK score they achieved. Notice though that for the gymnastic study the experimental procedure allowed me to compute the correlation between the change in imagery over time and the change in PK scores over time. They were all positive although the largest correlation was between the change in kinesthetic imagery and the change in PK scoring (r=0.20 for the kinesthetic imagery, r=0.04 visual imagery and r=0.13 for the total imagery score). This might suggest that the overall PK scoring environment was decreasing over time (hence the negative correlation between the overall PK scoring and the change in imagery ability) but that this did not change the observation that if a participant's imagery increased then their PK scoring increased. Unfortunately a similar analysis was not possible for the shooting participants because no PK score was taken before the imagery training started.

Overall PK Performance

Overall PK performance as measured by scoring above mean chance expectation (MCE) is shown for all four experiments below.

Experiment	N	Effect size (d)	t-value	p
Vault PK game (1)	22	0.18	0.726	0.24
Vault PK game (2)	14	−0.21	−1.170	0.13
Juggle PK game (1)	22	−0.12	−0.586	0.28
Juggle PK game (2)	26	0.29	1.471	0.08

Table 3.4: The effect sizes of the deviation away from MCE for those studies whose theoretical MCE could be calculated.

The average effect size weighted by the degrees of freedom was 0.07. Hence there is an overall very small effect showing a positive successful psi performance. The combined probability was not significant (p=0.28) but this was not surprising given the low power of the experiment (due to the effect size being so small). These results however should be tempered by the fact that control runs have not been taken concurrently with the psi data taken during the experiments. The reason for this was that the generation of random numbers due to hardware and software restrictions, considerably slowed the game format. Getting the computer to generate control data simultaneously was seen as too much of a sacrifice to the programs speed. This approach is justified because the experiments were not designed as proof orientated research, instead I was more interested on the role that imagery played on micro-PK performance. However, it would still be advantageous to collect this data if possible and future research if it could overcome the technical difficulties should aim to take parallel random numbers.

Models of Psi Functioning Incorporating Imagery

The experiments conducted in this section were never meant to test theoretical models that incorporate imagery in a theory of psi. The results appear to show that the use of an imagery strategy provides superior PK performance than a strategy that does not use imagery. Not only that but there is growing support that a participants self rated imagery is related to their PK ability. Two tentative theories that could explain the experimental effects are presented below.

Two Stage Model

One of the most sophisticated models is the "Two Stage Model". First advocated by Tyrrell (1947) and championed by Louisa Rhine (1978) amongst others (Sannwald 1959; Prasad & Stevenson 1968; Price 1973; Palmer 1979; Irwin 1979; Weiner 1982; Glicksohn 1986). Psychic information becomes conscious through two distinct stages. *Stage I* is the actual "receiving" of the information at an unconscious level, this psychic process is quite distinct and novel in terms of psychological processes that we know of. *Stage II* is when that information is passed from the unconscious to the conscious via a *mediating vehicle*. One such vehicle is visual imagery. Notice however, that this is strictly an ESP explanation, whereas ostensibly the experiment is supposed to be a PK experiment (where the flow of information or will is from the participant to the computer). One theory of the micro-PK effects suggests that the effect is not one of a participant forcing her or his will on the RNG, rather it is an ESP faculty that allows the participant to select a non-random sequence of numbers from the larger random sequence. Participants are able to do this by waiting to initiate the RNG. This model is called the Intuitive Data Sorting Model (IDS) (May, Radin, Hubbard, Humphrey & Utts 1985). The authors have tried to back up their model by including detailed analysis of the RNG meta-analysis of Radin *et al* 1985). One would therefore postulate that the results could only be related to the two stage model if one were to postulate that micro-PK effects are in fact ESP effects, such as the IDS model claims it is.

The experimental results could be interpreted as showing general support for the Two Stage Model. Participants imagery ability did appear to indicate higher micro-PK scoring. However, whether this is due to the imagery ability itself or instead general motivation is debatable as the correlations for the amount of time spent on the cassette based exercises were more or less the same for the imagery specific exercises rather than the overall use of exercises that included the dummy training procedure. Given that the Two Stage Model is mainly concerned with ESP results and if we were to take the micro-PK experiment as a special case of ESP then there are problems with the experimental replication of Braud's results that show both an increase in micro-PK ability and an increase in image controllability, after imagery was ostensibly trained. A theory that is more ESP based will not be that amenable to increasing the effect size of the micro-PK experiment, because the effect size is determined by the occurrence of local deviant strings of events amongst the otherwise normal distribution of these events. These events are probabilistic in nature too, so that it is more likely that we will see ten '0's in a sequence than if we see one hundred of them.This means that there is a ceiling effect of how much IDS ability a participant can demonstrate. May *et al*(1985) use this argument which is corroborated by analyses of the micro-PK database, to support their IDS model. The learning effects of participants imagery ability correlating with higher PK scores seen in the presently reported experiments, could only fit into this theory by stating that the imagery training brought the participants ESP facilities (ie to detect the local event variations) to (or closer to) the ceiling limit. A line in future research would therefore be to ascertain this theoretical limit and to assess how close participants scores were to it after they had been given the training, and especially to note if the scores were below or above the limit. However, it is interesting to note that the learning effects may have been demonstrated because of the experimental design. In the discussion of the first vaulting micro-PK experiment, I suggested on account of the effect sizes of the experimental groups over time that we were actually seeing the transition of the the control group going from not using an imagery strategy to one where they did. For the other training study (shooting PK study) this analysis was not possible due to a procedural limitation which meant that it was not possible to test the participants on the PK game before they had their imagery training. This also meant that it was not possible to correlate a change in micro-PK ability with a change in imagery ability. If the learning effect turned out to be an experimental artefact then this lends further support to the Two Stage Model which places micro-PK effects as variations of ESP.

Noise Reduction Theory

A further elaboration of the Two Stage Model involves the concept of psychic information being a very weak signal which is not normally detected because it is masked by noise that we are bombarded with by our normal senses (Honorton 1974, Braud 1975), hence it is termed 'Noise reduction Theory'. There could be two ways in which imagery fits into this model. The first is the most commonly subscribed to view which is actually a subset of the Two Stage Model, whereby imagery is a weak mediating vehicle that conveys the psychic information. In order to detect this weak mediating information, the masking effect of other sensory information (noise) must be decreased.

An alternative hypothesis which has different implications is that eliciting imagery is feedback strategy for reducing noise (from external stimuli) as it is itself a weak signal (ie we receive feedback when we have reduced the noise to such a level that imagery comes to our attention. Imagery may be an effective strategy for reducing noise (either internal or external), but of course there may be others that are more effective - for instance meditation techniques, sensory deprivation, the ganzfeld and sleep states. The experimental results however appear to show that strong visual imagery is correlated with more successful micro-PK performance. Strong vivid imagery would actually provide a potentially masking signal to the psi influence under this alternative explanation of the Noise Reduction Theory. One might therefore want to, in this interpretation of the model, revert back to the more direct 'force' explanation of micro-PK effects. This begins to contain similarities with Braud's (1981) lability hypothesis (see below), that is the strong will and intention expressed through imagery is providing the successful influence on a system producing random events. In short the results from the present experiments only supports the noise reduction model as a subset of either the Two Stage Model (which in turn requires an IDS explanation for PK effects), or as a mechanism for the Lability Hypothesis. It does not stand on its own as an explanatory model.

Lability Hypothesis

The lability hypothesis Braud (1981) has already been briefly discussed. It was proposed in order to attempt to reconcile psi effects (especially PK effects) and the second law of thermodynamics (as psi effects "appear to involve a local reversal of entropy"). Simply stated it involves counterbalancing the lability of two systems that will interact with each other psychically. Braud (1981) writes,

> Under certain conditions, the initially disordered state of the more labile system will become reorganized so that its final state will more closely resemble that of the more structured inert system [p.2].

In the case of PK that means that the more labile system (the RNG in this case) is counter balanced by structure and constraint of the intention of the PK agent. In this case it is expressed through imagery. The hypothesis states that the state of the target object will be influenced to a stronger degree when the intention of the agent is very strong or inert. One way to achieve this, Braud suggests, is to hold a very controlled and vivid image of the end state of the object. The participants appear to back this point up by demonstrating more successful PK effects if their associated imagery is more vivid. In addition the result of using an external perspective although it is a weak effect, does make sense from the standpoint of the lability hypothesis. The external imagery of the participants more closely resembles the screen animation than an internal perspective. This result is however weak and as previously mentioned does have alternative explanations such as that the participants external perspective imagery is stronger than an internal one.

The results on balance show more support for the Two Stage Model but it should be stressed is very weak support indeed and needs to be tempered by future research geared more towards exploring the different implications of the models.

Future Research and Considerations

These experiments are in agreement to a large extent with the belief that imagery has an important role to play in affecting the statistical nature of a pseudo-random source of numbers. There is some indication that imagery training may improve a participant's micro-PK scores. This has not been a consistent result in the previous parapsychological literature, although it is realised that the present results may actually be a reflection of the experimental design. However, I would like to offer some guesses as to why (in my opinion) I achieved relatively positive results despite the low power of the experiments and the lack of experimental control. In the first place the imagery training was directly linked to another activity other than affecting micro-PK performance: namely it was used to help the participants, (who were all doing an athletic task) use imagery as a mental technique (MT) to mentally rehearse their athletic performance. Thus the athletes may have therefore felt more motivated to take part in the imagery training, because they were actually rehearsing their imagery skills for something that was in a sense more tangible and more important to their everyday life. In contrast the call to use micro-PK influencing powers as we perceive them to be at the moment, must to most people seem very idiosyncratic and not a tremendously useful ability to have (unless you are an experimental parapsychologist!). In mental rehearsal (MR) used for an athletic task however, participants have visible proof when it appears to be having a real effect because they physically perform much better. Micro-PK performance is at the moment statistical in nature and not readily visible to the naked eye. Hence motivation to pursue an activity which does not show visible results may be considerably harder to maintain than one that does. I think that future imagery training ought to regard ecological validity of doing imagery training as a real consideration to bear in mind for future success.

The second point to be made regarding the apparent partial success of the experiments, is that the displays were deliberately tailored to reflect scenes that were directly relevant to the athletic task at hand. Furthermore the imagery exercises used to improve MR ability, could be directly used as a mental strategy to try and influence the RNG. This is a consideration that Braud 1981, 1989) makes explicit for the success of micro-PK performance (the lability hypothesis). In part this might explain why for instance an external perspective appeared to give more positive PK performance compared to an internal perspective, because the external perspective would match the computer's visual display which was external in perspective too. However,bearing in mind that this interpretation is offset by alternative ones; future experiments could ascertain the worth of the lability hypothesis, by setting up different visual displays that participants attempt to influence with different imagery perspectives (these would reflect the displays to a greater of lesser degree). For instance, the gymnasts could use a different perspective to affect two versions of the game used in the experiments discussed in chapter 10. One version would be exactly as it is at the moment, displaying scenes from an external perspective. Another version of the game would replicate the scene except it would be from an internal perspective. For the latter the gymnast would see the vaulting horse ahead of them and as the display proceeded it would appear to come closer and closer, culminating in dramatic changes of the computer's displayed environment, whilst the computer's gymnast would execute an acrobatic movement off the horse. The expected hypothetical results are depicted in the table below.

	External Display	Internal Display
External Perspective	+ + +	+ (+)
Internal Perspective	+	+ +

Table 3.5: Hypothetical results as predicted by the lability hypothesis, of imagery perspective used on different visual displays of micro-PK task such as the vault game.

The positive signs are used to denote size of PK effect. One can see that the the largest effect appears to be for the external imagery perspective as used for an external display. The next largest effect would be for the use of an internal perspective as used for an internal display. I would predict that it would not be as large as the previous combination because an internal perspective appears to be more difficult to generate (as seen by the MIQ results of the sports section of this thesis). The least effect will be seen by the orthogonal combinations that is when an internal perspective is used for an external display or vice versa. However, there may be a slightly larger effect for when an external imagery perspective is used for an internal display because of the generally greater external imagery ability of participants.

A third consideration which may account for the apparent success of the experiments is in the use of smaller number of participants which allows more attention to be paid to the individual. Mishlove (1981) has pointed out that there is a possible conflict between the role of the experimenter of psi research and the trainer of psi abilities. The former wishes to apply strict controls, treating all individuals the same, to run as many participants as possible and their overriding goal is to obtain results that can be published. The trainer on the other hand has the personal development of the individual in mind. The individual needs of the trainee (because of different levels of comprehension, motivation, initial ability etc.), can be best achieved by tailoring the training to the participant. Mishlove (1981) offers the following quote from one of his own trainees,

> ... there was too much emphasis on ESP test performance and not enough on personal development. If a person is going to pay for such a program, the emphasis should be on her/his development not on your [Mishlove's] personal success as a Ph.D. candidate. The underlying motive can hinder psychic development [p.16].

I tried to be sensitive to this "emphasis" and accordingly, as a compromise between being both an experimenter and trainer, I invested my resources on fewer participants so that I could have the time to be more sensitive to their specific needs.

Further Improvements for Future Research

The above points are the positive aspects of the research which I would certainly want to include in future research. However, like all research, there were negative aspects which I would want to improve on or conduct more research into.

Making the PK task more explicit

A persistent occurrence for all the PK experiments, was that the participants did not appear to fully appreciate what it was that I was asking them to do until they realised that they did not have any physical control of the game such as through the mouse of the keyboard. Future research ought to consider how to make the task more explicit without stressing the 'fantastic' aspects of PK, in case this puts up a 'mental block' of one sort or another. The tactic that I used in the shooting game maybe an attempt worth exploring further, that is to introduce participants to PK games that are relatively simple and that are conceptually easy to understand, before going on to a 'bells and whistles' PK game.

Improving the micro-PK game

One aspect that continually niggled me was the lack of smoothness of the display of all my constructed games. Individual animation sequences played at respectable speeds but the whole process ground to a halt whenever the computer had to generate a random number and choose the next appropriate piece of animation. Initially when the concept of the games was formulated, the idea was that the complete animation sequence would appear to the observer as a single uninterrupted whole. Hardware and software limitations however, ensured that this was not possible. However, since that time this ideal appears to be far more feasible on the kind of limited budget that I was on. Specifically games in future research should be in colour and be written in a lower (ie faster) level language, to make the animations novel, visually interesting and seamless.

Sequential Sampling Routine

Although the results of the one experiment did not support the increase in micro-PK effect size using a sequential sampling method, this is an avenue that ought to be explored further. One of the reasons for its apparent failure to replicate the previous effects (Puthoff, May & Thompson 1985, and Radin 1990) may have been again a hardware restriction that considerably slowed down the flow of the animation sequence. Despite trying to counter a possible tendency to become frustrated by claiming that this was good feedback, it might be that this interrupts the flow too much of the participants' imagery. In other words part of the task of the participants was to image the movement whilst another part of the task is to monitor the progress of the animation sequence and to pace their own imagery to be synchronous with the animation.

Absorption

It would certainly seem worth exploring the micro-PK performance with a state measure of absorption such as the one used in the second vault PK game. Although the correlation was a weak one it could be of potential benefit when trying to assess future micro-PK work. There are a number of problems though that ought to be borne in mind when regarding absorption and specifically the state measure looking at the passage of time. With regard to the latter aspect, there are instances when one can be completely absorbed in a task and overestimate the passage of time. Altered states associated with mystical states and peak/optimal or flow experiences, talk about a distortion of the passage of time but it need not be an underestimation. Instead one would use the distortion either way as an indicator of a possible absorbed state. How then to differentiate between an absorbed state overestimation of time and a bored state overestimation of time? For that one would need other measures that could converge on the true state of the participant. For instance a suggestion would be the amount of body movement that a participant showed during a session. Anecdotally I can report that my gymnast participants appeared to be bored when they were not looking at the screen, appeared to be distracted by the door opening behind them, were distracted by anyone who might move into their line of sight in the mini-lab (for instance if other gymnasts wanted to get matting or other equipment stored against the wall close to the mini-lab). These participants typically showed large overestimations of the time passage. One could therefore arrange to video the participant whilst they were doing the micro-PK task and have 'blind' judging procedures to assess the amount of body movement or head turning as a convergent measure of boredom. In contrast one could envisage a scenario where the participant shows little body movement but still overestimated that time passage. For these participants we might still like to conclude that they were in an absorbed state.

One of the experiments suggested that participants became less absorbed in the game the more they practised playing it.If this was more than just a chance result, then I would want to include levels that the player would go through that would introduce more novel elements the more the player became used to the game. As previously mentioned what criteria would be used for deciding whether to include more novel elements is not quite clear. It could be on PK performance or it could be literally on the number of times a particular player has played a game. It might also be related to the amount of absorption that a player appears to be exhibiting (eg via their assessment of the passage of time).

Directly Assessing Models that Incorporate Imagery

Future research could not only continue to explore whether imagery effects as seen in this small database, are replicated, but could also be designed to assess some of the theoretical models that attempt to incorporate imagery in a theory that explains psi effects. The following recommendations are steps towards doing that.

Imagery Perspective

The role of imagery perspective has already been discussed, however, it may be worth re-iterating the point that the animations naturally lend themselves to an external perspective. Braud's lability hypothesis (1981) states that for the most success the imagery should correspond as closely to the target as possible. In this case an internal perspective should yield more positive results if the computer's display is also from an internal perspective.

Practice on the imagery exercises

Only one of the experiments attempted to take a measure of how much imagery training the participants did at home. The correlation was high and replicates the previous findings of George (1982) and Braud (1982). Quite what this is due to is not quite clear as George (1982) had pointed out that this correlation could be more a measure of motivation. A future experiment could try to give an alternative training exercise such as the 'subliminal' training given to the gymnasts. However, the experiment was confounded because of its multiple baseline design, which meant that there was not enough data collected for the participants doing only subliminal exercises only. What does seem to be clear is that effort put into doing homework exercise appears to be a promising indicator of PK improvement. Future designs would assess if it is the actual imagery improvement (the first vault correlations between imagery improvement and micro-PK improvement would seem to indicate this) or if the frequency of homework exercise is a motivational indicator.

Instructional set

The idea that the micro-PK task is actually an ESP task in the form of the IDS model or as Walker believes the Quantum Mechanical Observational Theories (1987) is beginning to appeal to me as a more plausible explanation of the micro-PK effect rather than a direct 'force' altering the random sequence. I cannot pretend to be persuaded by the mathematics of either model as it is too complex for me. However, certain trends seen in the data appear to be more parsimonious if an ESP rather than a PK explanation is taken. Principally there are two reasons that sway me towards this explanation. The first is that the effect size of the micro-PK effect appears to be the same whatever that source of randomness is. That is it is the same for radioactive sources, electronic noise and pseudo-random algorithms (May *et al 1985*). It seems to me highly unlikely that the 'force' theories would have the same influence (ie the force has equal effect) on all these disparate systems. The ESP models however, contend the effect is actually due to the participant waiting to sample a local non-random sequence out of a larger overall random sequence. They have the control to sample such a sequence by initiating the random number generation by pressing a button to start a trial. The second reason that biases me towards the ESP explanation is that the effect appears to occur regardless of the complexity of the random number generation (May *et al* 1986). In other words it does not matter how fast the numbers are generated or if their a number of random processes that are combined to give a single number, the effect still remains. In other words the goal of the RNG is the important effect that we see in the results and the process is not important. It may be that this is the overlap between the success of goal orientated imagery and process orientated imagery.

This being the case I would like, in future experiments,to try and alter the instructional set that I would give participants, to explore this bias. The instructions would be more specific in how I thought the micro-PK process was occurring. For instance, I would explain that to the participants that they could not actually affect the computer, they could only 'time' their responses to make it appear that they had (and this required psi). An alternative instructional set would be to ask the participants to image their movement as best they could before they initiated the trial which would help them set up their intention and thus more accurately 'time' their response. One could look at differences in effect sizes between this method and the instructional set ("use your force"), although a better research design would be to look at the differences in instructional set in a single experiment.

SECTION 3:

Mental Imagery in Athletic and Micro-PK Performance assessed

Chapter 12
Overall Summary and Conclusions of the Thesis

Introduction

The thesis started by outlining two areas in which imagery appears to have an influence in enhancing performance. They are in sport psychology and parapsychology. The literature in these two respective areas was covered in chapters 2 and 9. At first glance the two sub-disciplines of psychology would not appear to have a large degree of overlap. However, on closer examination there are a number of areas where the two sciences do indeed share common ground. Two main areas are the subjective feelings of performing at a peak, and the use of mental strategies using imagery to enhance performance in both areas. The thesis has concentrated on exploring facets of the role of imagery for each area, rather than the peak performance aspects. The purpose of this chapter is to briefly sum up the thesis over both sections and to draw the two together. The thesis had three underlying themes running through it. The first was that the studies were not out to empirically demonstrate effects that were statistically significant. Instead the emphasis was on taking purported effects as seen in the literature and conducting process oriented research, to advance knowledge about possible factors that might contribute to these effects. In this case the two effects under investigation were: (i) mental rehearsal has a beneficial effect on athletic performance and (ii), imagery based mental strategies in goal oriented tasks appeared to facilitate success on a task that required the subject to ostensibly bias a physical system, through novel means unknown to science. The second theme in this thesis was to make the research strategy as ecologically valid as possible. This was achieved by working with athletes for the majority of the experiments reported in the thesis, and taking measurements in the surroundings of their own training locations and working around their normal training schedules. It was realised that the price to pay for ecological validity is a lack of experimental control and statistical power. However, chapter 3 explained how this is presently not seen as a waste of research effort in the behavioural sciences — as similar types of research can ultimately be collected and analysed in a meta-analysis. The final theme to be covered is that imagery is seen as a real ability that could vary from individual to individual; it could also vary within an individual over time in aspects such as its vividness and or controllability. It was appreciated that not all psychologist agree on this.

Imagery as a controversy in psychology

Imagery continues to be a controversial area in psychology (Rollins 1989, Denis 1989). As a major phenomena of the introspectionist schools of psychology, it disappeared as a topic of research with the advent of behaviourism. However, along with the emergence of cognitive psychology, imagery returned and is now in a "golden age" of research (Denis 1989).

However, imagery is presently not without its critics who questioned whether imagery is not merely an epiphenomenal by-product of some underlying propositional process (Pylyshyn 1973, Anderson 1978, Haugeland 1982). Some of these theorists have argued that imagery should be banished from cognitive psychology altogether on the grounds of the definitions of cognitive science. Rollins (1989) has written convincingly that this is an untenable argument. Benjafeld (1992) has said,

> ... The debate about the nature of imagery has been carried out with great intensity, and appears to have generated more heat than light [p. 171].

Denis (1989) points out that the propositionalists have mainly based their criticism on speculation and not gathered the data themselves. Instead they tend to react towards imagery researchers' results and their interpretation of the data. However, the imagery research does appear to favour the existence of a real cognitive ability other than merely an epiphenomenon.

Visual perception and visual imagery

There is convergent evidence that visual imagery in part shares cognitive and neurological mechanisms with visual perception (Hampson & Morris 1990, Goldenberg, Podreka & Steiner 1990, Marks 1990). Neurological damage to the brain that is known to affect perception, also affects imagery (Sunderland 1990) lending further support that the biological hardware is shared at least partially by both the perceptual and the imagery process. Hampson & Morris's (1990) description of the "BOSS" model of imagery and consciousness in cognitive processes, bears functional similarity to the modular workings of the visual perception system (Zeki 1992) in primates.

Cognitive researchers of imagery stress the functional equivalence of imagery to perceptual processes (Finke 1989). For myself the most impressive examples are the interference experiments and the visual illusion experiments. An example of the former is that of Brooks (1968) who showed that an imagery task became harder to do when a simultaneous task had to be carried out using perceptual processes of the same sensory modality (eg using visual imagery whilst doing a spatial task that required visual perception), compared to another task which did not use the same sensory modality (eg a verbal task). The same can be said for the other way around, that is imagery appears to interfere with visual perception (Segal & Fusella 1970, Reeves & Segal 1973). An example of visual illusions using imagery is that of Finke & Schmidt (1977) and Marks (1983), who have demonstrated the McCollough effect (McCollough 1965; colour aftereffects are induced according to the orientation of bar gratings on various coloured backgrounds) using visual imagery alone. Furthermore Marks (1983) showed that the effect was strongest for the vivid visualizers. As this is a visual illusion that is not that well known, it is not prone to expectancy effects. Although these demonstrate the functional equivalence of visual imagery and visual perception, Finke (1989) points out that this is not a total equivalence so that for instance, the neural units in the retina are not activated in visual imagery.

Imagery and Attention

Imagery, as a real cognitive ability, should then exhibit similarities with other cognitive processes and have similar limitations imposed on it, one of which is that imagery will commandeer attentional resources. To illustrate this Wickens (1984) writes of driving home in a car under normal circumstances using a familiar route does not require much attention, and one could happily hold a conversation at the same time. However, make the drive home unusual (one encounters unusual weather conditions) and conversation will probably diminish as full attention is required to drive the car safely. The capacity model of attention states that there is a single source of attention that can be used for various tasks (Kahneman 1973). However, more recently Hirst & Kalmar (1987) favour attention as the sum of multiple resources that can be used for different tasks. This fits in more parsimoniously with the interference effects reported above by Brooks (1968) and Reeves & Segal (1973). Chapters 4, 5 and 6 reported on experiments which were ostensibly designed to demonstrate the mental rehearsal effect seen in the sport psychological literature. Unlike the previous literature, it was decided to take more care in controlling against participant expectancy which would eliminate the criticism that any positive results seen would be explained by participants conforming their behaviour to their perceived expectations of what the experiment was trying to show. Only the experiment in chapter 4 showed a positive mental rehearsal effect. The others showed the reverse trend, that is that the control condition performed better than those that were expected to do well using mental rehearsal. This reverse effect was large enough to postulate that the use of imagery in mental rehearsal is not merely increasing athletes expectation of success, otherwise the two conditions should have shown similar increases in athletic performance. Instead it is postulated that imagery is competing for attentional resources which have in these cases detracted from the athletic performance — this has been referred to as 'cross talk' by Hirst & Kalmar (1987). It is very difficult to see how imagery as an epiphenomenon could cause such an effect. The conclusion in chapter 8 from these sets of experiments was that imagery in mental rehearsal is an ability that needs to be learnt and therefore must have attention paid to it, such that it is a 'controlled process' (Shiffrin & Schneider 1977). It is unlikely to confer real beneficial effects (other than increased expectancy) until both imagery and mental rehearsal become 'automatic processes' (Neisser 1976).

In the micro-PK experiments, there appeared to be a small but consistent effect which showed more positive scoring for those that used an imagery strategy than those who did not. In chapter 10 a single experiment explained how a measure of absorption correlated weakly with micro-PK scoring. This is interesting because absorption is defined as a complete and utter state of attention to an object (Tellegen & Atkinson 1974). The correlation was weak and not statistically significant; however, it points to a potential additional cross over for athletic and micro-PK performance.

Correlations between the sport- & para- psychology experiments

The question begs whether there is not some greater link between the two types of performance, that is that they both share neurological and/or cognitive processes that facilitate functioning in both spheres. It is tempting to think that an obvious candidate would be imagery. Indeed there are across the experiments, numerous occasions where participants' imagery ability correlated with both the athletic and micro-PK performance. The experiments were never intended to make this link an explicit one that would be explored in the data analysis, however such an analysis is possible and the results of the correlations between gain in athletic performance and the participants' respective micro-PK scores, is shown below (for the first vault experiment the gain in athletic performance is correlated with the gain in micro-PK ability, this correlation was not possible to compute for the other studies).

Experiment	N	Visual scale
Vault 1	19	0.35
Vault 2	13	0.40
Juggle 1	22	-0.16
Juggle 2	23	-0.08
Shooting	10	-0.43

Table 12.1: Correlations of participants' athletic and micro-PK performance

A meta-analysis of the results weighted by degrees of freedom gave an average correlation of r=0.04, clearly not a very large correlation. However, to do such a meta-analysis and come to the conclusion that there is no link between the two is perhaps jumping the gun a bit. For both juggling experiments and the shooting experiment, as we have already seen, athletic performance did not improve on account of using mental rehearsal. Therefore there is some justification to not expect a large correlation between athleticism and micro-PK performance in these circumstances. The gymnasts on the other hand did improve their gymnastic ability, it seems, on the basis of prolonged imagery training which they could subsequently incorporate in their mental rehearsal. The correlation for these participants is relatively large (and just failed to reach significance p is >0.05, <0.10). In the second vaulting experiment the average athletic performance was correlated with the average micro-PK performance. Both these experiments were looking at the effect of imagery performance and thus there was no gain in athletic performance as such to look at.

One might therefore postulate that if the vaulting study was a real result and not a chance result, is there some sense in which the neurological and/or cognitive processes overlap so that such common mechanisms are responsible for the correlations? I would suggest that the results are far too tentative to draw any conclusions. Given the weak correlation of micro-PK performance and the correlations of the gymnasts between their athletic and micro-PK performance, it could be that imagery again is an ability that will only have a benefit when it is an 'automatic process' and requires little attentional resources in order for it to be generated. If imagery is a 'controlled process' then the benefits of using imagery as a mental strategy are not likely to afford micro-PK enhancements or even retard athletic performance compared to high expectancy. More research specifically addressing this link is required to illuminate any hypothetical connection.

Imagery Perspectives

Again the propositionalist stance is not supported by the results of the imagery perspective experiments. These were covered in chapter 7, which tried to assess whether an internal or an external imagery perspective is more beneficial for athletic performance following on from mental rehearsal. Some sport psychologists speculate that there are benefits to be derived from either perspective, and this is the conclusion reached at the end of the three experiments in chapter 7. A model was proposed to explain which perspective will confer the most advantage in mental rehearsal for specific sports types. This was later confirmed by a questionnaire survey done with international athletes from two sports (diving and rugby). This research appears to be more in accord with the view that different processes can be occurring for each of the perspectives (Feltz & Landers 1983, Hardy 1989).

The perspective results of the micro-PK experiment require further replication but in chapter 11 some of the theoretical reasons, for different performance on the basis of using an imagery perspective, were outlined.

Conclusions

The thesis started out with the intention to explore enhancements of the athletic and micro-PK performance of athletes who, to varying degrees, had been instructed and / or trained to use an imagery based mental strategy. Much of the research resources went into trying to maintain ecological validity which, although there is room for further improvement, was successful. The studies were a methodological improvement on the previous work in similar areas, as control groups designed to guard specifically against expectancy were included in the research design. Despite the lack of statistical power, a picture of results emerged which at the very least, showed that imagery appeared to have a real effect on performance, although this was not always in the predicted direction. However, the discrepant results may have provided a clearer insight as to what the contribution of imagery is in performance enhancement for both athletics and micro-PK. These insights await future research and experimentation.

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Appendix I

The following questionnaires were used over the course of the experiments. The Movement Imagery Questionnaire (Hall, Pongrac & Buckholz 1985), the Subliminal Susceptibility Questionnaire (SSQ) and the Use of Imagery in Sports Questionnaire (UISQ). The latter two were developed specifically for the experiments - they are both copyrighted.

Movement Imagery Questionnaire.

Instructions:

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

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

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

RATING SCALES

Visual Imagery Scale

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

Kinesthetic Imagery Scale

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

1	2	3	4	5	6	7
Very easy	easy	somewhat easy	neutral	somewhat hard	hard	very hard

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

ACTION: Be sure to read the entire action before attempting it. Extend your elbow so that your hand leaves your shoulder and is straight in front of you parallel to the floor. Keep your hand in a fist. Make this movement slowly.

MENTAL TASK: Assume the starting position (exactly as described above). Form as clear and vivid a mental image as possible of the movement just performed. DO NOT PERFORM THE MOVEMENT. Now rate the ease/difficulty with which you were able to do this mental task.

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

ACTION: Raise your right knee as high as possible so that you are now standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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3. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up into the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.

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

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4. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

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

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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5. STARTING POSITION: Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm

1	2	3	4	5	6	7
Very easy	easy	some what easy	neutral	some what hard	hard	very hard

extended during the movement and make the movement slowly.

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

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

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

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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7. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try to touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.

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

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8. STARTING POSITION: Make a fist with your nondominant hand. Extend your arm above your head keeping your hand in a fist. Keep your other arm at your side.

ACTION: Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your fist clenched.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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

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

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very easy	easy	some what easy	neutral	some what hard	hard	very hard

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

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

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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

ACTION: Raise your right knee as high as possible so that you are now standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.

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

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12. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up into the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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

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

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

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14. STARTING POSITION: Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.

1	2	3	4	5	6	7
Very easy	easy	some-what easy	neutral	some-what hard	hard	very hard

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

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

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

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

16. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try to touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

17. STARTING POSITION: Make a fist with your nondominant hand. Extend your arm above your head keeping your hand in a fist. Keep your other arm at your side.

ACTION: Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your fist clenched.

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

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

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

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

Construct validity of the MIQ

The construct validity of the MIQ was originally made by Hall, Pongrac & Buckholz (1985), who quoted 3 experiments that showed predicted differences between groups on the basis of their MIQ scores. A more recent paper by Overby (1990) however, failed to show a significant difference between experienced and novice dancers. A look at the results is misleading because it appears to show that the novices scored higher on their MIQ scores for both the visual and the kinesthetic scales compared to experienced dancers. However, as can be seen from the MIQ in this appendix, the <u>higher</u> the perceived imagery ability the <u>lower</u> the subsequent rating score. Hence the results as presented in Overby's paper, actually show a meaningful relationship between the different levels of dancing ability (ie better dancers have a higher imagery ability). With only 40 subjects in her study it is quite possible that the power of her experiments was too low to show this relationship significantly. What one could postulate is that the low power is as a result of the imagery differences in this specialised population, being too small to detect with so few subjects. For instance, Overby's dancers were all volunteers; the experienced dancers being dance majors or recent graduates from her university: the novices were recruited from a variety of other classes, who like the experienced dancers, were told that the experiment was looking at imagery differences between experienced and novice dancers. Being volunteers, subjects more than likely took part in the experiment either because they were interested in dance, or imagery, or both. It is not unreasonable to suggest that such an interest probably stems from prior experience, in which case this common antecedent variable may explain the small difference between the perceived imagery ability between the two groups of dancers. That is, a larger effect would have been found between the experienced dancers and a random selection of athletes from sports that are not believed to require imagery to such a large extent as dancing (eg strength sports such as rowing). Some support that this population of dancers may have had closer imagery abilities that Overby might have hoped for, comes from the fact that she reports that visual thinking, as measured by Paivio's IDQ, is more or less the same for both experienced and novice dancers.

Sub-liminal Susceptibility Questionnaire (SSQ)

Name:
Age (years - months):
Sex:

Please answer the following questions by the rating system given below. Indicate your response by circling a number between 1 and 7 where 1 denotes very often and 7 means never.

1 - In general, do you think you are very aware of your environment ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

2 - Do you sometimes look at an object for a while and then suddenly see an unusual feature about it ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

3 - Can you recognise a word if it was spelt and / or spoken backwards ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

4 - Can you recognise a piece of music if it is played backwards ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

5 - Have you ever participated in a sub-liminal training exercise, such as to stop smoking, achieve a better memory or learn to relax more.

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

6 - Please indicate how often you have been hypnotised for whatever reason

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

7 - Have you ever been aware of sub-liminal scenes or messages that you were not told you were being given.

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

8 - Do you ever hear a voice or familiar sound when no such sound could have occurred such as hearing a friends voice when listening to droning or humming sounds (e.g. inside a passenger plane, or next to a computer, or noisey air conditioning) ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

9 - Do you ever find non logical thoughts entering your mind which seem totally irrelevant to the situation you are in when you had those thoughts ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Use of Imagery in Sports Questionnaire (UISQ)

Please fill out the following short questionnaire by reading filling out some details about yourself, reading through some definitions and then answering the following questions by circling a number scale from 1 - 7.

Sport:
Sex: Male / Female
Experience of sport (number of years):
Age (number of years):
Proficiency level:

Explanations of terms used

Mental imagery **is when you experience yourself doing something without you actually doing it, except in your mind.**

External imagery **is when you observe yourself mentally from a distance doing some action (such as playing sport), similar to watching yourself on video.**

Internal imagery **is when you observe yourself mentally doing some action as if you were actually there looking from within your body.**

Kinesthetic imagery **is when you mentally feel yourself doing some movement, so that you either feel your muscles move, or you can feel your whole body move through space.**

Do you tend to dream alot ?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you frequently remember your dreams?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Are your dreams often vivid?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Are your dreams often controllable?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you frequently use mental practice to help you in your performance?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you consciously plan your mental practice?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

How often do you use **internal** imagery?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **internal** imagery is frequently vivid?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **internal** imagery is often controlable?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

How often do you talk your self through a skill?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

If you do talk yourself through a skill, how often do you combine it with mental imagery of any sort?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

How often do you use **external** imagery?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **external** imagery is frequently vivid?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **external** imagery is often controlable?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Of the three types of imagery - internal, external and kinesthetic, please write a number to say which you prefer the most ("1" for your favourite and "3" for your least favourite).

Interanl imagery	Kinestheti c imagery	External imagery

How often do you use **kinesthetic** imagery?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **kinesthetic** imagery is frequently vivid?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Do you find your **kinesthetic imagery** is often controllable?

1	2	3	4	5	6	7
very often	often	sometimes	not sure	rarely	very rarely	never

Have you ever had training about how and when to use mental practice? Please give details.

Has your method of mental practice changed as you became better in your sport? Please give details.

Please use the space below and over the page, if there is anything you would like to comment on about using mental techniques to help your sport.

Thank you for your participation,

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Appendix II

The following appendices contain the imagery scripts that were put onto the cassette tapes. For the exercises used to train up imagery ability the structure was very similar for the gymnastics, trampolining and shooting. Namely the firs three exercises gave a brief introduction into the various types of imagery that were possible, visual perspectives and kinesthetic imagery. The final exercises were specific to the sports. The juggling scripts were specific to the experimental protocol and basically re-iterated the points that they had been taught in the instructional video. Text in italics was not recorded an aids either to instruct the reader or to give a description of the text.

General Imagery Training

Exercise 1: Journey through your house

Hello. My name is Audrey and over the following 5 exercises I will be your instructor.Make yourself comfortable before you begin this exercise. Sit or lie down. If anything is bothering you - the light is too bright or there is an annoying noise from somewhere - stop the tape, take care of it and start again.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin ! Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

This exercise is called "guided imagery" and it involves some exercises IN YOUR IMAGINATION ONLY. If I say lift your left arm I mean try to imagine yourself lifting your left arm I do NOT want you to actually lift your arm. You may find it easier to close your eyes.Try to empty your head of all your thoughts and instead concentrate on your home. You are standing in front of your front door.In your mind look down at your body legs and arms. Wiggle your toes - shake your arms. Feel your self doing it in your mind. Remember this is all in your imagination don't actually do it.

Now walk up to the door and open it like you normally do.Is the hall light on or off ? If it is off switch it on.Walk through to the kitchen. On the kitchen table you see a plate with a crunchy peanut butter sandwich and a glass of milk. Pick up the glass of milk and feel how cool it is.

Drink the milk as quickly as possible.Pick up the sandwich. Is the bread brown or white ? Take just one slow bite out of the sandwich and notice your teeth crunching the peanuts.Try to hear the crunching sounds in your head.Go out of the kitchen and back into the hall and run to your bedroom.

PAUSE

Push your door open ! Slam it shut ! Its alright there is nobody in the house to get annoyed at you, they are all out at work or in school. Open it and slam it shut again and feel how your room shakes a little.Open your bedroom door normally and go back to the front door.Did you leave it open when you came in or has it been shut ? Open it if it is shut and look out your front door. What do you see?Step out side and feel a breeze in your face. As you stand there take five deep breaths like you did in the beginning taking care to let your tummy go in and out.

PAUSE

You can still feel the refreshing breeze on your face.Take another five deep breaths but when you get to number three, open your eyes and finish the breathing.

PAUSE

That is the end of the first exercise.

Exercise 2: Visual Imagery

This is the second exercise in imagery which if you remember is the use of your imagination to try to make pictures in your head (this is often called imagery). It is a simple exercise that you can do any time as you don't always require a quiet place and all you need is a hand held object. For this exercise you need your favourite cup or mug. If you don't have it then stop the tape whilst you fetch it. In this exercise you will be comparing the real sight and feeling of the mug, to your imagery of the mug. Sit in a comfortable position and place the mug where you can easily study and look at it. Notice:

the outline it makes.

the texture (rough or smooth)

the colour

the shading and reflections off it

any patterns on the mug

in fact anything that you might need to look at if you were an artist trying to draw the mug.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together

Now close your eyes and try to see the mug in your head. Try to remember everything that you considered when you were looking at the mug. In your imagination reach out your hand and try to touch the mug to see what it feels like. Open your eyes and really reach out to see what it feels like. Did it feel the same? Close your eyes again and see the mug. What is its shape? Can you see the patterns painted on the mug ? Open your eyes to reconfirm what you see in your mind is fairly true to the real mug. Keep doing this sort of thing until you feel you are quite good at being able to "see" the mug in your head. Stop the tape if you want to do this several times.

(Mental rotation) Close your eyes and see the mug in your mind. Try now to either move around the mug (for instance imagine you are moving clockwise around the mug). Do it slowly and try to picture it like a movie film. After you have moved a little way around open your eyes and turn the mug around to the same position. Does it look the same to the picture you made in your head ? Did the handle of the mug move too ? Did the pattern change correctly ? Try this a few more times - You will need to stop the tape.

(Zoom) In your imagination try to imagine that you are becoming smaller and smaller until you have a "fly's eye" view of the mug. Pretend now that you are a fly that is sitting before your very large mug. Notice how the mug's texture is a lot rougher. Now try flying around the mug and fly right through the mug's handle.

Wait 10 seconds

Try flying into the mug until you reach the bottom of the inside. Take a good look around - what can you see above you ? Can you see any coffee or tea stains on the inside of the mug? Now fly out of the mug and grow to your normal size. Open your eyes and try to recreate what you saw as best you can by holding the mug as close to your eyes as possible - turn it the way you flew over it in your imagination. Does any of it look similar to what you saw in you mind's eye. Can you see anything that you hadn't noticed before.

(Summary): In this exercise you to looked at a familiar hand held object, your favourite mug, and you tried to see your mug in your mind with your eyes closed. You opened your eyes to compare your image to the real mug. You also rotated the image in your mind and compared this to the real object being rotated. This exercise can be practiced anywhere at any time with any object that you choose. Try this exercise with at least three other objects over the next three days. This is the end of the second exercise.

Imagery Training 3: Kinesthetic Body Sense

In this exercise you will be asked to do a mixture of real actions and then to use your imagery of those actions. You will always be doing the action for real, then you will usually be doing the imagery of the action you just performed.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

Now start to focus on your body especially how it feels. You may find it helpful if you close your eyes so that your are not distracted by what you see. Become supersensitive to every movement that your body makes. If you are still following the first instructions that I gave you then you should still feel how your tummy is going in and out. Notice now how your arms and shoulders feel.

Actually start to bring your right arm out to the side of you until it reaches right above your head. Really stretch and point your fingers upwards - you should feel the sides under your arms stretching.

Do the same again with your left arm and try to really concentrate on how the muscles feel when you do this.

Do the same again for the right arm and really concentrate on how the muscles feel.

You are now going to try to image this movement. **WITHOUT** moving your right arm, try to imagine the feelings you had when you really did move it just a moment ago. Recreate how some of your arm muscles are pulling and others must relax in order to raise your arm.

Do the same again for your left arm by first moving it sideways and upwards and then try to get the same feelings **WITHOUT** moving your arm.

Actually stand up - notice how your feet feel pressing on the floor. You may not pay attention very often to how your feet feel in this way so it may feel quite peculiar.

Take a step forward and notice all the leg muscles that you must use.

Notice how the pressing of the floor on your feet disappears when you lift your foot and how it reappears when you put your foot down again.

Take a step backward notice how this feels. Try to remember exactly how it feels.

Sit down now and try to imagine exactly how it feels to take a step forward.

Imagine you are taking a step back. Can you feel your muscles as if they were working to take a step backwards.

For the last exercise actually stand up and raise your hands above your head, stretch your whole body upwards so that you go up onto your toes. Notice exactly how the whole of your body feels - your feet muscles working to keep you on your toes - your tummy, chest and back are really stretched - your hands trying to touch the ceiling.

Sit down now and when I tell to you are, **WITHOUT** moving your body, going to try to imagine yourself standing up and stretching up towards the ceiling exactly like you were doing a moment ago. This time I have asked you to imagine a movement that you have not specifically concentrated on - namely standing up out of your chair. Try imagining "the stand up and stretch" now!

(Summary): In this exercise you were asked to try moving parts of your body with your eyes closed and to concentrate on exactly how it feels to do this. I then asked you to WITHOUT moving your body, try to remember and imagine exactly what it feels like to do the same movement. In your own time you might like to try practicing this special type of imagery with other parts of your muscles such as in your hand or finger movements, or jumping straight up and down with both feet, or lifting your knee as high as it will go and so on.

This is the end of the third exercise.

Shooting Scripts

Exercise 4: The Tube

I want you to think about trying to slow your heart and breathing. Pretend in your mind's eye that you are in your shooting position, holding your rifle. With each breath that you take see yourself taking a similar breath in your mind's eye. Let each breath be just a little deeper than the last one.....

Let your breathing become slower still and then gradually start to listen to your heart. Again see yourself in your shooting position and pretend that this body that you see in your mind's eye, is gradually slowing down and relaxing. Picture your heart in your body and watch it getting slower ....

As you watch and feel your body slow down, I would like you to image a thin gossamer tube gradually extending from the centre of the target right up to the end of the rifle barrel. In your minds eye there is now a system which consists of the rifle and an almost invisible tube that extends beyond the end of the rifle and right up to the target.The tube can be solidified for short moments of time - the bullet's path is constrained to the tube for this short moment. Because the tube is only rigid for part of the time, it is susceptible to wind conditions say, which would gently curve the tube in the wind direction.Get used to the idea of this tube being an extension of the rifle. It is so light that you do not feel the weight of the tube. It extends from the aiming mark on the target to the end of your rifle. Whilst it is light and flexible for most of the time, it can be temporarily solidified to constrain the bullet to the tube, to ensure that it hits the centre of the target.Whilst you continue with this I want you to picture your body gradually merging into the rifle. Let the boundaries between you and the rifle gradually dissolve. With each passing breath, you see and feel your body, that is in your minds eye, and the rifle gradually become one system.Practice this image until you feel balanced and comfortable with it, and then bring your mind back to the here and now.

Exercise 5: Become one with the system

I want you to slow your heart and breathing like we did in the last exercise. Do this by seeing your body in your normal shooting position. As you slow your breathing - feel and possibly see your heart slow ....

Feel that you are now part of a larger system which includes you, your rifle and a thin but strong tube which extends from the end of the rifle barrel to the centre of the aiming mark of the target.I would like you to continue this feeling of being part of a larger system, by also allowing your body to merge into the firing point surface.You are now totally connected to the firing point surface, the rifle has become an extension of your body and extended from your rifle is a light flexible thin tube extending up to the aiming mark.Concentrate now on feeling that this system (of which you are now a part) should feel balanced and in equilibrium.I would like you to decide on a metaphor for how to image your body when you are trying to become as still as possible - for instance you might think of your body as being a strong living tree such as an oak, or that your body turns into dense but living granite.Continue to keep your muscles relaxed and at the bottom of each breath I want you to imagine that - just for a moment - a wave of solidification runs from the end of the target , along the length of the thin tube and eventually along the rifle, into yourself and the firing point surface. The system either turns into oak or crystallizes into granite. At the bottom of each breath this solidifying "wave" turns the complete system into living but solid and heavy tissue.You may find at first that the wave does not extend through your system fast enough. Concentrate on letting this wave roll through the system faster and faster - remember that although you continue to relax your muscles, you are just making yourself more solid. Let this warm solidifying wave spread so that eventually (for just a few moments), you feel that the whole system turns into living but solid tissue (oak or granite for instance).Practice this for the next few minutes and then gradually bring your focus into the here and now.

Exercise 6: Suspend time

I want you now to try and achieve the same state relatively automatically that you were doing at the end of the last exercise. I will read off the list of things you should be achieving - with each item try to achieve that state as quickly as possible.See yourself and your rifle in your shooting position...

Slow your breathing and heart.Extend the system so that it includes an almost invisible tube that extends from the aiming mark of the target and goes right up to the end of the rifle barrel.With each breath gradually let your body awareness extend into your rifle and firing surface - there is no longer a division between you, your rifle or you and the firing point surface - everything becomes one balanced system.At the bottom of each breath - whilst continuing to relax - let a solidifying wave roll from the target along the thin tube into the rifle and your body and into the firing point surface into living but solid and dense tissue.At the bottom of each breath when the system (for a moment) have become solid, I want you to try to re-experience time...... do this by, without counting, trying to become really aware of time "passing"....

What I hope you felt was that you cannot feel time, it is not a sensation like weight or length can be, you did not actually "feel time passing" - I hoped you felt that time as we understand it became "timeless". If you did not experience this then try this exercise again and try to experience this "timelessness" at the bottom of each breath as you "solidify" into either granite or oak.Continue this for a while and then I want you to imagine that you do not actually experience "releasing" the trigger - rather you know there is a time when the trigger is not released and a time afterwards where it has been. You are not specifically aware of actually releasing the trigger.Remember all this is going on only in your head. You are imaging yourself in your shooting position. You, the firing surface, the rifle and a tube from the rifle, and going right up to the aiming mark of the target - are one system - your breathing and heart are slow but going at their optimum pace for your shooting. At the bottom of each breath you "solidify" into oak or granite and at that moment time does not "flow" - you only experience a time when the trigger was not released and a time after when it was.Try doing this again and this time I would like you to follow the bullet through the temporarily solid tube, right into the centre of the aiming mark.Practice this now for the next few minutes and then slowly bring your mind back to the here and now

Trampoline Scripts

Exercise 4: Internal Imagery

For this exercise you will try to use your imagery as if you were really there inside your body practicing using the trampoline. You will image doing 10 timed bounces and in addition you will image doing your favourite and your least favourite moves or tricks on the trampoline.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

During this exercise when I give you instructions I want you to start to follow them but continue to listen to what I am saying. Start to think about the trampoline hall where you bounce and the sounds associated with your bouncing. Close your eyes but continue to imagine the trampoline hall in your minds eye. Now you want to see yourself warming up next to the trampolines. What are you wearing, who else is there from the club?

Watch yourself stretching your muscles like you do in the real training session. Move closer and closer to yourself until you merge with yourself and you find yourself actually there in the trampoline hall just finishing your warm up.Now that you are there in the trampoline hall, you see everything from your point of view and can feel you muscles working as they really would do. Remember to follow my instructions as I speak to you. We are going to concentrate on the height and accuracy of your bounce. I want you to aim for two things when you start to feel your self bouncing - firstly you are going to feel yourself bounce consistently higher and secondly you are going to bounce if not exactly on the centre cross then at least very near it. You will feel very safe and secure despite the fact that you will be bouncing much higher than usual.

First imagine yourself climb onto the trampoline. Feel the texture of the bed under your feet.Warm up by doing a few bounces to shake your legs off and start to move your arms a bit. Remember that you are looking at everything from your point of view, looking out from your eyes. Can you see your spotters either side of you? What are you spotting at when you bounce?Continue to bounce and do a few simple tricks if you want, to continue to warm up and try not only to see the world from your head's point of view but also start to feel your muscles tensing and relaxing as they really would do if you were really bouncing. Can you hear the bed and the springs making their usual creaky and elastic sounds?Now you are getting ready to try and time yourself to do 10 timed bounces. You can see your coach by the side of the trampoline with the stop watch. Start to bounce higher and higher. You can feel your arm muscles stretching up to the ceiling as you reach the top of the bounce. You feel your legs bending quite a lot and you drive off the bed much harder than you usually do. To make sure you straighten your legs you feel you knees push backwards and your toes very tightly pointed towards the bed.When I say "Begin !" I want you to imagine yourself almost ready to start the timing and you will tell your coach "1...2...3....GO!" Remember you should feel and see this happening as if you were really there doing it. Concentrate on two things: firstly you will be bouncing much higher than you normally do and secondly you will be very accurate on landing on the or very near to the cross. Ready? BEGIN!

WAIT FOR 50 SECONDS

You are going to try to image four more tricks for fun - two each of your least favourite and your favourite tricks.Try your least favourite first. What particular point in the trick makes it the least favourite one?Now concentrate on these three points whilst trying it - firstly drive off the bed hard, but smoothly and confidently. Secondly as you lift off the bed make sure you are looking up so that you don't snatch the top off your trick. Lastly, the difficult part becomes very easy. Ready ? Now try it in the next 10 seconds.

10 seconds

Do exactly the same concentrating on pushing, looking up as you leave the bed and letting the difficult part of you trick become very easy.

10 seconds

Now try your favourite trick. Why is it your favourite? Concentrate on height and accuracy off and onto the bed and your favourite aspect of the trick. Ready? Try it!

Try this trick just one more time and as you feel yourself do it, you know that you look great and couldn't do it any better. Ready? Try it!

10 seconds

Slow your bouncing down.As you stop and climb off the trampoline, you feel refreshed but excited as start to warm yourself down by loosely shaking your legs and arms.This is the end of the fifth exercise.

Exercise 6: Bizzare Imagery for Trampolining

This is the sixth and final exercise in which you will be trying to use "bizzare imagery" in mentally rehearsing some trampolining exercises. I want you to imagine that you are bouncing on the trampoline which has a constricting tube hovering on the centre of the bed. The tube is semi-transparent so that you can clearly see someone bouncing inside it and yet you can clearly see the tube around the trampolinist. This tube is barely wide enough to let you bounce straight up and down in it. The tube will allow yourself to perform tricks and widens to increase your wider body width (the tube becomes oval in the case of doing a straight somersault. The purpose of this tube is to force you to bounce on the centre spot every time. If you accidentally bounce sideways you will rebound harmlessly off the sides of the tube and hence remain over the centre of the trampoline bed.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

Now concentrate on seeing your own body next to the trampolines. You notice that you are wearing your usual clothes that you use in your real training. For the next 10 seconds see yourself just finishing your warm up exercises.

10 seconds

See your self now climbing onto the trampoline. Watch how you warm up on the trampoline.

20 seconds

Notice driving into the bed and how you focus on your spot in front of you.As you watch yourself bounce up and down you become aware that the tube starts to materialize around your body and you become constrained in your horizontal travel.As you see yourself bounce you will see yourself shake your legs off and move your arms around a bit but you waver very little from the centre of the bed.See yourself getting ready to do your 10 timed bounces. You can also see your coach standing next to the trampoline with the stopwatch. Watch how no matter how hard you push off the bed the tube magically keeps you in the dead centre of the beds you watch yourself you become aware of the fact that you rebound off the sides of the tube much less than at the start of this exercise and the tube is becoming more and more transparent. You are about to try a routine of your choice.When I say "Begin!", you will see yourself almost ready to begin the routine and when you are ready you will hear yourself tell your coach,"1....2....3....GO!"Ready to start ? Begin!

Wait for 50 seconds

The tube slowly dissolves and is replaced instead by a thin strand of light that runs through your centre of gravity. Your centre of gravity can only go up and down this beam of light, you can only decide to bounce higher or lower. Notice that because it is a beam of light that is somehow attached only to your centre of gravity it does not affect how you move about your centre of gravity so you can still do all your tricks on the trampoline such as somersaults and twisting movements. Notice that like the tube, no-matter what you do you never move off the centre of the trampoline.

10 seconds

Watch yourself slow down your bouncing and notice how excited but at the same time refreshed you look as you climb off the bed and start to warm yourself down by loosely shaking your arms and legs.This is the end of the sixth exercise.

Juggling Exercises

MOTIVATED "as if" GROUP INSTRUCTIONS

Introduction Talk

In the past there have been claims made that there are certain mental actions that can be taken in order to improve physical performance on some task, such as juggling. Whilst these claims may or may not be true there have been claims made that the increased learning effects seen are just due to increased motivation. What you as a group are going to try to do is to "pretend" that you have received some sort of enhanced mental training that will help you to learn better and to eventually juggle really well. It is very important for you not to try and think about the juggling during these special sessions, I just want you to imagine that at the end of this session you have received some sort of mental training which will radically improve your learning and performance than if you had not had this imaginary training. Before each of these sessions I will try to help you to relax. I will then play some music and I want you to mentally count backwards from 999 n multiples of 7 i.e. the next number would be 992. You are provided with some paper and a pencil to note where you got to, at the end of the session and can continue from that number if you wish or start again and see if you can get as far or further. A score card at the end gives all the possible numbers you could have had so you can check to see how good you are. Do not worry whatever happens you will learn how to juggle by the end of the session, so please try to follow the instructions. It is not clear what type of training is better to learn a task like this that is why we are doing the research.

Session 1:

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

Here is your first snatch of music, as soon as the music starts, start counting backwards from 999 in multiples of seven. When I say stop record the number that you got on your piece of paper.

WAIT FOR A SONGS WORTH AT LEAST

STOP !

Now when you go to practice the first step remember that you have got to pretend that you have just received some great mental training that will help you master this first step really well.You are trying to throw the bag from one hand to the other in a perfect arc, and with your eyes focussed at the top of the arc.

SESSION 2

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.Here is your second snatch of music, as soon as the music starts, start counting backwards from 999 or if you like from where you left off last time, in multiples of seven. When I say stop record the number that you got on your piece of paper.

WAIT FOR A SONGS WORTH AT LEAST

STOP!

Now when you go to practice this next step remember that you have got to pretend that you have just received some great mental training that will help you master this step really well.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Throw the second bean bag under the top of the arc of your first bag which is in flight. Remember to be able to throw your first bean bag from both your right and your left hand.

SESSION 3

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

Here is your final snatch of music, as soon as the music starts, start counting backwards from 999 or if you like from where you left off last time, in multiples of seven. When I say stop record the number that you got on your piece of paper.

WAIT FOR A SONGS WORTH AT LEAST

STOP!

Now when you go to practice this final step remember that you have got to pretend that you have just received some great mental training that will help you master this last step really well.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Start off doing the 2 bag juggle keeping the third bag in one of your hands.When you feel confidant throw the third bag in, exactly as if it were a 2 bag juggle and stop (that is one cycle). Whenever you can do this starting from both hands try to add another cycle. Build up your cycles as you see fit.

Imagery Training Group

Introduction Talk

Introduction Imagery is the ability to be able to sense something inside your head without using your sense organs. The best way to describe it is to ask you to follow my instructions. Just take a few deep breaths to get rid of any tension.You might find it easier to close your eyes for these exercises. I want you now to try and see in your minds eye, a vision of yourself sitting on top of a mountain. In front of you is a white handkerchief, on which there are many, different coloured stones.Watch now how you pick up a stone. What colour is it ?See yourself throw the stone off the mountain, and follow the stones path off the mountain top.Now I want you to change your perspective of the same scene by moving behind the image your body and then let your perspective merge and become the same as that of the body that a few moments ago you were watching.You are now inside the body and can feel the body sitting on top of the mountain. Can you see the handkerchief with the coloured stones on it ?Select another stone and see and feel yourself pick up this stone. If you like, let this particular stone represent a worry or a concern you have at the moment.Now throw it off the mountain and watch its downward path for as long as you can.Bring your mind back to the here and now, and open your eyes. If you had even the vaguest feeling of these scenes that I was talking about, then you were experiencing Imagery. We are going to be using imagery to help you learn how to juggle. Before each step I am going to get you to relax and then try and guide you through the imagery exercise. If you found looking at your body easier, then you preferred EXTERNAL VISUAL imagery. The view from inside your body is called INTERNAL VISUAL imagery. Feeling your body move is referred to as KINESTHETIC imagery. I would like you to use whatever perspective you find easier or enjoy the most. When you are asked if you used any strategy when completing the tests, try and state which perspective you were using for the majority of the time.

SESSION 1

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

If you find it easier then close your eyes. Picture yourself or from within your own body trying to copy the movements that you saw on the video. Let us start with ball in your left hand. Throw it up in a nice perfect arc, and catch it with your right hand.Now do the same from your right hand to your left hand. Try to keep your eyes focussed at the top of the arc, the point of which is probably just above your head. Try doing the same again, first with your left hand to your right and then from your right to your left. Concentrate on doing this movement as many times as you can until I say stop. Remember to keep focusing at the top of the arc.Ok, bring your mind to the here and now. That is the end of this first session. Remember. You are trying to throw the bag from one hand to the other in a perfect arc, and with your eyes focussed at the top of the arc.

SESSION 2

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

You may find it easier to close your eyes. In your mind make a picture of you holding two bags. Throw one of them and as it reaches the top of its perfect arc, throw the other bag UNDERNEATH the flight of the first bag.See yourself do exactly the same but this time change the hand which throws the first bag. Again notice the perfect arcs you are throwing and how your eyes are still focussed at the top.Do the same again as many times as you can until I say stop, always alternate the hand that throws the first bag. Ok, bring your mind to the here and now. That is the end of second session.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Throw the second bean bag under the top of the arc of your first bag which is in flight. Remember to be able to throw your first bean bag from both your right and your left hand.

SESSION 3

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

You may find it easier to close your eyes. Make a picture now of yourself holding two of the bags in one hand and the third in the other. Just practice throwing the two ball throw, keeping the second bag in the one hand. Again notice how you are throwing perfect arcs and focusing at the top of those arcs.Try it again, just do the two ball juggle keeping the second bag in one hand.In your mind place two bags in the other hand and repeat the exercise.This time I want you to see yourself throw the third ball in and then stop, so that two balls start in one hand and then finish in the other hand. You are not doing anything fundamentally different to the two ball juggle.Try this exercise as many times as you can until I say stop.Ok, bring your mind to the here and now. That is the end of final session.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Start off doing the 2 bag juggle keeping the third bag in one of your hands.When you feel confidant throw the third bag in, exactly as if it were a 2 bag juggle and stop (that is one cycle). Whenever you can do this starting from both hands try to add another cycle. Build up your cycles as you see fit.

Subliminal Perception Training Group Introduction Talk

Introduction In the past there have been claims made about the use of subliminal perception to help people change their behaviour. In case you never heard of subliminal perception let me explain what it is and how it is supposed to work. Research has shown that people can pick up stimuli from the environment that are not consciously aware of. There are all sorts of psychological and physiological reasons for how this might occur, however the reasoning is that having picked up this information it appears that we can use and act on this information unconsciously, that is we are not consciously aware of why we might behave in a certain way. This has been put to various uses by recording a suggestive message or a scene with such a weak signal that we are not consciously aware of it. The signal is still supposed to be picked up even if there is much stronger signals overplaying the subliminal message. For instance, an audio tape has music recorded onto it, on top of this recording a very weak messages to help you learn to juggle is recorded. Or a nature film has the suggestive word "Relax" flashed up so quickly that you are not consciously aware of it, you might then find yourself quite relaxed after this clip. Uses of subliminal perception include advertising, self help courses in relaxation or new age thinking, as a memory aid for remembering facts etc. etc..I want to re-assure you now that the tape you are about to hear cannot force you to do anything you do not wish to already do. As you have signed up to learn how to juggle, so this tape is specifically designed for you quickly learn how to juggle. Of course all you will hear is some hopefully pleasant music. Before each snatch of music I will give you instructions to relax as this makes the effects from the tape much stronger.

SESSION 1

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.Try not to think of anything special, instead just immerse yourself into this piece of music you are about to hear.

WAIT FOR A SONGS WORTH AT LEAST

STOP !

Hope you enjoyed that, try now to come fully awake as usually the tape has the effect of letting people become a bit sleepier than they were before.Remember. You are trying to throw the bag from one hand to the other in a perfect arc, and with your eyes focussed at the top of the arc.

SESSION 2

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.Here is your second snatch of music, as soon as the music starts, start counting backwards from 999 or if you like from where you left off last time, in multiples of seven. When I say stop record the number that you got on your piece of paper.

WAIT FOR A SONGS WORTH AT LEAST

STOP !

Now when you go to practice this next step remember that you have got to pretend that you have just received some great mental training that will help you master this step really well.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Throw the second bean bag under the top of the arc of your first bag which is in flight. Remember to be able to throw your first bean bag from both your right and your left hand.

SESSION 3

When I say begin I want you to take 5 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 3 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your third breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.Here is your final snatch of music, as soon as the music starts, start counting backwards from 999 or if you like from where you left off last time, in multiples of seven. When I say stop record the number that you got on your piece of paper.

WAIT FOR A SONGS WORTH AT LEAST

STOP !

Now when you go to practice this final step remember that you have got to pretend that you have just received some great mental training that will help you master this last step really well.Remember the key points, you continue to throw perfect arcs and keep your eyes focussed at the top of the bean bags flight. Start off doing the 2 bag juggle keeping the third bag in one of your hands.When you feel confidant throw the third bag in, exactly as if it were a 2 bag juggle and stop (that is one cycle). Whenever you can do this starting from both hands try to add another cycle. Build up your cycles as you see fit.

Gymnastic Beam Script

Exercise 4: Internal Beam Routine

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

I want you for this exercise to concentrate on your beam routine as if you were actually there inside your own body. Become aware of what the scenery looks like from your point of view and how your body feels. You are standing in a gymnastic hall near to the beam before you do your routine. Look down and see your arms and body, you are wearing your competition or your favourite leotard.

Get ready now to see and feel yourself do your beam routine. Before you actually image it, briefly consider all the moves that you are going to do. When you are ready try to image your routine at about **normal speed.**

[WAIT]

I want you to do the routine again but this time paying special attention to the position of your hips and lower back. Whilst you do the routine I would like you to feel that your **lower back is flat**, your **hips** will be **tilted forward** and slightly **tucked under**. When you image the routine you will not be able to notice much difference as to how the scene looks so you have to concentrate on the feeling - remember you are taking an internal perspective and you are concentrating on feeling that your back is flat and your hips are tilted forward and tucked under. Try it now - again at normal speed if you can.

[WAIT]

Once again I want you to do your beam routine from an internal perspective making sure that you can feel a **flat back** and **hips tilted forward** and **slightly under**. In addition I would like you to see and feel that every time you finish an acrobatic move on the beam, (such as a handstand), you **stand right up out of the beam**, arms next to your ears and in line with the rest of your straight body, whilst you mentally tell yourself to **"Stick!"**. Concentrate on doing the routine with special attention to the two points, good back and hip position and standing up out of acrobatic moves and telling yourself to "Stick!". Try this at normal speed if you can.

[WAIT]

When you image your next routine, I want you to include everything you concentrated on the last time but this time I would like you to make sure that you feel in balance and that you are looking and **focussing** on your chosen focus spot - such as the end of the beam of closer to your feet if this is what you prefer. You must still try to remember to keep a **good back** and **hip position** and always **stand up** out of your acrobatic moves saying "**Stick!**" to yourself arms in next to your ears and in line with the rest of your body, but also be conscious of **focussing** at your focus spot.

[WAIT]

This is the last time I want you to image your routine. Like the last routine I would like you to see and feel all the elements such as back and hip position, standing up out of moves and focussing at your chosen focus spot either at the end of the beam or nearer to your feet. For this last time I would like you to also feel that your **dance skills** are working really well - it feels and looks **dynamic** and **rhythmical** - when your arms are spread wide, your shoulder blades are touching although you still feel that your hips and back are still in the correct position. Remember that you are still taking an **internal perspective** and that you are observing the scene as if you were really there and feeling your body and muscles move as they really would do in that situation. Try again if you can, to do the routine at normal speed and incorporate all the elements together - **flat back, hips tilted forward** and **tucked under, standing up** out of acrobatic moves arms by ears in straight lines with the rest of your body and saying "**Stick!**" to yourself, **focussing** at the correct place and letting your dance skills being **rhythmical and dynamic** - let your **shoulder blades touch** when your arms are extended apart.

[This is the end of the exercise]

Exercise 5: External Imagery for the Beam

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

I want you for this exercise to concentrate on your beam routine as if you were somebody else looking at your own body. Notice you are standing in a gymnastic hall near to the beam before you do your routine. Look and see you are wearing your competition or your favourite leotard.

Get ready now to watch yourself do your beam routine. Before you actually image it, briefly consider all the moves that you are going to do. When you are ready try to image your routine as if you were somebody else watching you do your routine at about **normal speed.**

[WAIT]

I want you to see the routine again but this time paying special attention to noticing the position of your hips and lower back. Whilst you do the routine I would like you to see that your **lower back is flat**, your **hips** are **tilted forward** and slightly **tucked under**. When you image the routine you will notice you maintain this position for most of your routine. Try it now - again at normal speed if you can.

[WAIT]

Once again I want you to do your beam routine from an external perspective making sure that you yourself with a **flat back** and **hips tilted forward** and **slightly under**. In addition I would like you to see that every time you finish an acrobatic move on the beam, (such as a handstand), you **stand right up out of the beam**, arms next to your ears and in line with the rest of your straight body, whilst you mentally tell yourself to "**Stick!**". Concentrate on doing the routine with special attention to seeing the two points - good back and hip position and standing up out of acrobatic moves and telling yourself to "Stick!". Try this at normal speed if you can.

[WAIT]

When you image your next routine, I want you to include everything you concentrated on the last time but this time I would like you see yourself in balance and notice that you are looking and **focussing** on your chosen focus spot - such as the end of the beam of closer to your feet if this is what you prefer. You must still try to remember to see a **good back** and **hip position** and watch yourself always **stand up** out of your acrobatic moves saying "**Stick!**" to yourself, arms in next to your ears and in line with the rest of your body, but also to see yourself **focussing** at your focus spot.

[WAIT]

This is the last time I want you to image your routine. Like the last routine I would like you to see yourself doing all the elements such as showing a good back and hip position, seeing yourself standing up out of moves and focussing at your chosen focus spot either at the end of the beam or nearer to your feet. For this last time I would like you to see your **dance skills** looking **dynamic** and **rhythmical** - when you see your arms spread wide, your shoulder blades should be touching although you still see that your hips and back are still in the correct position. Remember that you are still taking an **external perspective** and that you are observing the scene as if you were another person watching your own body do all the moves. Try again if you can, to see the routine at normal speed and watch all the elements working together - **flat back, hips tilted forward** and **tucked under, standing up** out of acrobatic moves arms by ears in straight lines with the rest of your body and saying "**Stick!**" to yourself, **focussing** at the correct place and watching your dance skills being **rhythmical and dynamic** - see your **shoulder blades touch** when your arms are extended apart.

[This is the end of the exercise]

Imagery Scripts for Gymnastic Vaulting

(Exercise 4: Internal Imagery for vaulting)

For this exercise you will try to use your imagery as if you were really there inside your body doing your vaults. You will image in this exercise, doing your vault several times.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

During this exercise when I give you instructions I want you to start to follow them but continue to listen to what I am saying. Start to think about the practice hall where you do your vaulting. Imagine the sounds associated with it. Close your eyes but continue to imagine the hall in your mind. You are looking at the gymnastic hall as if you were really there, looking from inside your own body. You are warming up and really feel yourself becoming warm as you stretch your muscles. If you look down at yourself can you see what you are wearing? Can you see your friends from the club warming up next to you?Remember you are inside your own body looking from inside your head and you can feel your muscles moving. In a moment you are going measure out your run up by doing a few practice sprints from the spring board away from the horse. When you are sprinting feel your legs moving fast and your arms pumping powerfully up and down. See whatever is straight ahead coming closer and closer. Ready to try it? Ok try it a couple of times in the next few moments from the springboard!

Wait 10 seconds

How did that feel ? Could you feel yourself running as fast as you can ?When you do a vault I want you to concentrate on feeling yourself going high off the horse. To help you get that feeling I want you to walk over to the horse and stand on it looking down at the crash mat. This is how high you are going to jump off the horse.Now we are going to try a to do your vault 5 times. For this vault remember that you are going to go "on low and off high". To do this I want you to concentrate on your sprint - feel your arms pumping and your legs moving fast as you jump onto the springboard. Ready ? Try it !

Wait 10 seconds

Did you feel yourself go high off the horse ? Feel yourself walk back to the start of the run up position as I continue to talk. You are going to try the vault once more. This time I really want you to go for the height by concentrating on doing three things. Firstly you are going to sprint fast but in control. Secondly you are going to kick your heels up fast as you leave the spring board. Thirdly you are going to stretch your arms forward so that you touch the horse as a soon as possible. Ready ? Try it!

Wait 10 seconds

Did that feel any higher ? Did you kick and reach ? As you walk back to try the run up starting position I want you to fix in your mind that you are going to see and feel the following things as if you were really there in the gymnastic hall. Your sprint is fast and controlled to make you go "on low", you kick and reach as you leave the springboard and shortly after your hands touch the horse you are going to push off hard by shrugging your shoulders so that your shoulders go up to your ears. Ready ? Try it!

Wait 10 seconds

Did you notice yourself going higher ? Did you really feel yourself push through the shoulders as you left the horse.Walk back to where you start your run up and you are now going to concentrate on feeling and seeing all the things we have concentrated on so far. When you are ready you are going to run fast so that you can go "on low" and allow you to come "off high". You are going to "kick - reach - and push". The whole vault will feel like you are "popping" off the horse. Ready ? Try it!

Wait 10 seconds

If you felt everything like I described then you should have felt how much higher you came off the horse - this also makes you travel further. You are going to try the same as last time - "on low - kick - reach - push - pop" and I want you to notice how easy it is to do the vault because of your height. You have much more time to actually do the vault and because of that you have much more time to spot your landing correctly. Ready ? Try it !

In this exercise you tried to feel and see everything as if you were really there inside your body. You practiced your vault 5 times, each time concentrating on something slightly different but always trying to feel and see yourself go higher. This is the end of the fifth exercise.

Exercise 5: External Imagery for Vaulting

For this exercise you will try to use your imagery as if you were another person looking at yourself doing your vaults. You will image in this exercise, doing your vault several times.

When I say begin I want you to take 8 deep breaths. At first use only your tummy to fill your lungs and then gradually start to use your chest as well. Let each breath be just a little deeper than the last one. Ready? Begin !

When I say begin, take another 5 deep breaths and with each breath relax a part of your body beginning with your legs - by the time you get to your fifth breath you should be relaxing your head muscles. Ready ? Begin !

Are you relaxed ? If you are then check to see if your upper thighs, shoulders and jaw muscles are relaxed. If not then relax each of these in turn. Let your legs relax, your shoulders drop and your teeth should be slightly apart or very lightly together.

During this exercise when I give you instructions I want you to start to follow them but continue to listen to what I am saying. Start to think about the practice hall where you do your vaulting. Imagine the sounds associated with it. Close your eyes but continue to imagine the hall in your mind. You are looking at yourself in the gymnastic hall watching how you are. Can you see what you are wearing? Can you see your friends from the club warming up next to you?Remember that in your minds eye you are somebody else looking at your body doing all the gymnastics. In a moment you are going to watch yourself measure out your run up by doing a few practice sprints from the spring board away from the horse. Watch your legs moving fast and your arms pumping powerfully up and down. Ready to try it? Ok try it a couple of times in the next few moments from the springboard!

Wait 10 seconds

How did that look ? Could you see yourself running fast but in control ? You are now going to watch yourself do your vault 5 times.Whilst watching yourself do a vault I want you to concentrate on seeing yourself going on low onto the horse and then high off the horse. To do this I want you to concentrate on seeing your sprint like you did when you measured out your run up and watch how you jump low onto the board so that you bounce off the board forward very fast. Ready ? Try it !

Wait 10 seconds

Did you see yourself go high off the horse ? Watch yourself walk back to the start of the run up position as I continue to talk. You are going to try the vault once more. This time I really want you to see yourself go high by concentrating on seeing three things. Firstly you are going to sprint fast but in control. Secondly you will see yourself kicking your heels up fast, as you leave the spring board. Thirdly you will notice how you stretch your arms forward so that you touch the horse as a soon as possible. Ready ? Try it!

Wait 10 seconds

Did you see yourself kick and reach ? Watch as you walk back to try the run up starting position and fix in your mind that you are going to see the following things. Your sprint will be fast and controlled to make you go "on low", you will "kick and reach" as you leave the springboard and shortly after your hands touch the horse you will see yourself pushing off hard from the horse by shrugging your shoulders so that your shoulders go up to your ears. Ready ? Try it!

Wait 10 seconds

Did you notice yourself going higher ? Did you really see yourself push through the shoulders as you left the horse. As you walk back to where you start your run up and you are going to notice seeing all the things we have concentrated on so far. When you are ready you will watch a fast sprint so that you will go "on low" and come "off high". You will see yourself "kick - reach - and push". The whole vault will look like you have "popped" off the horse. Ready ? Try it!

Wait 10 seconds

If you saw everything I described then you should have seen how much higher you came off the horse - this also makes you travel further. You are going to watch the same as last time - "on low - kick - reach - push - pop" and I want you to notice how easy it looks to do the vault because of how high you came off the horse. You will see that you have much more time to actually do the vault and because of that you have much more time to spot your landing correctly. Ready ? Try it !

Wait 10 seconds

In this exercise you tried to pretend you were somebody else looking at yourself doing your vault. You watched yourself practice your vault 5 times, each time concentrating on something slightly different but always trying to see yourself go higher.

This is the end of the fourth exercise.

Appendix III

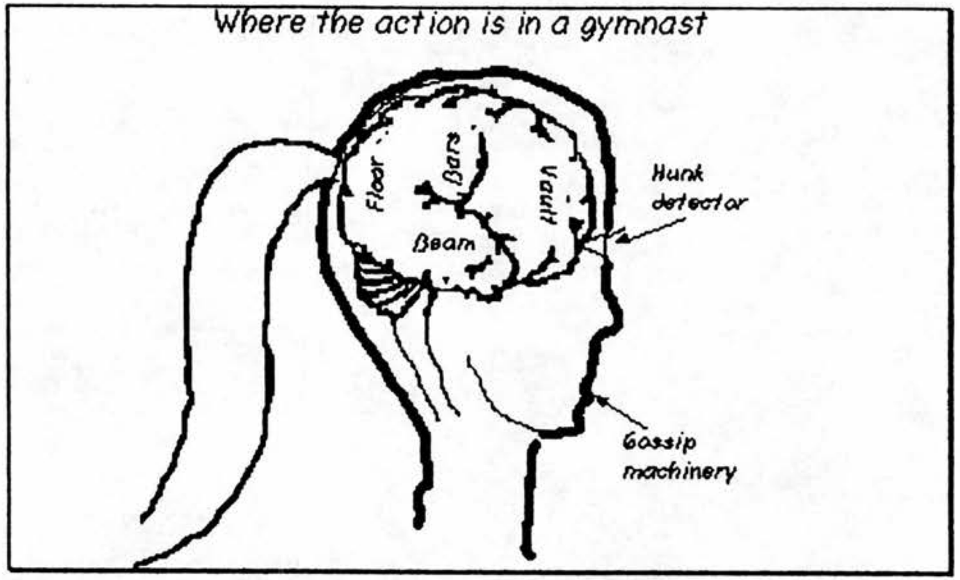
The following booklet was produced to implement a more general mental training programme for female gymnasts. It was designed to be used by both coach and advanced gymnasts who may be interested in setting up their own mental training programme. My thanks go to Maggie Bisset for helping in the construction of the booklet.

Mental Training and Rehearsal Programme

SECTION 1 - INTRODUCTION AND OVERVIEW

This booklet sets out to introduce the terms and concepts used in the mental training programme which will be implemented into normal training sessions. It is hoped that it will clarify any points that coaches may be asking or that a gymnast may have. There are three sections: the first is this introduction. The second gives a rough guide-line as to how the training will be implemented. The final section is the exercises themselves; set out in common sections, it will probably be the section you will refer to most often.

Large anecdotal and research evidence suggest that an athletes mental life is a very important contributor to the actual physical performance. With the majority of top athletes acknowledging the large contribution that the mind has why is it that we give almost no training to athletes for their mental performance. The top athletes appear to have developed their skills more by accident than a systematic training programme. Our aim is simply to cut out the trial and error phase of acquiring the necessary mental skills and provide the gymnasts with the experience of some of the major mental techniques believed to be beneficial. To a large extent this is all we can do since we cannot "see" the gymnast actually doing what we ask them to, rather the gymnasts will have to decide for themselves which is the appropriate mental technique to use. The following tools are what we hope to give the gymnast:



relaxation techniques: specifically progressive relaxation and autogenic relaxation.

visualisation techniques: both external visualisation i.e. as if they are looking at the action from a distance much as in a cinema film, and internal as if they were actually there at the location looking out of their bodies.

kinesthetic imagery: this is the feeling that the gymnasts can mentally feel themselves move without actually moving.

scene setting: incorporating imagery abilities to recreate scenes of locations such as places where the gymnasts might compete.

bizarre imagery: using imagery techniques to image things that could not be present either because they are out of proportion or they are out of context e.g. there are bugs underneath the springboard which must be "squashed".

injury recovery/prevention: the use of imagery skills in all modalities to project images of well being or recovery from minor injuries.

SECTION 2 - GUIDE-LINES

The exercises have been designed to go in a regular order - they can be thought of in two modes. The first deals with actually presenting the mental routine, the second is in actually practise this skill. Especially in the initial stages these two functions will overlap to a large extent. There is also a two tier structure to the exercises: core modules for which there is just the initial effort put into the exercise when it is first conceived, and satellite modules which aim to instruct something specific and topical for which there will have to be some investment to design the exercises. Our aim is to achieve the right balance of these two types of exercises as there are advantages and disadvantages to both approaches. On the one hand core modules give a sense of orientation and are familiar to the gymnast which can give them reliable exercises to fall back on in times of stress such as before a competition, satellite modules on the other hand can be tailored to specific instances of points being made and prevent boredom setting in on over learnt exercises. Broadly speaking there is an inherent cycle to the training which is as follows:

relaxation 1

relaxation 2

visual imagery - external

visual imagery - internal

kinesthetic imagery

bizarre imagery

injury recovery/prevention

3 ideals

There are certain ideals that we wish to achieve when implementing this mental training regime: the first is that we wish the gymnast to see this as a perfectly normal part of their training - there is nothing extraordinary about what they will be trying to do nor is ti any wonder cure that will sort out their problems instantly; secondly if there is a degree of agreement among the coaches we hope the gymnast will rapidly acquire a set of mental tools that can be used for mental rehearsal, arousal (fear) control and injury recovery/prevention; thirdly the exercises should be fun - this is especially important as we cannot see whether the gymnast is "doing the business" mentally in the same way that we can check to see if the are doing their drills etc. - in other words we have to rely on the gymnasts own motivation to really do the exercises.

When do we do the mental bit ?

Whilst most of these exercises will be implemented at specific times during the normal club session it is important to stress to the gymnast to use the exercises in conjunction with their normal physical training, i.e. during formal competition, throughout regular training and also at home for their home drills. Keeping a log of their mental activities related to their gymnastics allows the gymnast to chart any changes that have undergone. These logs can be kept along with their normal logs as it will also encourage the gymnasts to not view their mental training as being fundamentally different from their usual training.

For the more formal training sessions there will be a mixture of taking the sessions in groups or with the whole club. We should try our utmost to see that there is always some sort of mental training every session even if it is a very simple exercise to relax at the end of physical training. Initially there will be a large emphasis on having the mental routines at the end of any physical practise. We do not know if this should always remain so or if there is room to manoeuvre to having sessions at the beginning or in mid physical training.

SECTION 3 - THE TRAINING CORE MODULES

In this section there follows examples of some of each of the exercises to be covered in the ten week rotation; they may be treated as core modules (i.e. standard exercises that need no preparation). Please feel free to amend the wording in any way you feel necessary in order to cater to your audience or make it more interesting for the listeners who may be listening to this exercise for the tenth time.

Progressive Relaxation :

Aim: To achieve a deep state of relaxation throughout the whole body. This is a very much shortened version of the original exercise.

Overview: Developed in the 1930's this is by far the most effective method to get people to relax. Its shortfall is that it takes an extraordinary amount of time to do it properly ($1\ ^1/_2$ hours). It relies chiefly on alternately tensing and then relaxing specific muscle groups. The usual practise is to start at one end of the body and then to progress up to the other end.

SCRIPT

I want you all to lie down comfortably on your backs, arms loosely by your sides, legs slightly apart. You may find it easier to close your eyes. In this exercise we are going to tense certain parts of our muscles - notice how it feels and then relax those muscles completely and notice how that feels to when they were tense. We are going to start at the feet and then work our way up the body finally tensing and relaxing muscles in our head. Try to only tense the muscles that I mention specifically and remember to keep breathing whilst you actually do the exercises.

Starting with your feet pull your feet up towards your face so that you really feel the tension in your toes and ankles. Hold it (5 secs) .... now relax your feet and notice the difference.

Push your feet away from you to have pointed toes. You should feel the tension on the bottom of your feet and also in your calf muscles - hold it (5 secs) - relax and notice the difference.

Now push your knee back as far as it will go and really tense your upper thigh muscle, hold it (5 secs) - relax and notice the difference.

As you lie there I want you to clench your buttock muscles as hard as you can, you should feel your hips rise off the floor a few centimetres, hold it (5 secs) - relax and notice the difference.

Moving onto your stomach, tighten it as much as possible and hold it - relax and notice the difference.

You should by now feel that the lower half of your body is completely relaxed. If you are not sure if some part of the body we have already covered is not completely relaxed then briefly tense and relax that part of the body now (wait 5 secs).

Now we move onto the upper part of the body. Starting where we left off I want you to inflate your stomach as much as possible and hold it (5 secs) - relax and notice the difference.

Now inflate your chest so that your back arches off the floor, hold it - relax and feel the difference.

Concentrate on your shoulders, I want you to try and pull them to the side of your body as hard as possible, hold it - relax and feel the difference.

Pull your lower arms up to your shoulders and tighten your bicep without trying to tighten your lower arm, hold it - relax and feel the difference.

Put your arms down now and with your palms down form a fist with your hands, I want you to clench your fist and straighten your elbows as hard as you can, hold it, relax and notice the difference.

You should by now feel that the lower and upper half of your body is completely relaxed. If you are not sure if some part of the body we have already covered is not completely relaxed then briefly tense and relax that part of the body now (wait 10 secs).

We now move onto your head and neck which is one of the most important parts of the body to relax. Push your head against the floor as hard as you can, hold it - relax, you should feel your neck and upper part of your back relax.

Push your face up to the ceiling as high as your can, hold it - relax, notice the difference.

Try now to push your chin into your chest as hard as you can, hold it - relax and feel the difference.

Try to stretch your mouth into a wide a grin as possible, let the corners of your mouth reach around to touch your ears, hold it - relax and notice the difference.

Form a frown and at the same time pull your nose up and clench your teeth, hold it - relax and notice the difference.

Now raise your eyebrows as high as they will go, try to make them leave your face like a cartoon character, hold it - relax and feel the difference.

You should by now feel that the whole of your body is completely relaxed. For the final exercise I want you to tense the whole of your body, tense each piece as I mention it: feet - legs - buttocks - stomach - chest - arms - neck - face - hold it (wait 5 secs) - hold it (wait another 5 secs) - and relax your whole body should feel relaxed, notice the difference in feeling between what you feel now and what you were feeling a few moments ago.

Tips: Especially initially it may help for some of the movements to actually do a quick demonstration from a point where they can all see you without having to change their position much. Try looking at the gymnasts whilst they are doing the exercises to make sure that they are not tensing some additional muscle group other than the one that you specified.

Short Script: Lie down on back with legs slightly apart and arms by side with palms down.
Alternately tense and relax the following muscle groups noticing the difference between the two:
feet towards face - ankles
feet away from face - calf
push knee back - upper thigh
buttock clench - buttocks
clench stomach - stomach
inflate stomach - stomach

inflate chest - intercostal muscles
pull shoulders to the side of body - pectoral and lateral muscle groups
bicep curl with palms facing away from face - bicep and forearm.
fist clench - forearm
head back on floor - lower neck and across shoulders
head kept parallel and pushed upwards - neck and shoulders
chin to chest - neck
grin - face muscles
grimace - face muscles
eyebrows - face muscles
everything - whole body

Autogenic relaxation

Aim: Achieve a state of relatively deep relaxation throughout the body very quickly.

Overview: Developed at the beginning of the century by a German psychologist Johannes Schultz, it is an effective method of deep relaxation only after effective training. Originally it is claimed that it takes many months of intensive training to achieve the state whereby a person can become completely relaxed in less than 10 seconds (contrast this with the progressive muscle relaxation). It relies on associating trigger words with the state of relaxation especially with respect to physiological symptoms. We are attempting to replicate only part of this phenomenon by taking far less time to go through the whole training regime. However it will be the main way that the gymnasts will relax due to its speed in bringing about a change i.e. ideal to use just before a routine in competition or learning a new and difficult move. The trigger word we will use is: "Relax!".

SCRIPT

Sit so that you are comfortable. Shake your arms and legs to get rid of any excess tension that you may have. Concentrate on your legs - let them become relaxed by feeling pleasantly warm - and feeling very heavy.

Let them become heavier still.

And now let them feel as if they were made of lead.

Shift your concentration to your arms. Let them become pleasantly warm and feel very heavy - you will notice how your arms will pull your shoulders down to the floor. Let them become heavier still.

And now let them feel as heavy as lead.

Now move your concentration to your stomach - not the stomach muscles but the stomach itself. When I say so I want you to feel your stomach becoming settled and cozily warm.

Ready .... relax!

Bring your focus to your forehead. When I say so I want you to feel your forehead becoming light and refreshingly cool.

Ready .... relax!

Return now to both your legs and arms. When I say so both your arms and legs will feel very heavy, notice how gravity is pulling on your limbs they will feel heavier and heavier until they feel as heavy as lead - they will also feel comfortably warm. Ready .... relax!

Coming back to both your stomach and your forehead, when I say so your stomach will feel cozily warm and settled and your forehead will feel light and refreshingly cool. Ready .... relax!

Finally when I say so your arms and legs will feel warm and become so heavy they will feel they are made of lead - your stomach will be cozily

warm and settled and your forehead will be pleasantly cool and light.

Ready .... relax!

__Tips__: If you want to extend this exercise split up the left and right legs and arms and then combine them. It is especially important to lay emphasis on the trigger words, "Relax!" let it be spoken clearly and slowly. allow an appropriate time to generate the feelings when you ask them to, about 15 - 30 seconds depending on the exercise. Feel free to elaborate the script in any way that you think will help the gymnasts generate the appropriate feelings.

__Short Script__: Sit comfortably
Legs feel pleasantly warm and heavy
Arms feel pleasantly warm and heavy
Stomach feels settled and cozily warm
Forehead feels light and refreshingly cool
Arms and legs feel warm and heavy
Stomach feels warm & settled - forehead light & cool
Arms, legs - heavy & warm, stomach - warm & settled, forehead - light & cool

External Visualisation

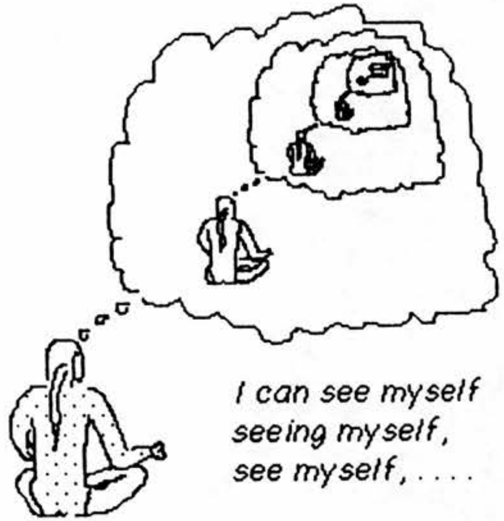
Aim: To try and get the gymnasts to mentally generate picture like images as if they were from a stationary viewpoint such as an observer watching a video.

Overview: There is no formal historical basis for this exercise rather it capitalises on the fact that the majority of people report having images in their head. We hope through these exercises to elaborate the basic skills and bring them under better control. The exercise is a slight modification of the "easel test" whereby a picture or small object is shown (originally a picture was shown on an easel) to people and they are asked to mentally recreate that picture in their head after the picture is hidden away. Questions concerning elements in the picture may be asked to check to see how well they have re-created that picture. The picture is re-shown to our gymnasts so that they can see what it is that they left out and hopefully learn how to form better images.

Instructions and Scripts:

The crucial part in this exercise obviously is the picture and for that some prior preparation is needed to select an appropriate picture and get to know it yourself. The best picture appear to be those that are not needlessly complicated but have a sense of movement on them. Contours that slope predominantly one way are a good example such as a hillside or in the shape of branches leaning one way in a tree. A few people in the picture is better than just one or two and crowds are possibly too difficult. For objects choose something with similar considerations as for the picture, objects have the great quality of being able to rotate them in three dimensions. Of course these are merely guide-lines to be ignored at your discretion depending on what you think the overall impression of the picture or object is. Here is the sort of thing I might say in such an exercise after I had put them through a relaxation (basically to change their focus of attention):

Right, now I want you to study this picture/object and try to memorize it as much as possible because very soon I am going to put it away and I am going to ask you to see it in your mind's eye....... Has every one had a good look ? Ok so now it is away I want you to try and recreate that picture/object inside your head, you may find it easier to close your eyes but it is not strictly necessary........... Can everyone see the picture/object ? (In the unusual event that someone point blank says they cannot see anything, ask them if they remember what the picture/object is about - then ask them if they can perhaps see one element of the picture/object - or even something similar to it - i.e. just go back as far as you can until they say that they perceive something, then reassure them that that is enough and next time they are bound to see more.) So if you can see the picture/object. Susan can you tell me how many people there were in the picture, and what colour was the lady's jumper that was nearest to us? Are you sure it was red ? Does everyone else think the colour was red ? Relax for awhile and try to recreate the picture again in your heads. Still red ? (And so you continue on through the picture getting at things in more and more detail and continually referring them back to recreating the picture in their heads to look for the answers). Right now for the moment of truth, here is the picture again and you see that the lady was wearing red but you see now that it was a shirt and not a jumper (dead sneaky eh ?).



Internal Visualisation

Aim: To get the gymnast to try and mentally recreate picture like scenes that they would really see as they move around the real world.

Overview: The object in this exercise is to concentrate on what is seen as the gymnast moves through an obstacle course that has been set up before hand prior to the exercise, i.e. by having a direct comparison the gymnasts can quickly compare what they ought to be seeing, with what they subjectively feel they are seeing when asked to recreate the scene.

SCRIPT:

The object of this exercise is to move over this small obstacle course that has been built and to try and remember exactly what it is you see when you go over the course. After you have finished the course I want you to take a place out of the way of anyone else and try to recreate the picture in your head of what you saw when going over the course. After you have done that, go through the course again to see how well you recreated the scene in your head.

Tips: Try to actually do the course yourself and notice exactly what it is that you actually see in the movements. There is a great temptation to think that this is some sort of test and the younger gymnasts especially, will try to recreate what they think they ought to see as opposed to what they actually saw. For instance if they step up onto something they will tell you that they saw something straight ahead. It is more than likely that they actually looked at their feet as they stepped up onto the object. For the older gymnast I find it helpful to stress that this exercise will highlight they elements that they do not see internally when going over the course. Try to emphasise the moving aspect of internal imagery. Beginners (myself included) tend to see internal perspectives as a series of interlocking still frames.

Kinesthetic Imagery

Aim: To get the idea of what it feels like to recreate the sensation of body movement i.e. muscle movement and feeling the body move through space (e.g. when doing a somersault).

Overview: We are going to concentrate on recreating muscle movement by asking the gymnasts to make a movement and then to recreate that movement. While the movements below are presented in a rather simple fashion - they build up to progressively more complicated motions.

SCRIPT:

We are going to perform various actions and then try to recreate the feeling of repeating that movement without actually doing the movement. You might find it easier to close your eyes in order to concentrate on feeling the movement but this is not necessary.

Stand in a space where you have room to move and not bump into anyone else. Shake your body loosely to get rid of any excess tension and strain. I want you to feel that you are now split into two bodies. One of them is in the here and now, the one you can touch and see. However there the other part of your body which is an exact copy of your *here and now* body - it is your ghost body. Your mind can feel both bodies but everyone else can only see the *here and now* body. The bodies can move independently but normally they move at exactly the same time and place. Today we are going to make the two bodies move separately.

Now raise your left arm very slowly in front of you so that it eventually is next to your left ear. Now lower your arm and shift your attention to your ghost body. Feel how your ghost body moves in exactly the same way as you just did by moving your left arm slowly in front of you, up to your left ear.

Now do the same with your right arm, raise it slowly in front of you until it is pointing upwards. Remember that feeling whilst you change your concentration to your ghost body. Now make your ghost body's right arm move slowly upwards until it is pointing upwards and try to feel the same movements.

Back to the *here and now* body and keeping your arms straight, stretch your fingers and move your arms sideways and upwards until they are resting next to your ears, keep stretching the whole of your arms, shoulders and fingers upwards. Lower your arms and change control to your ghost body - feel it do exactly the same movement.

With the *here and now* body lift your left knee slowly upwards until it is level with your hips. Lower it as your shift to your ghost body and repeat the same movement.

Try doing exactly the same with your right knee - lift it to hip height noticing how it feels and then do exactly the same with your ghost body, feeling exactly the same movement.

With your *here and now* body drop it slowly into a crouch, with your arms hanging by your side. Notice what your muscles are doing and pay attention to what it feels like for your upper body to go downwards. Straighten yourself and at the same time change attention to your ghost body. Force it to do the same movement and feel exactly the same motion, feel not only the muscles in your legs but also get the feeling that your ghost body is going downwards.

We are going to reverse the order in which we do the next few exercises so keep your mind in your ghost body. With your ghost body rise up onto your tip toes and at the same time bring your arms out straight out to the sides until they reach shoulder height. I want you to experience what your ghost body feels in its ankles and shoulders and arms. Could you also feel your ghost body move upwards ? Sink back into the *here and now* body and repeat the action we have just done in the ghost body - How does that compare with the feelings you experienced first ? Return to your ghost body and repeat the action and try to get the same feelings that you felt with your *here and now* body.

In your ghost body prepare to jump forward about 30 cm in front of your *here and now* body. Keep your feet together and as you jump upwards swing your arms forward and upwards. Do this now with your ghost body. You should feel like you are about 30 cm in front of your *here and now* body. Try to remember what you felt - muscles moving, body going upwards and downwards, did you also feel the contact with the ground as your legs took up the strain ? Let your mind drift backwards to join your *here and now* body. In front of you you can just see a slight shimmer where your ghost body is still standing. I want you to jump in exactly the same way back into your ghost body and notice how it feels compared to what you felt before.

We are going to do that exercise once more, so let your mind return to your ghost body and jump forward another 30 cm with it recreating all the feelings that the *here and now* body felt when you did it just now. Remember to leave your *here and now* body behind you. Remember the feelings, was it the same as you would do in your *here and now* body ? Just to check let your mind fly back to your *here and now* body and repeat the action jumping into your ghost body. Did that feel the same ? For now let your ghost body and your *here and now* body stay together until you want to practise a similar exercise.

__Tips__: Don't be shy about actually demonstrating the actions that are being shown. Try to emphasise the difference between actually doing the exercise and feeling it without doing any movements. The point of doing the exercise first is to generate the correct feelings first so that the gymnasts know what to generate. Therefore if anyone is having problems generating this imagery take them back to the original movement.

__Short Script__: Stand in a space with room to move. Imagine you have a ghost body with which you can move independently from you *here and now body*. Alternately do and then feel the following:

left arm up slowly in front until shoulder is at your ear
right arm up slowly in front until shoulder is at your ear
both arms out to side until shoulders touching ears
left knee up until level with hip
right knee up until level with hip
drop into a crouch arms down by sides

reverse order so that the ghost body does the action first then the *here and now body* and then let the ghost body have one more try just for comparison to the real thing.

stand on tip toe and arms out to side at shoulder height
jump forward 30 cm
jump forward another 30 cm and stop when the *here and now* body does the jump

Scene Setting

Aim: To incorporate aspects of the above exercises into a mental rehearsal of entering a gymnastic hall such as before a competition. It can also be used to make a possible scenario occur (such as falling off an apparatus) and teaching the gymnast to be mentally prepared for it.

Overview: This exercise uses imagery skills to mentally enter into a competition hall and acquaint themselves with their surroundings. Whilst this exercise is fairly general, nearer actually going to another gymnastic hall the exercise can be tailored specifically to that hall. The theory behind this exercise is to hopefully install a feeling of familiarity and thus avoid any tension due to novel surroundings. Practising a scenario will hopefully also give the gymnast a feeling of "having seen it all before" and thus not be mentally thrown into a feeling of stress.

SCRIPT:

Put yourself into a comfortable position. You may find it easier to close your eyes for this exercise but this is not necessary. Take a few deep breaths to get rid of any tension or strain.

I want you to think now about going to a competition in another hall other than the one that you practise in. Put yourself in the position of actually approaching the hall having just got changed. You might be thinking about who you are going to compete against today. If you so think about the other competitors then do not compare yourself with them. Think positive thoughts instead, such as how much you are looking forward to the competition, and no matter how good or bad the others are, you are going to enjoy the competition.

Try and imagine that you are actually inside your body walking towards the hall thinking these positive thoughts.

You enter the hall and notice immediately the size of the hall. Look up to see how high the roof is from where you are standing. Is the hall at the right temperature ?

Take a closer look at the layout of the hall and familiarise yourself with where each of the apparatus is laid out. The biggest area is obviously the floor. How close are the other apparatus to the wall ? Can you see the score table ?

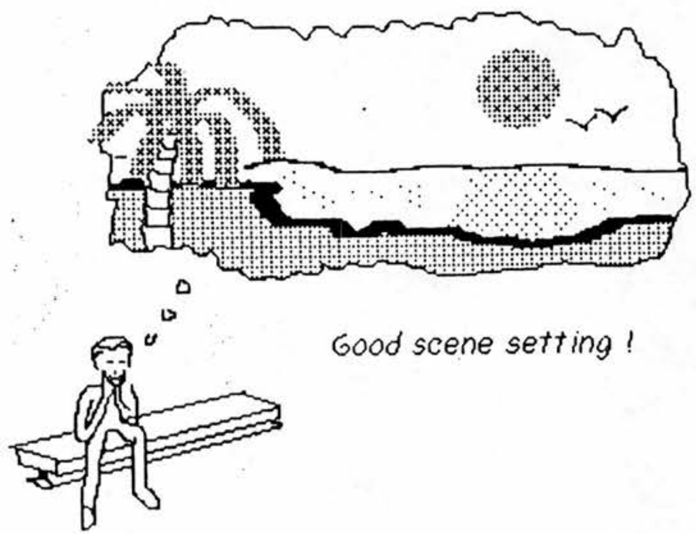
Be aware now of the spectators that have entered the hall before the competition has started properly. You are aware of their chatter but as you listen to it be conscious of slowly letting it fade into the background as you bring your concentration back to the centre of the hall. It is as if you could turn the volume knob, that controls the crowd, right down.

Have a look at the people in the centre of the hall and start to recognise some of the other competitors, maybe some of them are friends. Are they warming up or just wandering around talking ?

If they talk to you that's ok, but start to concentrate on getting your body warmed up and ready to compete. Let their conversation be on your surface whilst you gather your energies into yourself. After a while this distraction should peter out without being rude.

See yourself doing some warm up exercises, both physical and mental. Your concentration is gradually focussing completely on the competition in which you are going to give your best BUT at the same time you know that you the competition is going to be fun and you are going to enjoy yourself.

Take a few breaths to relieve any tension you may have built up and bring your mind back to the here and now. Feel refreshed and relaxed as return to the here and now.



Good scene setting !

Tips: The more attention to detail you can give to make the gymnast feel that this is a real hall you are talking about the better - however do not put in so much detail that the gymnast becomes confused.

Short Script: put the gymnast into the perspective of actually being there
(i.e. internal and kinesthetic imagery mode)
enter hall and notice size, light and temperature
look at layout
notice spectators and gradually bring focus away from them
notice competitors and gradually bring focus away from them to the gymnast
start to do warm up, feeling good about the competition and looking forward to it

Injury Recovery Prevention

Aim: To give the gymnast some mental procedures to focus their attention on either recovering from or preventing injuries.

Overview: The use of bizarre imagery to bring focus to specific parts to the body that are prone to injury is now a popular use of imagery in the alternative medical approach to recovery and well being. Whilst the actual validity for what seems to make this approach work is hotly debated (the power of the *placebo* effect should not be underestimated), we need only concern ourselves at present that there seems to be strong support for the occurrence of a real effect happening.

SCRIPT:

Get yourself into a comfortable position either sitting or lying down. I want you to take eight deep breaths and with each breath let any excess tension flood out of your body.

Take another 5 deep breaths and let each breath relax your muscles a little more.

Are you relaxed ? If so your thighs should feel heavy, your shoulders should be hanging down and your teeth should be apart or very lightly together. If not then relax each of these muscles in turn.

Bring your attention to your ankles. Your ankles are made up of a number of smaller bones. Try to picture these bones in your mind and at the same time become aware of them in your ankle. I want you to try and picture and feel these bones moving apart from each other ever so slightly and then coming back together perfectly in place.

It is similar to you feeling that your knee muscle is just out of place and if you shrug your leg right it will click back into place. I want you to try this once more with your ankles. Let all the small bones just move apart very slightly and then fit back together perfectly.

Keep your concentration on your ankles, imagine and feel that down your leg there is a pipe which is filling your ankles with some metal to strengthen your ankles. This metal is called *calcium* and is essential to keep your bones strong. Now bring your attention to your ankle muscles. Picture and feel that any harmful substances or chemicals are being pulled out of your muscles and they begin to feel like a new piece of elastic band which at the moment is relaxed.

Let your focus of feeling move up from your ankles slowly to your lower back. Try to picture all the bones in the lower part of your spine and feel them at the same time. Try to pull them apart ever so slightly and let them come back together perfectly.

Now feel the muscle in your lower back that are attached to your back muscles and keep it straight. Let them relax if any tension has built up since we have started. Picture and feel any harmful chemicals being drawn out of your muscles to leave them totally refreshed and clean.

Now picture yourself floating but just touching a very light blue liquid. This liquid is refreshingly cool and it will clean out your body in a moment. Imagine this liquid being soaked up by your body and you can actually see and feel the level the liquid is at on your body.

Now that your body has completely soaked up the cleansing liquid you can feel it swirling around your body getting into all the parts of your body, even along your arms and legs and into your fingers and toes. Can you feel the liquid swirling around your face and head\?

Now let the liquid drain out of your body. Notice how much darker the liquid is. This is a mixture of stress, tiredness, tension and harmful chemicals, that the liquid has cleaned out of your body.

Take a few deep breaths to bring your concentration back to the here and now and notice how much better you feel since you started - relaxed but healthier and refreshed.

Tips: Do not feel constricted to the areas that I have targeted. Work on any part of the body that you feel is more prone to injury amongst your group.

Short Script: Relax by taking a few deep breaths
focus on ankle bones let them expand apart and come back together
let ankle bones fill with metal

harmful chemicals pulled out of ankle muscles and tendons - feel relaxed
lower back bones pulled apart and back together again
harmful chemicals pulled out of back muscles and tendons - feel relaxed
body floating on and then washed out by cleansing liquid
feel relaxed but refreshed

PROBLEMS &/OR QUERIES ??

Contact me if you have any problems or any suggestions or even interesting or amusing anecdotes, I would love to hear from you:

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Appendix IV

Raw Data sets

Vault 1

Grp	Ability	miq diff	vis diff	feel diff	diary	I diary	GVA 1-3	GVA 4-6
Subliminal	Advanced	•	•	•	29	11	0	-5.17
Imagery	Advanced	•	•	•	35	35	4.5	.25
Subliminal	Advanced	7	-1	8	48	20	2.25	3.5
Imagery	Advanced	2	0	2	20	20	3.67	4.83
Subliminal	Intermed	10	5	5	12	3	-.33	-5.25
Imagery	Intermed	•	•	•	37	37	0	1.33
Imagery	Intermed	21	7	14	43	43	2.5	-.5
Subliminal	Intermed	•	•	•	47	20	.5	-1.67
Subliminal	Intermed	25	11	14	•	•	1.5	6.5
Imagery	Intermed	21	9	12	•	•	0	0
Imagery	Novice	26	14	11	•	•	-1.33	0
Imagery	Novice	-3	-3	0	•	•	6	1.33
Subliminal	Novice	9	3	6	42	15	-5.33	5.67
Subliminal	Novice	4	0	4	•	•	-4.67	-1.33
Subliminal	Novice	11	4	7	•	•	.67	-1
Imagery	Novice	8	3	5	54	54	1.33	-3.33
Imagery	Novice	7	4	3	0	0	1	4
Imagery	Advanced	•	•	•	31	31	-10	3
Imagery	Advanced	•	•	•	20	20	4.5	-3.5
Imagery	Intermed	•	•	•	•	•	1.33	.67
Subliminal	Intermed	6	2	4	16	0	-1.17	1
Imagery	Advanced	•	•	•	33	33	.5	2.83

Juggle 1

Group	MIQ see	MIQ feel	MIQ tot	Sublim	Jug1	Jug2	Group 2	Sess.	Sex	GJA
As if	17	20	37	40	4	8	contrl	morning	female	4
Sublim	27	15	42	36	7	6	contrl	morning	male	-1
Sublim	13	18	31	50	2	5	contrl	morning	female	3
Imagery	24	24	48	38	5	7	exptl	morning	male	2
Imagery	13	44	57	39	3	5	exptl	morning	female	2
Imagery	10	17	27	33	4	5	exptl	morning	female	1
Sublim	20	18	38	42	5	6	contrl	morning	female	1
Imagery	24	28	52	32	4	6	exptl	morning	female	2
As if	24	36	60	27	3	2	contrl	morning	male	-1
As if	27	30	57	38	2	7	contrl	morning	female	5
Imagery	16	14	30	34	3	4	exptl	afternoon	female	1
Imagery	23	21	44	40	4	7	exptl	afternoon	female	3
Imagery	12	19	31	36	2	5	exptl	afternoon	female	3
As if	16	15	31	41	2	5	contrl	afternoon	male	3
Sublim	12	29	41	39	4	9	contrl	afternoon	male	5
As if	29	26	55	41	3	5	contrl	afternoon	female	2
Sublim	22	23	45	35	4	7	contrl	afternoon	female	3
As if	21	29	50	37	2	4	contrl	afternoon	female	2
Sublim	12	40	52	43	6	11	contrl	afternoon	female	5
Imagery	25	14	39	39	2	3	exptl	afternoon	male	1

Juggle 2

Session	Sex	Group	Miq S	Miq F	SPSQ	Pre	Post	GJA	MIQ tot
Morning	Female	as if	9	28	33	9	21	12	37
Morning	Female	sub	30	23	41	6	11	5	53
Morning	Female	as if	12	30	41	8	4	-4	42
Morning	Female	imag	13	21	45	10	13	3	34
Morning	Female	sub	18	29	37	9	13	4	47
Morning	Female	sub	35	35	39	8	15	7	70
Morning	male	imag	25	27	40	2	10	8	52
Morning	Female	imag	26	21	38	15	13	-2	47
Morning	Female	as if	11	36	37	6	10	4	47
Afternoon	male	sub	15	33	33	6	9	3	48
Afternoon	male	sub	24	43	44	11	18	7	67
Afternoon	Female	as if	16	42	43	6	26	20	58
Afternoon	male	sub	27	18	40	6	12	6	45
Afternoon	male	sub	10	30	46	16	36	20	40
Afternoon	male	as if	27	27	40	13	18	5	54
Afternoon	male	imag	25	42	48	6	11	5	67
Afternoon	Female	sub	15	19	40	5	11	6	34
Afternoon	Female	imag	12	11	37	7	10	3	23
Afternoon	Female	sub	18	29	47	6	14	8	47
Afternoon	Female	imag	14	22	42	7	20	13	36
Afternoon	Female	imag	18	38	40	5	9	4	56
Afternoon	Female	sub	13	26	32	4	9	5	39
Afternoon	male	imag	9	54	37	10	12	2	63
Afternoon	male	imag	15	21	39	6	14	8	36
Afternoon	male	imag	10	28	47	6	14	8	38
Afternoon	Female	imag	11	18	44	6	9	3	29

Shoot

SSQ	Group	Wk1-3	Wk4-6	GSA	miq diff	vi dif	ki dif
39	Sublim	97.04	97.27	.23	-16	-6	-10
41	Sublim	96.2	96.39	.19	18	7	11
43	Imagery	98.03	98.22	.19	5	0	5
39	Imagery	97.48	96.33	-1.15	-6	-1	-5
42	Sublim	98.33	98	-.33	•	•	•
49	Sublim	95.99	97.79	1.81	•	•	•
45	Imagery	95.56	97.65	2.09	6	8	-2
43	Sublim	97.74	97.95	.21	14	11	3
42	Imagery	98.32	97.32	-1	-11	-5	-6
47	Sublim	96.14	97.75	1.61	14	17	-3
41	Imagery	92.04	94.04	2	27	18	9
36	Imagery	96.52	95.2	-1.32	28	18	10

Vaulting Perspective

Levl	Internal	External
int	7.08	6.88
int	6.91	6.88
int	6.74	6.77
int	6.76	6.77
nov	6.16	6.14
nov	6.25	6.08
nov	•	•
nov	6.08	6.07
adv	8.45	8.21
adv	7.38	7.18
adv	8.18	8.23
int	7.41	7.43
int	7.13	7.2
int	7.57	7.35
int	6.79	6.83
int	6.38	6.5
nov	5.93	5.43
nov	6.06	6.16
adv	7.93	7.91
adv	7.44	7.52

Beam Perspective

Ability	Internal	External
adv	7.15	6.65
adv	7.57	7.57
adv	6.67	6.63
adv	7.6	8
adv	6.93	6.47
adv	7.95	8.2
nov	2.91	2.94
nov	3.12	3.18
nov	3.12	2.93
nov	2.63	2.37
int	2.96	2.98
int	2.65	2.58
int	3.67	3.68
int	3.5	3.48
int	2.2	2.03

Perspective Questionnaire

Sport	Sex	Exper	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	Fav	N fav	q16	q17	q18	Int:Ext
Diving	F	13	1	2	1	•	1	1	1	1	2	1	1	1	2	1	int	kin	2	1	2	1
Diving	F	18	1	2	2	3	2	3	3	2	3	2	3	1	1	2	int	kin	2	3	3	3
Diving	F	4	2	2	6	6	7	7	4	7	7	6	6	7	7	6	int	ext	3	3	6	.57
Diving	M	15	3	7	7	7	3	6	2	3	3	3	2	5	2	3	kin	ext	1	2	2	.4
Diving	M	16	3	3	2	2	3	5	2	3	2	6	2	2	3	2	int	kin	3	3	2	1
Diving	M	10	3	3	5	4	3	3	3	4	3	2	3	3	4	3	ext	int	2	3	3	1
Diving	M	15	3	3	3	6	1	3	2	2	2	1	2	3	2	2	int	kin	2	2	2	.67
Diving	F	13	3	3	3	4	3	5	3	2	2	2	3	3	3	3	int	ext	3	2	2	1
Diving	F	9	3	2	2	7	2	4	6	6	7	1	2	2	2	1	ext	int	3	4	4	3
Diving	F	12	2	2	2	4	2	5	2	1	2	5	2	1	1	1	int	kin	7	7	7	2
Diving	F	10	1	2	2	3	2	2	6	6	6	1	1	1	1	3	ext	kin	7	7	7	6
Diving	F	10	3	3	2	5	1	3	1	2	3	1	1	2	2	3	int	kin	2	2	4	.5
Diving	F	18	3	5	3	7	2	5	2	1	1	1	1	7	7	7	int	ext	3	3	1	.29
Diving	F	10	2	3	3	3	3	3	3	5	5	3	2	2	2	3	int	ext	3	3	3	1.5
Diving	F	5	2	3	2	3	2	4	6	5	5	3	2	2	2	3	int	ext	2	3	3	3
Diving	M	5	2	3	3	3	3	3	3	4	4	4	5	1	2	3	ext	kin	5	5	5	3
Diving	•	•	3	2	3	3	3	5	2	2	3	2	5	3	3	2	int	kin	5	3	3	.67
Diving	•	•	3	2	3	3	3	5	2	2	3	2	5	3	3	2	int	kin	5	3	3	.67
Diving	•	•	6	6	3	3	3	5	2	2	2	1	1	3	3	4	ext	kin	5	5	6	.67
Diving	M	15	3	3	1	3	1	2	1	2	2	2	1	5	2	7	kin	int	1	3	2	.2
Diving	M	12	3	2	2	7	2	1	2	3	5	3	2	3	5	6	ext	kin	1	3	5	.67
Diving	M	11	1	3	3	3	7	7	5	4	4	5	6	3	4	4	ext	int	3	4	6	1.67
Diving	M	10	2	3	3	4	6	6	5	6	6	5	6	3	5	4	ext	int	5	5	5	1.67
Rugby	M	20	3	3	2	2	3	3	3	2	3	3	3	2	3	3	ext	kin	6	7	7	1.5
Rugby	M	16	3	3	6	6	3	3	7	7	7	7	•	3	2	3	ext	kin	6	6	6	2.33
Rugby	M	6	7	7	7	7	7	7	3	2	4	3	2	4	4	3	ext	kin	7	7	7	.75
Rugby	M	•	7	7	7	7	7	7	3	3	2	2	3	3	3	3	ext	kin	4	4	4	1
Rugby	M	21	3	2	3	5	3	5	6	5	2	2	2	7	7	7	ext	int	6	6	6	.86
Rugby	M	20	5	6	5	4	5	5	2	3	3	3	5	7	7	7	int	kin	7	7	7	.29
Rugby	M	•	1	2	2	2	2	3	3	2	2	1	1	1	1	1	ext	kin	3	3	3	3
Rugby	M	22	2	2	2	2	4	5	5	2	2	2	6	6	7	7	ext	int	6	6	7	.83
Rugby	M	20	3	2	3	3	5	6	3	5	3	2	3	5	5	5	int	kin	5	5	5	.6
Rugby	M	•	3	2	3	2	2	5	2	2	5	6	7	3	3	2	int	kin	6	6	6	.67
Rugby	M	6	2	3	4	2	3	5	4	3	3	2	3	3	4	2	ext	kin	6	5	5	1.33
Rugby	M	18	3	3	5	3	2	3	3	5	4	2	3	5	5	5	ext	kin	6	6	6	.6
Rugby	M	15	2	2	3	3	3	3	2	3	3	3	4	3	3	4	ext	kin	6	6	6	.67

Appendix V- Hardware and PK Game Construction

The hardware is and Apple Macintosh SE, 1Mb RAM (this was later upgraded to 2.5 MB RAM), 8 MHz. The choice of computer was strictly limited by the choice of software available at the time of program writing and implementation. Not being a programmer and not wanting to learn how to program I wanted a program that could easily build up animations. The only piece of software available at a reasonable price was Macromind's ™ "Videoworks II". The program uses the Graphical User Interface (GUI) which requires absolutely no programming to create an animation. The sequence and order of playing of relevant pieces of animation was controlled from within Apple's own hypertext application program "Hypercard". Incorporated into Hypercard is a high level scripting (programming) language which because of its more common english syntax makes it a lot easier to learn than some of the more well known commercial languages such as Basic, Fortran, Cobal etc. as well as being a lot less insensitive to incorrect syntax. Hypercard is the platform which controls the input and output of the program and directs how an animation should proceed given various inputs (the subject and the RNG). At that time it was realised that the randomness function of the computer was unknown and there was a large chance that it was inadequate for the studies point of view. This was to be rectified in future game construction.

The actual structure of the animation is actually a tree structure which in the more complex programs allowed a more realistic simulation to occur in that the range of possible choices of animation sequences was determined by the previous animation choice.

The games were contructed in a modular manner with small subsections of animation that are bolted together to form one larger animation. This allows a large number of variable complete sequences to be displayed using relatively small number of shorter sequences of animation. For instance suppose we want to display a sequence that has two possible outcomes, moving a dot left or right. Furthermore we want to display at least 5 motions (going either left of right). We can loop this animation process three times and only use two animation sequences (left and right). However if we were to link three of these animations into one longer animation and we still wanted to display the same number of movement permutations as the previous example (e.g. left, left, left, left, left or left, left, left, left, right or left, left, left, right, right etc. etc.) then we would actually need 32 longer permutations.

Problems with the running of the PK games

During the second week of testing the second PK game with the gymnasts, the computer "froze" and could not be induced to start up again. The results from this week were abandoned. The computer was taken into engineers, which subsequently meant that I could re-boot the hard disk and reformat the whole disk. This appeared to do the trick as the computer ran trouble free all week and in the third (now second) session, it caused no problems. In the fourth (now third) session it worked alright during the testing time but shortly after it was set up away from the gym, it again showed the same problem. A phone call with the company that sold the hard disk, suggested after some of the more obvious remedies were tried, that it could be a media problem - that is the disk was just getting old. However the disk at the time was only two and one half years old and was expected to last well beyond that time. In addition a colleague in the department has exactly the same hard disk which is only three weeks younger than mine and reported no problems whatsoever. Eventually the hard disk was reformatted and the the whole software was loaded back on from original disks. A disk checking program found no bad sectors before that start of the fifth (now fourth) session.