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THE EFFECTS OF MENTAL IMAGERY ON TENNIS SERVING PERFORMANCE ACROSS RACES

BY

WILLIAM DREWRY SCALES III

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
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1995

ABSTRACT

THE EFFECTS OF MENTAL IMAGERY ON TENNIS SERVING PERFORMANCE ACROSS RACES

BY

WILLIAM DREWRY SCALES III

The purpose of this study was to determine the degree to which mental imagery affects tennis serving performance and to assess any differences with imagery effectiveness across African American and Caucasian races. Thirty five male college-aged tennis players participated. Twenty were of Caucasian descent and 15 were African American. High- or low-ability tennis players were determined according to the National Tennis Rating Program (NTRP). Pre- and post-intervention skills tests were used to specifically assess subjects' serving ability. Treatment group subjects were led through group relaxation and imagery procedures and given a tape of the session. Control group subjects were introduced to a placebo tape of nature sounds. After seven days of practice with the tapes subjects' serving performances were recorded during a match. Results revealed no significant performance differences between treatment and control subjects. Although no significant race differences in performance surfaced certain noteworthy trends were observed.

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DEDICATION

This thesis is dedicated to my parents, Dr. William D. Scales II and Mrs. Diana B. Scales. Each page of this work is a reflection of your own existence that I have been so fortunate to have instilled in me as your son. Thank you very much for your endless encouragement and support through this process. I love you.

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CHAPTER 1

Introduction

Popular beliefs about race and ethnicity have a major impact on sport opportunities and the way coaches, fellow players and spectators respond to athletes of color. For example, golf championships sponsored by the Professional Golf Association in 1991 were held at a country club where there were no black persons with memberships at the club because it would make white members uncomfortable! (Coakley, 1994). Coaches in team sports have persisted in placing black athletes into certain positions on teams that were considered non-thinking positions. This concept of racial stacking appears to "correspond closely with racist beliefs about skin color and intelligence, leadership and decision making, dependability, motivation and emotion, running and jumping, and what many people call instincts" (Coakley, 1994, p. 253). Additionally, evidence of these misconceptions is augmented by reporters referring to black's athletic prowess as animal-like.

The issue of racial differences encompasses all minorities and is not limited to the black athlete. Coakley (1994) discussed the beliefs held by the majority culture toward Native Americans, Hispanics, Asian Americans and African Americans and reported that the majority culture persists in stereotypic beliefs about these cultures, the cultures' view of sport and in which sports ethnic and racial groups are likely to choose to participate. There is indeed a need for more research and education to help dispel stereotypic beliefs and gain an appreciation of the sport perspectives about people of color.

From a psychological perspective similar myths have been perpetuated. For instance when observing the learning styles (e.g., Ewing & Yong, 1992) of minorities, many in the majority culture tend not to acknowledge the fact that individuals do not all grasp the knowledge of how to do certain skills or tasks in the same manner. Athletic performance involves many cognitive, behavioral, and social processes thus, the issue of racial differences in learning styles in sports also deserves consideration because learning occurs in different cultural contexts differently.

The use of mental imagery in sport is a learned skill which must address various ethnic learning styles in order to be an effective tool for performance enhancement of all athletes. However, ethnic considerations in the study of imagery in sport have gone completely unnoticed. Consequently, in many instances, researchers attribute the lack of effectiveness for imagery influence on one's athletic performance to factors other than different perceptions and learning styles among races or individuals.

The Process of Mental Imagery

Mental imagery is a process whereby and individual rehearses or practices an activity solely through the mind. This rehearsal of tasks in the mind is a cognitive technique that utilizes several methods to help one prepare for an actual event. Positive self-talk, control of attention, preparatory arousal, relaxation, elimination of negative thoughts, and anxiety are a few of the mental strategies thought to be important in preparing to perform in an achievement arena (Murphy, 1990; Suinn, 1993). These strategies, which can be practiced through, or in conjunction with, mental imagery, enable an

individual to experience an occasion in his or her head so as to better handle the actual event when it occurs. Mental imagery has been used to facilitate concentration, memorization, skill acquisition, behavior modification, and sport performance (Clark, 1960; Corbin, 1972; Feltz & Landers, 1983; Kirchenbaum & Bale, 1980; Mahoney & Avener, 1977; Richardson, 1967a & 1967b).

Mental Imagery and Sport Performance

The evolution of applied sport psychology has brought about vast experimentation with mental imagery to assess its influence on sport performance enhancement (Kirschenbaum & Bale, 1980; Suinn, 1983). Generally, the direction of research in sport psychology is concerned with the use of imagery as a psychological tool to facilitate sport or motor skill performances (Vealey, 1986). Utilizing a sport-related imagery process allows athletes to familiarize themselves with potential problems and particular scenarios of an athletic event. This use of mental imagery prior to performance helps and athlete to rehearse an event in their head so that they are better able to cope with and expect certain situations during the actual contest (Orlick, 1980). Furthermore, imagery rehearsal techniques used in sport enable athletes to transfer themselves to competitive conditions, enhance specific correct responses, and sometimes eliminate anxiety or negative thoughts (Suinn, 1993). In most cases proper and complete use of mental imagery processes enable athletes to cope with competitive occurrences of sport which are prevalent during athletic competition. However, the desired expectations of mental imagery may not be achieved due to an athlete's overall imagery ability, lack

of relaxation, pr appropriate type of imagery for certain types of athletes.

The field of sport psychology has introduced several models and experimentations to better explain the value of mental imagery in sport. These contributions to the field have allowed for information to be applied to a number of areas within athletics. Some researchers who have examined imagery techniques have found it to be an effective and useful method for improving athletic performance (Desirato & Miller, 1979; Gough, 1989; Kirchenbaum & Bale; 1980; Kolonay, 1977; Schleser, Meyers, & Montgomery, 1980). However, there are studies that have presented contrary results which suggest that mental imagery has either no influence or negative effects on one's sport and exercise performance (Epstein, 1980; Hall, Buckolz, & Fishburne, 1989; Meyers, Cooke, Cullen, & Liles, 1979; Mumford & Hall, 1985; Weinberg, Gould, Jackson, & Barnes, 1980; Wilkes & Summers, 1984).

Research Reporting Non-Significant Results Using Imagery

Some of the literature concerning mental imagery has not always revealed the intended positive influence. In fact, Murphy, Woolfolk, and Budney (1988), in a study which subjects were asked to imagery to produce certain emotions, reported that imagery had a negative effect on task performance. Subjects were asked to squeeze a hand grip dynamometer as hard as they could after one of three types of preparatory arousal (anger, fear, relaxation). Results for the 24 male subjects indicated that the strength performance measured from the task was less than the strength performances recorded during the pretest. One possible explanation why these

researchers had negative effects would be that they were unable to ensure that proper imagery was being used. In addition, the use of arousal could have caused subjects to focus their energies to areas other than the grip task.

Given the stereotypic belief that Black athletes are stronger than White athletes (Coakley, 1994), it would be interesting to determine if racial differences might occur under similar conditions. The means for invoking fear and angry feelings in these subjects could be different across ethnic or economic backgrounds. Athletes who emerge from unsafe neighborhoods where, unfortunately, fear has become a part of everyday life could have different perceptions when using imagery which could in turn affect the outcomes of strength performances on the hand grip dynamometer.

Other investigations of mental imagery in sport have been conducted and studies were unable to show any influence on athletic performance. Similar to the present investigation Weinberg, Gould, Jackson, and Barnes (1980) chose to examine three mental preparation strategies and how they influenced the performance of a tennis serve. The three mental strategies used for this experiment were imagery for preparing to serve, positive self-efficacy statements, and attentional focus. In addition, a control condition of normal serving preparation was included. It was discovered that none of these mental strategies was more influential on serving performance than normal serving preparation. To help improve the results of this study it may be necessary to assess each subjects' imagery ability because without considerable practice with imagery

significant improvements in performance may not occur. No significant influence of mental imagery has been noted in other areas such as dart throwing (Epstein, 1980), leg kick tasks (Wilkes & Summers, 1984), figure skating (Mumford & Hall, 1985), and racquetball (Meyers, Cooke, Cullen, & Liles, 1979).

Research Reporting Positive Results Using Imagery

Several of the studies conducted in the past have supported the notion that imagery has positive effects on performance. Of particular relevance to the present study is an experiment conducted by Highlen and Bennett (1983) who chose to examine elite athletes who participated in open- and closed skill sports. These researchers chose these two types of sports and attempted to determine the influence of certain imagery strategies. Elite divers (a closed skill sport) reported using imagery strategies during training, one hour prior to competition, and immediately before executing a dive (Highlen & Bennett, 1983). These imagery processes were discovered to help athletes cope with anxiety and improve performance. Additionally, no evidence was found to suggest that closed-skill sport athletes utilize more imagery techniques than do open-skill (wrestling, tennis, etc.) sport athletes.

Effects of Imagery On Open- And Closed-Skilled Sports

One of the issues raised by the Highlen and Bennett (1983) study is how imagery affects performance of a closed-skill performed within an open-skill sport. Tennis is considered an open-skill sport, and the present study may find evidence to suggest that there is more imagery used for the tennis serve which is a closed skill. Positive effects of mental imagery on athletic performance of

open- and closed-skill sports have been supported through research of various sports and tasks such as, basketball (Meyers, Schleser, & Okwumabua, 1982; Hall & Erffmeyer, 1983), putting (Woolfolk, Parrish, & Murphy, 1985), volleyball (Shick, 1970), swimming (White, Ashton, & Lewis, 1979), racquetball (Gray, 1990), women's lacrosse (Heishman & Bunker, 1989), and gymnastics (Start & Richardson, 1964).

The Relationship Of Mental Imagery And Ability Level

The extent to which mental imagery is applicable to athletes of varying skill levels brings forth another important concern in the study of mental imagery. Sport psychologists, coaches, and athletes face the question of whether or not mental imagery is appropriate for every one. The relationship of athletic ability and imagery has been addressed by Gough (1989), in a study which examined the influence of imagery on batting performance of baseball players of different ability levels. Each of the three varsity baseball players in this study (i.e., poor ability, moderate ability, high ability) were exposed to an imagery session which was preceded by relaxation. Results from this study indicated that the subject with the lowest batting ability improved his batting performance from 12% to 55% after imagery training. The moderate ability subject showed no significant improvement, while the highest ability subject improved his batting performance from 50% to 70% after imagery training.

Other studies formulated to address the relationship between ability and imagery have not been consistent with the Gough (1989) findings. Additional knowledge concerning this issued dictates that advanced athletes display more muscle activity during imagery use

than do beginner athletes (Harris & Robinson, 1986). This may suggest a difference in the actual influence of imagery on performance between high and low skilled athletes based on how involved an athlete is with the imagery process. With such a substantial increase in performance for the lowest ability subject in the Gough (1989) study one might conclude that imagery has the greatest influence and usefulness for lower ability athletes. However, some information suggests that there is no difference in imagery effectiveness across ability levels (Jowdy & Harris, 1990).

Although the aforementioned studies of mental imagery have shown positive effects on athletic performance, each may not have accurately assessed imagery's influence. As for the Highlen and Bennett (1983) study, there was no mention of what type of imagery practice was being used. Subjects reported that they were using imagery at certain times, but the researchers failed to assess if subjects were actually using imagery techniques. Due to the fact that imagery is a skill, studies which have asked subjects to engage in imagery without teaching subjects the skill may be misleading or confounded by the subject's inability to image correctly. Thus, researchers need to implement an instructional program of imagery or use a test of mental imagery to add some assurance that subjects are actually using imagery.

Racial/Ethnic and Cultural Differences

An additional shortcoming of the Highlen and Bennet (1983) study, which is also common to many other studies, is the lack of ethnic considerations when selecting subjects for imagery experiments. Paying closer attention to the issue of race in imagery

studies may yield differential information regarding its effectiveness. It has been shown that some information on certain standardized tests may not be interpreted by all races the same as intended by those who develop them (Cleary, 1968; Cleary, Humphreys, Kendrick, & Wesman, 1975; Goldman & Hewitt, 1976; Jensen, 1969; Samuda, 1975; Sax, 1980). Therefore, it seems logical to explore whether race differences may also exist in how well imagery is followed. That is, certain racial /ethnic groups because of educational and cultural experiences may need to tap into race-specific cues to facilitate effective mental imagery. Without a knowledge and research base for understanding racial and cultural differences in the use of cues, differences would be dismissed or regarded as individual differences. This conclusion is derived from the fact that he/she does not respond to the best of his/her imagery ability according to an imagery approach developed by the majority culture. Furthermore, generalizations of the influence of imagery across sports has yet to be discovered, which makes one wonder why the issue of race has not been addressed. One explanation to clarify why race has not been considered would suggest that differences in imagery effectiveness across ethnic backgrounds may not be reasonably expected. Yet, how can one come to such a conclusion without any empirical evidence? Thus, there is a need to investigate racial/ethnic and cultural considerations when attempting to completely understand the mental imagery phenomenon.

The topic of race differences in other psychological areas has not gone unnoticed. For instance, Ewing and Yong (1992) examined

the learning style preferences among gifted African American, Mexican American, and American-borne Chinese middle grade students. The purpose of the investigation was to determine whether there were significant race, gender, and grade differences among their subjects. Evidence from the study suggested that African American and Chinese American subjects preferred a more visual modality learning style, while Mexican Americans preferred a kinesthetic modality. Thus, certain racial groups studied may have specific learning preferences when trying to acquire the skill of mental imagery to enhance performance.

Additional research which focused on the extent to which cross-cultural differences influence learning has provided information relevant to the present study. For example, Lam-Phoon (1986) compared the learning styles of Caucasian and Asian college students and concluded that their learning styles were significantly different. Caucasian students were also noticed to remember less well auditorially and visually than Asian students. Sims (1988) also contributed to the cross-cultural difference literature by revealing that underachieving Black children significantly more than Whites prefer auditory, visual and kinesthetic teaching. Contrary to Sims' (1988) results, Blacks have been noticed to not have a significant visual or kinesthetic learning style advantage over Chinese-American, Greek-American, or Mexican-American children (Dunn, Gemake, Jalali, Zenhausern, Quinn, & Spiridakis, 1990). The information regarding visual learning styles in these studies is highly relevant for the present study with the visually oriented mental imagery phenomenon. Finally, these cross-cultural studies

are important because students who are taught material with an approach which complements their learning style demonstrate positive behavior and attitude toward the material (Dunn, Beaudry, & Klavas, 1989).

Sociological studies have continuously shown differences in the treatment of athletes based on race (Coakley, 1994). In the face of ethnic diversity in sports today and to better understand the race and performance issue, it is also important to understand psychological/mental aspects of sport which focus on both similarities and differences in learning and performance based on racial/ethnic identity.

Mental Practice versus Physical Practice

Another concern in studies of mental imagery is the issue of mental practice versus physical practice. It is generally understood that physical practice is superior to mental practice in the acquisition of performance of a skill. Some evidence to support the physical practice advantage has been found in ball-and-socket tasks (Gilmore & Stolurow, 1951), basketball free throw shooting (Clark, 1960), and sit ups (Kelsey, 1961). However, alternating physical practice and mental practice is also considered to produce major improvement in skill acquisition and performance. Whiteley (1962) used the method of alternating physical practice and mental practice for boys performing a complex gymnastic skill. Results of this study showed that this method was superior to just mental or physical practice. Similar results of this kind have been found in a number of other studies (Egstrom, 1964; Trussell, 1952; Whiteley, 1962).

More recently, the technique of imagery has been expanded by sport psychologists. Suinn (1976) developed an extension of mental and physical rehearsal which he called visual motor behavior rehearsal. Visual motor behavior rehearsal (VMBR) is a covert activity whereby a person experiences sensory-motor sensations that reintegrate reality experiences, and which include neuromuscular, physiological, and emotional involvement (Suinn, 1993). The VMBR technique utilizes a relaxation session prior to the actual imagery process, which includes visual, auditory, tactile, kinesthetic, and emotional cues. This method of visual imagery has been widely accepted, and its effectiveness for improving athletic performance is supported by many investigations (Gravel, Lemieux, & Ladouceur, 1980; Hall & Erffmeyer, 1983; Seabourne, Weinberg, Jackson, & Suinn, 1985; Weinberg, Seabourne, & Jackson, 1981).

Noel (1980) conducted a study to determine the effect of visuo-motor behavior rehearsal (VMBR) training on tennis serving performance during tournament play. Subjects were 14 male tennis players who were classified as being of high-ability or low-ability. Baseline service accuracy was obtained prior to the start of the tournament. Seven subjects (treatment group) were trained in the VMBR process 10 days prior to the tournament, while the control group received no VMBR training. Results reported that the high-ability VMBR group had significant improvement in their serving performance, while the low-ability VMBR group's serving performance decreased. One major factor overlooked in this study was the imagery ability of the subjects involved. Those of the low-ability VMBR group may not have been familiar with the use of

imagery, and thus were not able to use it effectively. Those of the high-ability VMBR group may have already rehearsed some imagery techniques previously. In addition, as Noel mentioned, the imagery scripts that were used may not have been tailored for the low-ability VMBR group. It is necessary to present in the imagery scripts cues that are recognizable for the athletes. Noel suggests that the single imagery script may have been too advanced for the low-ability group. Furthermore, the original study only tabulated the serving accuracy in the first set. This may have been limiting in that, during the latter sets of a tennis match is when a player will need to utilize imagery the most so as to combat loss of concentration, pressure, and fatigue. Finally, Noel used self-report methods to help determine the influence of VMBR on subjects' serving performance and, as mentioned earlier, these methods may not be completely accurate.

The present study is a replication of the Noel (1980) study. A major extension of the Noel (1980) study for the present investigation will address the race variable in an attempt to build upon the previous findings and introduce needed information regarding racial/ethnic variation and the use of mental imagery. Although the literature concerning mental imagery has been of some value to the area of sport psychology, there exist certain issues that reduce its credibility. First, the ability of researchers to assess the degree to which imagery influences athletic performance has not been easy. The success or failure of an athlete's performance in many cases is not solely determined by the presence of mental imagery. The mental imagery practice may be of some influence, but

it is difficult to determine to what extent, especially considering all other aspects which may influence the outcome of a sporting event. Secondly, of the many research studies conducted dealing with imagery very few, if any, chose to include the variable of race within the investigations. This is an important factor because it is difficult to make any generalizable statements about mental imagery's effectiveness without considering the experiences and learning preferences of every category of people. Therefore, research on mental imagery should be expanded to address this lack of consideration.

Assessing The Effectiveness Of Mental Imagery Use

Limitations may exist in utilizing self-report measures in assessing the effectiveness of imagery. For example, the accuracy of subjects reporting about the quantity and quality of the imagery experience is not able to determined. Often times self-report questionnaires are developed that do not completely measure imagery's influence or do not address the entire scope of what a subject is imagining at the time of practicing mental imagery (Murphy, 1990). That is, some questionnaires fail to address the influence of imagery on the less evident factor of athletic performance. These factors may be the finer points of performance that help determine the overall success or failure of an athlete. However, self-report measures can be beneficial. Self-report methods, such as the MES (Magnitude Estimation Scaling), provide subjects with opportunities to describe imagery experiences in detail without structural limitations which can be found in questionnaires which employ ratings or Likert-type scales (Stevens,

1975). In addition, open-ended self-report techniques allow subjects to express in greater detail their perspectives of the effectiveness of mental imagery.

Different self-report techniques may be particularly valuable in helping researchers understand how various groups of people perceive and/or experience the effectiveness or ineffectiveness of imagery. Given the reported racial differences that exist in research for other cognitive processes and behaviors such as making attributions in help-seeking behavior (Chetham, Shelton, & Ray, 1987), it is prudent to examine racial differences in perceived effectiveness of the imagery sessions. That is, African Americans may attribute possible changes in performance outcomes to an imagery program because they benefit more from visual cues; where as, Whites may attribute possible performance changes to physical practice or confidence gained from visualizing a successful serve.

A need for the present study was devised by examining the previous research concerning mental imagery. The main criticism of the previous research concerning mental imagery is the lack of consideration for racial differences of subjects. In addition, certain shortcomings of Noel (1980) lead to a need to further the knowledge concerning imagery and tennis performance. Therefore, the question surrounding the present study is whether mental imagery techniques affect tennis serving performance, and if so, are there any differences due to the racial/ethnic backgrounds of the players.

Due to the lack of previous research dealing with the use of imagery in tennis, the present study focuses on the extent to which mental imagery affects serving performance only. This study is

necessary for sport psychologists, coaches, instructors, as well as tennis enthusiasts, in that expanded knowledge will be gained about the effect of mental imagery on a specific sport and task during competition. Another purpose of the present study is to understand any differences across race with imagery use because of the limited information regarding this variable. Finally, the present study was developed for the purpose of applying results to real-world settings so benefits may increase effectiveness of tennis players and coaches.

Hypotheses

The first hypothesis for the present study was that those high-ability subjects were exposed to mental imagery training would show more improved serving performances than low-ability subjects who were exposed to mental imagery.

The second hypothesis for the present study predicted that the serving performances of all the subjects in the VMBR groups would show more of an improvement than subjects in the control groups.

Furthermore, the third hypothesis stated that there would be no differences in serving performance due to race between the high-ability VMBR and control groups prior to treatment. One does not reach these high levels of performance without having consistent physical ability to serve.

However, it is also hypothesized that the African American subjects of the low-ability VMBR group will have better serving performances than the Caucasian subjects in the low-ability VMBR group. The predicted advantage in serving performance for the low-ability African American subjects stems from the previously

reported literature concerning learning preferences. Researchers' rationale for forming this hypothesis is that, because mental imagery is visually oriented and African Americans have a preference for visual styles of learning, they may be more receptive to the procedure.

Assumptions And Limitations

One of the major assumptions for the present study is the fact that the VMBR technique is useful for enhancing athletic performance. This assumption stems from the previous research which suggests that VMBR is a valued mechanism for enhancing athletic performance. Along with this notion we also assume that progressive muscle relaxation enhances the effectiveness of the mental imagery practice. Relaxation has been shown to help make mental imagery more effective (Berstein & Borkovek, 1973; Gauron, 1984; Hellstead, 1987; Styler & Connolly, 1984; Suinn, 1993), therefore, we expect the same influence to occur in the present study. A final assumption suggests that environmental factors are controlled in this study because most matches will be held indoors, so there should not be any negative environmental conditions that will influence the serve ability of players in this study.

The present study may also have certain limitations. The manner in which subjects are classified as high-ability and low-ability subjects may be inaccurate. For example, one of the subjects may exhibit high tennis ability overall but may have a relatively poor serve.

Delimitations

The following delimitations will be imposed for the present study. First, this study only focuses on subjects' serving percentage and the mechanics of their serves which may influence their accuracy, as opposed to entire match performance. By exclusively examining these two areas of subjects' serves, researchers can not determine the influence of mental imagery (if any) on other aspects of a player's performance. Finally, the study was delimited to male subjects of a Midwest and Southern geographical region, and only African American and Caucasian subjects were studied.

Significance

The present study is of particular relevance for the previous and future research concerned with mental imagery effects on athletic performance. This study contributes more specifically to the understanding of imagery's influence on tennis serving performance during competition. The significance in gaining this knowledge opens up the possibility of making certain real-world applications to tennis instruction, practice, and competition. Coaches and players alike will find information dealing with enhancing performance to be of the utmost importance. Furthermore, focusing on the race variable will present a major worth to the sport psychology field, as very few, if any, studies have elected to examine any cultural differences with the use of mental imagery. The findings from this study should also play a role in igniting further research in the area of imagery associated with tennis performance. This in turn, may help to establish some theoretical framework for future experiments.

CHAPTER 2
Review of Literature

The experimental literature dealing with the mental imagery phenomenon is vast and encompasses a variety of fields. For the purposes of the present study, literature concerning mental imagery in sport is the main interest. However, the previous studies dealing with mental imagery in other related areas also have merit and will be reviewed briefly. A commonality exists between each area that has focused on mental imagery; specifically, the degree to which the formation of mental images influences the outcomes of a particular task. With a similar focus on mental imagery across disciplines, related information can be shared in order to completely understand imagery's role in learning and performing skills.

The capacity of an individual to imagine exemplifies one of the many fascinating mind processes that has intrigued scientists and researchers. An ability to imagine is a characteristic that describes many human beings, but is rarely identical in any two (Ahsen, 1984). The often used phrase "an imagination running wild" underlines the power of the mind in action and the unique creativity of a particular person. Dreams are another form of imagining which are often times examined to determine their meaning and are used for other psychological evaluations. The clarity and genuineness of dreams can seem so real it is frightening which induces further speculation into how the mind is able to create such vivid, real-life images. Mental images are a vital portion of one's memory. As a child many of us remember playing such games as "Concentration" where the

object was to make a match of certain figures on the under side of a card based on your memory of where those two figures were last seen. Images to help facilitate memory have continued in the area of law enforcement. Many times we hear of witnesses trying to recreate a crime scene in their head, or of artists drawing faces to help victims better remember and describe the characteristics of a perpetrator. In addition, mental imagery has been a concept of interest for many sport psychologists. Many successful athletes have revealed how they were able to visualize images in their head prior to, and during, athletic endeavors which enabled them to perform at an elevated level (Vealey, 1986). These examples of the workings of the mind to produce images illustrates the importance of understanding mental imagery and how it works.

Mental imagery procedures have been prevalent for several years, but may not have always been recognized as such. There is evidence to suggest that before the turn of the century there existed certain rituals, and expressions of spirituality, that had similar procedures and outcomes to the modern uses of imagery. As early as the days of Descartes (1596-1650) there is support for imagery's presence as he states, "Man is a soul and a body, the soul being spiritual and the body being material, and acted like a machine" (Ahsen, 1984). It may be difficult to determine the true meaning of this statement but it does appear as if there was reference to some imagery experience.

The research involving mental imagery has produced an abundance of literature that has brought forth two theoretical perspectives to explain why mental imagery enhances performance.

These two major developments are known as the psychoneuromuscular theory and the symbolic learning theory. The psychoneuromuscular theory suggests that during imagery rehearsal the muscles of the body respond and activate as if they were actually performing, but to a smaller degree of intensity. Psychoneuromuscular theory also asserts that this muscle activity is identical to the learning or correcting of muscle movements during physical activity. There have been several research studies conducted examining the psychoneuromuscular theory and many have supported its basis (Anderson, 1981; Harris & Robinson, 1986; Jacobsen, 1930; Jowdy & Harris, 1990; Shick, 1970; Schramm, 1967; Suinn, 1980). Conversely, Feltz and Landers (1983) indicated that "it is doubtful that mental practice effects are produced by low gain innervation of muscles that will be used during actual performance" (p. 48).

The symbolic learning theory proposes that the benefits of mental practice are not due to muscle activity. Instead symbolic learning theory mentions that mental imagery allows an individual to rehearse the movements and prepare for the tasks involved with a particular physical activity. An extension to the symbolic learning theory is the belief that imagery rehearsal will have greater effects on tasks high in cognitive content (Suinn, 1993). The notion of mental imagery being more advantageous for cognitive tasks has been supported by some studies involving maze-learning and stabilometer tasks (Minas, 1978; Morrisett, 1956; Ryan & Simons, 1981; Wrisberg & Ragsdale, 1979). A final component of the

symbolic learning theory asserts that mental practice will be most beneficial during the early stages of learning.

In the initial stages of understanding mental imagery it was necessary to distinguish it from other related concepts. As mental imagery
began to gain recognition it was often compared with the term "perception". Mental imagery emerged as a distinctive concept from perception in that it involved all sensory modalities (Richardson, 1983). Further evidence of neuropsychological aspects of mental imagery helped it to gain attention. Continued early research with mental imagery led scientists to conclude that the images seen during mental imagery are produced in the right hemisphere of the brain and can also be used to induce affect (Langhinrichsen & Tucker, 1990).

To gain a thorough understanding of the mental imagery phenomenon it is necessary to develop meaningful definitions. Accurate definitions of mental imagery are important because they are the foundations of knowledge upon which research ideas and experiments are developed. As mentioned earlier, mental imagery is present in a variety of areas, thus it is necessary to utilize definitions that are specific to a distinct area of interest. For the purposes of the present study it is essential to work with a definition which is applicable to the sport domain. Such a functional definition has been developed by Richardson (1969) which states, "Mental imagery refers to all those quasi-sensory and quasi-perceptual experiences of which we are self-consciously aware and which exist for us in the absence of those stimulus conditions that

are known to produce their genuine sensory or perceptual counterparts" (pp. 2-3). This is a sound definition and should be useful for understanding mental imagery's role in sport.

The research on mental imagery has been associated with the concept of mental practice. These two terms are very similar and share some common characteristics. However, a distinction can be made between mental imagery and mental practice, although these terms are often used synonymously. The terms mental imagery and mental practice are similar in that both are concepts with the purpose of augmenting the performance of some physical activity. Moreover, both mental imagery and mental practice involve a mental trial of the particular upcoming physical activity. Earlier studies which examined the concept of mental practice were developed with the impression that mental practice was a helpful tool only for skill acquisition (Clark, 1960; Corbin, 1972; Smyth, 1975; Vandell, Davis, Clugston, 1943). Later developments in sport psychology have provided some other stated differences between the terms mental practice and mental imagery. Murphy and Jowdy (1992) make a distinction between mental practice and mental imagery by stating that, "Imagery refers to to a mental process. Mental practice, on the other hand, is a descriptive term for a particular technique used by athletes and many other individuals" (p. 222). Mental imagery should be considered a mental process; whereas, mental practice describes a particular technique used by athletes (Horn, 1992). In an early analysis of mental practice, Richardson (1967a) provided a definition which has been recognized in studies that followed. Richardson states, "Mental practice refers to the symbolic rehearsal

of a physical activity in the absence of any gross muscular movements" (pp. 95). This is a general definition and is necessary to distinguish between other related terms such as, mental rehearsal, imaginary practice, and symbolic rehearsal, to name a few.

The applied psychology curriculum has exhibited the most interest in mental imagery and has a mature history of attempting to understand all its uses. During the early days of applied psychology, imagery was understood to be more than just mental pictures. Sir Francis Galton (cited in Bugelski, 1984) understood that it applied to other perceptual areas, and he initiated a classical approach to exploring mental imagery. Galton felt that mental imagery was more functional for children than adults in the areas of learning, perception, thinking, and meaning. At this point imagery was most useful for memory recall. Continual use of mental imagery for the study of cognitive abilities through the 1920's and 30's focused on areas of motivation, physiology, behavior therapy, as well as other related areas and fields. These same types of studies are conducted today to assess one's memory and mental imagery capabilities.

Mental imagery as a technique to enhance performance has been of interest to the sport psychology field. In many instances, we may hear of athletes utilizing imagery techniques prior to an athletic event. Imagery rehearsal as used by athletes still remains a form of ritual, to assist in the success of a sport performance. The three major uses of imagery in sport are to enhance performance, modify cognitive behavior, and learn skills (Cautela,

1986; Rushall, 1988). Each individual athlete has his/her own specific perspective and procedures for imagery which is ultimately intended to allow one to visualize correct performances so as to eliminate the possibility of undesirable responses in a sport setting (Suinn, 1983).

Upon examining the concept of mental practice from several early studies (Jacobson, 1932; Perry, 1939; Sackett, 1934, 1935), the issue of whether mental practice is an effective method for enhancing skill acquisition and skill development has evolved as a major focus for the field of motor development and sport psychology. Vandell, Davis, and Clugston (1943) conducted one of the first studies to determine the function of mental practice in skill acquisition. Subjects for this study were male Junior high, Senior high, and college freshmen students. Two motor skills were selected for this study, a dart-throwing task and free throw shooting. The basketball hoop had all the standard dimensions, while the target for dart-throwing consisted of 17 concentric circles with a number assigned to each circle. The center circle was assigned 17 while the other circles decreased in value as the circles got larger. The mental practice group was asked to sit comfortably and imagine themselves throwing darts at the target in the manner in which they had done the previous day. The remaining two groups consisted of either actual practice with no practice between days or actual practice on each of the twenty days of the study. Informative results from this observation revealed that directed mental practice of a motor skill improves the performance of the later performance of a particular motor skill. In addition, mental practice was

discovered to be almost as effective as physical practice in this study. The knowledge gained from this study initiated further research studies which also found supportive results for juggling performance (Corbin, 1967a), free throw shooting (Clark, 1960), volleyball serving (Shick, 1970), gymnastics skills (Start & Richardson, 1964), and muscle endurance (Kelsey, 1961).

The established empirical information suggesting that mental practice is helpful for skill acquisition raised one further issue. Many researchers from the sport psychology and motor development fields have ventured to determine whether mental practice or physical practice is most beneficial for skill acquisition, skill development, and motor task performance (Egstrom, 1964; Feltz & Landers, 1983; Gilmore & Stolurow, 1951; Halverson, 1949; Hird, Landers, Thomas, & Horan, 1991; Kelsey, 1961). Of the many investigations conducted to examine the mental practice versus physical practice debate there has been workable information revealed to better explain which is most effective. Mental practice is known to be helpful and is better than no practice at all (Feltz & Landers, 1983). In addition, mental practice used alternately with physical practice is better than either one alone (Horn, 1992; Singer, 1972; Weinberg, 1981). The notion of mental practice and physical practice used together for better performance has initiated further studies to determine the most effective ratio for achieving successful task outcomes. Although there has been some generally understood findings from various experiments, much more information is needed to better conclude the debate between mental practice and physical practice.

The process of mental imagery use in sport and other performance- related fields is a systematic exercise designed to bring about positive outcomes of an individual's execution of a particular skill or task. Mentally feeling or viewing one's self actually taking part in an activity allows athletes to rehearse the actions of that event before physically taking part in an upcoming endeavor. An initial awareness prior to an upcoming event via mental imagery practice enables an athlete to better prepare for and expect the various occurrences of the given physical activity. Mental imagery is considered a performance enhancement tool, but may not be successful with every athlete. Each athlete has a different capacity for obtaining clear images, and whether or not an athlete actually believes in the power of mental imagery is important to its successfulness in enhancing performance (Vealey, 1986).

Several research investigations conducted by sport psychologists have presented an abundant amount of knowledge concerning the influence of mental imagery on performance. Some of these research studies have shown
mental imagery to be a useful method for performance enhancement, whereas others have shown no support or negative results in performance with mental imagery use. In one of the premier investigations of mental imagery, Vandell, Davis, and Clugston (1943) noted mental imagery to be useful for improving performance of a variety of sport skills. Knowledge of this kind was further elaborated on by Start and Richardson (1964) who chose to investigate imagery's influence on a gymnastic skill. Subjects for

this study were thirty-two males whose age ranged from 18-21, and who had no previous practice with the chosen gymnastic maneuver. The very basic gymnastic maneuver was known as a Single Leg Upstart on the High Bar. Researchers of this study analyzed and recorded the proper movements of the gymnastic skill. Instructions of the various movements of the maneuver were devised in sequential order to allow the subjects to better imagine the skill while using mental imagery. Subjects practiced the gymnastic skill five minutes daily over a six day period, and on the seventh day they were to perform the skill for the first time. Tests of vividness of visual images and autonomy of imagery were administered in the next two weeks to follow.

Results from the Start and Richardson (1964) study provided useful information in the understanding of mental imagery. Start and Richardson found that vividness of imagery was not a significant factor in the mental practice of a physical skill, whereas kinesthetic imagery was a minor factor in the success of performing the gymnastic skill. However, those subjects who had uncontrollable vivid images were noticed as having low performance scores. Finally, it was concluded from this investigation that vivid and controllable images together are helpful for predicting performance of a skill.

Improvements in the sport task of free throw percentage as a result of mental imagery have been noticed in a younger population of basketball players (Wrisberg & Anshel, 1989). In this study forty young males, who ranged in age from 10.2 to12.4 years were selected. Each of the participants in the study was a participant in

a sport skills camp and had some skill in shooting free throws. Subjects were randomly assigned to one of four groups: 1) imagery practice during the treatment phase of the study, 2) an arousal learning and practice group, 3) combined imagery and arousal adjustment group, and 4) control. A 15-minute cognitive strategy instruction session comprised of either mental imagery, arousal adjustment, or a combination of the two, was given to subjects in the three treatment groups. Subjects were told to use imagery at the free throw line prior to shooting, while arousal reduction was to be implemented due to the normal nervousness associated with free throw shooting.

Wrisberg and Anshel (1989) provided support for mental imagery effectiveness for a younger group of basketball players and their findings are also in accord with those found by Kolonay (1977). Results from this study showed that subjects who were exposed to the imagery condition had an improvement in their free throw percentage. The greatest gain in performance from the pretest to posttest was exhibited by those subjects in the imagery and arousal combination group. Information gained from these two cited studies suggest that mental imagery is a useful tool in the sport of basketball for college and youth players. Additional research which has experimented with the influence of imagery on basketball performance has also found it to be beneficial for female collegiate players (Hall & Erffmeyer, 1983; Kendall, Hrycaiko, & Martin, 1989; Schleser, Meyers, & Montgomery, 1980), as well as other basketball skills (Meyers, Schleser, & Okwumabua, 1982).

An extensive amount of research on mental imagery has employed a variety of procedures and experimentations in several sports. One interesting form of testing mental imagery is with the use of videotape modeling. This style of testing was used by Gray (1990) in a study examining its effectiveness with mental rehearsal as opposed to mental rehearsal without modeling on racquetball skills. Gray (1990) revealed that imagery rehearsal used with videotaped modeling showed significant improvement in the racquetball skills of 24 male beginner racquetball players. This study provides support for the usefulness of mental imagery and is also consistent with previous literature (Hall & Erffmeyer, 1983). Further positive effects of mental imagery have been noticed in other sports such as putting in golf (Woolfolk, Parrish, & Murphy, 1985), volleyball (Shick, 1970), swimming, (White, Ashton, & Lewis, 1979), baseball (Gough, 1989), and tennis (Davis, 1991).

Although mental imagery is intended to be a technique for enhancing physical performance, often times negative or ineffective results occur with its implementation. Negative effects of imagery may surface in some instances due to a lack of consideration for the length and duration of practice, scheduling and the character of practice, the type of task, and individual differences of subjects (Corbin, 1972). The issue of negative consequences of pre performance imagery on a motor skill accuracy task of putting has been explored (Woolfolk, Parrish, & Murphy, 1985). In this study thirty subjects were randomly assigned to either a success imagery group, failure imagery group, or a control group. Those subjects in the success imagery group were told to imagine performing a

mechanically correct putt and then imagining the ball rolling right into the cup. The failure imagery group was told to imagine performing a mechanically correct putt, but the ball rolling and narrowly missing the cup. The control group was instructed to just try and make the putt. There were six trials of ten putts each for every group of subjects.

Results from the Woolfolk, Parrish, and Murphy (1985) study indicated that the successful imagery group was significantly more accurate with their putting than the failure or control groups. Furthermore, the positive outcome imagery group improved its putting performance by 30.4 percent from baseline, while the failure imagery group declined in putting performance by 21.2 percent from baseline. Complementary results were also found in a study which chose to include the role of self-efficacy along with mental imagery (Woolfolk, Murphy, Gottesfeld, & Aitken, 1985). The fifty subjects in this study also attempted the motor accuracy test of golf putting. Subjects' self-efficacy was measured prior to each of the two trials of ten putts each. Subjects were randomly assigned to one of the five imagery groups which consisted of 1) successful outcome with motor performance, 2) failure outcome with motor performance, 3) motor performance only, 4) successful outcome only, and 5) failure outcome only.

Results indicated that failure imagery had a greater influence on decreasing performance than successful imagery's influence on improving performance. Furthermore, success or failure imagery was found not to have an effect on self-efficacy. Researchers concluded that pre- performance imagery can either enhance or

degrade performance of a fine motor skill accuracy task, and that failure imagery appears to consistently decrease performance (Budney & Woolfolk, 1990). A decrease in performance due to unsuccessful imagery is consistent with other studies of its kind (Meyers, Schleser, Cooke, & Cullivier, 1979; Powell, 1973).

Unlike the results for fine motor skill tasks, questions arose concerning whether negative outcomes with imagery use can also occur with gross motor skills. Murphy, Woolfolk, and Budney (1988) addressed this issue in a study investigating the influence of emotional imagery on the task of squeezing a hand grip dynamometer. The thirty subjects for this study performed under three conditions of anger, fear, and relaxation. Imagery training was provided prior to each of the test trials. The subjects were asked to imagine a personal situation which most closely reflected the appropriate emotion of anger, fear or relaxation. When this emotion was achieved subjects were to squeeze the grip dynamometer.

Results from the Murphy, Woolfolk, and Budney (1988) study indicated that the mean strength scores on the grip dynamometer were significantly lower in the imagery groups than the other two groups. Furthermore, strength responses under the relaxation condition were significantly less than the anger and fear conditions. A decrease in mean strength performance from baseline was also noticed in a follow up investigation (Budney, Woolfolk, & Murphy, 1987).

Along with the cases of negative outcomes of mental imagery use there is a tendency for an absence of any change in performance due to imagery procedures. Although the mental imagery process

may be carried out correctly by researchers and athletes, instances can occur where imagery has no influence on performance. Several mental imagery investigators have attempted to conduct studies which expose the benefits of mental imagery use for athletes, but have noticed ineffective results in some cases. A study of this kind by Ryan and Simons (1981) was performed to observe imagery and frequency of mental rehearsal as factors which influence the acquisition of motor skills. Thirty-nine male undergraduates were selected for this study and were randomly assigned to either a physical practice group (PP), a mental practice group (MP), or a no practice group (NP). Two apparatuses were used for this experiment, a stabilometer and a dial-a-maze, which were to test each of the subjects' perceptual motor skills.

Instructions were given to each of the subjects in the three groups by the researchers on the procedures of the experiment. Subjects in the PP group were given twelve 30 second trials on each apparatus with a 30 second rest between trials. During the 30 second rest period on the stabilometer the PP group computed arithmetic problems and unscrambled words during rests on the dial-a-maze task. The MP subjects performed one 30 second trial on the stabilometer and then were asked to sit, close their eyes, relax, and as vividly as possible imagine themselves balancing on the stabilometer. These mental rehearsal trials occurred nine times and lasted for 30 seconds with a 30 second rest period. For the final two trials the MP group did arithmetic problems during the 30 second rest period. During the dial-a-maze tasks the MP group followed similar procedures as they did in the stabilometer trials

with one trial of actual practice, nine trials of mental rehearsal, and the final two trials of actual practice. The NP subjects were given one trial on the stabilometer, a 9 minute rest and then two more 30 second trials with a 30 second rest between each trial. Subjects in the NP group performing the dial-a-maze task were given one trial, then a rest period during the time a PP subject would finish the task and final tasks with a 30 second rest period.

Results from the Ryan and Simons (1981) study revealed that performances on the dial-a-maze task showed no significant differences between the MP and PP groups, but both were significantly different than the NP subjects. Performance results on the stabilometer task indicated no difference between the MP and NP groups, but both were significantly better than the PP group. One possible explanation provided by Ryan and Simons (1981) for the no effect results in their investigation was minimal attention given to vividness and controllability of mental images. Furthermore, the relative frequency of mental rehearsal may have been a factor influencing the acquisition of motor skills.

Another study using similar procedures and a task like that of the dial-a-maze in the Ryan and Simons (1981) investigation was also conducted. Hall, Buckolz, and Fishburne (1989) sought to examine university students' ability to recall and recognize a list of movements. Subjects were in either high or low imagery ability categories and were presented with a particular movement on a computer monitor. After the presentation of the movements, subjects were to perform a recall and recognition task of regenerating the same movements. Results indicated that there

were no differences in recall and recognition performance between the two groups of imagery ability.

Moreover, imagery has been noticed to be ineffective in more physical tasks. For instance, Wilkes and Summers (1984) examined imagery as well as other cognitive strategies and revealed that those subjects exposed to mental imagery practice performed the same as the subjects in the control group on a leg-kick maneuver. One may assert from these results that the representative images being imagined may be an influential factor that determines the effectiveness of mental imagery practice (Hall, Buckolz, & Fisburne, 1989). Proper images as well as other factors have been a concern among many researchers who have conducted similar studies and found mental imagery to have no effect on performance (Corbin, 1967b; Epstein, 1980; Shick, 1970; Steel, 1952; Weinberg, Gould, Jackson, & Barnes, 1980).

One popular technique for visualization known as, visuo-motor behavior rehearsal (VMBR; Suinn, 1972) has contributed a great deal to the mental imagery literature. Suinn (1993) refers to his imagery development as, "a covert activity whereby a person experiences sensory-motor sensations that reintegrate reality experiences, and which include neuromuscular, physiological, and emotional involvement" (p.499). One aspect of the VMBR method that distinguishes it from other imagery methods is a relaxation process that precedes the imagery steps. Relaxation prior to imagery is thought to help facilitate the mental imagery process (Suinn, 1985; Vealey, 1986). The VMBR method resembles actual physical actions as it attends to visual, auditory, tactile, and kinesthetic senses

involved during an athletic performance. However, despite the fact that the VMBR technique is not hard to learn, Suinn (1983) states, "The value of mental practice is influenced by the subjects' level of skill in the mental process itself" (p. 511).

The recent conception of the VMBR technique has sparked several research studies to test its validity for enhancing athletic performance. In one of the first experiments using the VMBR method, Kolonay (1977) chose 72 male college basketball players as subjects to see if VMBR would improve their free throw shooting. These subjects were randomly selected to either a VMBR training group, a relaxation only group, a imagery rehearsal without relaxation group, or a control group. The training for each of the experimental groups was implemented during practice and lasted for six weeks. Kolonay (1977) found that the subjects exposed to the VMBR training improved 7 percent in their free throw shooting accuracy. Subjects who were in the groups exposed only to imagery or relaxation showed no difference in their free throw shooting performance. The latter results provide support for the argument that relaxation is important for helping the imagery process.

Further investigation of mental imagery has been conducted to see its influence on enhancing performance. Building upon the format used in the Kolonay (1977) study, Weinberg, Seabourne, and Jackson (1981) added a placebo-control group to their experimentation with mental imagery. These researchers chose 32 male subjects from a karate program and randomly placed them in the groups of either, VMBR, relaxation alone, imagery alone, or the placebo-control. This study was an effort to see how these four

conditions would influence the subjects' performance of several karate skills. A statistically significant better performance was noticed for the VMBR group than the relaxation only, and imagery only groups on sparring skills. In addition, the VMBR subjects were noted as having significantly lower state anxiety levels than subjects in the other three conditions.

The findings in the previously mentioned articles are related to results noticed in the Gravel, Lemieux, and Ladouceur (1980) study which revealed that subjects in the VMBR condition had a significant decrease in frequency of negative cognitive interferences. Reasoning for this connection is that negative ruminations could increase state anxiety prior to and during performance. A number of other experiments have been performed using similar methods in the cited articles, and many of them have found support for the VMBR technique in improving athletic performance (Hall & Erffmeyer, 1983; Seabourne, Weinberg, Jackson, & Suinn, 1985).

Relevant information for the present study has been provided through the literature examining mental imagery in a tennis setting. The serve in tennis is a very important aspect of the game and thus it has been the focus for some researchers. Weinberg, Gould, Jackson, and Barnes (1980) conducted a study to see how the serve was affected by the use of various cognitive strategies of male and female advanced and beginning tennis players. Participants involved in this study were 20 males and 20 females of high- and low-ability. The subjects for this study were to perform a tennis serving test using one of the four mental strategies of imagery, statements of

positive self-efficacy, attentional focus, or no mental practice. Results indicated that the mental preparation strategy had no influence on facilitating the tennis serve. However it was noted in the discussion that the average degree of clarity of images expressed by the subjects was only at a midpoint level. This may suggest that there was a need for more practice with the imagery in order to help increase the vividness of images and, thus, its effectiveness.

Davis (1991) has conducted a case study which provides further insight into imagery in the tennis arena. This study involved implementing a performance enhancement program to achieve psychological and performance goals of a female freshman tennis player. The subject in this study had been playing competitive tennis since the age of nine and had dreams of becoming a professional. Interviews were conducted with the subject to determine her strengths and weaknesses in tennis. Furthermore, the interviews allowed the subject to set certain psychological and performance goals. Throughout the study the subject attended meetings to monitor her progress toward the goals. In addition, imagery sessions were scheduled with the participant three times a week. One of the subject's performance weaknesses was with her serve during a match. The imagery sessions used to help her achieve her goal was found to be a positive influence. Furthermore, the imagery sessions were also shown to be valuable in helping correct technical areas with her forehand and backhand return of serve. Finally, the exposure to imagery sessions helped the subject to

suppress negative and doubtful thoughts and maintain a positive image during a match.

Based on the knowledge cited from research involving mental imagery practice to this point, there are several components of imagery which determine its success or failure for enhancing performance. These factors which can determine the effectiveness of imagery are imagery ability, vividness of images, imagery perspective, and relaxation. Each of these factors deserves attention when conducting mental imagery research for it is believed that they have some influence on the results of imagery use (Horn, 1992).

An individual's ability to image is a major concern when conducting mental imagery research. Imagery ability is considered the capacity to which a person can picture images with respect to controllability and vividness factors. Controllability refers to the degree to which a person is able to manipulate or dictate the processes of his or her mental images. Vividness describes the clarity with which a person is able to see his or her mental images. The controllability and vividness aspects of imagery ability are so valuable that there are instruments used to assess these two areas. The Vividness of Visual Images Questionnaire (VVIQ; Marks, 1973) and the Test of Visual Imagery Control (TVIC; Gordon, 1949) are two developments which are a means of measuring these aspects.

One's ability to image is important in that it is believed that there are differences in ability among various individuals (Richardson, 1969). In addition, there exists the notion that mental imagery is best suited for those who have a good degree of imagery

ability (Horn, 1992). While working under these assumptions, Start and Richardson (1964) noticed that those subjects who had a high degree of vividness and controllability of their images showed higher gymnastics scores than subjects with either lower controllability or vividness ability. Hall, Buckolz, and Fishburne (1989) provided further support for the difference in imagery ability suggesting that individual differences in imagery ability has an effect on motor performance. However, Hall et al. (1989) also indicated that there were no differences between high and low ability imagery subjects on tests of recall and memory of performance. These findings are contradictory to the Hall, Pongrac, and Buckolz (1985) results that indicate high ability imagery subjects reproduce movement locations more accurately than do low ability imagery subjects. Many other studies examining imagery ability have provided support for the notion that good controllability and vividness are important for affecting performance (Goss, Hall, Buckolz, & Fishburne, 1986; Housner, 1984; Orlick & Partington, 1988; Ryan & Simons, 1982).

Through mental imagery experiments in sport psychology, researchers have recognized that one's imagery perspective is a factor effecting imagery effectiveness. The internal and external imagery perspectives are specific aspects of the total imagery perspective. Mahoney and Avener (1977) provided an explanation of these two perspectives which states: "In external imagery, a person views himself from the perspective of an external observer (much like home movies). Internal imagery, on the other hand, requires an approximation of the real-life phenomenology such that the person

actually imagines being inside his/her body and experiencing those sensations which might be expected in the actual situation" (pp. 137).

An understanding of imagery perspectives of athletes is a concept which helps to determine the style and direction of mental imagery sessions. Mahoney and Avener (1977) have posited that the better athletes have a tendency to use more internal imagery from their work with elite male gymnasts. These results have led to a fundamental belief that internal imagery is better suited for more elite athletes, whereas an external imagery perspective is most appropriate for nonelite athletes (Doyle & Landers, 1980; Hall, Rodgers, & Barr, 1990; Mahoney, Gabriel, & Perkins, 1987; Murphy, Jowdy, & Durtschi, 1989; Rotella, Gansneder, Ojala, & Reilly, 1980).

In contrast to the acceptance of certain perspectives for specific ability level athletes, some researchers have asserted that there is no relation among these variables (Meyers, Cooke, Cullen, & Liles, 1979). Attempting to determine how imagery perspective influences athletic performance, Epstein (1980) examined subjects performing a dart-throwing task. Subjects for this investigation were 33 female and 42 male undergraduate students who were randomly assigned to either an internal imagery condition (n=30), an external imagery condition (n=30), or a control condition (n=15). The dart target was comprised of nine concentric circles with a number assigned to each individual circle. The center most circle had the highest number (9), while each of the next larger circles decreased in number until the last circle (1). Prior to conducting the dart-throwing task subjects were tested to determine their imagery

perspective. Baseline dart-throwing ability was established by having each subject attempt 30 dart throws toward the target. After baseline measures were established, subjects in each of the two imagery conditions engaged in a imagery training session representative of the perspective group for which they were selected. A post experiment questionnaire followed which asked targeted subjects to rate their efficacy and to identify their thoughts prior to performing the task. Results indicated that for mean dart-throwing accuracy, there was no significant difference across the imagery perspective groups. Similar results for the lack of relationship between imagery perspective and performance have been noticed in figure skating (Mumford & Hall, 1985).

The literature suggesting no relationship between imagery perspective and performance has not always been upheld. Unlike the information revealed in the Epstein (1980) study, other research studies which have examined this issue have discovered that imagery perspective can be a determinant of favorable and less favorable task performances (Mahoney & Avener, 1977; Morgan & Pollock, 1977). Information suggesting that there is such a relationship is usually in favor of internal imagery being the better perspective which leads some to believe that external imagery has a negative influence. In defense of the external imagery perspective, it should be mentioned that kinesthetic cues are usually absent from external imagery. Furthermore, during external imagery subjects who are asked to see themselves performing a particular task usually report becoming self-conscious and nervous which diverts

attention away from performance (Epstein, 1980). Further studies are necessary to resolve this discrepancy in the literature.

Additional research surrounding imagery perspectives has endeavored to focus on biofeedback information as a result of athletes use of imagery. A study of this type was conducted by Harris and Robinson (1986) to determine if athletes of varying skill levels utilizing two imagery perspectives (i.e., internal, external) would display a difference in muscle activity. Subjects for this study were 36 karate students, who were classified according to skill level as either beginning (n=16 males, 2 females) or advanced (n=14 males, 4 females). Each subject was randomly assigned to an imagery perspective group and chloride electrodes were applied to the middle deltoid muscle of each arm. Each of the seated subjects were exposed to taped relaxation and imagery instructions that were played through earphones while being monitored by the researcher. The relaxation procedures were familiar to the subjects because it was used in their regular training. Subjects were instructed to perform five right lateral arm raises by counting: Raise arm 1-2-3-4-5, (pause 1 sec.) hold, 1-2-3-4-5, relax, 1-2-3-4-5. Muscle activity was recorded when the arm was in the "hold" position. Results indicated the the internal imagery perspective produced more deltoid muscle activity than did the external imagery perspective but this was not a significant difference. These results are in accord with Hale's (1982) findings which also suggest that internal imagery generates more bicep muscle activity. Further results (Hale, 1982) reveal that advanced students preferred the internal imagery perspective more so than the beginning students.

Information about muscular activity during mental imagery is of particular value to the understanding of mental imagery. By examining the feedback of muscle activity during mental imagery, researchers can better determine if an athlete is actually using imagery and the degree of sensory activity. Furthermore, by distinguishing between an internal or external perspective prior to imagery practice it may be easier for researchers to determine the cause of an athlete's muscle activity. The knowledge presented from Harris and Robinson's (1986) study which suggested that advanced athletes prefer more internal imagery directly relates to the issue of whether a particular perspective is more appropriate or effective for the skill level of a particular athlete. Having raw data from muscle activity during the use of internal or external imagery may actually answer some of the questions regarding whether an imagery perspective is influential for performance of a task.

Relaxation procedures to help induce mental imagery sessions is another topic of debate in the sport psychology arena. Many of the mental imagery practices and studies are performed by having some form of relaxation exercise prior to moving into imagery. This order of steps in the imagery process is commonplace in many instances because of the belief that a considerable level of relaxation will help facilitate mental imagery (Suinn, 1985; Vealey, 1986). However, several researchers who have examined the role of relaxation in imagery have not found any support to suggest that it has any major positive influence on imagery (Gray, Harding, & Banks, 1984; Hamberger & Lohr, 1980; Weinberg, Seabourne, & Jackson, 1981, 1987). The discrepancy between the importance of relaxation

prior to imagery reveals no definitive answers. Further research involving the relaxation technique with imagery is necessary to determine what is best for releasing imagery's fullest potential.

The reviewed literature has reported much of the work conducted with mental imagery. However, there are certain issues which have not received as much attention in the literature. First, in conducting mental imagery studies more emphasis should be placed on measures taken to help educate athletes how to properly use mental imagery. This should help avoid any confounding factors of subjects not knowing how to tap into visual images. Secondly, the amount of time practicing mental imagery before it becomes effective is another issue deserving of more attention. In many of the studies conducted there was no judgment of what was too much or too little time spent practicing mental imagery. Finally, the population of subjects used for imagery studies has been limited in that ethnic backgrounds have not been addressed in determining if there are any differences in imagery effectiveness among races. Addressing this issue will help mental imagery knowledge to be more applicable to larger populations.

The need for exploring the role of racial/ethnic factors in mental imagery effectiveness is imperative. With the many cross-cultural studies that have been conducted in non-athletic settings, it is puzzling to understand why the race variable has not received as much attention in sport psychology research. It is especially important for sport psychology to examine this area in order to get a broad based understanding of what factors are involved for making imagery optimally useful for the masses. In the case of learning

styles, it has been pointed out that African American and Chinese american grade students have preferences for a visual style of learning (Ewing & Yong, 1992). This finding is especially useful for educators in that they may adjust their teaching environment in such a way that is comfortable for the students to achieve their greatest learning potential.

In comparisons of Blacks and Whites learning styles, pertinant information has been reported. It has been noted that Black children have a significant preference for visual styles of learning than Whites (Sims, 1988). Taking into account that imagery is such a visual process the discovery that Blacks have a preference for visual styles of learning must be explored in conjuction with mental imagery research. From research of this kind scientists may find that ceratin learning styles are also appropriate when learning and using the mental imagery tool for performance enhancement. Finally, racial/ethnic factors are necessary for imagery studies focused on inducing certain emotions. As reported in the Murphy, Woolfolk, and Budney (1988) study, methods used to invoke anger, fear, and relaxation emotions on subjects showed no significant impact on a hand grip task. Without acknowledging racial/ethnic backgrounds as in the Murphy, Woolfolk, and Budney (1988) study one can not assume that every individual responds to emotion stimuli to the same degree or in the same manner.

The present study is a replication of Noel (1980) and attempts to address some of the overlooked issues with mental imagery research. The present study will provide some degree of imagery training prior to subjects' practice with imagery on their own. This

design will be observed to determine its influence on the overall results and will be compared to other literature to see if it was actually positively influential. Furthermore, the present study's work with subjects representing two different ethnic backgrounds will possibly contribute information regarding any racial differences with imagery use, susceptibility, perspective, and effectiveness to the existing mental imagery literature.

As further experimentation and exposure to mental imagery continues widespread use and acceptance should occur. Many athletes and coaches who are introduced to the concept of mental imagery are often skeptical. However, meta analysis of the mental imagery research studies find that mental practice does in fact have a positive and significant effect on performance (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983). The many empirical investigations provide a credible background for helping one to become involved with implementing imagery practices. In addition, the many components and common beliefs about imagery make it known that it is a detailed process. Although there are no steadfast theories of mental imagery, there has been enough evidence revealed to support its effectiveness. As mental imagery research advances, eventually, a theoretical basis will be established. This occurrence will allow an even greater understanding of mental imagery which should result in a great number of athletes and coaches endorsing imagery to help enhance performance in many domains.

CHAPTER 3

Method

Subjects

Subjects for the study were 35 male volunteer college tennis players. Of these subjects, 15 were of African American descent, while another 20 were Caucasian. The average age of the subjects involved with this study was 20.2 years (SD = 1.08). Ages ranged from 17 to 25 years. Each subject was classified as a high-ability or low-ability tennis player on the basis of the United States Tennis Association's (USTA) National Tennis Rating Program (NTRP). Those subjects classified as high-ability were capable of competing on most college level teams. Thirteen of the high-ability subjects were on a college or university tennis team at the time of the study, while four of the high-ability subjects had previous experience on a college or university tennis team. The low-ability subjects would be considered club level players. Each of these subjects had been playing competitive tennis for at least 3 years.

Instruments

A demographic survey was used to gain the necessary background information for each subject. This survey was developed to obtain pertinent information of subjects for use in the study (See Appendix A). A form devised by the primary researcher was used in the study to assess subjects' control and vividness of images. The items on the imagery control and vividness questionnaire can be found in Appendix B.

Procedures

Approval to conduct this study using human subjects was obtained from the University Committee on Research Involving Human Subjects (UCRIHS). (See Appendix C.) Subjects were selected to participate in the study by observing their tennis ability at various racquet clubs, local tournaments, and dual collegiate matches located in the midwest. This selection process was based on the USTA's National Tennis Rating Program (See Appendix D). An assistant, who was well trained in the USTA rating system, was employed to help with the subject selection process. Ratings of the potential subjects were made by the primary researcher and the assistant individually while observing play of various possible subjects, and then compared to establish agreement between the two raters. In the event that the two raters were not in agreement, or a subject was thought to be playing below his true ability level at the time of observation, the primary researcher, whose own rating on the NTRP would place him in the high-ability group, would play a set with the subject. The trained rater observed the play and rerated the subject.

Ability level was described as either high tennis ability or low tennis ability based on the NTRP ratings which can range from 1 to 7. Those subjects who received an NTRP rating which ranged from 3.5 to 4.5 were classified as low-ability for this study. Those subjects who were classified as high-ability received an NTRP rating which ranged from 5 to 7.

Subjects were given a written description of the study, without revealing the purpose of the study, and permission was obtained from subjects to participate in the study. Each of the

subjects was randomly assigned to either the imagery or control group. This process of random assignment was first performed by assigning a number to each of the subjects selected for the study. These numbers were blindly drawn from a container and alternately placed into the imagery (treatment) or control group. Separate draws were made for African American and Caucasian subjects to assure equal distribution within the treatment groups.

Base measures of service accuracy were deemed necessary to verify overall ability assessments. Therefore, each subject was notified by phone/mail in order to schedule a practice match prior to testing. Matches played prior to the test day were among participants of either group, or with a confederate of the researcher, of similar ability, when necessary. The reason for the practice match was to gain a base measure of serving accuracy for each of the subjects.

To strengthen the assessment of actual tennis ability, a serving-specific skills test was implemented prior to the pretest matches. This serving skills test involved each subject of high-and low-ability being asked to attempt 12 serves into a designated serving area following a warm-up. Six of these test serves were to be directed into a 4' by 5 1/2' box in the deuce court (3 to a box at the left corner, and 3 to the box at the right corner) and six to the ad court (3 to the box at the left corner, and 3 to the right corner). Three points were awarded to the subjects for each serve which bounced in the designated area and one point was awarded if the serve bounced outside the area but was in the appropriate service box, thus scores could range from 0-36. Scores from the serving

skills test were totaled and subjects were classified as above average or average servers according to their scores. A serving skills test was helpful for determining serving ability and for confirming the accurateness of the NTRP system.

Subjects who were assigned to the imagery condition were gathered for a group training session 10 days prior to their first test match. This training took place after the base measures were gathered from the pretest matches. At this session subjects were given a description of the relaxation and imagery process. During this training, participants were also informed of how the imagery process works, how one is to properly use imagery, and the ways in which it enhance performance.

Assessments of imagery vividness and controllability were made using the visual imagery control and vividness questionnaire devised by the primary researcher. The imagery condition subjects were led through the 30-minute progressive relaxation session, followed by the tennis serving-specific imagery session (See Appendix E for imagery scripts.) After this session subjects were given an audio cassette tape which contained exactly the same relaxation and imagery procedures previously conducted by the researcher. The imagery procedures in the initial group session and on the audio tape were conducted from an internal imagery perspective. Subjects in the control group were given a meditation audio cassette later the same day. The imagery condition subjects and those in the control group were told to practice with the tape for the next seven days. For the imagery group, three of these days were for practicing just the relaxation portion of the tape, while the

other four days were for practicing the relaxation and imagery process together. A time log (See Appendix F) accompanied the audio cassettes for both groups of subjects to allow subjects to record each time they practiced the session. Subjects in the control group rated how they felt about the meditation; subjects in the imagery group rated the degree of relaxation achieved, vividness of images, and controllability of images.

The researcher contacted each of the subjects by phone to verify that the tapes were being used. Verification for the imagery group subjects was done once during the three days the subjects were to be practicing just relaxation, and twice during the four days of practicing the relaxation and imagery process together. The control group subjects were contacted on either the third or fourth day during their seven day practice with the meditation cassette. Questions were answered and the techniques used were clarified.

On the day of the subjects' test match, members of the research team were assigned to a particular court to record the number of good first and second serves in a best 2 out of 3 sets match between the subjects. To establish pairings for the tennis matches, subjects names were randomly selected within ability groups, and paired together to play their test match. Subject pairings for matchplay were made regardless of their assignment to the treatment or control condition. All the high-ability subjects played other subjects of similar ability, while matches were also played between subjects of low-ability. Prior to the start of each subjects' first match, the serving skills was administered again to

compare the serving percentages and ability with the scores from the prematch skills test.

Members of the research team were equipped with several CompuTennis forms (See Appendix G) while observing a match between subjects. The CompuTennis system is a method of charting the events which take place during a tennis match. Researchers were not concerned with all of the items on this form, only the serving portion. These researchers recorded a good or bad first serve based on the call of the subject who was receiving the serve. Although the researcher may not have agreed with the call of the subject, most amateur matches are played without line judges, so this method of recording serving accuracy was used. Members of the research team had no definitive information regarding the ability level of the subjects, and were also unaware of whether they were in the imagery or control group. During match play the principal researcher walked around the tournament site to verify if the observers were recording properly.

After each of the subjects in the imagery condition completed their match, they completed the Sport Imagery Questionnaire and post-match questions about the match and control of visual images during the match. Then each of the subjects, regardless of group, completed a form (see Appendix H) which asked them to rate their serving performance (1=much worse than usual to 5=much better than usual), and the degree of relaxation during the match (1=much less relaxed than usual to 5=much more relaxed than usual). The imagery condition subjects were also asked to report the degree to which the imagery influenced their serves during the match (1=very

bad influence to 5=very good influence). The imagery subjects were also asked if they used imagery during their match. If these subjects did use imagery, they were asked when imagery was used and what specific images were processed during the tennis match. Questions for each group of subjects also attempted to determine any other cognitive strategies that were used during a match. The control group subjects were asked if they implemented any imagery techniques of their own during their match. After each subjects' match they were given their service percentages and informed of a final meeting. At this final meeting all of the subjects were debriefed about the study and given the available results.

CHAPTER 4

Results

The results reported for this study are organized according to each of the four hypotheses which guided the study. A statement of the hypothesis and a brief rationale precedes mention of the statistical methods used to test that hypothesis. Various descriptive statistics and tables have also been presented to provide a clearer understanding of the results. A final perspective of the overall results serves as a summary for the observed outcomes.

In the first group of analyses, the first and second hypotheses of the study were tested simultaneously. For the first hypothesis, it was predicted that the high-ability subjects in the treatment group would show greater improvement in serving performances after mental imagery training than would the low-ability treatment group subjects. This hypothesis was thought to be reasonable when recognizing the fact that elite tennis players should be able to concentrate more on cognitive or visual aspects of the game compared to the lower-ability tennis players who still have to focus much of their attention on the execution of various strokes in order to hit satisfactory shots. The second hypothesis stated that the serving performances of the treatment group subjects will show a greater improvement than the subjects in the control group.

Descriptive statistics were run for the two treatment groups and two ability groups to find the means and standard deviations for both first and second serve percentages. The descriptive data (i.e., means and standard deviations) for serving percentages of high-and low-ability treatment group and control group subjects are depicted

in Table 1. In looking at Table 1 it is interesting to note that the high-ability subjects were able to maintain a first serving percentage of around 60 for pre-test and posttest, whereas low-ability subjects averaged 51 percent of first serves for pre- and posttest. Another group of numbers that stand out in Table 1 are the second serve percentages of high-and low-ability subjects in the pre-test. The high-ability subjects managed to get only 50 percent of their second serves in, but with a relatively large standard deviation. On the other hand the low-ability treatment and control subjects achieved 66 percent of their second serves in the pre-test. Finally, it was surprising to find that the mean of 67 percent of first serves achieved by the high-ability control group subjects was greater than the posttest first serve percentages of both high-and low-ability treatment group subjects.

To obtain a value of improvement of serving performances, the pre-intervention serving percentages of the treatment group subjects were subtracted from the post-intervention percentages for both the first and second serves. The mean degree of improvement achieved for the groups is depicted numerically in Table 2. In Table 2 there are some interesting numbers which should be recognized. For instance, the -.01 mean first serve improvement for the high-and low-ability treatment group subjects suggest that there was no improvement in serving percentage from pre-test to posttest. In addition, the .14 mean second serve improvement score for high-ability treatment group subjects and the -.13 for high-ability control group subjects shows a large difference in second serve improvement between the two groups. By comparing the

improvement scores of the treatment and control groups, we see that the control group subjects (i.e., total) got worse with second serve performances, whereas the treatment group subjects (i.e., total) did not. However, the low-ability treatment group subjects showed no improvement in second serve percentage.

Table 1

Means and Standard Deviations For Serving Percentage On First and Second Serves Of High- And Low-Ability Treatment and Control Subjects

	PRE-TEST				POST-TEST			
	1ST SERVE		2ND SERVE		1ST SERVE		2ND SERVE	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Treatment Group								
High-Ability (N=9)	.59	.17	.49	.36	.58	.09	.63	.31
Low-Ability (N=8)	.52	.13	.66	.16	.51	.12	.66	.15
Control Group								
High-Ability (N=7)	.65	.18	.66	.29	.67	.15	.53	.40
Low-Ability (N=11)	.50	.10	.64	.14	.51	.12	.66	.15

Table 2

Means And Standard Deviations Of First And Second Serve Improvement Scores Of High-And Low-ability Treatment And Control Group Subjects

	1st Serve Improvement		2nd Serve Improvement	
	M	S.D.	M	S.D.
Treatment Group				
High-Ability (N=9)	-.01	.13	.14	.55
Low-Ability (N=8)	-.01	.14	.00	.23
Total	-.01	.13	.07	.40
Control Group				
High-Ability (N=7)	.01	.20	-.13	.62
Low-Ability (N=11)	.03	.15	-.07	.25
Total	.02	.17	-.09	.39

Separate 2 X 2 (ability X treatment group) analysis of variance (ANOVA) tests were used to assess differences in improvement on first and second serve percentages between high-and low-ability treatment and control group subjects. Results of the 2 X 2 (ability X

treatment group) ANOVA on first serve percentage improvement revealed no significant interaction differences between tennis ability and assignment group, $F(1, 31) = .028$, $p > .05$. For the main effect "tennis ability" there was no significant difference in degree of improvement, $F(1,31) = .025$, $p > .05$. A similar nonsignificant finding was observed for the main effect of "assignment group", $F(1,31) = .383$, $p > .05$. The serving percentage means along with standard deviations of the main effects of "tennis ability", and "assignment group" are presented in Appendix I. These findings did not support Hypothesis 1 which predicted a significant difference between high-and low-ability treatment groups on first serve percentage improvement.

To assess the degree of second serve improvement, a 2 X 2 (ability X treatment group) ANOVA test was performed. No significant difference in second serve percentage improvement was found between the two treatment groups, $F(1, 31) = 1.29$, $p > .05$. For the main effect "tennis ability" there was also no statistical difference in the degree of improvement on the second serve, $F(1,31) = .080$, $p > .05$. A nonsignificant interaction finding for ability and assignment group was also revealed, $F(1,31) = .484$, $p > .05$.

These findings for improvement in first and second serve percentages did not support the second hypothesis predicting a difference between the treatment and control groups. It may be concluded from these results that the mental imagery intervention used for the treatment group subjects was not as positively influential as desired. In addition, the placebo tape used by the control group subjects may have been perceived as a method for

relaxing which helped their tennis game and made them perform better than expected. This Hawthorne Effect may have caused some threats to the internal validity of the study. It may be difficult to determine exactly why these outcomes came about. Possibly the subjects in the low-ability group realized somewhere along the way in the study that they were characterized as such and began to play uncharacteristically better to impress the researchers. If so, this Avis effect may explain better serving performances of low-ability subjects and, thus, a lack of a statistical difference. One may also assert that high level tennis players usually have a consistent range of serving percentages during a match, thus no significant improvement would occur as rapidly as in 7 days.

The following set of results examined the possibility of the race variable being a factor in differences in serving performances that might have occurred between the subjects. This observance of the race variable pertains to the third hypothesis which predicted that there would be no differences in serving percentages as a result of race between the high-ability treatment group and high-ability control subjects. African American and Caucasian elite level tennis players were believed to be able to consistently achieve satisfactory serving percentages during a match. In order to test this hypothesis a new variable had to be created. The race and ability variables were combined to form four groups (i.e., African American high-ability, Caucasian high-ability, African American low-ability, and Caucasian low-ability) which allowed us to make the necessary computations.

The first step in testing the third hypothesis was to select those players who were classified as high-ability. Separate 2 X 2 (race/high-ability X assignment group) ANOVAs were run on the first and second serve performance percentages to ascertain any race differences among high ability tennis players prior to treatment. A descriptive statistics command was run to obtain the serving percentages of the two groups to be tested for differences. The mean pre-test first and second serving percentages of the high-ability African American and Caucasian treatment and control group subjects are presented in Table 3. In looking at Table 3 it is interesting to note that the high-ability African American and Caucasian subjects of both the treatment and control groups demonstrated similar first serve percentages during the pre-test. However, there is roughly a twenty percentage point difference within the two assignment groups on first serve performance percentages between the two represented races. Secondly, each of the four groups demonstrated similar second serve percentages during the pre-test with the exception of the Caucasian control group subjects who averaged a mean serving percentage of .75. Finally, it should be recognized from Table 3 that with the exception of the Caucasian control group, each of the other three groups of subjects demonstrated a lower second serve percentage than their first serve when usually tennis players demonstrate higher second serve performance percentages than the first serve.

Table 3

Pre-Test Serving Percentage Means Of Treatment and Control Group High-Ability African American And Caucasian Subjects

	PRE-TEST					
	1ST SERVE			2ND SERVE		
	M	S.D.	N	M	S.D.	N
Treatment Group						
African American Hi-Ability	.50	.16	5	.49	.33	5
Caucasian Hi-Ability	.71	.10	4	.49	.45	4
Total Group	.59	.13		.49	.38	
Control Group						
African American Hi-Ability	.51	.18	2	.44	.48	2
Caucasian Hi-Ability	.71	.15	5	.75	.19	5
Total Group	.51	.16		.66	.27	

Results of the 2 X 2 (race/high-ability X assignment group) ANOVA test for differences in serving performance on first serve percentages according to race and ability groups in the pre-test revealed interesting findings. Differences in first serve performance percentage between the four groups (i.e., the interaction of race/ability and treatment groups) during the pre-test was not significant, $F(1, 12) = .002$, $p > .05$. However, the main effect for race/high-ability produced a significant finding, F(1, 12)

= 7.82, $p < .05$. Specifically, Caucasian players placed 71 percent of their first serves in compared to 50 percent for African American players, (M_C=.71, S.D. = .10; M_{AA}=.50; S.D.= .16). The main effect for assignment group (i.e., treatment or control) revealed no significant difference, $F(1, 12) = .006$, $p > .05$. See Total Group means and standard deviations in Table 3.

Next, a 2 X 2 (race/high-ability X treatment group) ANOVA was run for second serve percentages in the pre-test. The interaction differences for second serve performance percentages between the four groups did not approach significance, $F(1, 12) = .762$, $p > .05$, ES = -1.4. However, a very strong effect size was found which suggests that group differences may exist. A lack of significance may be due to the small number of subjects. For the main effect of race on second serve percentages in the pre-test, a nonsignificant finding was also obtained, $F(1, 12) = .428$, $p > .05$, ES = -1.4. Similar nonsignificant test results were revealed for the main effect for assignment group, $F(1, 12) = .601$, $p > .05$. The relatively large effect sizes for these high-ability subjects in the pretest stems from poor second serve performances by three of the groups and fairly normal performances by the other. Noticing the effect sizes in these groups brings about puzzling questions as to why African American and Caucasian treatment and control subjects were giving away considerable more points on their second serves than Caucasian control group subjects who were of similar high-ability. The majority of nonsignificant findings for the first and second serves in the pre-test can be largely attributed to the small number of subjects in each cell. This rationale is thought to be reasonable

from seeing the variance in some percentages as reported in Table 3.

These results for first and second serve percentages on the pre-test did not support Hypothesis 3. Race differences were found for the first serve only where Caucasian players scored higher than African American players. A 2 X 2 (race/high-ability X assignment group) ANOVA was used to test for first and second serve performance differences in the posttest between the high-ability race groups and treatment or control groups. Descriptive statistics provided the means and standard deviations for both first and second serve performance percentages of the four groups and are presented in Table 4. In looking at Table 4 it should be recognized that the mean for high-ability African American treatment group subjects' first and second serve performance percentages are identical to high-ability African Americans in the control group. Furthermore, the mean first serve performance percentage of the high-ability Caucasian control group subjects is greater than the mean performance percentage of either of the two high-ability race groups in the treatment group. Finally, Table 4 shows again that in the posttest three of the respective groups demonstrated lower second serve percentages than their first serve percentage, with the exception of the Caucasian treatment group subjects who demonstrated a relatively high mean second serve percentage as compared to the other three groups of subjects. This trend in poor second serve percentages is worthy of a closer investigation.

Table 4

Posttest Serving Percentage Means And Standard Deviations Of Treatment And Control Group High-Ability African American And Caucasian Subjects

	POST-TEST					
	1ST SERVE			2ND SERVE		
	M	S.D.	N	M	S.D.	N
Treatment Group						
African American Hi-Ability	.56	.10	5	.43	.27	5
Caucasian Hi-Ability	.62	.10	4	.89	.03	4
Control Group						
African American Hi-Ability	.56	.18	2	.43	.46	2
Caucasian Hi-Ability	.71	.12	5	.57	.43	5

The 2 X 2 (race/high-ability X assignment group) ANOVA test provided the necessary results to determine any differences between the four groups in posttest serving performance percentages. The interaction of assignment group and race/ability results of first serve percentages in the post tape indicated no significant differences, $F(1,11) = .879$, $p>.05$, ES = -.75. For the main effect of race/high-ability, test results failed to find any

significant differences with first serve percentages in the post test, $F(1,11) = .673$, $p > .05$. Results of the test for the main effect of assignment group also failed to reach significance, $F(1,11) = .957$, $p > .05$, ES = -1.3. In terms of practical significance, the noted effect sizes are valuable. An accurate first serve in tennis is often times thought to dictate the outcome of a point. In this case the treatment group subjetcs were not able to serve first serves as well as the Caucasian control subjects which is an interesting occurrence when considering winning points in a tennis match. A 2 X 2 (race/high-ability X assignment group) ANOVA was performed to assess group differences on the second serve percentages. The second serve results between the four groups in the posttest were similar. The interaction results of differences in second serve performance percentages indicated no significant differences, $F(1, 11) = 2.29$, $p > .05$, ES = .75. It is important to notice the effect size in this case because the second serve percentages of the Caucasian high-ability treatment group subjects increased greatly from the pretest, while the Caucasian high-ability control decreases, and the African American subjects had similar performances to the pretest. Possibly the imagery practice is perceived most useful for the second serve of Caucasian players and more useful for first serves of African Americans. The main effect of race/ability also indicated no significant differences between the African American and Caucasian groups on second serve performance percentages, $F(1,11) = .177$, $p > .05$. The main effect of assignment group also revealed no significant findings, $F(1,11) = 4.45$, $p = .058$, but an evident trend was noticed which almost rendered this variable

statistically significant. The means and standard deviations for first and second serving percentages of these two main effect groups can be seen in Appendix J. The lack of significance noticed in the first serve performance percentages could also be due to a low population of subjects per cell. However, these results do support the third hypothesis. Thus, elite level tennis players (i.e., high ability) regardless of race were able to serve consistently during the pre- and posttest matches.

The final group of analyses tested whether any serving performance differences could be found between African Americans and Caucasians who were exposed to mental imagery training. The final hypothesis predicted that low-ability African American subjects in the treatment group would display better serving performance percentages than low-ability Caucasian subjects in the treatment group. Only African American and Caucasian low-ability subjects of the treatment group were included for this analysis. The serving percentages of these two groups can be seen in Table 5. Important values to be recognized in Table 5 are the similar performance percentages of African American subjects on first and second serves. The .59 mean serving performance percentage demonstrated by the African American subjects on second serves is only marginally higher than their first serve performance percentage when a greater difference between the two is expected. Finally, the .47 mean serving performance percentage of low-ability Caucasian subjects on first serves is particularly interesting in that, a first serve percentage less than 50 percent is usually not conducive to winning very many points in tennis even for low-ability subjects.

Table 5

Comparison Of Mean Pre-test Serving Percentages Of Low-Ability African American And Caucasian Treatment Group Subjects

	PRE-TEST					
	1ST SERVE			2ND SERVE		
	M	S.D.	N	M	S.D.	N
African American Low-Ability	.58	.18	3	.59	.12	3
Caucasian Low-Ability	.47	.09	5	.71	.18	5

To test hypothesis four regarding race differences among those who were exposed to VMBR training, separate t-tests were performed on first and second serves for pre-test and post-test serving percentages. The t-test results for serving performance differences between the two groups of low-ability players in the pre-test provided valuable information. In testing for differences (race/ability in VMBR condition only) in first serve performance percentages between the two groups in the pre-test, no significant results surfaced, $t(6) = 1.19$, $p > .05$, ES = 1.2. Similar test results were found for differences in second serve performance percentages during the pre-test between the African American and Caucasian

low-ability players, $t(6) = -.97$, $p > .05$. The analyses on first and second serve percentages failed to support the fourth hypothesis.

The fact that no significant differences were found between African American and Caucasian low-ability subjects on pre-test serving performance percentages suggests that any differences found in the post-test performance will be a result of the treatment and the response of the races to the intervention. There should be no expectation of any serving differences between the two similar ability groups prior to any form of mental imagery intervention.

A t-test was used to test for first and second serve performance differences following the intervention between the low-ability race groups and the treatment groups. Means and standard deviations for first and second serve performance percentages of the two groups are presented in Table 6. In looking at Table 6 one should again recognize that the .47 mean first serve performance percentage demonstrated by the Caucasian low-ability subjects is not very high. A mean serving percentage identical to that in the pre-test is intriguing considering these subjects were exposed to mental imagery to enhance their serving performance. In addition, it should be noted that the African American subjects also had similar serving percentages as they did in the pre-test. Finally, in comparing the second serve percentages of the two groups there appeared to be no large discrepancies and each performed reasonably well.

Table 6

Posttest Serving Percentage Means Of Low-Ability African American And Caucasian Treatment Group Subjects

	POST-TEST					
	1ST SERVE			2ND SERVE		
	M	S.D.	N	M	S.D.	N
African American Low-Ability	.56	.13	3	.72	.19	3
Caucasian Low-Ability	.47	.12	5	.62	.14	5

Results for any differences between the two groups on first serve percentages were informative. The t-test results for the groups was discovered to be nonsignificant, $t(6) = .93$, $p > .05$, ES = .75. The t-test results for posttest second serve performance percentage results of African American and Caucasian low-ability subjects were similar to the first serve results. T-test results for the two groups proved to be nonsignificant, $t(6) = .83$, $p > .05$, ES = .71. The large effect sizes noted are wothy for practical significance. The large effect size between African American and Caucasian low-ability subjects was maintained from pre- to posttest which could be attributed to numerous reasons. However, the large effect size for second serves between the two groups may

suggest that African American low-ability athletes view imagery as most useful for second serves similar to what was suggested for Caucasian high-ability subjects in a previous analysis.

The results for first and second serve percentages did not provide any support for the original hypothesis made for these two groups. The basis of this hypothesis was formed according to previous written literature suggesting that African Americans preferred more visual styles of learning. With mental imagery being such a visual activity the hypothesis was believed to be reasonable. The degree to which this knowledge applies to tennis skills can be questioned due to the results found in this study. Furthermore, the question of whether the mental imagery training was best suited to help low-ability level athletes who participate in a highly cognitive game is still to be determined.

Due to a lack of support for the hypotheses in this study, it was necessary to closely observe other variables that may provide insight into the observed outcomes. First, the awareness of mood item on the Sport Imagery Questionnaire (Vealey, 1988) was believed to have some influence on the outcomes related to the third hypothesis. Specifically, there may be a difference in attitude toward the second serve between African Americans and Caucasian tennis players. The treatment group subjects' self-reported responses to the questions addressing an "awareness of mood during practicing your best serve alone" are depicted in Table 7.

Table 7

Comparison Of Means and Standard Deviations of Responses To The Awareness Of Mood Item Of African American And Caucasian Subjects In the Treatment Groups

	M	S.D.	N
African American High-Ability	2.60	1.140	5
Caucasian	3.50	.577	4

The range of responses to this item were (1) no awareness at all to (5) extremely aware of mood. In looking at the mean responses the African American subjects had a low degree of "awareness of their mood" which provided a gap between the mean responses of the two groups of subjects. However, results of a t-test analysis reveled that this variance in mean responses to awareness of mood was not significant, $t(7) = -1.43$, $p > .05$. A lack of awareness of mood about the serve could mean that there was not a great deal of concentration or there was not much interest as to whether the serve was accurate. The "awareness of mood" variable may also provide insight into a subject's reactions to hitting a successful or inaccurate serve. With this knowledge one may better determine

how much emphasis is placed on both the first and second serves. Furthermore, one could reasonably assume that the race variable may be influential in how willing subjects are to truthfully report their particular mood. This, variance between groups may provide support for the notion that African Americans and Caucasian high-ability subjects may place differing degrees of emphasis on the serve.

By taking a look at some of the items on the demographic questionnaire researchers found other important variables to help understand the results. One question from this form asked if subjects implemented any pre-serving strategies of their own during the match. This question was asked of both the treatment and control groups. Responses to this item for African American and Caucasian subjects are presented in Table 8.

Table 8

Self-Reported Responses Of Pre-Serve Strategies Implemented By African American And Caucasian Subjects of Both Treatment And Control Groups

	YES		NO	
	(%	N)	(%	N)
African American	86.7	13	13.3	2
Caucasian	95	19	5.0	1

Surprisingly, the majority of the African American and Caucasian subjects reported that they already implemented some form of pre-serving strategy. This finding is important when assessing the power of the mental imagery intervention used in this study. The chi square analysis that was run on the responses of subjects having any preserve strategies indicated no significant differences, $X2$ (1) = .76, $p > .05$. The fact that the majority of the subjects of both races across assignment groups already used some type of pre-serve strategy may mean that the mental imagery practice is something different from what they are used to and either they are not willing to change or the imagery was redundant with their strategy. Researchers were not able to determine what type of strategies were being used. However, it was apparent that these strategies could have confounded the study.

Another item of interest on the demographic questionnaire which provided better interpretation of the results was subjects' preference for learning new skills. The possible responses to this question were kinesthetic, visual, cognitive, or physical. Researchers sought to determine how these responses related to the serving percentages. A one-way multivariate analysis of variance (MANOVA) was used to determine any differences in serving percentages between African American and Caucasian subjects according to their preferences for learning new skills. The mean first serve percentages after treatment for African American subjects who reported preferring either kinesthetic, visual, or cognitive learning was .524 (SD = .140), whereas those who reported preferring physical methods was .539 (SD =.111). For second serve

percentages of African Americans the mean was .536 (SD =.157) for cognitive, kinesthetic, and visual learners, as opposed to .540 (SD = .313) for physical learners. In the case of first serve percentages the one-way MANOVA test revealed that there were no significant differences between serving performances and preference for learning new skills, $F(1,31)$ .021, $p > .05$. Likewise, no significant differences were noticed for second serve percentages, $F(1,31) = .109$, $p > .05$. These finding are relevant because researchers were working under the understanding that African Americans had a visual preference for learning but we found no support for our fourth hypothesis.

Finally, the results regarding the use of mental imagery were also helpful for interpretation. Observing whether or not treatment group subjects used imagery prior to their match, researchers found that 76 percent of the subjects reported using imagery prior to their match. The use of imagery during the match was also a factor of interest. Researchers noticed that 94 percent of the treatment group subjects reported using imagery during their match. When asked whether they thought mental imagery was helpful for their serve during the match, 64.7 percent of the treatment group subjects reported that it was helpful. In comparing African Americans and Caucasians on imagery use, researchers found that 60 percent of the African American subjects reported using imagery prior to the match, whereas 50 percent of the Caucasians reported using imagery prior to their match. For the variable of imagery use during the match, 66.7 percent of African Americans reported using it during the match, as opposed to 80 percent for Caucasian

subjects. Finally, subjects self-reported responses of imagery being helpful for their serve during the match. Forty percent of the African American subjects indicated that imagery was helpful for their serve during the match, while 25 percent of Caucasian subjects reported imagery as being helpful for their serve. Athletes' perceptions of imagery and imagery use can provide clearer understanding of the observed results.

In summary, the results from this study can be useful for better understanding imagery when used in a tennis setting while observing race factors. Although the majority of the hypotheses were not supported statistically other observed outcomes and trends toward significance are of value. The knowledge brought into this study from previous literature was a basis for the hypotheses. A lack of support for these hypotheses shows that some information is not applicable to all domains or that there may have been some methodological errors within the study. The differences noticed in second serve performances of African Americans and Caucasians is an outcome that needs to be examined further to determine a reason for such an occurrence. Furthermore, the mental imagery intervention proved not to be better suited for either high-ability or low-ability subjects. Imagery may not have been as effective due to the possibility that many of the subjects already have a pre-serving strategy. To protect against this a screening process should be implemented in future research before assigning groups. In addition, an appropriate mental imagery intervention technique needs to be dynamic enough to accommodate high- and low-ability athletes as well as athletes of different races.

CHAPTER 5

Discussion

This experimentation with the mental imagery phenomenon has enabled researchers to gain insight and raise questions about imagery that have not received much attention in other studies. Although results do not allow us to make any definitive assertions, certain findings suggest there is a need for additional studies to explore race variables when attempting to understand imagery use and its effectiveness. More specifically, this experimentation suggests less evident factors of a tennis match that can have a strong impact on performance while using mental imagery. Some of these important factors are the emphasis placed on the second serve, athletes existing preserve and prematch strategies, use of imagery during a match, and level of competition. By uncovering subtle but valuable aspects of the tennis game through research, studies such as this provide a basis for making sport psychology applications to the sport. Information gained from this study builds upon prior research with imagery and tennis which contributes to the possibility of an established framework for imagery.

The statistical analyses provided no support for Hypothesis 1 which predicted that all high-ability treatment group subjects will show greater improvement in serving performance than low-ability treatment group subjects. These results left researchers feeling particularly puzzled as to why there was no significant difference found. The rationale for making such a hypothesis seemed quite reasonable. High-ability tennis players were thought to have reached a point in their sport development that would allow them to

feel fairly comfortable and confident in their physical tennis abilities. Thus, high-ability level tennis players would have substantial opportunities to focus on the cognitive strategies of tennis or the visual processes of mental imagery practice during a match. Conversely, lower-ability level tennis players need to still pay close attention to the mechanics and execution of various strokes in order to play with any degree of proficiency. With the majority of attention placed on physical components, low-ability tennis players were believed no to be able to spend much time with the practice of mental imagery during a match.

With reasonable considerations to back our hypothesis and knowledge gained from the literature, why were there no statistical differences between the two groups on serve improvement? In a similar experiment of cognitive strategies and their influence on tennis serving performance Weinberg, Gould, Jackson, and Barnes, (1980) found high ability subjects to have significantly better serving performances than subjects categorized in the low-ability group. However, results of this study were in disagreement with those findings. One may reasonably question whether those subjects who were placed into either the high- or low-ability classification were truly of high- or low-ability status. In addition, one may find it relevant to mention that there may be those players who have good overall tennis games but are poor servers or vice versa. In response to these concerns the significant differences in mean serve skills test scores for high- and low-ability subjects support the fact that subjects' assignment to either group was accurate. Furthermore, the serve skills test itself was developed as a means

of additional evaluation to validate the skill assessments of the NTRP ratings. It would seem that with these two major questions considered in the format of the study there would be some noticeable differences to support the hypothesis. Other factors such as subject population, size of sample, time of year, and age of subjects may be influential reasons for the lack of a statistically different finding.

Several other questions and explanations have been raised in an attempt to comprehend why there was no support for the researcher's second hypothesis. The predicted advantage in serving percentage improvement for all subjects exposed to the mental imagery sessions rather than those subjects in the control group was not thought to be an impossible occurrence because of the focus of this study on mental imagery effects on tennis serve performance. Furthermore, this hypothesis was formed along with conclusions drawn from other studies which mentioned that mental imagery can be helpful for improving athletic performances (Desirato & Miller, 1979; Gough, 1989; Kirchenbaum & Bale, 1980; Kolonay, 1977; Mendoza & Wichman, 1978; Schleser, Meyers, & Montgomery, 1980; Suinn, 1972, 1977). The unexpected results showing no difference between the control and treatment groups was a mystery.

The discovery that the control group subjects actually showed more improvement in first serve improvement brought about additional questions. Noel (1980) found that low-ability control group subjects had a greater improvement in first serve percentage than did the low-ability treatment group subjects. How can it be

that these results surfaced in two different studies? In the present study the mental imagery intervention tape was reportedly used by 94 percent of the treatment group subjects. Moreover, the question of whether the 7-day period of mental imagery practice was long enough to actually have a positive influence on serve performances was explained by reports of 64 percent of subjects stating imagery to be effective during play.

Supervision of subjects during mental imagery use and length of intervention have been popular concerns of researchers when conducting mental imagery experiments. In this study, methods of supervision were implemented by contacting subjects by phone to ensure their use of the tape. Ideally, researchers would like to have a reliable method of monitoring each subject's practice, but it is very difficult. The amount of time necessary for imagery practice is a difficult issue due to individual differences of time it takes athletes to learn, use and be influenced by mental imagery. Furthermore, a lack of significant findings could be due to the small number of subjects and that the control group subjects may have been using some other pre-serve strategies. Finally, with the emphasis of the study on the use of mental imagery to help serving performance subjects may have focused too much of their attention on thinking and visualizing as opposed to the actual playing of the tennis match.

In examining the results of the third hypothesis researchers began to utilize the race variable and its influence on mental imagery effectiveness. The third hypothesis asserted that there would be no differences in serving performance due to race between

all high-ability subjects who received the mental imagery treatment. The results testing this hypothesis found no statistical differences for first serve performances. Tennis players who are of elite status should be able to serve consistently will regardless of their ethnic backgrounds. However, the results of second serve performances between high-ability treatment group subjects proved to be in disagreement with our rationale. An unexpected significant difference was found between African American and Caucasian high-ability treatment group subjects on mean second serve percentage. This finding showed Caucasian subjects to have significantly better second serve percentages which made researchers ponder several explanations for such an unlikely occurrence.

What could be the cause of the second serve differences between African American and Caucasian treatment group subjects considering that the first serve percentages did not differ between groups? Is there so much emphasis placed on the first serve by a player of a particular race that they have a tendency to overlook the importance of an accurate second serve? Do subjects need to mentally imagine first and second serve performances in their practice in order to become more successful with them during a match? These questions as well as others have been mentioned in a discussion of these outcomes. There may have been some unknown factors as to why the African American subjects performed so poorly on their second serves. It is necessary to replicate this finding with a larger sample to determine if this outcome is to be expected repeatedly. A difference in degree of emphasis placed on the second serve between African Americans and Caucasian elite

level players could exist, but that could not be determined from this investigation. Further studies examining the race variable in tennis are necessary in order to reveal if perceptions of value for the second serve differ between African American and Caucasian elite tennis players. If rehearsing the second serve during mental imagery practice is truly helpful it exposes a shortcoming of this study. During the mental imagery practice sessions there was no distinction made on the audio cassette between which serve, first or second, the subjects were performing. Once again this may be an important factor to be considered in future imagery studies involving tennis and race variables.

In a final analysis of the relationship between mental imagery effectiveness and the race variable on serving performance further questions have been raised regarding the fourth hypothesis and the observed results. The prediction that low-ability African American treatment group subjects would serve better than Caucasian subjects of the same classifications was statistically inaccurate. The premise for making such a hypothesis was formulated from results of the Ewing and Yong (1992) study which suggested that African Americans have a preference for visual learning. With mental imagery being so visually based, the fourth hypothesis was thought to be appropriate and reasonable. However, results of this study were not able to provide any support for the Ewing and Yong (1992) findings. The Ewing and Yong (1992) results found African Americans to have a preference for more visual styles of learning. However, in the present study low-ability African American subjects' serving performances were not significantly different

from low-ability Caucasians, which was incongruent with the Ewing and Yong (1992) findings.

Is the visual preference African Americans have for learning only applicable to classroom and not athletic settings? This was a major question of debate in this study. Tennis is a sport in which there is a great deal of cognitive activity involved for strategies, reading serves, and analyzing your opponent. These thinking aspects of tennis are to be studied and learned much like schoolwork assigned from a classroom. With this, in mind would it be wrong to assume that a visual preference for learning in school should also be transferred to a visual preference for learning and competing in sports? In response to this question one might reasonably assert that the low-ability subjects used in this study placed more emphasis on the physical aspects of the sport in order to be proficient as opposed to the cognitive areas involved in a tennis match. Therefore, the time spent by subjects on the physical skills involved in the matches were apparently taking precedence over practicing the mental imagery skills. Furthermore, it may have been necessary to make the imagery practice for low-ability subjects more individualized. This would have been helpful considering the possibility that the low-ability subjects may have been mentally imagining incorrect serving techniques, which in turn may have caused their serving performance percentages to decline (Suinn, 1993). Unfortunately the question of whether mental imagery is suited for lower-ability athletes could not be determined from the results of this study.

Various other observed outcomes of this investigation provided interesting thoughts for discussion. In the case of such poor second serve percentages for African American subjects in the treatment group, several attributions and questions were raised as to why this occurred. Were the high-ability African American subjects only instructed on how to hit a powerful first serve and not an accurate second serve? Do high-ability African American athletes place so much value on getting the first serve in that they lose sight of the importance of the second serve if the first one is inaccurate? Or were the majority of the African American subjects just "having a bad day" with the second serves? The concept of an awareness of mood when practicing the serve was thought to be a relevant variable to help explain the poor serving percentages of high-ability African American subjects. In looking closely at the mood variable for African Americans there was a smaller mean score of awareness of mood with a larger standard deviation in relation to Caucasian subjects. With this finding researchers can suggest that some African Americans just hit their first and second serves without much thought of placement and accuracy. However, the degree to which the mood variable has a causal relationship with poor second serves for high-ability African American subjects can not be determined. Each of the questions raised regarding the occurrence of low second serve percentages of African American subjects should be entertained further in research studies of a similar kind.

In examining the descriptive statistic results of this experiment further questions and assumptions were generated to

better understand the outcomes. For instance, the fact that the majority of subjects in either assignment group or ethnic background reported having some form of preserve routine was an interesting discovery. This finding was particularly important when assessing the impact of the mental imagery tape used for this study. Were the subjects' self-reported pre-serve strategies so commonplace in their match routines that they were reluctant to experiment with using the mental imagery process? Moreover, was the mental imagery tape powerful enough to make a positive improvement in the subjects' serving performances?

Explanations for the previous two questions deserve discussion. First, without being able to determine what type of pre-serve strategies subjects were using, it was difficult to determine how great or minimal an interference those strategies were to the mental imagery intervention. In future studies of this kind it would be essential to extend this variable by asking subjects to provide a brief explanation of the strategies they use (if any). This would be helpful in that researchers could possibly show subjects how mental imagery is similar or can be used in conjunction with their existing strategies prior to testing their performances. The statistics of the item effectiveness of imagery on serve during the match on the post-match questionnaire provided some input regarding the impact of the imagery tape. Sixty-four percent of the treatment group subjects reported that imagery was effective for their serve during the match. This finding would provide support for the mental imagery tape being a positive influence. However, it is incongruent with some of the observed serving percentages and lack of

statistical significance for the hypotheses of the study. The validity of subjects' responses to items on questionnaires has been a concern in many other studies and could will be a misleading issue in this experiment.

Another issue worthy of discussion revolves around the use of subjects from two different ethnic backgrounds. An area of concern raised after the results of this study was the degree to which the events of a tennis match might change depending upon whether subjects were competing against someone of the same or different race. Based on the background tennis experiences of the primary researcher, it was believed that in some cases this may be an influential factor. When players from two different races are competing, it may be more than just a tennis match, but a battle between races. A strong drive to defeat an opponent fueled by dislike for their race can cause heightened pressure and tension. With such feeling present during a match, mental imagery tools can easily be discarded. In most cases during this study the matches were between same race subjects. However, there were several exceptions when there were different races competing. The argument that two subjects of different races competing against one another can possibly influence a match may be a contributing factor for high-ability African Americans having such low percentages of second serves. They may have been trying too hard to "ace" their opponent on the second serve and thus left little margin for error. The present study was unable to substantiate the validity of whether this race mixing for competition was a factor.

Therefore, future studies should examine more closely this issue to determine if it may affect the outcomes of a match.

The subjects' exerted effort and interest during testing also tuned out to be an area of concern. Originally the format of the study was designed such that the subjects would be playing in a tournament-like atmosphere to facilitate positive competition and winning attitudes. Time constraints and necessary resources caused such a format to be altered. Each match was supervised by the primary researcher to make sure of a satisfactory degree of effort by subjects. However, it was difficult to determine if the experimental match setting used to collect the data is indicative of a subject's normal level of intensity during a competitive match situation where there is more at stake. Some of the data collected was during a collegiate match, but this still does not ensure a true representation of an individual's success or failure with imagery over time. It is the opinion of the primary researcher that a tournament setting design which makes subjects feel as though there is something to lose would protect against any lack of exerted effort and provide more generalizable results.

The present study was an extended replication of Noel's (1980) examination of VMBR use in tennis players of high- and low-ability. It was the intention of this study to build upon the knowledge provided by Noel as well as, try to provide additional insights to understanding mental imagery. The methodology of the two studies was very similar. The manner in which subjects were classified by ability was however, more detailed in the present study. The use of the NTRP rating system provided an accurate representation of

ability which made the distinction between the two ability groups more evident. In addition, a larger, younger population of subjects from two ethnic backgrounds were extensions of the original study. Such additions to the original study were developed in hopes of finding more generalizable results.

In comparing the outcomes of Noel's (1980) work and the present study certain similarities and differences were noticed. Working under the findings noticed by Noel (1980), the present study hypothesized that high-ability imagery subjects would improve their serving percentages more so than low-ability subjects exposed to mental imagery. A similar finding of greater improvement in serving percentages was noticed for the high-ability group but, it was for the second serve. The first serve percentages of high-ability subjects in the present study remained almost the same, whereas Noel (1980) found this group to improve significantly. Why did this difference in results between the studies occur? One might reasonably argue that the subject population differences between the two was a factor. Furthermore, the fact that subjects in a tournament setting as in the Noel (1980) study may concentrate more on the accuracy of their first serve.

Other interesting findings from the two studies are worthy of comparison. For instance, in the Noel (1980) study the low-ability treatment group subjects were found to have declined in their serving percentages. Although a decline in percentage was not found in the present study, the low-ability subjects serving percentages were nearly identical from pre-tape to post-tape. These similar findings brings up the question of what is the best imagery practice

for low-ability subjects? With this question in mind the mental imagery tape used in the present study was believed to be suited for high- and low-ability athletes.

Finally, in the present study support was found for the hypothesis that predicted no difference in serving percentages due to race. However, a trend toward significance was observed for second serves and was due mainly to high-ability African American subjects having such low second serve percentages. In comparing the first serve percentages of the subjects in the present study there is some variance with those percentages in the original study. The first serve percentages of high-ability subjects after tape use in the Noel (1980) study are higher than that of the present study. Why there was variance in first serve percentages among high-ability subjects from the two studies could possibly point to the value of collecting data from a tournament setting and also the existence of any race differences in mental imagery use and effectiveness for elite level tennis players.

In summary, although the present study was not completely statistically beneficial, it did provide valuable perspectives on research dealing with mental imagery. By extending the Noel (1980) study with a larger and more diverse subject population certain events were noticed. The larger number of subjects in the present study was found still to be rather small when subjects were broken into the race and ability categories. However, researchers were able to notice some numeric trends and make various assumptions about the results. Using the race variable in this study brought about interesting outcomes in serving percentages and imagery practice

responses. A lack of statistical significance did not allow researchers to make a legitimate argument for race differences in mental imagery effectiveness. However, there were some cases of strong effect sizes for pre- and post-test serving performances between the races which may have suggested some differences and did provide some practical significance. Follow-up studies building on the present methodologies and assumptions may find there to be important race considerations when using and researching mental imagery with athletes.

In drawing conclusions from the present study certain relevant suggestions can be made about mental imagery effectiveness. First, coinciding with Noel (1980) there needs to be careful attention given to the design of the mental imagery tape when dealing with high- and low-ability athletes. In the Noel (1980) study comparing high- and low-ability tennis players' effectiveness with mental imagery, the low-ability group declined in performance. However, in the present investigation there was no difference between the two groups even with critical consideration of the make-up of the audio tape. If there is such a need for an ability specific mental imagery practice, is there also a need for a race specific format? This question leads to the researcher's second conclusion. Statistical requirements for significance were not reached in this study when testing the race variable. However, the drastically low second serving percentages noticed by high-ability African American subjects is an occurrence that should not remain unexplained. Whether this is a factor of the mental imagery tape or mental imagery practice in general could not be determined, but it is

believed that there is something there that previous research has to this point not addressed. Therefore, replication of this finding is needed with a larger sample.

In addition, researchers can logically conclude from this study that introducing a new performance enhancement tool to athletes can be difficult. The normal preserve and prematch routines that athletes are used to can confound research with mental imagery. Subjects may at first appear to be interested in the imagery process but in a match they avoid using the process because they are more comfortable with their normal strategies. A longer training period and introduction to mental imagery practice could have improved the present study and also produced more significant results. Finally, a subject's preference for learning new skills was found not to be a determinant of how well they were able to serve. For mental imagery purposes in athletics this suggestion points to an interesting connection between visual learning and performance and should be examined further to test its reliability.

In completing the present study a wealth of knowledge was gained which can be considered useful in a practical sense. One of the main issues which guided this study was the degree to which mental imagery enhanced serving performance. Many of the previously documented studies have suggested mental imagery to be a helpful performance enhancement tool. As this research extends to a more diverse population, as in the present study, a logical implication can be made suggesting that mental imagery practice should be designed according to ability level. The tests of the race variable did not produce any valid arguments about race differences

with imagery use and effectiveness. Although second serve percentages and mood when practicing imagery may be found to be relevant areas when using the race variable in other mental imagery studies.

Furthermore, the supervision of mental imagery practice is vital for reaching a degree of effectiveness. Without being able to truly determine the amount of imagery practice a subject goes through, sport psychologists have difficulty assessing its influence. This brings about another implication that more time needs to be spent practicing the imagery process than was designated. This may leave a coach disgruntled in that it takes time away from physical practice. However, the more an athlete becomes familiar with the imagery procedures, they will be able to use the tool on their own and begin to see some positive gains in performance. The mental imagery tool has proven to be a beneficial tool for sport performance and with continued formats of this kind its span of effectiveness can be generalized to a broader group of people in order to establish solid theoretical models.

APPENDICES

APPENDIX A

Demographic Information Form

Demographic Information Form

Instructions

Please read each of the following questions carefully and respond by writing in the space provided. Please be as accurate as possible. Be sure to answer each question.

Name _____ Race _____ Age_____

1. How many years have you played competitive tennis?

2. Are you currently playing tennis for any high school, or college/university?

_____ (1) high school _____ (2) college/university
_____ (3) not currently on a team

2a. If "not currently on a tennis team", have you ever played tennis for any college or university team?

_____(1) Yes _____ (2) No

2b. If you are in college, have you ever played tennis for any high school team?

_____ (1) Yes _____ (2) No

3. Indicate which of the following best describes your preference for learning new skills?

___ Kinesthetic (focusing on the "feelings")
___ Visual
___ Cognitive
___ Physical practice _ Other ways, explain:

4. Please provide any tennis ranking that you presently have or have had in the past.

   a. Highest city ranking _____
   b. Highest state ranking _____
   c. Highest national ranking _____

5. Was the majority of your tennis instruction provided through private or group lessons?

   _____ (1) Private _____ (2) Group

6. How would you describe the coaches who provided most of your tennis instruction?

   _____ (1) teaching professionals

   _____ (2) amateur instructors _____ (3) peer teachers

7. Has the majority of your tennis play been in a country club or public park setting?

   _____ (1) country club _____ (2) public park

8. How often have your rackets been strung with gut strings?

   ___ (1) Very often

   ___ (2) Sometimes (half or less of the time)

   ___ (3) Never

9. Have you ever or do you presently implement any preserving strategies during a match? (self-talk, imagery, relaxation, etc.)

_____ (1) Yes _____ (2) No

9a. If yes, what strategy (ies) do you utilize during your matches?

10. Explain any goals you set for yourself prior to a tennis match.

11. Explain any strategies you utilize to help you concentrate during a tennis match.

12. Do you have any pre-match routine to help you prepare for a match?

_____ (1) Yes _____ (2) No

12a. If yes, briefly explain your routine.

APPENDIX B

Control and Vividness of Visual Images Questionnaire

MENTAL IMAGERY QUESTIONNAIRE

Instructions

In the following questionnaire you are to read the descriptions of four different sport scenarios. You will be asked to imagine the written sport description on your own with as much attention to detail as possible. As you image keep in mind that visual images include many senses such as hearing, moods, touching, and smelling to make images seem as real as possible.

After you read each description think of all the specific aspects of that description such as the skill, the people involved, the place, and the time. Next, close your eyes and take a few deep breaths to become relaxed. With your eyes closed clear your mind of any other thoughts and try imagine vivid images of the written scenario.

There are no right or wrong images. Try to use your imagery skills to make as vivid images as you can. Upon completion of your images of the written scenario, please rate your imagery skills using the following scales.

for items a-d:

1 = no image present at all

2 = not clear or vivid, but a recognizable image

3 = moderately clear and vivid image

4 = clear and vivid image

5 = extremely clear and vivid image

for item e:

1 = no control of image at all

2 = very hard to control

3 = moderate control of image

4 = better-than-average control of image

5 = complete control of image

PRACTICING ALONE

Focus on the execution of your tennis serve. Now imagine yourself practicing your serve in the facility where you normally practice without anyone else present. Close your eyes for about a minute and try to see yourself in this facility, hear the sounds, and feel your body performing your tennis serve. Pay attention to your state of mind and mood while you are performing your tennis serve. Try to see yourself from behind your eyes or from inside your body.

a. Rate how well you saw yourself performing the tennis serve. 1 2 3 4 5

b. Rate how well you heard the sounds of performing your tennis serve. 1 2 3 4 5

c. Rate how well you felt yourself making the movements of your tennis serve. 1 2 3 4 5

d. Rate how well you were aware of your mood. 1 2 3 4 5

e. Rate how well you controlled the image of your tennis serve. 1 2 3 4 5

f. Could you see the image from inside your body? yes no

PRACTICING WITH OTHERS

Now you are performing your same tennis serve but this time you are practicing the serve while your teammates and coach(es) are present in the facility where you normally practice. This time, however, you make a major mistake with your serve and mishit the ball badly and everyone notices. Close your eyes for about one minute to imagine making that error and the situation immediately afterward as vividly as you can. Try to see the image from behind your eyes or inside your body.

a. Rate how well you saw yourself in this situation. 1 2 3 4 5

b. Rate how well you heard the 1 2 3 4 5

sounds in this situation.

c. Rate how well you felt yourself making the mistake with your serve. 1 2 3 4 5

d. Rate how well you felt the emotions of this situation. 1 2 3 4 5

e. Rate how well you controlled the image. 1 2 3 4 5

f. Could you see the image from inside your body. yes no

PLAYING IN A MATCH

Imagine yourself performing the same movements of that tennis serve in a match, but imagine yourself doing that serve very skillfully and the spectators and your teammates showing their appreciation. Now close your eyes for about one minute and imagine this situation as vividly as possible.

a. Rate how well you saw yourself performing a successful tennis serve. 1 2 3 4 5

b. Rate how well you heard the sounds of your tennis serve. 1 2 3 4 5

c. Rate how well you felt yourself making the movements of your tennis serve. 1 2 3 4 5

d. Rate how well you felt the emotions of this situation. 1 2 3 4 5

e. Rate how well you controlled the image. 1 2 3 4 5

f. Could you see the image from inside your body. 1 2 3 4 5

APPENDIX C

University Committee on Research Involoving Human Subjects (UCRIHS) Approval Letter

MICHIGAN STATE
UNIVERSITY

February 28, 1994

TO: Mr. W. Drew Scales III
4591-3A Donerail Place
Okemos, MI 48864

RE:

IRB #:	94-055
TITLE:	THE EFFECTS OF MENTAL IMAGERY ON TENNIS SERVING PERFORMANCE ACROSS RACES
REVISION REQUESTED:	N/A
CATEGORY:	1-C,D
APPROVAL DATE:	02/17/1994

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project including the revision listed above.

Renewal: **UCRIHS approval is valid for one calendar year, beginning with the approval date shown above.** Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

Revisions: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

Problems/ Changes: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517) 355-2180 or FAX (517) 336-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:pjm

cc: Dr. Martha Ewing

OFFICE OF
RESEARCH AND GRADUATE STUDIES
University Committee on Research Involving Human Subjects (UCRIHS)
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APPENDIX D

National Tennis Rating Program (NTRP)

THE NATIONAL TENNIS RATING PROGRAM

GENERAL CHARACTERISTICS OF VARIOUS PLAYING LEVELS

1.0 This player is just starting to play tennis.

1.5 This player has limited experience and is still working primarily on getting the ball into play.

2.0 This player needs on court experience. This player has obvious stroke weaknesses but is familiar with basic positions for singles and doubles play.

2.5 This player is learning to judge where the ball is going although court coverage is weak. This player can sustain a rally of slow pace with other players of the same ability.

3.0 This player is consistent when hitting medium paced shots, but is not comfortable with all strokes and lacks control when trying for directional intent, depth, or power.

3.5 This player has achieved improved stroke dependability and direction on moderate shots, but still lacks depth and variety. This player exhibits more aggressive net play, has improved court coverage, and is developing teamwork in doubles.

4.0 This player has dependable strokes, including directional intent and depth on both forehand and backhand sides on moderate shots, plus the ability to use lobs, overheads, approach shots and volleys with some success. This player occasionally forces errors when serving and teamwork in doubles is evident.

4.5 This player has begun to master the use of power and spins and is beginning to handle pace, has sound footwork, can control depth of shots, and is beginning to vary tactics according to opponents. This player can hit first serves with power and accuracy and place the second serve and is able to rush net successfully. Aggressive net play is common in doubles.

5.0 This player has good shot anticipation and frequently has an outstanding shot or attribute around which a game may be structured. This player can regularly hit winners or force errors off of short balls and can put away volleys, can successfully execute lobs, drop shots, half volleys and overhead smashes and has good depth and spin on most second serves.

5.5 This player has developed power and/or consistency as a major weapon. This player can vary strategies and styles of play in a competitive situation and hits dependable shots in a stress situation.

6.0 to 7.0 These players will generally not need NTRP ratings. Rankings or past rankings will speak for themselves. The 6.0 player typically has had intensive training for national tournament competition at the junior level and collegiate levels and has obtained a sectional and or national ranking. The 6.5 player has a reasonable chance of succeeding at the 7.0 level and has extensive satellite tournament experience. The 7.0 is a world class player who is committed to tournament competition on the international level and whose major source of income is tournament prize winnings.

APPENDIX E

Mental Imagery Scripts

IMAGERY SCRIPT
Tennis Serve

Low-Ability

Feel the atmosphere in the tennis facility where the tournament is being held. As you enter for your first match notice the overall feeling in your body when you first walk into the arena.

Recognize the odor/smell of new tennis balls in the tennis facility. Notice other odors that are also present. Smell the odor of tennis balls and the tarps in the facility

Feel the temperature in the tennis arena. Feel how stuffy the air is. Notice how warm or how cold you feel as you first walk into the tennis arena. Feel the hard court surface under your feet as you walk onto your designated court.

See the other matches going on around you as you enter. See the Big Ten banners on the walls of the facility. See the lights, notice how bright or how dim it is in the facility. See the bleachers, and if there are any spectators sitting in them. Notice the courts, pay attention to how clean they are and how every court looks the same. Also notice all of the green items in the facility.

Hear the echo of the ball being hit by other participants in the arena. Hear the sound their racket makes as they hit various strokes. Hear their feet shuffle across the court as they are playing their matches. Hear an occasional grunt, or other outburst by some of the other participants. Hear the buzz in the lights.

***FLOW INTO SERVING ***

As you are getting ready to serve first pay attention to your stance/body posture. See yourself positioned at the baseline ready to attempt your first serve. Notice how you are facing the net in a comfortable position.

Once you have postured yourself at the baseline ready to serve, see yourself gripping the racket with the proper/normal grip for serving. Squeeze the grip of the racket. Feel the texture of the leather grip along your fingers before you begin to serve.

As you assume your normal position for serving, notice how you direct your attention to the appropriate service box which you are serving. See yourself staring across the net for a brief moment, focusing on the left or right (deuce or ad) service court. Think about what you need to do to get your serve in that box.

Now focus on the start of your service motion.

Pay attention to your toss. Notice how your tossing arm rises upward in a fluid motion. See how your straight tossing arm extends up over your head , and you begin to release the ball. Observe how the ball goes straight up into the air just out in front of your body, and just a tad bit higher than you can reach with your racket. Notice how perfectly placed the toss is for you to hit your **best** serve.

While your toss is in the air, begin to look at how your knees bend slightly but you still maintain your balance. Next, see how your body uncoils so that you can extend and hit the ball. Notice how you stretch with your racket arm high enough to reach your toss. See your body fully extended to make contact with the ball, while your eyes remain locked on the ball.

See yourself coming closer and closer to contacting the ball. As you hit the ball, notice how the muscles in your hand, wrist, and forearm, tighten to handle the impact of your racket contacting the ball. Feel the ease of contact as you hit the ball right in the sweet spot of your racket. Hear the echo of the thump sound of the tennis ball as you make contact.

After you have made contact with the ball, follow through in the direction of your target. See your racket arm still moving downward from it's position high above your head, and across your body. Pay attention to how fluid a movement you have in your body as the momentum from your serve carries you a few feet inside the baseline.

As you successfully get one of your best first serves into the appropriate service box, pay attention to the feelings you have. Pay attention to the satisfaction and pleasure you feel knowing you have put one of your best first serves in play. Notice your mood after hitting a good first serve. Observe how the mood from that serve helps you gain confidence in your serve, and also overall ability to win the match.

IMAGERY SCRIPT
Tennis Serve

High-ability
"The Place" same as for low ability.

***FLOW INTO SERVING ***

As you are preparing to serve feel your normal body position/posture as you stand at the baseline. Look down at your front foot and see that you have it correctly planted just behind the baseline as you normally would. Pay attention to the comfortable stance you maintain while you see the net in front of you. Feel the fuzz from the tennis ball in your hand as you are bouncing it up and down on the court while you continue to prepare for your first serve. Begin to think about which serve you want to hit, taking into consideration all factors that may affect that decision. (Give some? --lights, balls, favorite, etc.)

Once you have postured yourself at the baseline ready to serve and have decided which serve you want to hit, feel your hand gripping the racket. Feel your hand wrapped around the grip of the racket the way that makes it possible to hit the serve you have decided upon. Feel the texture of the leather grip in the palm of your hand and along your fingers. Notice how your fingers fit comfortably in place along the ridges on the grip of the racket. Feel the tension in the muscles of your hand, fingers, wrist, and forearm as you are holding the racket in preparation for your first serve.

Next take a glance at your opponent and notice where they are positioned to receive your serve. Recognize if their position changes your choice of serve. Further prepare for your first serve by taking into consideration where they are positioned. Also, consider any weakness that you have found in your opponent that may influence your choice of serve.

Once you have correctly prepared, take a moment to glance across the net to focus on where in the service box you would like your first serve to bounce. Focus on that specific area of the service box. Stare at that area and think about what it takes for you to get the ball there on your serve. Continue to look at that area of the service box to which you want your serve to land. As you are looking hear yourself talking in your head about the important things to remember when trying to hit that target in the service box.

After all factors are considered, begin to start you service motion. Feel your racket arm and tossing arm rise to

begin the service motion. Start to bend your knees in order to get the thrust into the court. Extend your body all the way out to reach high and make contact with the ball after your toss. Continue to reach upward toward the ball. Contact the ball, and feel the muscles in your hand and forearm tighten to absorb the impact. Hear the sound of the strings of your racket as you hit the serve. Also hear the sound of the ball at contact. Feel your feet in the air as you lunge fluidly into the court as you follow through with your service motion.

Upon completion of one of your best first serves, feel yourself begin to immediately prepare for your opponents return. Become alerted to whether your opponent is pulled out of position because of your serve, or whether he will be able to return an offensive shot. Begin to anticipate if your opponent is going to hit a forehand or backhand return. Feel yourself alert and in a good ready position, awaiting the return of your opponent.

After you get one of your best first serves into the appropriate court, notice the positive feelings you have. Experience the feelings of satisfaction, pleasure, and relief that comes as a result of hitting the serve to the desired target and getting one of your best first serves into play. For that moment after your serve feel the good mood you have. Let that good mood from your successful first serve increase the confidence you have in your serve, and also confidence in you overall ability to win the match.

APPENDIX F

Time Logs For Mental Imagery and Meditation Practice

NATURE SOUNDS AND MUSIC PRACTICE RECORD

Name_____

Drew Scales- (517)347-4814

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Date							
Start Time							
End Time							
		Degree of Calmness Achieved					
None at all	1	1	1	1	1	1	1
Slight	2	2	2	2	2	2	2
Moderate	3	3	3	3	3	3	3
Good	4	4	4	4	4	4	4
Great	5	5	5	5	5	5	5

Questions

Briefly answer the following questions after each day of practice with the tape.

1. Describe the most memorable thoughts that you experienced while listening to the tape.

2. Describe your mood while listening to the tape.

3. Explain the ease with which you were able to listen to the tape.

RELAXATION AND VISUAL IMAGERY PRACTICE RECORD

Name_____

Drew Scales #-(517)347-4814

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
DATE							
Start Time							
End Time							
		Degree of Relaxation Achieved					
Not at all	1	1	1	1	1	1	1
Slightly	2	2	2	2	2	2	2
Moderately	3	3	3	3	3	3	3
Very	4	4	4	4	4	4	4
Extremely	5	5	5	5	5	5	5

Vividness of Visual Images

Not at all	1	1	1	1
Slightly	2	2	2	2
Moderately	3	3	3	3
Very	4	4	4	4
Extremely	5	5	5	5

(over)

	Day 4	Day 5	Day 6	Day 7
DATE				
Controllability of Visual Images				
No Control at all	1	1	1	1
Slightly Controlled	2	2	2	2
Moderately Controlled	3	3	3	3
Very Controlled	4	4	4	4
Extremely Controlled	5	5	5	5

Questions

Briefly answer the following questions after each day of practice with the relaxation and mental imagery tape.

1. Describe your overall feelings about the relaxation and mental imagery practice today.

2. How well were you able to follow the voice heard on the tape?

3. Describe your mood or any emotions that you were aware of during the relaxation and mental imagery practice today.

4. (for days 4–7 only) Describe the clarity of the sounds you heard mentioned during the mental imagery practice tape?

5. (for days 4–7 only) How well were you able to see your serving movements as mentioned on the tape?

6. (for days 4–7 only) Explain how well you were able to control your emotions while serving during mental imagery.

QUESTIONS RESPONSE SHEET

DAY 1

Question #1—

Question #2—

Question #3—

DAY 2

Question #1—

Question #2—

Question #3—

DAY 3

Question #1—

Question #2--

Question #3--

DAY 4

Question #1--

Question #2--

Question #3—

Question #4--

DAY 4 (continued)

Question #5--

Question #6--

DAY 5

Question #1--

Question #2--

Question #3--

Question #4--

Question #5--

Question #6--

DAY 6

Question #1—

Question #2--

Question #3--

Question #4--

Question #5--

Question #6--

DAY 7

Question #1--

Question #2--

Question #3--

Question #4--

Question #5--

Question #6--

APPENDIX G

CompuTennis Form

COMPUTENNIS

SCORE SHEET

Your Low-Cost Introduction to Smart Tennis

SRV	SERVICE	RETURN OF SERVICE	KEY SHOT—WINNER OR ERROR	APPROACH SHOT	POINT SCORE P1	POINT SCORE P2	GAME SCORE P1	GAME SCORE P2
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				
	1st ++ -- 2nd ++ --	BH FH GS PA AP ++ + -F --	P1 P2 BH FH GS PA AP DS LB VL SM ++ -F --	P1 P2 BH FH				

TO SCORE:

1. Enter DESCRIPTIVE DATA on the back of the first SCORE SHEET. Be sure to complete all entries.
2. Enter page and set no(s). player names and initials on top of every SCORE SHEET.
3. Score each point per instructions. Use as many SCORE SHEETS as needed.

SYMBOLS

PLAYERS (Identified by Initial):
- P1 Player 1
- P2 Player 2

QUALITY/RESULTS OF SHOTS:
- ++ Winner or Service Ace
- \+ Forcing Shot
- -F Forced Error
- -- Unforced Error

STROKE SIDES:
- BH Backhand
- FH Forehand

STROKE DESCRIPTORS:
- GS Groundstroke
- PA Passing Shot
- AP Approach Shot
- DS Drop Shot
- LB Lob
- VL Volley
- SM Smash

FOR REPORTS:

1. Send to the nearest CompuTennis CT120 Owner

or:

2. Send to:
COMPUTENNIS SERVICE CENTER
SPORTS SOFTWARE, INC.
949 Sherwood Avenue, #201
Los Altos, CA 94022
(415) 941-6363

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APPENDIX H

Post-match Questionnaire

Post-match Questionnaire

Control Group

Instructions

Please read each of the following questions carefully and respond by writing in the space provided. Remember to answer each question.

1. Did you use any imagery techniques "prior to" your match?

_____ (1) Yes _____ (2) No

1a. If yes, describe a situation prior to the match when imagery was used.

2. Did you use any imagery techniques during your match?

_____ (1) Yes _____ (2) No

2a. If yes, describe a situation in the match when imagery was used.

3. Did you implement any other cognitive strategies (self-talk, relaxation, pumping up, concentration, etc.) during your match?

_____(1) Yes _____ (2) No

3a. If yes, explain what type of strategies you used.

4. Did you implement any cognitive strategies (self-talk, relaxation, pumping up, concentration, etc.) prior to your serve?

_____ (1) Yes _____ (2) No

4a. If yes, explain what strategies you used and how those strategies influenced your serving performance.

5. Please rate your degree of relaxation during your match by placing a circle around the number which best represents your level of relaxation.

1-- Much less relaxed than usual
2-- Slightly less relaxed than usual
3-- Normal level of relaxation
4-- Slightly more relaxed than usual
5-- Much more relaxed than usual

6. Please rate your overall serving performance by placing a circle around the number which best represents how well you served during your match.

1-- Much worse than usual
2-- Slightly worse than usual
3-- Normal
4-- Slightly better than usual
5-- Much better than usual

Post-match Questionnaire

Treatment Group

Instructions

Please read each of the following questions carefully and respond by writing in the space provided. Remember to answer each question.

1. Did you use any imagery techniques "prior to" your match?
   _____ (1) Yes _____ (2) No

1a. If yes, describe the situation when imagery was used "prior to" your match.

2. Did you use any imagery techniques during your match?
   _____ (1) Yes _____ (2) No

2a. If yes, describe a situation in the match when imagery was used.

3. State in a word or phrase a few aspects of your game that you imagined during the match.

4. How well were you able to control the images of your serve during the match?

   1-- Not well at all
   2-- Fairly well controlled
   3-- Moderately controlled
   4-- Well controlled
   5-- Very well controlled

5. Briefly explain any problems with the images you experienced during your match and the training session (i.e., toss not coming down, can't see the ball, no racket, etc.)

6. How has your introduction to imagery changed or influenced your serve?

7. Do you perceive imagery as a helpful strategy for improving the serving performance of a tennis player of your ability?

_____ (1) Yes _____ (2) No

7a. If yes, why do you perceive imagery to be helpful?

8. Do you believe that imagery was effective for improving your service performance during the match?

_____(1) Yes _____ (2) No

8a. If yes, briefly explain how you think imagery has helped your serve.

9. Describe any cognitive strategies (self-talk, relaxation, pumping up, concentration, etc.) other than imagery that you implemented during your match.

10. Briefly describe the feelings you experienced while using imagery before or during your match.

12. Please rate your degree of relaxation during your match by placing a circle around the number which best represents your level of relaxation.

1-- Much less relaxed than usual
2-- Slightly less relaxed than usual
3-- Normal level of relaxation
4-- Slightly more relaxed than usual
5-- Much more relaxed than usual

13. Please rate the degree to which the imagery session influenced your serving performance, by placing a circle around the number which is most appropriate.

1-- Very bad influence
2-- Somewhat bad influence
3-- No influence
4-- Good influence
5-- Very good influence

14. Please rate your overall serving performance by placing a circle around the number which best represents how well you served during your match.

1-- Much worse than usual
2-- Slightly worse than usual
3-- Normal
4-- Slightly better than usual
5-- Much better than usual

APPENDIX I

Serving Percentage Means With Standard Deviations Of Treatment And Control Group Subjects

Appendix I
Serving Percentage Means With Standard Deviations Of
Treatment And Control Group Subjects

	PRE-TEST				POST-TAPE			
	1ST SERVE		2ND SERVE		1ST SERVE		2ND SERVE	
Treatment	Mean	.55	Mean	.57	Mean	.55	Mean	.65
Group	S.D.	.152	S.D.	.288	S.D.	.111	S.D.	.242
	N	17	N	17	N	17	N	17
Control	Mean	.56	Mean	.65	Mean	.58	Mean	.55
Group	S.D.	.151	S.D.	.203	S.D.	.172	S.D.	.277
	N	18	N	18	N	18	N	18

Serving Percentage Means And Standard Deviations For
Tennis Ability And Assignment Group

	POST-TAPE			
	1ST SERVE		2ND SERVE	
	Mean	.62	Mean	.58
Tennis	S.D.	.122	S.D.	.345
Ability	N	16	N	16
	Mean	.54	Mean	.64
Assignment Group	S.D.	.111	S.D.	.242
	N	17	N	17

APPENDIX J

Post-tape Serving Percentage Means And Standard Deviations For Race And Assignment Group

Appendix J
Post-Tape Serving Percentage Means And Standard Deviations For Race And Assignment Group

		1st Serve		2nd Serve
African American	Mean	.56	Mean	.43
	S.D.	.107	S.D.	.29
Caucasian	Mean	.67	Mean	.71
	S.D.	.115	S.D.	.347

		1st Serve		2nd Serve
Treatment Group	Mean	.58	Mean	.63
	S.D.	.093	S.D.	.311
Control Group	Mean	.67	Mean	.53
	S.D.	.145	S.D.	.401

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