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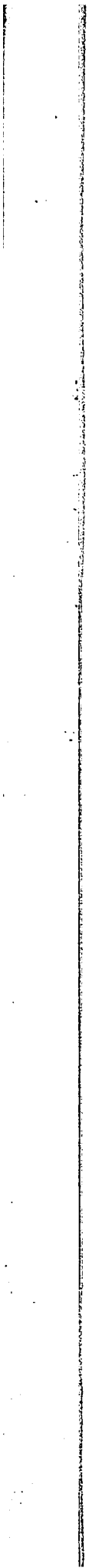
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Effect of Mental Training Techniques on Knowledge
and Performance of Volleyball Skills

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A Thesis submitted in partial fulfillment of
the requirements for the degree of
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School of Human Kinetics
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Running Head: MENTAL TRAINING

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Abstract

This study examined how certain mental training techniques affected skill acquisition and performance of a sports skill (overhand volleyball serve). The uniqueness of the study was the particular population - twelve recreational athletes (versus elite athletes) with mean age of 43.8. The subjects were divided into two groups with measures taken on three different occasions - pre-test, mid-test and post-test. Group 1 received the Mental Training Program (MT) and engaged in physical practice during the first half of the experiment, while Group 2 engaged in physical practice only. Group 2 then added the M.T. Program while Group 1 continued to practice physically. The M.T. Program focussed on relaxation, mental modelling of elite olympic volleyball players, and imagery. At the pre-test, subjects were given an Imagery Ability Questionnaire to assess whether they were high or low imagers. Five different tasks were performed to obtain both qualitative and quantitative data for analysis. Quantitative and qualitative analyses demonstrated both statistical and practical significance for an increase in knowledge, in addition to a performance increase in the skill. This was a positive beginning to new and exciting research involving recreational rather than elite athletes, and the impact mental training techniques have on this population (mean age = 43.8). Results are discussed with relevance to the effect on research that these findings have in terms of adults learning a new sport skill, improving performance of that newly acquired skill and the positive impact that mental training techniques have on them.

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Introduction

Recent studies have highlighted the positive effect of mental training on sport performance enhancement (Hall, Buckolz, & Fishburne, 1992; Kendall, Hrycaiko, Martin, & Kendall, 1990; Van Gyn, Wenger, & Gaul, 1990; Ryan & Simons, 1983; Meyers & Schleser, 1980). However, the majority of these studies concentrated on one particular population, that of athletic university students who play sports regularly and/or competitively. Very little research on the impact of mental training has focussed on the middle-aged population who may have been athletic in high school and university. Because of the age difference (about 20 years) middle-aged people may have a greater amount of experience which could be reflected in both the cognitive and physical aspects of their movement skills. Therefore, it is possible that the targeted population for this study (mean age = 43.8) would demonstrate a different knowledge base than undergraduate students.

Many different mental training techniques have been used to try to improve motor skills, in the context of both learning and performance. One technique which has been the topic of discussion in much of the research literature is imagery. Van Gyn et al., (1990) studied the effects of imagery on the transfer of training from practice to performance and demonstrated that imagery did play an important role in the transfer of

practice skills to performance. Hall et al., (1992) examined the relationship between imagery and motor skill acquisition to determine if this technique was effective. The authors concluded that imagery works by serving a motivational as well as a cognitive role in changing behaviour. As far as cognition relates to imagery, Hall et al., (1992) explained that imagery influences both strategies and responses that are involved in motor skills. With respect to imagery and motivation, a person would use his/her imagery ability to imagine certain goals and to determine and practice the necessary steps to achieve them. Orlick (1990), has documented many such cases in his account of successful athletes and their use of mental imagery in various sports.

From a cognitive perspective, Anderson (1982) has suggested that skill acquisition involves two key aspects of knowledge; declarative and procedural. According to Anderson (1982), skill acquisition is represented by the development/building of procedures from the factual, or declarative knowledge base. This represents a model of skill acquisition consistent with the traditional instructional method. However, while mental training techniques have been used to improve the learning and performance of motor skills, their impact on the development of the relevant knowledge base has not yet been examined.

Statement of the Problem

The purpose of this study was to examine the impact of mental training on the acquisition of a sport skill (overhand serve in volleyball), with middle-aged subjects. Specifically the focus was on the cognitive aspects of motor skill acquisition (role of knowledge) and the impact of mental training techniques. This particular population was expected to handle this experiment well with respect to discipline, commitment and desire to play the sport, since they had been involved in recreational volleyball for the last four to six years. The term, "recreational volleyball" defines the type of volleyball played by the subjects; players in this study had not played competitively for about 15 - 20 years (or may never have played competitively) but they had played volleyball recreationally twice a week for the last several years. This community group had previously been involved in a pilot study on the differences in knowledge base of expert versus novice volleyball players (Green, 1989), which may have helped to diminish the Hawthorne effect.

What the subjects knew about the skill was examined, in terms of whether they could predict their performance and how well they performed the task. This was accomplished by asking the subjects questions, by observing and/or videotaping their actions and testing their performance. The results should help to determine whether this particular population can further develop both their knowledge of the skill of volleyball, as well as enhance their performance through specific mental training techniques.

The study took place in the community, with 12 recreational volleyball players (mean age = 43.8) who had been involved over the last four to six years in a fitness and volleyball program, held twice weekly for 90 minutes each night.

Hypotheses

The null hypothesis is that the use of mental training techniques will have no effect on the knowledge and performance of volleyball skills in middle-aged populations.

The research hypothesis is that in line with the existing research on the topic of mental training, it is expected that knowledge of volleyball skills as well as performance, will increase significantly due to the different treatments of mental training.

Significance of the Study

This study is important and relevant to existing research on the topic since it will contribute some answers about the impact of mental training techniques on skill acquisition. Rather than conducting another study involving college-aged subjects in a competitive sport situation or a laboratory, this study involved a "real world" situation with middle-aged subjects.

Review of Literature

Denis (1985) presented some positive results for the acquisition of motor skills in concert with mental training, however, he quickly emphasized that many questions about the data collected have been left unanswered. Understanding skill acquisition or human learning has been the central topic of many studies, and several explanations have been offered as to how humans acquire motor skills and how knowledge is used to put these skills into action (Whiting, 1972; Robb, 1972; Kerr, 1982; Anderson, 1982; MacKenzie & Marteniuk, 1985). Reaching further into the realm of skill learning, is the complex analysis of skill in sports. Allard and Burnett (1985) underscored the idea that acquiring a motor skill is a combination of knowledge of the correct procedures and a cognitive component similar to skills other than sports. Current literature on the topic of skill acquisition is vast; however, my study will focus on two main areas, examining first, the role of knowledge (cognitive aspects), and second, the impact of mental training techniques on acquiring the motor skill of an overhand serve in the sport of volleyball.

Cognitive Aspects of Motor Skill Acquisition

Skill in sports is dependent on the ability of the player to adapt to changing situations during a game by selecting whatever information is needed, deciding on a plan of action and putting that plan into play.

Garnier (1980) stated that acquiring skill in ball games, especially those involving trajectories, "is not the simple repetition of motor responses; it implies training all the systems involved in the perceptual, decision-making and motor responding skill" (p. 39).

Cognition in the realm of human movement is portrayed by highly successful performance in new or different situations (Anderson, 1982). Most of the research into levels of performance has concentrated on differences in novice versus expert athletes, without accounting for the ways in which a novice reaches higher levels of skill. The differences found between expert and novice athletes have centered around their knowledge bases, with the experts evidencing greater knowledge (Allard, 1982; Allard & Burnett, 1985; Borgeaud & Abernethy, 1987). Experts are able to recall more meaningful information from one quick look and then they put this information into units for processing (Allard & Burnett, 1985). Problem-solving ability is seen as the cornerstone of skill learning, whether learning a new skill or modifying an already acquired skill and, in being successful, problem solving requires the use of an integrated knowledge base (Wall, McClements, Bouffard, Findlay, & Taylor, 1985).

Thomas, French, and Humphries (1986) made the distinction between declarative and procedural knowledge. The factual knowledge that one has or already knows about the world is represented as declarative knowledge which is kept in the long-term memory as mental images.

Procedural knowledge is acquired with experience or practice and is represented by the ability to perform a skill, kept in the long-term memory as productions with "IF-THEN condition action pairs" (Anderson, 1976; Masson, 1990). Anderson (1987) explained the condition-action pairs by specifying that IF a certain state occurs in working memory THEN particular actions (mental and/or physical) will take place.

As Anderson (1982) pointed out, it is the knowledge acquired from past experiences that enables a person to handle a new situation and it is this skilled knowledge (procedural knowledge), which has been automated over time and practice, that can be generalized and applied to the new situation until specific new knowledge is learned or acquired. Since one can generalize already existing procedures to aid in the performance of a new situation, it appears that transfer of this procedural knowledge is possible. Anderson (1987) stated that positive transfer between skills can take place provided the skills involve similar processes or productions. Behaviour appears to be controlled by a hierarchical goal structure (Anderson, 1987) resulting in processes or productions happening because of the goal structure rather than just executing specific actions; hence the transfer effect.

To perform at a skilled level entails the representation of any meaningful declarative knowledge (previously acquired) to the existing general productions or processes and attempting to satisfy the

hierarchical goal structure (Anderson, 1987; Masson, 1990). This declarative knowledge is acquired through experience which could have been in the form of observation of correct or incorrect models of behaviour or instruction (Anderson, 1987), and with practice and exposure, the generation of specific skill processes or productions takes place (Anderson, 1983, 1987). Any less specific, general processes or productions not utilized in the generation of the skilled processes, do not disappear but are kept or stored to use in other situations (Anderson, 1987). It is this knowledge, represented as general processes or productions that surface at the initial stage of skill acquisition, that is referred to as general procedural knowledge.

The measurement of a person's general procedural knowledge and the influence it has on skilled performance has not yet been accomplished. However, Norman and Bobrow (1976) discussed certain characteristics of procedural knowledge. The authors hypothesized that procedural knowledge is understood to be carried out through perceptual recognition where the appropriate procedure is triggered automatically by the recognition of relevant patterns of incoming information. This perception recognition would result in the activation of correct procedures and, along with relevant declarative knowledge, analysis of the incoming sensory information and finally the production of a response and/or action.

Another characteristic of procedural knowledge outlined by Anderson (1976) was the fact that it is sometimes difficult or impossible to verbally communicate this type of knowledge, therefore, instead of asking the individual to try to explain what took place when performing a task, their performance of the task can be used as a measure of their general procedural knowledge. Thus, using both recall and recognition processes, may provide access to different elements of the knowledge base.

MacKenzie and Marteniuk (1985) defined motor skill as a relationship between internal action plans generated to solve a particular problem, and the translation of these into specific movements. They used a simple example of moving one's arm to reach for an object, and the fact that much is still unknown about the control of similar simple movements. Among the unknowns are the amount of time needed to adjust to a feedback response and change a movement, the types of visual feedback used by subjects when making aiming movements, and whether the control of well learned movements is handled by extensive integration of sensorimotor information. In this context, a qualitative analysis of verbal responses by subjects' descriptions of their own performances, may provide some of the answers to the unknowns; hence, this current study is well suited to investigate the role of knowledge and feedback in motor skill acquisition. In particular how does a person decide on a particular movement, why, and what were the thought processes at the time. The authors stressed that a

dynamic interaction exists between knowledge and movement and that future research should consider the relationship of the parts of a "movement system" (eyes, head and arm, for instance make up a reaching movement system) in order to fully understand movement skills.

Skill in sport is dependent not only on skill in performing, but skill in perceiving as well, since the player must know when to make a move and must know how to move. Allard, Graham, and Paarsalu (1980) evaluated the importance of perception to basketball skill. Their experiments demonstrated that basketball players' encoding/perception had the same "information chunking" as in skilled chess or bridge players. In an additional study, Allard (1985) stated that a significant interaction was apparent between skill in perceiving and performing. Jagacinski, Newell, and Isaac, (1979) investigated basketball players' ability to predict successful or unsuccessful shots, and found that no evidence existed that basketball players could predict their performance any better than knowledgeable observers. Since perception is so important for skill in sport, the current study has incorporated a task to quantitatively and qualitatively analyze the subjects' ability to predict.

Bamford and Marteniuk (1988) conducted a study on visual feedback involving individual differences in spatial orientation and visualization abilities in relation to motor performance. The results indicated that visualization ability was important to a motor task.

Human learning or skill acquisition could not take place without an indication of whether the skill was being properly performed, and as such, feedback is considered as one of the most important variables (Bilodeau & Bilodeau, 1961; Kerr, 1982). The literature reviewed presented several types of feedback systems/models outlining how each works, however, Kerr (1982) simplified the systems by classifying feedback as either intrinsic (refers to an individual's sensory feedback), or extrinsic (refers to any type of artificial or external feedback). The importance of feedback will be analyzed in the current study, both intrinsically and extrinsically. The experimenter will provide extrinsic feedback on the success of the subjects' serves to specified areas (in or out) and the subjects themselves will provide the intrinsic feedback by viewing their own performance and commenting verbally on the reasons why the serve was successful or unsuccessful.

Mental Training Impact on Skill Acquisition

Minas (1978) stated that mental training is: "the covert or imagined rehearsal of physical activity in the absence of gross muscular movements". A similar definition was given by Denis (1985) but he made an important addition of "in the absence of any observable muscular movements".

Research on the effects of mental training has been conducted for more than seventy years and it has been shown that mental training does improve motor skill learning and performance as evidenced by the many reviews on the topic (Minas, 1978; Feltz & Landers, 1983; Paivio, 1985; Denis, 1985; Andre & Means, 1986; Hall, Buckolz, & Fishburne, 1992). Nonetheless, from the review of literature, it appears that the techniques of mental training vary greatly leading to inconsistent results; this is a major shortcoming of the research in this area (Feltz & Landers, 1983; Denis, 1985; Hall, 1980, 1985). Additional studies have also shown similar improvements in the performance of motor skills. However, from the research it is unclear whether the effectiveness of mental training is conditional upon cognitive demands of a task compared to motor demands (Wrisberg & Ragsdale, 1979; Ryan & Simons, 1981)

Several processes are involved in mental training, such as visual imagery, kinesthetic imagery, relaxation, positive self-talk, modelling/video observation. Mental training techniques varied greatly throughout the literature, however, the techniques that provided the most improvement in skill and performance were mental imagery and relaxation. Van Gyn et al., (1990) demonstrated in their study that imagery played an important role in the transfer of skills from practice to performance.

Meyers and Schleser (1980) obtained very positive results with a college senior basketball forward who had concentration problems which interfered with his shooting performance. The athlete was given a program of progressive relaxation and asked to use imagery to report on numerous game situations, and was then given a rationale for cognitive intervention. After some practice using imagery to improve concentration, the athlete was given a series of coping strategies to use on his own, including such components as "task description, recognition of task difficulty, self-observation, self-reinforcement for successful performance, and insufficient effort attributions and external attributions as opposed to self-blame for failure". He practiced relaxation and imagery exercises daily which involved visual, sensory and kinesthetic components. The subject improved his performance by obtaining a significant increase in points scored per game, shooting percentage, and percentage of total team scoring.

Using similar imagery techniques to the previous study, Meyers, Schleser, and Okwumabua (1982) demonstrated an improvement in the basketball performance of a female athlete (center position). This basketball player consistently made 75% of her practice free throws, but during game situations she averaged only 40%. After a training program of cognitive behavioural intervention using relaxation, imagery and self-instruction strategies, her game performance improved considerably.

Orlick (1990) has documented many accounts of improvement in performance using mental imagery and found that the most successful athletes image themselves doing the particular skill they are working on and actually feeling the action (kinesthetic and visual imagery). When all the senses are involved in imagery, the neural pathways controlling the performance of skills become slightly activated thereby pre-programming the brain and the nervous system allowing the body to follow. Orlick (1990) stressed the absolute importance of "feeling-oriented imagery" to excel in sport, suggesting that athletes trying to develop imagery start by getting into the normal position of the actual movement so that the feeling of the movement can be incorporated into the imagery thereby enhance the learning of the skill. As imagery practice develops, athletes can feel the movements even when perfectly still.

Jowdy and Harris (1990) investigated just how muscular activity, in conjunction with mental imagery, was a function of motor skill level. The authors generalized that the mechanisms underlying mental practice effects were either of a cognitive or physiological perspective. The idea put forth by Corbin (1972; as cited in Jowdy & Harris, 1990) was that an image creates muscular activity which in turn provides kinesthetic feedback, with the feedback allowing for adjustments to the motor program, resulting in performance enhancement. Similarly, Kendall, et al., (1990) studied the effects of mental practice techniques in real-game

situations and results showed that mental imagery rehearsal, self-talk (cue words) as well as fifteen minutes of a relaxation technique in each session, enhanced the clarity of imaging, therefore improved performance.

Hall (1980) referred to a "dual coding model" which was conceptualized by Paivio (1971, 1977; as cited in Hall, 1980). The model assumed that "both verbal and non-verbal information are represented and processed in independent but interconnected symbolic systems...". Hall (1980) reported that imagery has a great influence on the memory of movement information and suggested that to improve mental imagery, specific instructions should be used for the imaging session. His study demonstrated that following specific instructions for imagery helped to encourage the non-verbal imagery which resulted in greater recall of memory for movements.

One further study demonstrating the value of feeling the movement in imagery was carried out by Van Gyn, et al. (1990). The authors were concerned with the idea of specificity of the imagery with respect to performance, and stressed the importance of involving the muscle groups and biomechanical properties of the particular action being imaged.

Kendall, Hrycaiko, Martin and Kendall (1990), studied the effects of mental training techniques on basketball game performances. The authors used real-game situations and their results showed that by using the mental training techniques of imagery and relaxation, performance was improved.

The techniques of relaxation and video observation/modelling, as well as imagery, have been supported by Orlick, Li-Wei and Qi-Wei (1991) in their study of mental imagery training for young table-tennis players. The success of utilizing the mental training technique of imagery has been attributed in the literature (Feltz & Landers, 1983; Kendal et al., 1990; Van Gyn et al., 1990; Hall, 1985; Hall et al., 1992; Orlick, 1990; Burhans et al., 1988)) to the ability of a subject to be able to image.

Hall, Pongrac, and Buckolz (1985) reviewed a number of studies to determine the many reasons why the measurement of individual differences in the ability to image were not very successful. The authors found two main problems with the measurement of imagery ability; the subjective tests themselves and the tasks used to validate the tests. Their studies evolved into the design of a questionnaire to look at the relationship between motor skill performance and ability to image. The Movement Imagery Questionnaire (MIQ) is an 18-item questionnaire (items were positively correlated) which measures individual differences in imagery of movement, both visual and kinesthetic imagery. The authors stressed that interaction between the test (imagery) and the task (performance) must allow the subjects to recognize the usefulness of their ability to image, and that certain variables, which might affect the interaction, are taken into account (e.g., skill level, strategies used).

As Hall, Buckolz, and Fishburne (1992) further stated, if subjects are asked to use imagery and have a very low ability to image, that technique will have little or no effect on performance, however, if subjects could image easily and effectively, the results would probably show a positive effect on performance. Feltz and Landers (1983) also brought this fact out. Therefore, the decision was reached to have a Movement Imagery Questionnaire completed by the subjects prior to the present study. The mental training program for the current study will consist of the most successful techniques of relaxation, mental imagery and video observation/modelling as documented in the literature reviewed.

As previously mentioned, an earlier pilot study on Metacognitive Knowledge and Skill in Sport Performance (Green, 1989) demonstrated the usefulness of qualitative analysis in this area and served as a catalyst for the proposed study. The focus will be on verbal replies to answer the many questions existing in the literature (how a person decides on a particular movement, why, what the thought processes were at the time and what provided the motivation to practice and learn the skill and enhance performance).

Method

Subjects

Subjects for this study were chosen from a group of twelve middle-aged males and females (mean age = 43.8, sd 7.08) who have been participating over the last four to six years in a community volleyball and fitness program. The program consisted of 45 minutes of exercise and 45 minutes or more of volleyball each night, twice per week, and was held for ten months of the year. The subjects were selected on the basis of availability and willingness to participate in this study. None of these subjects can be classified as elite volleyball players, although some of them have played organized sports while attending high school or university, therefore, some have more expertise than others. This difference in expertise will be taken into account when analyzing the results qualitatively but for the purpose of this study, all subjects will be considered recreational athletes. For the purpose of this study, a subject is considered a recreational athlete if the average age is about 43 years and they have not played any organized sport for about 20 years. The volleyball games played during this program have been strictly for fun and socialization, not to practice and acquire greater skill, however, some competition existed.

Apparatus

Since this fitness and volleyball program took place in the community at an elementary school, the volleyball court and net had some limitations. The court was a standard size but the extra extension for the serving area did not exist due to the limited space of the gymnasium. The height of the net was 7 ft., lacking the standard height of 7 ft., 4 1/8 inches for women nor 7 ft., 11 5/8 inches for men. The volleyball was a standard, inflated, leather volleyball, measuring 25 5/8 inches in circumference.

A colour video camera with built-in microphone was used to tape the subjects as they completed the tasks. A cassette tape recorder was used for the verbal comments. A stop-watch was used to record the time taken for each task.

Procedure

The subjects were randomly separated into two equal groups. The program took place over a period of two, four-week sessions. Group 1 was assigned to the mental training program which included relaxation, video observation and modelling, as well as mental imagery sessions. Group 2 served as the control group for the first four-week session. Both groups were given a pre-test at the beginning of the program, a mid-test half-way through, at four weeks, and a post-test at the end of the program, at eight weeks. The treatment was reversed for the second four-week session. Group 1 continued to practice and Group 2 was introduced to the mental training program.

Experimental Design

The experimental design consisted of a pre-test, mid-test, and post-test as follows:

Pre-test (Tasks 1 - 5)

- Task 1 complete the Movement Imagery Questionnaire (MIQ) to help determine mental image ability; (Appendix C)

- Task 2 verbally provide instructions (videotaped) on how to perform an overhand serve, to demonstrate declarative and/or procedural knowledge;

- Task 3 perform 12 overhand serves (videotaped) serving to two different target areas (6 trials in each target area), to establish physical skill in the overhand serve; (Note: before performing this task, the subject was asked to verbally comment on his/her confidence level with regard to his/her ability to correctly serve to each target area, i.e., 10 out of 12 serves in.)

- Task 4 view their own performance on Task 3 and provide verbal comments regarding their serves, explaining any errors made and providing reasons; (Replies were audio-taped in order to obtain an indication of any improvements in their knowledge base (declarative or procedural). Data was

collected over the complete time frame of the experiment to provide a measure of whether their knowledge increased and whether it was incorporated into their performance (i.e., actual learning took place - a permanent change in their behaviour or improvement in performance).

Task 5 perform 12 overhand serves using two different target areas to serve to (6 trials in each target area) as above, but just before serving each serve, predict whether the shot went IN or OUT of the target area and if OUT, explain why they made that choice.

Mid-Test (Tasks 2 - 5)

Tasks 2-5 Both groups performed the same tasks as the Pre-Test.

Post-Test (Tasks 2 - 6)

Tasks 2-5 Both groups performed the same tasks as the pre- and mid-tests.

Task 6 Attend a debriefing on the effectiveness of the mental training program.

Mental Training Program

During the first week of the program, one 40-minute session took place to introduce the value of mental training and the techniques that would be used. The experimental conditions that the groups were exposed to were relaxation training, video observation of olympic players performing overhand serves, and repetitive mental imagery of the skill of serving. Relaxation was the focus during the second session, to help subjects feel the different muscle groups in their bodies and to help control their focussing abilities and level of energy or activation. Positive verbal reinforcement was used along with cue words to help the subjects in this segment of the mental training program.

Once a week for the remaining three weeks, subjects watched a video of the overhand serve technique, performed by olympic athletes, designed to teach the skill of overhand serving. The subjects were asked to focus on that particular skill during the mental imagery.

From week 2 to week 4, a complete mental imagery training session took place twice a week for forty minutes each session and included the following components: 1) relaxation; 2) mental preparation for imagery; 3) viewing video of Olympic players for mental modelling; 4) mind/body imagery of the skill of overhand serving, with positive self-talk.

Analysis:

Data analysis was both quantitative and qualitative and is presented in that order by task number. Quantitative results (multiple ANOVAs) show the outcome of the performance tasks - Tasks 3 and 5, as well as the imagery ability of the subjects - Task 1. Qualitative results concentrate on the verbal response tasks - Tasks 2, 4 and 6; in addition, they provide means and standard deviations to substantiate the qualitative analyses. In all the quantitative analyses, mixed model anovas (3 X 2 anovas with 3 levels and a between and within factor) at $\alpha = .05$, were performed rather than a Manova due to sample size. Furthermore, because of the small sample size involved, correction of the alpha for multiple anovas was deemed not necessary (Huberty & Morris, 1980).

To obtain interrater reliability and to avoid experimental bias, the qualitative data was analyzed and categorized by another researcher familiar with this practice. In specific tasks where data was categorized, interrater reliability was in excess of 90%.

Results

Task 1 - Imagery Ability

Anovas were performed on pre- and post- measurements of both visual and kinesthetic imagery of the subjects (Table 1).

Results from the Anovas for kinesthetic imagery ability show that:

- between-group effect was not significant at $F(1,10) = 0.72$, $p > .05$, indicating that there was no statistical difference in kinesthetic ability between groups;
- within subject effect, over time, was significant at $F(1,10) = 6.40$, $p < .05$, indicating that there was an improvement in kinesthetic ability from the beginning of the whole program to the end with all subjects (both groups);
- an interaction effect measured over time was not significant, (group X time) at $F(1, 10) = 0.67$, $p > .05$, indicating that there was no difference in Group 1 versus Group 2, however both groups improved equally over time.

Results from the Anovas for visual imagery ability showed that none of the effects were significant, indicating that there was no group difference, nor improvement in visual imagery, nor any interaction effect over time. Table 1 lists the results.

Figure 1 shows the imagery ability by groups. A summary of the means and standard deviations are contained in Appendix A.

Table 1. Summary of Imagery Ability Analysis of Task 1

Imagery Ability	Anova Effect	F-Value	<u>p</u>	Significant
Kinesthetic	Between Group	0.72	.415	No
	Within Subject	6.40	.030	Yes
	Interaction	0.67	.432	No
Visual	Between Group	0.00	.974	No
	Within Subject	1.33	.276	No
	Interaction	0.04	.838	No

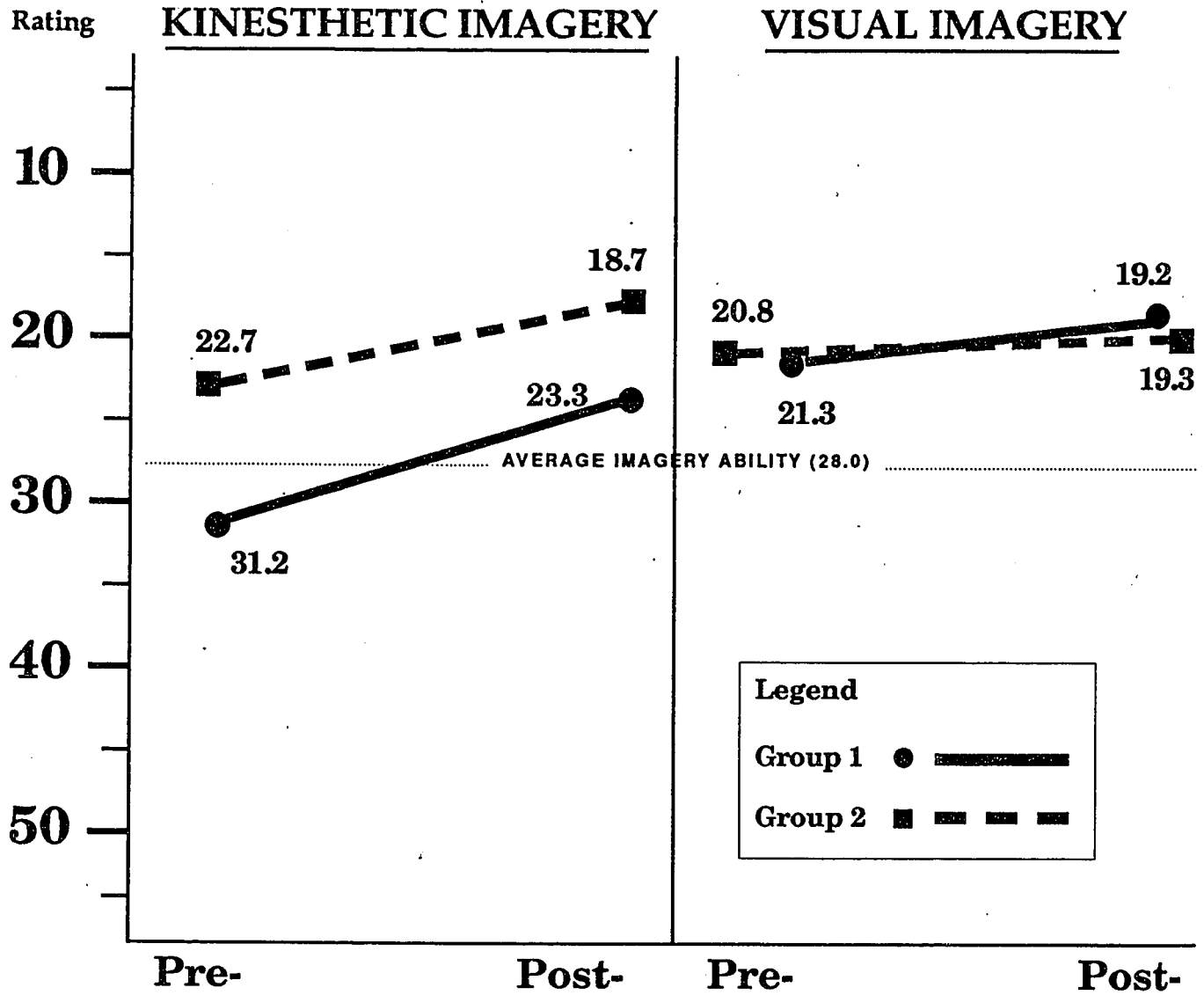


Figure 1. Imagery ability comparisons for Task 1

Notes: Rating scale:
 High imager = 8.0
 Low imager = 56.0

Group 1 = Experimental group
Group 2 = Control group

Task 2 - Verbal Instructions

Verbatim responses on how to perform an overhand serve were analyzed and categorized into levels by rating the subjects' responses at three different times - pre-test, mid-test and post-test. These category levels were determined by the apparent knowledge each subject imparted at different times during the program, which was compared with a handout on correct serving technique. The levels were numbered from 1 to 3, where 1 = very basic knowledge; 2 = more than basic knowledge; 3 = concrete knowledge of the skill.

To assure unbiased results and interrater reliability, a researcher in the field performed the same analysis and categorization, assigning skill level ratings (91% reliability).

Figure 2 shows that Group 1 had more knowledge at the pre-test (1.5) than Group 2 (1.1). Appendix B provides a summary of categorized knowledge results, using the means and standard deviations.

At the mid-test, Group 1 increased by 1.0 to 2.5, Group 2 by 0.4 to 1.5. At the post-test, Group 1 increased again but not by much, to 2.8, whereas Group 2 increased also to 2.1.

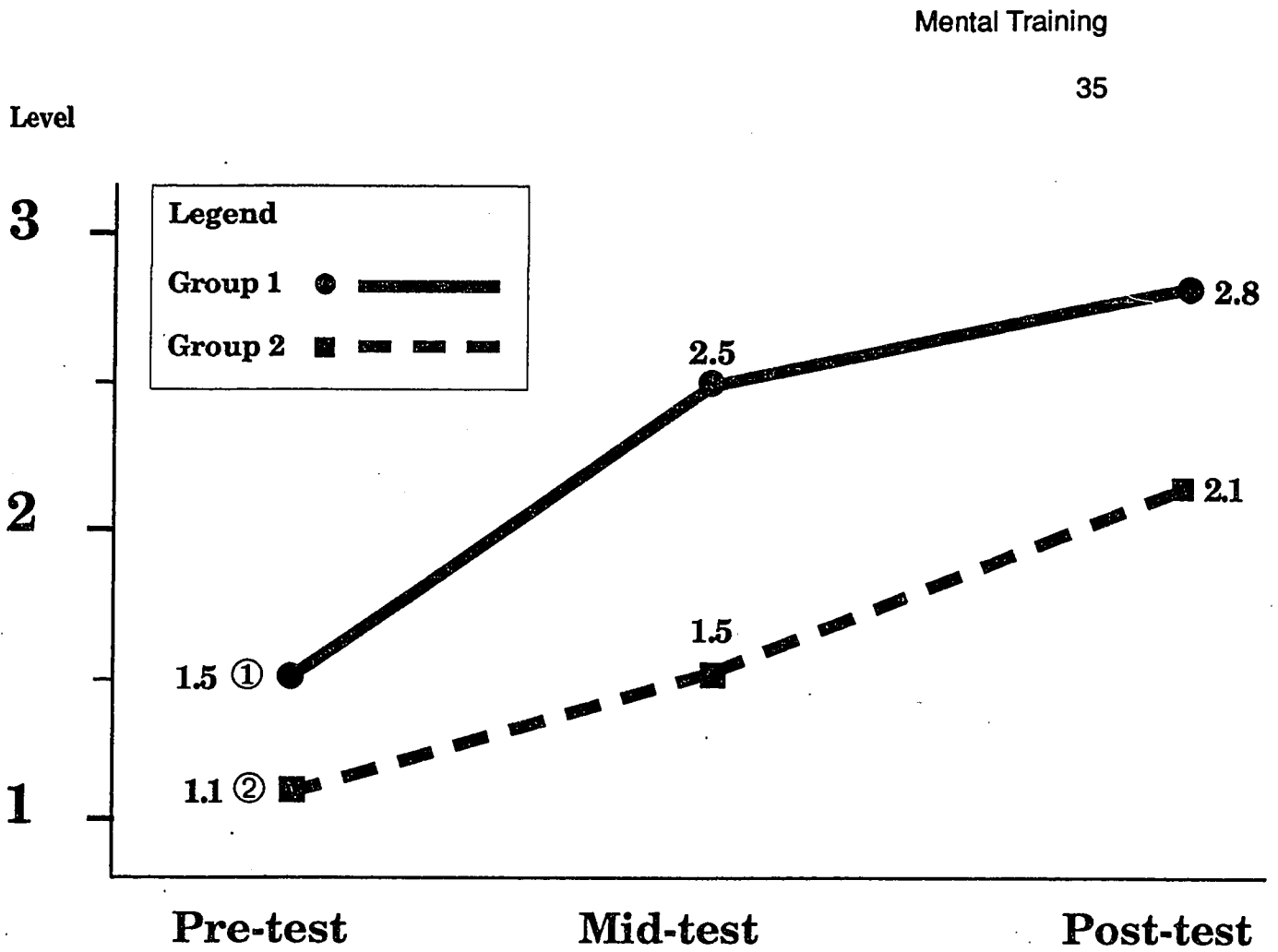


Figure 2. Categorized knowledge levels for Task 2

Notes: Group 1 = Experimental group
Group 2 = Control group

These verbatim responses were analyzed and categorized on the basis of three levels determined from a handout sheet on how to serve an overhand serve. Some of the responses in point form for each level follow, which provide an indication of subjects' knowledge bases and increases in knowledge.

Level 1

Response A: Throw ball straight up
Hit it with serving hand
Point hand up

Response B: Ball in left hand, right hand fist
Lift ball above level of net
Hit with right fist

Response C: Grab ball in left hand
Lift it up at height of your head
Hit it

Level 2

Response A: Feet apart
Slightly bent arm with ball
Toss ball up and bring elbow back
Hit ball with palm of hand

Response B: Focus on the ball
Take a step backwards
Low, controlled toss
Hit ball with heel of hand

Level 3

Response A: Feet about 18" apart
Hold ball in left hand and as you toss ball up, at the same time
bring elbow up and forearm back
Once ball is in air, keep your eye on ball and as ball is falling,
step forward and swing your forearm through hitting ball
with heel of hand or palm

Response B: Take a position about 45 degrees to angle of flight
Hold ball in both hands and look down intended line of flight
With upward motion and smooth take-back with elbow close,
toss ball in air
Hit ball with heel of hand in line of flight

Tasks 3 and Task 5

These results will be discussed in combination since they were both performance tasks. The difference between the two tasks was in the prediction component. In Task 3, the subjects were asked to provide an overall prediction for all 12 serves before beginning (i.e., one prediction: 8 out of 12 serves will go over the net in the correct side of the court). In Task 5, the subjects were asked to provide a prediction each time they served (i.e., twelve predictions: just as they hit the ball they were to say "IN" or "OUT").

Task 3 - Performance - Overall Prediction

An ANOVA at Alpha = .05, was performed for each task. Results on performance are summarized in Table 2 and showed that:

- within subject effect, over time, was significant at $F(2,18) = 9.55$, $p < .05$, indicating that performance increased from the beginning of the whole program to the end, with all subjects;
- between group effect was not significant at $F(1,9) = 0.52$, $p > .05$, indicating that performance was the same between groups or there was no difference in Group 1 versus Group 2 performance;
- an interaction effect measured over time was not significant, (Group X Time) at $F(2,18) = 0.26$, $p > .05$, indicating that there was no difference in performance between groups, but both groups performed better over time.

Figure 3 shows the actual and predicted performance results of Task 3, by groups. Appendix C provides the performance means and standard deviations for Tasks 3 and 5.

Table 2. Summary of Performance Analysis of Tasks 3 and 5

Task	Anova Effect	F-Value	<u>P</u>	Significant
3	Between Group	0.52	.491	No
	Within Subject	9.55	.001	Yes
	Interaction	0.26	.777	No
5	Between Group	0.96	.353	No
	Within Subject	5.46	.014	Yes
	Interaction	0.34	.715	No

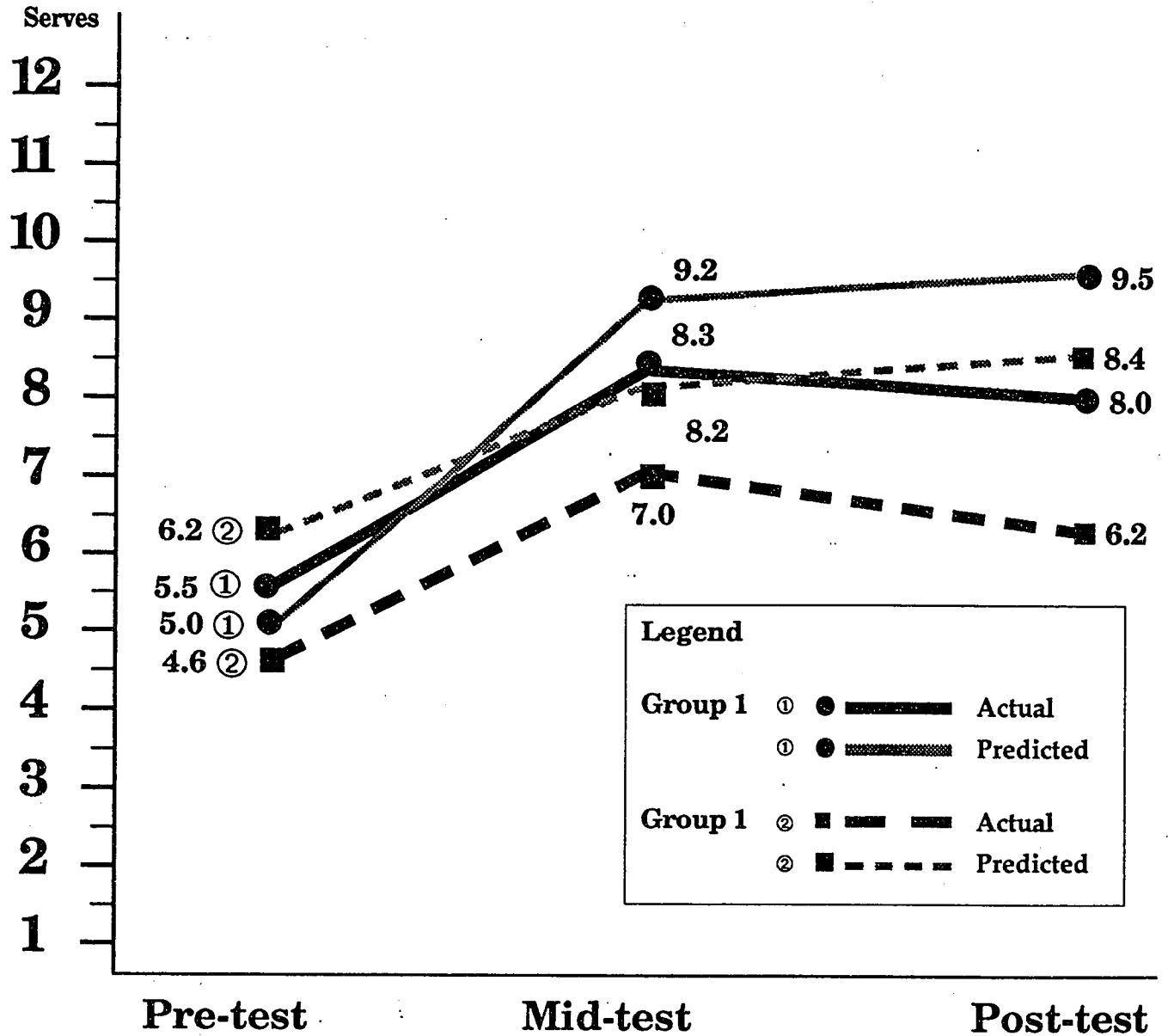


Figure 3. Performance results of Task 3

Notes: Group 1 = Experimental group (6 subjects)
 Group 2 = Control group (5 subjects)

Because there was significance over time, post-hoc analysis was performed by three dependent sample t-tests on all eleven subjects for Pre-Mid, Pre-Post and Mid-Post to determine where the effect was (Table 3). One of the subjects was not available for the Pre- to Mid- period, therefore statistical analysis was done on the basis of 11 subjects rather than 12 (Zumbo, 1992, personal notes).

The significant differences occurred between Pre-Mid and Pre-Post. Pre-Mid at $t = 3.74$, $df = 10$, $p = .004$, indicating that there was a significant difference in Task 3 performance for all subjects from the Pre-test to the Mid-test. As well, significant differences were found between Pre-Post at $t = 3.52$, $df = 10$, $p = .006$, showing that performance improved over the span of the whole program.

Prediction analysis was looked at by using the ratio of actual over predicted performance (A/P) and a 3×2 Anova to determine whether groups or subjects were able to improve their prediction capabilities, or knowledge, of how they would perform (Table 4). For comparative purposes, Figure 3 shows the success rate of the serves in Task 3. Appendix D contains the raw data used to compile Figure 3.

No significant differences were found:

- between group effect, $F(1, 9) = 1.32$, $p > .05$;
- within subject effect, $F(2, 18) = 0.98$, $p > .05$;
- interaction effect measured over time,
 $F(2, 18) = 0.22$, $p > .05$;

indicating that the subjects' ability to predict their own performance did not improve in Task 3.

Table 3. Summary of Post Hoc Analysis for Performance of Tasks 3 and 5

Task	T-tests	T-Value	F-Value	p	Significant
3	Pre-Mid	3.744	14.017	.004	Yes
	Pre-Post	3.516	12.362	.006	Yes
	Mid-Post	1.107	1.225	.294	No
5	Pre-Mid	1.936	3.748	.082	No
	Pre-Post	3.194	10.201	.010	Yes
	Mid-Post	1.747	3.052	.111	No

Table 4. Summary of Actual/Prediction Ratio Analysis of Tasks 3 and 5

Task	Anova Effect	F-Value	<i>p</i>	Significant
3	Between Group	1.32	.280	No
	Within Subject	0.98	.395	No
	Interaction	0.22	.804	No
5	Between Group	0.98	.349	No
	Within Subject	5.35	.015	Yes
	Interaction	0.13	.881	No

Task 5 - Performance - Individual Predictions

Results on performance showed that (Table 2):

- between group effect was not significant at $F(1,9) = 0.96, p > .05$, indicating that there was no difference in Group 1 versus Group 2 performance;
- within subject effect, over time, was significant at $F(2, 18) = 5.46, p < .05$, indicating that performance increased from the beginning of the whole program to the end, with all subjects;
- an interaction effect measured over time was not significant (Group X Time) at $F(2, 18) = 0.34, p > .05$, indicating that there was no difference in performance between groups, but both groups performed better over time.

In addition, Figure 4 shows the actual and predicted performance results of Task 5 by groups.

Because there was significance over time, post hoc analysis in the form of three dependent T-tests were done on all eleven subjects for Pre-Mid, Pre-Post and Mid-Post (Table 3).

The significant difference occurred from Pre-Post, at $t = 3.194, df = 10, p = .010$, indicating that performance of Task 5 improved over the span of the whole program for all subjects.

Pre-Mid was not significant at $t = 1.936, df = 10, p = .082$, indicating performance did not improve over that time period. Mid-Post was not significant at $t = 1.747, df = 10, p = .111$, indicating performance did not improve over that period.

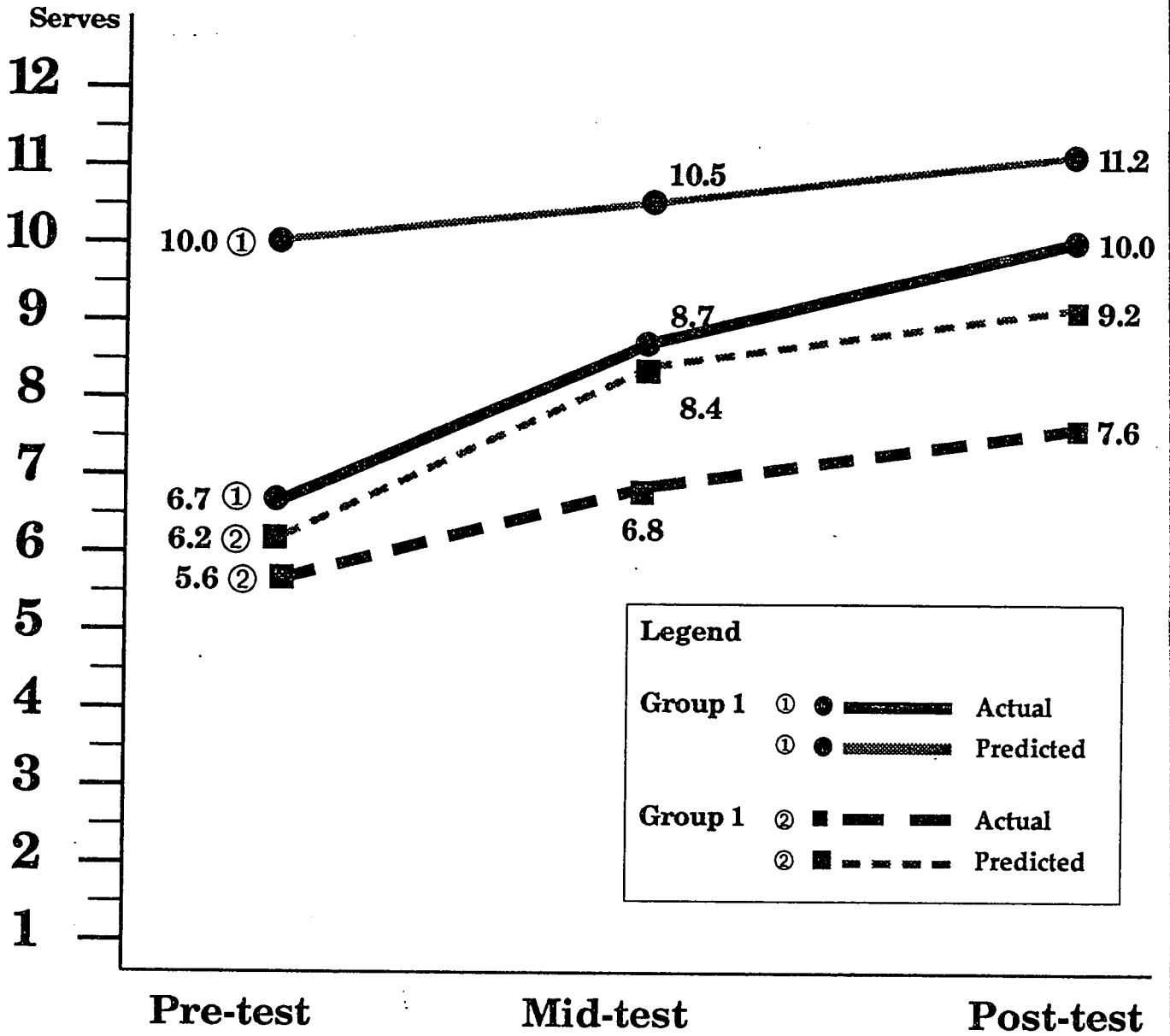


Figure 4. Performance results of Task 5

Notes: Group 1 = Experimental group (6 subjects)
 Group 2 = Control group (5 subjects)

Prediction analysis, as in Task 3, was again looked at by using the ratio of actual over predicted performance (A/P) and a 3×2 Anova to determine whether groups or subjects were able to improve their prediction capabilities, or knowledge, of how they would perform. Anovas showed (Table 4):

- within subject effect, over time, was significant at $F(2, 18) = 5.35$, $p < .05$, indicating that all subjects increased their prediction capabilities over the span of the whole program;
- between group effect was not significant at $F(1, 9) = 0.98$, $p > .05$, indicating that prediction capability was the same for both Group 1 and Group 2 averaging over the 3 times;
- an interaction effect measured over time was not significant, (Group X Time) at $F(2, 18) = 0.13$, $p > .05$, indicating that there was no difference in prediction capability between groups.

Figures 3 and 4 provide clear trends in performance increases across the whole program. Appendices D and E list the raw data, including individual and mean scores. Because there was significance over time, post hoc analysis was done to determine where the effect was (Table 5). It was found that the effect occurred between mid to post and pre to post. Mid-post at $t = 2.366$, $df = 10$, $p < .05$, and Pre-post at $t = 2.843$, $df = 10$, $p < .05$, indicated that predicted performance was close to or matched the actual performance in Task 5 over those time measures. The pre to mid measure was not significant at $t = 1.789$, $df = 10$, $p > .05$.

Table 6 shows a summary of the means and standard deviations for A/P ratios for Tasks 3 and 5 for comparative purposes.

Table 5. Summary of Post Hoc Analysis for A/P Ratios of Task 5

Task	T-Test	T-Value	F-Value	p	Significant
5	Pre-Mid	1.789	3.200	.104	No
	Pre-Post	2.843	8.082	.017	Yes
	Mid-Post	2.336	5.456	.040	Yes

Table 6. Summary of Means & Standard Deviations for Actual/Predicted Ratios for Tasks 3 and 5

TASK 3

GR.	PRE	MID	POST	AVGS
1	1.10 (.431)	.933 (.234)	.842 (.139)	.958
2	.750 (.771)	.710 (.448)	.652 (.439)	.704
AVGS	.942	.832	.755	

TASK 5

GR.	PRE	MID	POST	AVGS
1	.628 (.277)	.810 (.127)	.957 (.131)	.798
2	.532 (.505)	.640 (.385)	.780 (.246)	.650
AVGS	.585	.733	.876	

Task 4 - Video Analysis

Verbatim responses after viewing video of performance on Task 3 were analyzed and categorized into levels by rating the subjects' responses at the pre-test, mid-test and post-test. These levels were determined from the subjects' explanations of how they served and whether they recognized any errors, and were compared with a handout on correct serving technique. The levels were numbered from 1 to 3, where 1 = gave brief response with no explanation; 2 = gave some brief explanation; 3 = gave specific explanation.

To assure unbiased interpretations, another researcher in the field undertook the same analysis and categorization assigning ratings to the responses (interrater reliability was 94%).

Figure 5 provides a clear summary of the subjects' self-analysis of their performance (categorized levels). Appendix F shows subject feedback listing means and standard deviations.

Some of the responses, in point form, for each of the three levels follow. These provide an insight into how the subjects felt they played, the errors they made and the reasons why they did not serve correctly.

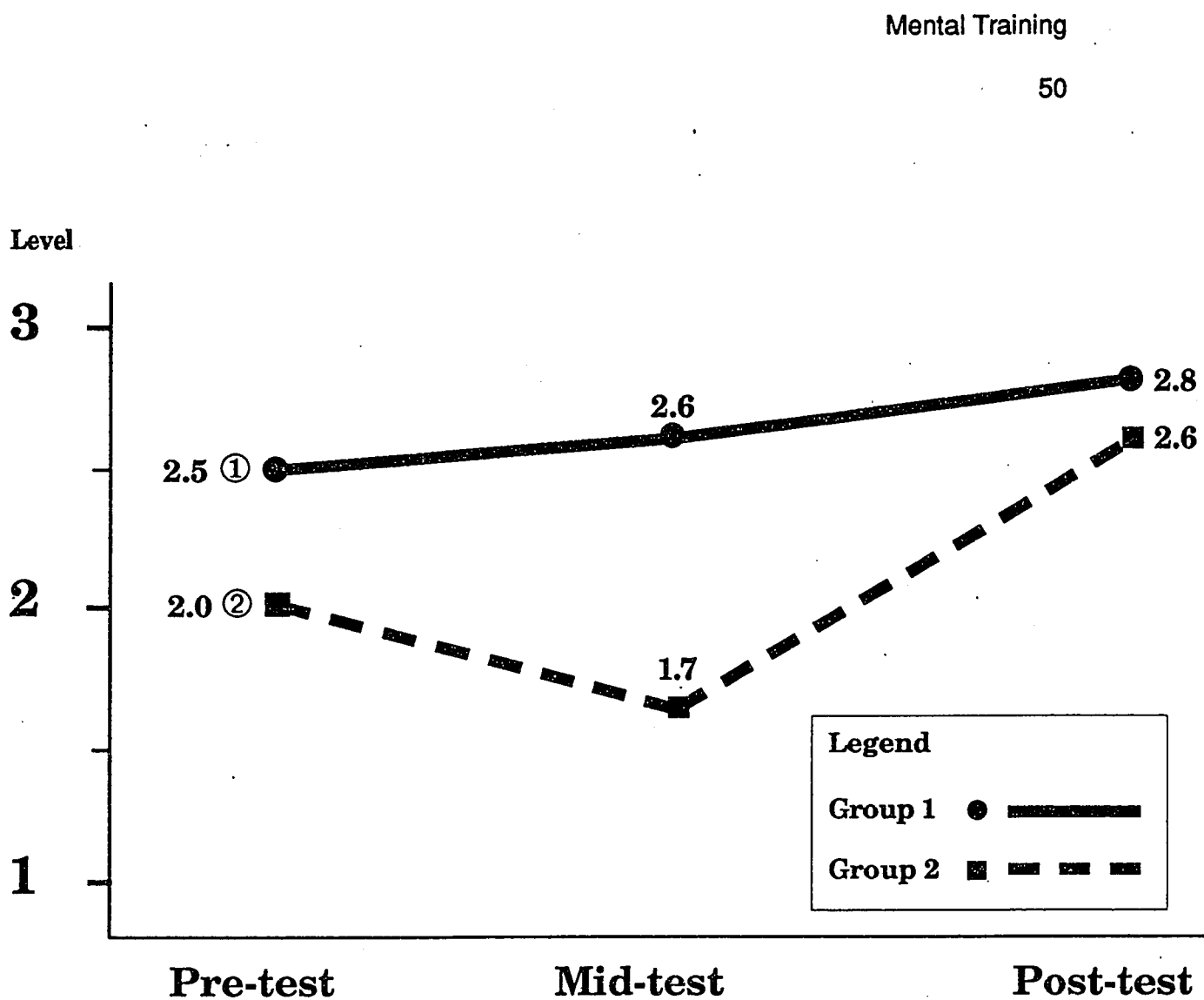


Figure 5. Subjects' self-analysis of performance (categorized levels) Task 4

Level 1

Response A: I am used to serving ball underhand and this is first time in my life I tried this and it is hard for me

I don't know why I didn't make it - I am not used to it

I should have moved my arm quicker and hit it harder

From the first moment I hit the ball I knew that I was not going to make it and thought if I did it the other way I would get it.

Response B: I didn't visualize

I didn't do it the right way - all I wanted was to put the ball on the other side

If I want to do it I will concentrate more.

Level 2

Response A: I hit the balls off the top of my hand instead of the heel of the hand and you could hear a slapping sound and ball goes straight down.

Response B: My head was tilted way back like I do when reading with bifocal lenses and I should have had more forward focus

The step forward wasn't aggressive and it wasn't a hard serve

Response C: My arm is never back as far as I think I have it - like it stops and I don't know why

My toss I think is good

Because my arm doesn't go back as far as it should I think that's why I don't have as much force - sometimes.

Level 3

Response A: I am hitting ball consistently with wrong part of my hand - slapping it instead of palming it
My arm was really sore so I think my arm motion was definitely wrong
I hit it with so much force and it wasn't going anywhere Quite a few hit the net and bounced back I think because I was slapping the ball rather than pushing it more
I wasn't hitting it up, I was hitting it down.

Response B: I was trying to power the ball over the net and wasn't pushing the ball up to get a trajectory
I should have tried to get underneath ball and get a bit more trajectory
I was playing like my old tennis serves
I had too much force and too much weight.

Response C: First, I didn't concentrate and didn't take my time
Second, the ball was not high enough
Third, the ball was forward, it was not near my hand - I had to go for it
Last, it was not hard enough.

Task 6

The debriefing on the effectiveness of the mental training program was analyzed, mostly qualitatively, using verbatim responses to questions, however, eight questions with numerical ratings were averaged both by groups and overall to determine what the critical elements were in the program.

Figure 6 shows graphically how each group felt the mental training program affected various mental training components. In addition, Figure 7 compares the overall range of helpfulness derived from the program as applied to each of the components.

Appendix G provides the means and standard deviations of the rated questions used to compile Figures 6 and 7.

Table 7 provides a summary of the responses to the four questions asked on mental training skills.

Actual responses of the subjects in answer to some of the questions are listed in tabular form in Tables 8 and 9, which are indicative of the importance qualitative analyses have in this study.

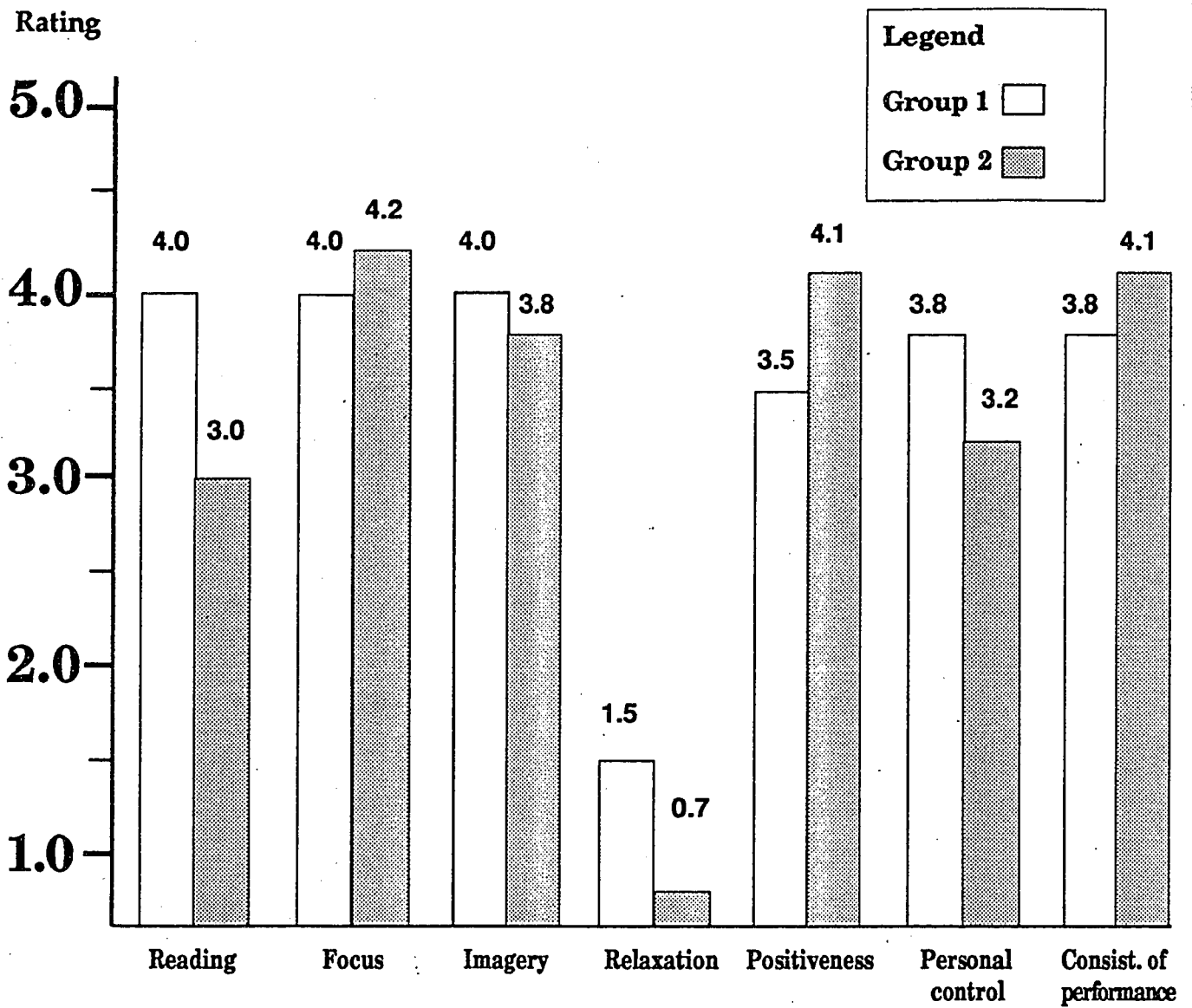


Figure 6. Effectiveness of mental training components by group for Task 6

Rating

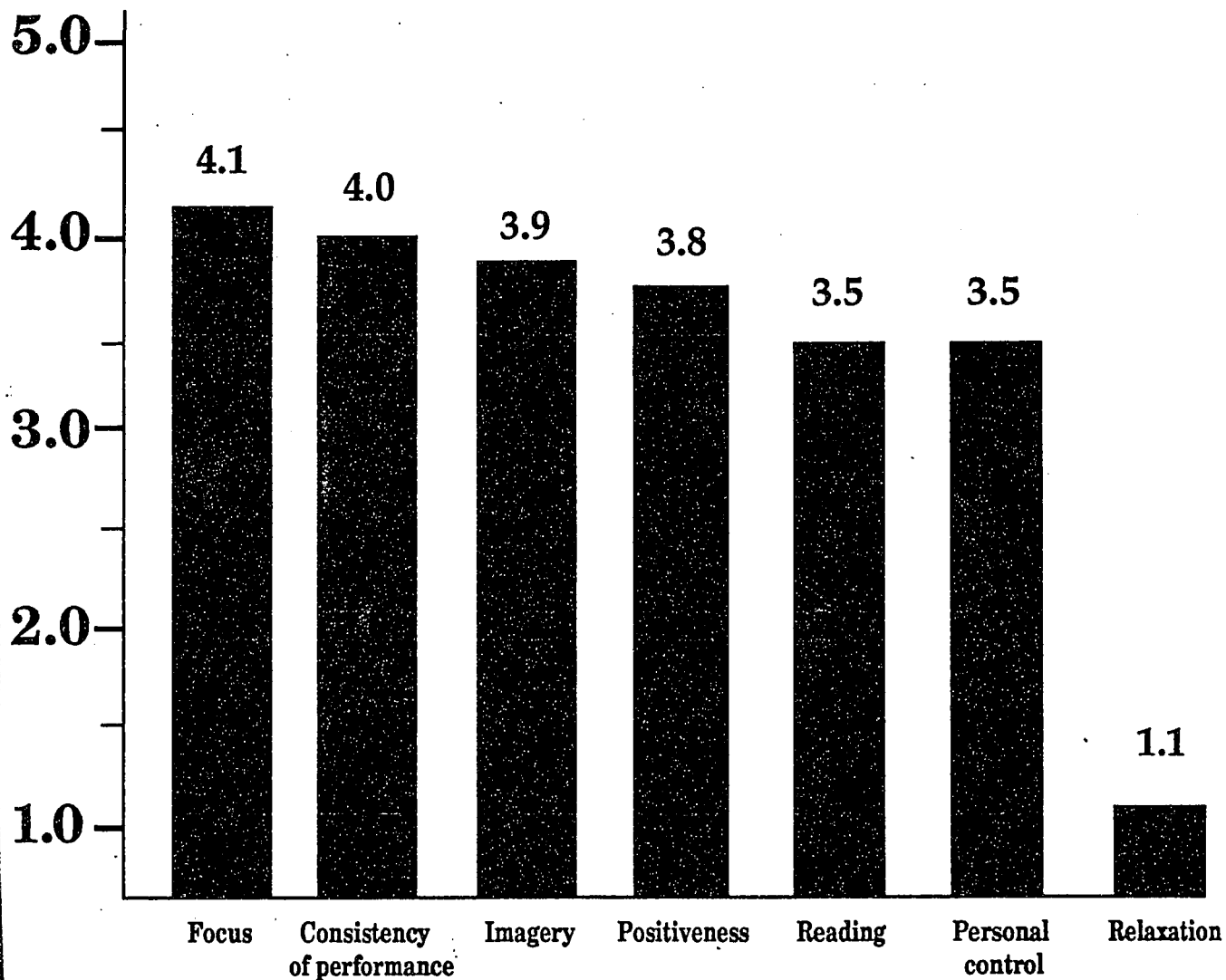


Figure 7. Effectiveness of mental training components (overall means) for Task 6

**Table 7. Responses to Questions on Mental Training Skills
- Task 6**

Question #	Group 1	Group 2	Overall
1.	Yes = 4 No = 2	Yes = 2 No = 4	Yes = 6 No = 6
2.	*M = 3 *I = 2 *R = 1	M = 3 I = 3	M = 6 I = 5 R = 1
3.	Yes = 6 No = 0	Yes = 5 No = 1	Yes = 11 No = 1
4.	Yes = 6 No = 0	Yes = 6 No = 0	Yes = 12 No = 0

- # 1. Have you ever used Mental Training before?
- # 2. Which one of the mental training techniques did you find most beneficial?
- # 3. Did you use imagery while performing serves during a game situation?
- # 4. Do you think you will use these skills again in your life?

* M = Mental Modelling; I = Imagery; R = Relaxation

Table 8. Responses to Question #2 on Effectiveness of the Mental Training Program - Task 6

QUESTION #2. Which one of the mental training techniques did you find was the most beneficial?

Mental Modelling

Group 1:

- "To think of the perfect serve, I would think of them (the olympic athletes) more than me doing it, you know. I could just see them."
- "But I can see how, no matter what you do, no matter what you're using it for, I mean, if you do it, if you keep practicing it, it will definitely be helpful."
- "The mental modelling I guess was much more, given that I didn't know anything about how to do the serve at the outset. That was more from a learning perspective, in terms of learning what the actual motions were that were necessary, but then in terms of perfecting the motion, or getting the feeling that you're doing it properly, once you get the confidence that you've learned a reasonable amount of what the motions are that are required to do it right, and perform the task properly, the work of doing it yourself and serving and thinking it through, and basically imaging, as you see exactly what it is you want to achieve, seems to, really seems to work."

- "Well, I think initially it was good to see the olympic athletes doing their serve because it gave you a mental image of what the serve should look like and when you were doing your own mental imaging, you could then picture yourself in place of that athlete and imagine yourself doing the same thing."

Group 2:

- "I liked the modelling. I probably would choose the modelling first, the visualization and then practice, having a chance to practice... I think it's part of a flow chart and you can't separate one without the other. I mean people do practice and I was doing that before and it wasn't getting anywhere."
- "I would say more towards watching the athletes a little bit, you know for correct form and then you can try and pattern yourself after that, but then as I had spoken to you earlier, I can never really visualize myself personally doing it sort of thing, I just picture a person doing it sort of thing, it's not necessarily me but that's what I can do and you can feel and get the motion of the idea. It changed my idea. Like I was incorrect in the whole idea of how to do an overhand serve as you know when I started. I think modelling of that, plus being able to image. I think I'm pretty good at imaging. I think I'm real good at it as a matter of fact."

- "Yes, watching the athletes. We can see where our mistakes is. So first I was hitting the ball a different way, so when I watched this tape, I saw there is some technique in it so I try it the next time and I did it. It was the first time I did an overhand serve."

Imagery

Group 1:

- "Well you could feel your arm move. I couldn't actually feel my hand hit the ball as much, but I could feel the motions of pulling my arm back and then swinging it, yes, and I could really feel the ball going up in the air."
- "It was more visualization to be honest. I think it's necessary to see the professional type people doing it. You need that in the first place but after that, for me anyway and at the level that we're at, you can visualize what you want to do having seen them do that, and seeing them repeat it time and time again."

Group 2

- "Probably the visual training. That was an important part when it came down to doing the task. It helped also to see how the so-called perfect serve was performed. Once I could see that, then I could, the visualizing could take over."

- "The visualization I think is the one. I guess imagining myself doing it, seeing the movements but also the feeling side."
- "The video (visualization film - WHAT YOU SEE IS WHAT YOU GET) really helped. Seeing those people like Sylvie Bernier was I think really helpful."

Relaxation

Group 2:

- "For me relaxation helped me more than anything because I tend to rush things. I found that I would visualize it a few times before I started to play but during the play I didn't use it that much. I found that if I thought too much about what I was doing, I blew it. I tended to do better if I just relaxed. My big thing was to relax before the serve and then I would do better."
-

Table 9. Responses to Question #4 on Effectiveness of the Mental Training Program - Task 6

QUESTION #4. Do you think you will use these skills again in your life?

- "Yes, it makes you think of using it or trying to use it with other things."
- "Yeah I would. I can see myself doing it in skiing and running and other sports that I do."
- "I think they would be useful, yes. I think for all of us, it was a unique experience, never having done that before and learning a new skill, which we all seem to be using now, when you watch us play. There are not many of us that continue to serve underhand."
- "Yeah, I've tried them a couple of times on the golf course to see if I could visualize. It's this business of visualizing the shot through inasmuch as, again, I'm an occasional golfer like I am an occasional volleyball player. If you could visualize what you want to do with the shot, it does seem to work."
- "Yes, particularly in sports. I play other sports that require focussing and that's curling, and to a large extent, baseball as well. So, I want to use these (techniques) to see if I can improve my performance."

- "I could see myself doing that in terms of, one of the things I've been doing personally is a lot of assertiveness and self-esteem work and I can see using that where you try to visualize an upcoming event and then you are more relaxed and as you go into it, you feel that this is a *déjà vu*, you know, I've done this before."
 - "Absolutely, forever and ever. I love it Susan. It's like a gift to us."
 - "I like it. It's something new and I learned how to serve the overhand ball. It's something about the mental and physical and the modelling, and everything. It was very great."
-

Discussion

This study was designed to examine the thought processes underlying skill learning and acquisition, with reference to a unique population of recreational as opposed to elite athletes (mean age 43.8 years). Mental training techniques were introduced as the treatment in an attempt to improve the level of knowledge and performance of a sport skill. Discussion of the results concentrates on the statistical significance as well as the importance of qualitative analyses of this type of intervention with this particular population.

The results compiled appear to support the use of mental training techniques to enhance the performance of the recreational athlete. Very little research exists on the effect of mental training techniques with non-elite athletes, or specifically recreational athletes, using a sport environment. Feltz and Landers (1983) concluded from their extensive studies, that mental training effectiveness was greater on symbolic or cognitive tasks compared to motor tasks; however, even though group differences were not significant in the performance tasks of this study, within-subject differences across time were in fact significant. The design for this study used Group 2 as a control group for the first four weeks of the program; while Group 1 was receiving the intervention as well as practicing, Group 2 practiced the skill only (even though most did not

know how to perform the skill correctly). Was the improvement over the span of the program due to physical or mental practice? A possible answer to this question may arise from the analysis of the verbatim responses.

To provide some clarity and conciseness in discussing the results, comments for each task will be presented separately. The design of the study encompassed two main areas of interest. First, the role of knowledge in skill acquisition (tasks 2 and 4), and second, the impact of mental training techniques (tasks 3, 5 and 6). Task 1, as previously mentioned, was used as an indicator of the subjects' visual and kinesthetic imagery ability.

Task 1 - Imagery Ability

The analyses results of subjects' imagery ability, through the use of the Movement Imagery Questionnaire (Hall, Pongrac, & Buckolz, 1985) were statistically significant for the kinesthetic imagery of movements for all subjects (Table 1.) This questionnaire was used to determine if the population in this study were high or low imagers since research (Hall, Pongrac & Buckolz, 1985; Feltz & Landers, 1983) has shown that if subjects could image easily, the technique of imaging would probably have a positive effect on performance.

Burhans, Richman, and Bergey (1988) concluded that athletes who have low imagery skills and cannot visualize a specific skill should concentrate on the results of a previous successful performance alone. The authors used an example of competition in open-skilled sports where difficulty exists in identifying the specific skills needed during critical time frames.

Figure 1 showed that at the pre-test, subjects in Group 1 were a little below average in their ability to image kinesthetically, while Group 2 was a little above average; both groups were above average in visual imagery. Significant differences (over time) in kinesthetic imagery clearly pointed to an improved ability to use this feeling type of imagery, an ability which Orlick (1990) found was used by the most successful athletes. Even though the statistical analyses did not show significance between the groups, in fact Group 1 improved by 14.5% and Group 2 by 7.1% (Figure 1).

Visual imagery showed no significance, but this was not surprising as most subjects expressed no problems in visualizing or picturing events in their minds from the very beginning. The kinesthetic imagery did pose problems for the subjects since they had difficulty feeling the moves. However, again using the means (Figure 1), all subjects demonstrated above average visual imagery (12% above average) and improved from pre- to post-test by a further 4.6%. While these improvements were small, the trend to improve was clearly indicated (Figure 1) and with more practice over a longer time frame, further improvement would seem probable.

Some confusion existed among participants with the questionnaire and some of the actions required were not applicable to this population. For instance, one of the actions described in the questionnaire was to perform a front somersault on a mat, and finish in a standing position; it was of course decided not to have any subjects try this to avoid any possible injury. The rating scale was adjusted to incorporate this change. This particular movement questionnaire was utilized because of its high reliability (visual = .828. kinesthetic = .834), however, it would be advantageous to have a more skill-specific questionnaire with very simple actions.

Task 2 - Verbal Instructions

Subjects were asked to provide verbal instructions giving the correct method of performing an overhand serve, with the purpose of trying to determine the subjects' declarative knowledge base. They performed this task at three different times, as it was assumed that their knowledge of making an overhand serve would expand over time. This verbatim response task was one of the methods used to assess any increases in knowledge. It was originally thought that if a subject did not have verbal skills, actions would compensate, however, since only two of the subjects actually demonstrated the serve, observation of the videotape did not reveal any extra information. The graphical presentation of categorized knowledge levels (Figure 2) did show

that Group 1 possessed a little more knowledge at the pre-test and added to their knowledge by 1.0 of a level (33%) over the period they received the mental training program (pre-mid), compared to Group 2 (13%) over the same period. From mid-post, Group 2 had the mental training program but their knowledge increased by only 0.6 of a level (20%).

Since the quantitative analyses did not provide support for group differences after receiving the mental training program, the decision was made to concentrate on how all subjects (both groups) improved their knowledge and performance. The effects of the mental training program seemed to help increase Group 1's level of knowledge at the mid-test. This was apparent since the taping was done quite randomly giving them no opportunity to prepare their responses before they were taped. After the mental training program was completed for Group 1, there was a two-session lapse before Group 2 could begin and that extra time was used for the impromptu videotaping of this task.

The post-testing was different, however, since a proper schedule had to be drawn up, so subjects knew exactly when they would be taped. It was expected that some subjects might have pre-rehearsed what they would say, since by the third testing session, they all knew what the tasks entailed. The results for Group 2, however, showed that they definitely had not rehearsed their responses on how to serve correctly because only two out of six subjects obtained a Level 3 on the knowledge category.

It was crucial in this categorizing to have a high interrater reliability and this was accomplished (90%).

In the review of literature, Anderson (1983) mentioned that knowledge from past experience (procedural knowledge) can help with a new situation until specific new knowledge can be acquired. This was evidenced in this study since some of the subjects utilized their past knowledge of serving in tennis to help them in this novel skill of the overhand serve. While tennis and volleyball serving are very different, there are some similar processes and as practice continued, the new skill evolved and performance improved over time.

Tasks 3 and 5 - Performance - Overall and Individual Predictions

These tasks will be discussed together since they were both performance tasks, and the only difference between them was in the prediction component. Quantitative analyses of their performance did show significance (Table 2), but only in the within-subject effect over time, $p = .001$ for Task 3 and $.014$ for Task 5. The between group effect was not significant and this could have been accounted for by the fact that the sample size was so small ($N = 12$), as well as by the variance in scores. Nonetheless, performance seemed to improve over time as evidenced by the results. Questions arise as to why the improvement; was increased performance due to the mental training program or to physical practice? The answer can

only be assumed or inferred. The subjects were asked to physically practice 10 overhand serves before they began their recreational games of volleyball (which took place twice per week for about forty minutes). Subjects who were receiving the mental training program were also asked to mentally practice 10 overhand serves each day. However, there was no strict monitoring of the physical or mental practice. From some of the verbal responses, it was evident that daily mental practice was being done by some of the subjects. Also, while practice serves were not actually counted, the subjects did advise that they had performed at least 10 overhand serves during the physical practice sessions. In addition, during the actual volleyball games, of which there were at least two per night, each subject would have served at least four times during a game, and all were using the overhand serve. From the research, the combination of both physical and mental practice provided the most improvement in performance (Gabriele, Hall, & Lee, 1989).

Figure 3 provided a graphical account of performance scores achieved out of a possible 12 serves and showed that Group 1 improved the most. In Task 3, Group 1 increased from 5.5 serves out of 12 to 8.3 (pre-mid period). This was a performance increase of 23% over the time they had the mental training program. In contrast, Group 2, from mid-post, the time of their mental training program, decreased from 7.0 serves out of 12 to 6.2 serves, a 7% decrease in performance. Comparison with Task 5 performance (Figure 4)

shows a higher increase in performance over Task 3 for Group 1. In the pre-mid time frame, for Task 5, Group 1 increased from 6.7 to 8.7 serves out of 12, or 17%. In the mid-post time frame, for Task 5, Group 2 increased from 6.8 to 7.6 serves out of 12, or just 7%. Due to the very small sample size, statistical significance for group differences did not surface. Overall performance for both groups for Task 3 was 18% increase and 23% increase for Task 5.

Even though statistically Group 1 did not increase their performance more than Group 2, the evidence presented lends support to the research hypothesis that this mental training program would have an impact on performance. In addition, it can be said that if performance increased, this can be used as a measure of the subjects' procedural knowledge (Anderson, 1976).

Post hoc analysis (Table 3) showed that overall performance increased in Task 3 during the period from pre-test to mid-test, as well as pre-test to post-test. The only explanation for these results is possibly the practice of Group 2, who were modelling the subjects in Group 1. Another explanation could be the decrease in performance for Group 2, from mid to post in Task 3, which perhaps was due to Group 2 having to readjust the incorrect movements they had been practicing, to the correct method of serving the overhand serve. When compared to the post hoc analysis for Task 5, this pre-mid significant difference did not occur. The only effect brought out by the post hoc analysis was the pre-post difference for all subjects, which was expected due to the overall performance increase.

Subjects' ability to predict the outcome of their serves was considered in line with research on the importance of perception in sport as well as skill (Allard, Graham & Paarsalu, 1980; Allard, 1985). In Task 3 (Table 4), using the ratio of actual over predicted with Anovas, no significant differences were found, indicating no improvement in prediction capabilities. The outcome of the quantitative analysis for Task 5 (Table 4), however, showed significance for within subject effect over time, indicating subjects improved their prediction capabilities over the span of the whole program. This seems logical, given that performance also increased.

One more relationship to performance that should be highlighted is the comparison of Group 1 and 2's success rates of actual scores versus predicted scores for Tasks 3 and 5. Looking over the graphical presentations of performance results (Figures 3 and 4), Task 3 serves which were performed first, seemed to be warm-up serves for the next set of serves in Task 5. For example, looking at Group 1, Task 3 (Figure 3), their predicted score at the pre-test was low (5 predicted out of 12, actual score 5.5) demonstrating a lack of confidence in ability. In contrast, their Task 5 (Figure 4) predicted score at the pre-test was much higher (10 serves predicted out of 12, actual score 6.7) demonstrating more confidence and perhaps more at ease with the serves. This trend continued on for the mid-test which was after Group 1 had the mental training. In Task 3, at the mid-test, Group 1 predicted a much higher score of 9.2 out of 12 (actual was 8.3), and at Task 5, the prediction went a bit

higher to 10.5 out of 12 (actual was 8.7). The results have some very interesting trends and seem to point to the fact that more knowledge and more practice (whether mental or physical) bring more confidence and better performance. This trend was noticeable with both Groups.

The current study's results reflect Abernethy's study (1988) on the effects of age and expertise with badminton players. Abernethy showed that age exerted a significant influence on prediction performance of an adult group compared to other age categories. As Abernethy cautioned, a particular stroke would not improve just because of the maturation process but the ability to predict would increase with a combination of task-specific experience combined with maturation. This seemed to be the case in the current study's results.

The post hoc analysis (Table 5) found the effect to be mid-post and pre-post, which strongly supports the notion that as knowledge about the skill is increased so too is performance increased. This means that predicted performance was close to or matched the actual performance. This performance can be considered as an expression of what the subjects know, and since performance improved, knowledge also improved, (Kerr, 1982).

Table 6 provided a summary of the actual over predicted ratios which statistically support (a ratio of 1.0 indicates predicted score matched actual score) that Group 1 had a greater ability than Group 2 to predict their performance across the three measures of pre-, mid- and post-tests. This would

imply that Group 1 had more knowledge, due to the mental training intervention, because this increase in ratios occurred during the period they had the intervention while the other group did not. Both groups had physical practice so the increase was not just due to the physical practice. This was true for both tasks 3 and 5. For Task 3, the average for Group 1 was .958 compared to .704 for Group 2. For Task 5, the average for Group 1 was .798 compared to .650 for Group 2.

Originally it was decided to use the videotapes to observe subjects' actions to compare with their verbal responses, which could then be analyzed by simple frequency counts of movements of arm, hand, leg, et cetera. The feasibility of using the videotapes for this type of analysis was found to be inappropriate, as the data obtained from videos was not meaningful and could not be matched with the verbal responses. Therefore, the increase in knowledge could not be substantiated by observation of the videos, as had been anticipated. For that reason, the actual increases in performance were used as a measure of the increase in knowledge (Orlick, 1992, personal communication).

Task 4 - Video Analysis

Subjects' self-analysis of their performance was impressive (Level 2 and higher) even with their pre-test responses at the beginning when they did not know how to perform a serve correctly. Figure 5 shows that both groups were able to provide reasonable explanations at a starting level of 2.5 for Group 1, for

the pre-test and 2.0 for Group 2. At the mid-test, Group 2 decreased to a level of level of 1.7 and Group 1 increased to 2.6. The post-test result showed Group 1 increased to 2.8 and Group 2 increased to 2.6. Their intrinsic knowledge and problem-solving abilities enabled them to provide specific feedback on how to serve better, as evidenced in their verbal responses. They seemed to be able to pick out some of their errors and provide corrections. Reports were made about how they felt about the serves while performing them (intrinsic feedback), and how they looked on tape (extrinsic) compared to the way they perceived how they looked. As stated previously, skill acquisition is dependent on feedback (Bilodeau & Bilodeau, 1961; Kerr, 1982), and this particular population demonstrated that they were capable of not only recognizing correct and incorrect movements, but recalling past experiences and applying that previous knowledge to existing knowledge in order to learn the new skill.

The effect of an individual's perception of his or her performance was discussed in a study by Ebbeck (1990) as it related to exercise workout sessions. Ebbeck found that the self-concept one has of his or her ability affects performance. The results discussed here do in fact show that once the subjects felt confident in their ability to perform the overhand volleyball serve (i.e., after watching the mental modelling of olympic athletes), their self-image of how they played was affected, which in turn improved their performance.

Again, observation of the videotapes to attempt to add to the information provided by each subject, did not provide additional insight. In fact, the observation caused some confusion on the part of the observer since the subjects picked out things they had felt while performing, and the observer had an entirely different perspective, so commentaries were completely unmatchable.

The qualitative analyses for this task certainly did not show any great differences between Groups, however this task provided evidence that all subjects were in fact learning the skill, because they developed changes in their behaviour which became permanent, as can be seen from the results of the performance tasks (Tasks 3 and 5).

Task 6 - Effectiveness of Mental Training Program

The final measure of success of any program is based on the feedback or evaluation of it by the participants. Questions in this debriefing were kept to a minimum to try to solicit personal comments about the program. The feedback from the answers to the ratings on several questions, as well as the answers to the other questions, was quite informative. From the rated questions, it is evident that focussing was the mental skill that was helped most by the mental training program and that the least helpful of the skills practiced was relaxation (Figures 6 and 7).

Table 7 lists the extremely positive feedback that 11 of the 12 subjects use imagery while performing their overhand serves, and that 12 of the 12 subjects intend to use the mental training skills learned over the course of the program in other sports or in other aspects of their lives.

Table 8 lists some of the responses from question 2 which provide insight into how the subjects viewed the mental training program and which technique they felt helped them the most with this new skill. Table 9 displays some of the responses from question 4 which demonstrate practical significance of the overall results. These verbatim responses were detailed and added much to the reasoning behind qualitative versus quantitative analyses. Without individual personal comments, the thorough understanding that is needed to determine how people learn a new skill cannot possibly hope to be discovered.

Conclusion

This study was a positive beginning to a new and exciting research area involving recreational rather than elite athletes, and the impact mental training techniques have on this particular population.

The fact that statistical significance did not support between-group differences for performance is secondary to the realistic and positive outcome of this study, since the ability to predict actual performance was found to be statistically different between groups. Mental training did appear to increase the level of knowledge, and this was demonstrated in the prediction capabilities. From Figures 3 and 4, it was evident that Group 1 seemed to improve slightly more than Group 2, however, the overall result is that all subjects experienced an increase in both their level of knowledge and in their

performance of this novel skill of the overhand volleyball serve. While inference can be the only rule in research, the data is supportive that mental practice did dominate over physical practice . Another positive outcome as a result of the introduction to the mental training program is that subjects demonstrated from their verbatim reports that they will be putting these techniques into action, and some have already done so in sports such as baseball, curling, golf, and running.

Although the design did not include a follow-up measure with the subjects, it has been observed by the investigator that since the end of the program , the subjects have maintained the gains they had made and are, in fact, performing the overhand serve and scoring points.

The real outcome of this study is that this population not only learned mental training techniques but how to apply them to learn a novel skill (the overhand volleyball serve). In addition, they seemed to improve their performance and their knowledge. Using imagery seems to have become a habit with some subjects. This human movement and learning concept could become a great lifestyle adjustment process for people in their thirties and forties, since this population genuinely wants to become more active. As well as keeping healthy and fit, they are looking for an extra feeling - something that will give them a sense of personal accomplishment, with some fun. Recreational sports seem to provide them with what they are looking for, as evidenced in their verbal responses.

The beginning of this human movement process could logically be led by the parents (those in 30's, 40's) who have, or will have, very young children. As role models, they will be able to teach their children at a very early age, how to use mental training skills and the whole process could escalate from there. It could become as routine or automatic as teaching young children basic survival skills. This would effectively change lifestyles in the real world situation.

Many adults may never have learned or accomplished a sport skill before in their lives simply because they may have failed to learn the correct motor response. With the mental training skill of imaging the perfect skill (mental modelling) these adults could learn new skills, play fun sports involving some competition, which would provide them with a great feeling of personal accomplishment, self-confidence and self-esteem, to mention just a few of the rewards. Further, movement skills help to retain reaction time and hand-eye co-ordination, not to mention the positive vibrations and positive feelings which occur in people who are active and feel more alive because they play sports.

Future Recommendations

Timing seemed to be a critical element in the study as far as scheduling the testing at the pre-, mid- and post-tests. Since this population included busy, professional people with many responsibilities as well as families to care for, it would be advantageous to organize the taping of the performance tasks

with more time allotted to self-analysis of the videotaped task. In this study, both performance tasks were taped one right after the other, and then the subjects would view the one task to provide verbal comments. However, perhaps the extra time, and another set of serves in the next task, actually helped them by allowing more time to think about their performance and to be more effective in their feedback analysis. As well, it might be more expedient to have the subjects serve more than 12 serves for the mid-testing after they had had some practice for several weeks which would facilitate the statistical analysis.

The actual videotaping was another factor for reconsideration. The subjects were filmed at a full-body angle so that all body movements could be seen by the investigator, however, the subject was all that was visible. It would have been more useful if the whole court had been visible so that the flight of the ball could have been followed. Also it was extremely difficult to decipher the subjects' specific movements on the video since freeze-frame capabilities were not available. In other words it was difficult to match the verbal responses with the subjects' movements.

Another concern was with ensuring the participation of subjects for the whole study. One subject was unable to attend until about the mid-test time, therefore, Group 2 had only five subjects instead of six for the first half of the program.

Some methodological considerations worth noting for future research are as follows:

- The time allotment for the intervention should be at least 8-10 weeks in order to facilitate quantitative analyses.
- Commitment and a thorough understanding by the subjects of the time periods involved in the study is crucial, i.e. time allotment for mental training program, testing times and debriefing time.
- The use of a proper control group, equally matched with subjects in the experimental group, should be considered to ensure realistic and meaningful statistics.
- Recruitment of at least 10-12 subjects in each group would improve chances of statistical significance.
- Performance tasks should involve a greater number of serves — at least 16-20 per task.
- There should be constant monitoring of physical and mental practice of serves, i.e. daily log sheets completed by participants.

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Appendix A

Means and Standard Deviations for Imagery Ability for Task 1KINESTHETIC IMAGERY ABILITY

GROUP	PRE-TEST	POST-TEST	AVGS	IMPROVEMENT
1	31.2 (19.6)	23.3 (15.1)	27.3	8.1 (14.5%)
2	22.7 (11.9)	18.7 (5.6)	20.7	4.0 (7.1%)
AVGS	26.9	21.0		6.0 (11%)

VISUAL IMAGERY ABILITY

GROUP	PRE-TEST	POST-TEST	AVGS	IMPROVEMENT
1	21.3 (10.5)	19.2 (9.7)	20.3	2.1 (4%)
2	20.8 (10.2)	19.3 (4.6)	20.1	1.5 (3%)
AVGS	21.1	19.3		2.6 (5%)

Note: High Imager = 8.0 (minimum)
 Low Imager = 56.0 (maximum)
 Average = 28.0

Appendix B

Categorized Knowledge Results for Task 2

 KNOWLEDGE LEVELS *
 MEANS AND STANDARD DEVIATIONS

GROUP	PRE-	MID-	POST-
1	1.5 (.55)	2.5 (.55)	2.8 (.42)
2	1.1 (.22)	1.5 (.55)	2.1 (.66)

 KNOWLEDGE INCREASES

GROUP	PRE - MID	MID - POST	PRE - POST
1	1.0 (33%)**	0.3 (10%)	1.3 (43%)
2	0.4 (13%)	0.6 (20%)**	1.0 (33%)

* LEVEL 1 = very basic knowledge
 LEVEL 2 = more than basic knowledge
 LEVEL 3 = concrete knowledge of the skill

** Group 1 had Mental Training Program from Pre-Mid
 Group 2 had Mental Training Program from Mid-Post

Appendix C

Performance Means & Standard Deviations for Tasks 3 and 5

Group	Time			
	PRE	MID	POST	AVGS
TASK 3				
1	5.5 (2.67)	8.3 (1.51)	8.0 (1.27)	7.3
2	4.6 (4.45)	7.0 (4.53)	6.2 (4.49)	5.9
AVGS	5.1	7.7	7.2	
TASK 5				
1	6.7 (2.81)	8.7 (2.34)	10.0 (1.27)	8.5
2	5.6 (5.03)	6.8 (4.32)	7.6 (3.78)	6.7
AVGS	6.2	7.8	8.9	

Note: Group 1 = 6 subjects

Group 2 = 5 subjects (adjusted to correspond with statistical analyses)

Appendix D

**Success Rate of 12 Serves with Overall Predicted (P)*
and Actual (A)* Performance for Task 3**

Subject #	Pre-Test		Mid-Test		Post-Test	
	P	A	P	A	P	A
Group 1						
1	4	4	8	6	10	6
4	4	6	12	8	10	9
6	5	8	10	10	9	9
7	7	9	10	8	10	9
10	7	4	8	10	9	8
11	3	2	7	8	9	7
Group 1 X's	5	5.5	9.2	8.3	9.5	8

Subject #	Pre-Test		Mid-Test		Post-Test	
	P	A	P	A	P	A
Group 2						
2	8	10	10	11	10	10
3	4	7	10	9	10	11
5	8	0	9	5	8	4
8	3	0	2	0	5	0
9	8	6	10	10	9	6
12	**	**	6	10	8	11
Group 2 X's	6.2	4.6	7.8	7.5	8.3	7

* One overall prediction was made before the 12 serves.

** This subject was not able to participate until mid-test.

Appendix E

**Success Rate of 12 Serves showing Predicted (P)*
and Actual (A)* Performance for Task 5**

Subject #	Pre-Test		Mid-Test		Post-Test	
	P	A	P	A	P	A
Group 1						
1	10	3	10	7	11	9
4	9	6	12	10	12	10
6	10	10	9	7	10	9
7	11	10	11	10	10	9
10	12	6	12	12	12	11
11	8	5	9	6	12	12

Group 1 X's	10	6.7	10.5	8.7	11.2	10
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Subject #	Pre-Test		Mid-Test		Post-Test	
	P	A	P	A	P	A
Group 2						
2	12	12	11	11	12	12
3	7	7	9	7	9	9
5	0	1	10	6	8	6
8	0	0	0	0	5	2
9	12	8	12	10	12	9
12	**	**	7	5	8	8

Group 2 X's	6.2	5.6	8.2	6.5	9	7.7
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* Each serve was predicted as the hand struck the ball.

** This subject was not able to participate until mid-test.

Appendix F

**Categorized Videotape Analysis (Subject Feedback)
for Task 4 — Means and Standard Deviations**

FEEDBACK LEVELS*

GROUP	PRE	MID	POST
1	2.5 (.55)	2.6 (.49)	2.8 (.41)
2	2.0 (.71)	1.7 (.52)	2.6 (.49)

INCREASES IN FEEDBACK

GROUP	PRE-MID	MID-POST	PRE-POST
1	0.1 (3%)**	0.2 (7%)	0.3 (10%)
2	Decrease 0.3 (10%)	0.9 (30%)**	0.6 (20%)

* LEVEL 1 = gave brief response with no explanation
 LEVEL 2 = gave some brief explanation
 LEVEL 3 = gave specific explanation

** Group 1 had Mental Training Program from Pre-Mid
 Group 2 had Mental Training Program from Mid-Post

Appendix G

Rated Questions on Effectiveness of Mental Training Elements for Task 6

MT Element	Group 1		Group 2		Overall	
	X's	SD	X's	SD	X's	SD
Reading	4.0	0.89	3.0	0.89	3.5	1.00
Focussing	4.0	1.26	4.2	0.41	4.1	0.90
Visualization	4.0	0.89	3.8	0.93	3.9	0.87
Relaxation	1.5	1.87	0.7	1.63	1.1	1.73
Positiveness	3.5	1.76	4.1	0.66	3.8	1.30
Personal Control	3.8	0.75	3.2	1.60	3.5	1.24
Consistency of Performance	3.8	0.75	4.1	0.66	4.0	0.69
Overall MT Program	4.3	0.52	4.0	0.89	4.2	0.72

Most Helpful Overall = Focussing (4.1)

Least Helpful Overall = Relaxation (1.1)

Rating Scale: 1 = Not much help; 5 = very helpful

Appendix H
Letter of Informed Consent

THESIS TITLE: Effect of Mental Training Techniques on Knowledge and Performance of Volleyball Skills

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Dr. M. Loyer, Chairperson, Faculty of Health Sciences,
Human Research Ethics Committee, 787-6705

This research project examines the relationship existing between knowledge and skill in sports performance as well as the impact of mental training techniques. The participants involved will be asked to take part in a mental training program over a four-week session and to complete the following tasks three times during the complete eight-week session (pre, mid and post-session):

- Task 1. complete a Movement Imagery Questionnaire;
- Task 2. provide instructions verbally on the correct method of executing an overhand serve; (Responses will be recorded using a tape recorder and a video camera.)
- Task 3. perform 12 overhand volleyball serves, serving to two different target areas, commenting beforehand on the confidence level of correctly serving to each target area; (Responses will be recorded using a tape recorder and a video camera.)

- Task 4. view their own performance on Task 3 and provide verbal comments regarding their serves, explaining any errors made and providing reasons why they played the way they did; (Responses will be recorded using a tape recorder.)
- Task 5. perform 12 overhand volleyball serves, serving to two different target areas, predicting the outcome of each attempt immediately the ball is released (IN or OUT response); (Responses will be recorded using a tape recorder and a video camera.)
- Task 6. attend a debriefing session on the effectiveness of the mental training program .

All results will be kept confidential with only the experimenter, Susan Green, having access to the audio and video cassettes. Any published data will be in the form of group analyses only.

Any questions regarding this project may be asked at any point before, during or after participation. Instructions will be given individually to each participant before each task. The time required to complete all six tasks is estimated to take forty minutes. The mental training program will take place for 30 minutes each night, twice a week, for four weeks.

It should be understood that at no point in the investigation will there be exposure to any risk and that withdrawal from the project can take place at any time. Having read the above information, I give my informed, voluntary consent to participate in this project.

DATE: _____ SIGNATURE: _____

Appendix I
Task Instructions

Task 1 - Complete Imagery Questionnaire.

Task 2 - Verbal Instructions

I am to provide verbal instructions on the correct method of executing an overhand serve, from the right back position with both feet in the service area.

I am to THINK ALOUD while planning my instructive dialogue. THINK ALOUD means that I must verbalize everything that I think about from the start of the task until I feel I have completed it. I am to say everything that I feel must be known in order to successfully learn the skill. If I wish, I may perform or demonstrate parts of the skill while providing instructions. If I remain silent for any length of time I will be reminded to THINK ALOUD. The experimenter may question my instructions at any time by asking "why" so that certain points are made clear. Any questions I have regarding task performance may be raised at the onset of the task, prior to task performance.

During the performance of this task all of my actions and instructions will be recorded using a tape recorder and video camera.

Task 3 - Physical Performance

Before performing this task, I am to comment on my confidence in correctly serving to each target area. The confidence rating will be LOW for 0-4 out of 12 correct serves, AVERAGE for 5-7 correct serves, and HIGH for 8-10 correct serves.

I am to perform twelve volleyball serves while in the right back position with both feet in the service area, being careful to take my time, concentrate and anticipate the flight of the serve, then to complete the successful serve. I am to use two different target areas, as marked, with six trials in each area.

I am to change positions after every two serves, then reposition myself to simulate real conditions.

Any questions I have regarding task performance may be raised at the onset of the task, prior to task performance.

During the performance of this task, all of my actions and responses will be recorded using both a tape recorder and a video camera.

Task 4 - Video Replay

I am to view my own performance of Task 3 just completed, and provide verbal comments regarding my serves, explaining any errors made, and providing reasons why I played the way I did.

Any questions I have regarding task performance may be raised at the onset of the task, prior to task performance.

During the performance of this task, all of my responses will be recorded using a tape recorder.

Task 5 - Physical Performance with Prediction

I am to perform twelve volleyball serves while in the right back position with both feet in the service area, being careful to take my time, concentrate and anticipate the flight of the serve, then to complete the successful serve. I am to use two different target areas, as marked, with six trials in each area.

Immediately upon release of each ball, I am to verbally indicate whether or not I believe my serve is going to be successful. If I think my serve is going to be successful, I am to say "IN". If I think my serve is not going to be successful, I am to say "OUT". I am to indicate why I thought my serve was not going to be successful (whether or not it actually was). I am to change positions after every two serves to simulate real conditions.

Any questions I have regarding task performance may be raised at the onset of the task, prior to task performance.

During the performance of this task, all of my actions and responses will be recorded using both a tape recorder and a video camera..

Task 6 - Attend a debriefing on the effectiveness of the M.T. Program.

Appendix J

Movement Imagery Questionnaire

MOVEMENT IMAGERY



QUESTIONNAIRE

Craig R. Hall and John Pongrac

Faculty of Physical Education
The University of Western Ontario
London, Ontario
Canada

INSTRUCTIONS

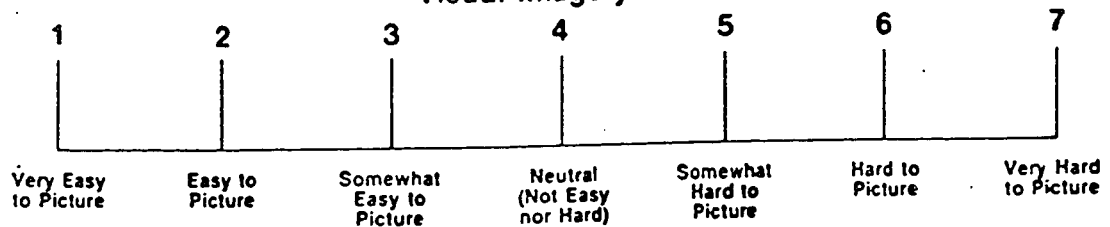
This questionnaire concerns two ways of mentally performing movements, which are used by some people more than others, and are more applicable to some types of movements than others. The first is the formation of a mental (visual) image or picture of a movement in your mind. The second is attempting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

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

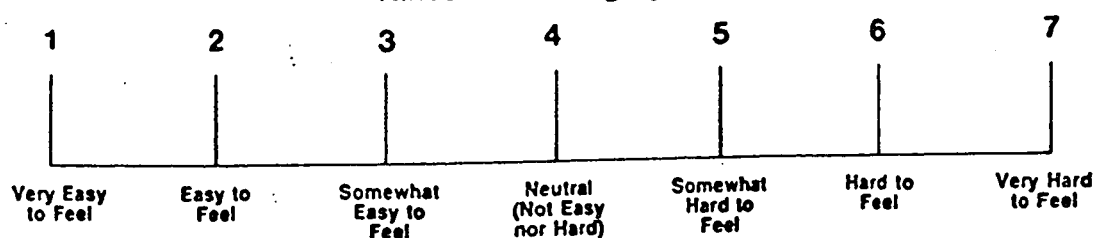
After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task. Take your rating from the following scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating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

RATING SCALES

Visual Imagery Scale



Kinesthetic Imagery Scale



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

Rating

- 2. STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.
- ACTION:** Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.
- MENTAL TASK:** Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 3. STARTING POSITION:** Stand with your feet slightly apart and your hands at your sides.
- ACTION:** Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 4. STARTING POSITION:** Stand with your feet slightly apart and your arms at your 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.

Rating

- 5. STARTING POSITION:** Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
- ACTION:** Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 6. STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.
ACTION: Raise your left leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your support (right) leg straight. Now lower you left leg so you are once again standing on two feet. Perform these actions slowly.
MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 7. STARTING POSITION:** Stand with your feet slightly apart and your arms fully extended above your head.
ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.
MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 8. STARTING POSITION:** Make a fist with your nondominant hand. Extend your arm above your head keeping you hand in a fist. Keep you other arm at your side.
ACTION: Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your hand clenched
MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 9. STARTING POSITION:** Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.
ACTION: Perform a front somersault (roll) on the mat and finish in a standing position.
MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

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

Rating

- 11. STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.
- ACTION:** Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 12. STARTING POSITION:** Stand with your feet slightly apart and your hands at your sides.
- ACTION:** Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
- MENTAL TASK:** Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 13. STARTING POSITION:** Stand with your feet slightly apart and your arms at your sides.
- ACTION:** Jump upwards and rotate your entire body to the left such that you land in the same position in which you started. That is, rotate to the left in a complete (360°) circle.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 14. STARTING POSITION:** Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
- ACTION:** Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
- MENTAL TASK:** Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 15. STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.
- ACTION:** Raise your left leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your 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. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 16. STARTING POSITION:** Stand with your feet slightly apart and your arms fully extended above your head.
- ACTION:** Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.
- MENTAL TASK:** Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 17. STARTING POSITION:** Make a fist with your nondominant hand. Extend your arm above your head keeping 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 hand clenched.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

- 18. STARTING POSITION:** Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.
- ACTION:** Perform a front somersault (roll) on the mat and finish in a standing position.
- MENTAL TASK:** Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

MOVEMENT IMAGERY QUESTIONNAIRE

Information Sheet

The Movement Imagery Questionnaire (MIQ) is designed to measure individual differences in visual and kinesthetic imagery of movements. It has been found to possess a high reliability (visual .828; kinesthetic .834) when administered separately to individuals in a quiet room, free from distraction.

SCORING: The questionnaire contains two subscales. To obtain the visual imagery score sum the ratings given to the following items: 1, 3, 5, 7, 11, 13, 15, 17, 18. To obtain the kinesthetic imagery score sum the ratings given to the following items: 2, 4, 6, 8, 9, 10, 12, 14, 16. The minimum score that can be achieved is a 9 (high imager) and the maximum score possible is a 63.

EQUIPMENT: The only equipment necessary to administer the MIQ is a pencil and an exercise (floor) mat.

NOTE

Additional copies of the MIQ are available in sets of 50 at a cost of \$25.00 per set plus postage. These may be obtained by writing:

Dr. Craig R. Ball
Faculty of Physical Education
University of Western Ontario
London, Ontario, Canada
N6H 3K7

Appendix K

Schedule of Mental Training Program

The content for each mental training session (30 minutes) is outlined below. The treatment group will meet twice each week for a duration of four weeks or a total of 8 sessions.

SESSION	CONTENT DETAIL
1.	Introduction and value of mental training techniques. Video presentation of "Visualization - What You See is What You Get" from Coaching Association of Canada, with a practice session on imaging with positive thoughts and cue words. Reading assignment from Orlick's (1990) "In Pursuit of Excellence".
2.	Review of reading assignment from the previous session. Importance of thorough relaxation techniques and the use of Orlick's (1990) audio tape for a practical session of relaxation.
3.	Video presentation of the correct technique for the overhand serve from the 1984 Olympic Volleyball Technical Skills film. Relaxation session including visual and kinesthetic imagery.

SESSION	CONTENT DETAIL
4.	Video observation of technical components of the overhand serve, with many repeats of the same movements. Relaxation session to ready the subjects to obtain quality visual and kinesthetic imagery. Imagery practice, with focus on positive cueing.
5. - 8.	The remainder of the four weeks will follow the same procedure of: watching the overhand serve performed over and over by olympic athletes (mental modelling) to make sure the subjects have the correct skill in their imagery and are able to call the feeling of the movement into play during imagery (approx. 6 mins); relaxing to mentally prepare for imagery; finally practicing mental imagery (both visual and kinesthetic).

Appendix L

Debriefing on the Effectiveness of the Mental Training Program

The debriefing session consisted of a personal interview with each subject to obtain feedback on the effectiveness of the program and how it affected them personally. To begin the interview, subjects were asked the following general questions on mental training skills:

1. Have you ever used Mental Training before?
2. Which one of the mental training techniques did you find most beneficial to you?
3. Did you use imagery while performing serves during a game situation?
4. Do you think you will use these skills again in your life?

For comparison purposes, the next part of the interview consisted of questions with ratings, designed and used by Orlick (1986) with elite athletes:

How do you feel each of the following helped you with respect to performing the overhand serve in volleyball?

(The rating scale was 1 = not much help; 5 = very helpful.)

- 1) the reading on Mental Imagery taken from Terry Orlick's "In Pursuit of Excellence", second edition, 1990;
- 2) the practice of focussing during training;

- 3) using imagery (visualization);
- 4) relaxation;
- 5) the overall mental training program?

How much do you feel the Mental Training Program affected:

- 1) the positiveness of your thinking as far as serving is concerned?
- 2) your feelings of personal control over serving?
- 3) the consistency of your performance?

Do you have any other comments about the whole Mental Training Program, or do you have anything you wish to add?