THE EFFECTS OF MENTAL IMAGERY ON FREE THROW PERFORMANCE OF VARSITY BASKETBALL PLAYERS DURING PRACTICE AND COMPETITION

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By

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ABSTRACT

The purpose of this study was to examine the effects of mental imagery in practice and in competition on the free throw shooting performance of basketball players. The subjects were 3 male university caliber basketball players. A single subject multiple baseline design was implemented. Each subject was introduced to the imagery rehearsal intervention at different times during the 14 week competitive basketball season. Free throw data was collected during 50 practice sessions and 32 games. Results in both practice and competitive situations were examined using a graphed means comparison. In the practice condition an increase in free throw performance for all 3 subjects during the post treatment intervention was found. In the game condition, Subjects A and B indicated post treatment improvement. Mental imagery can be an effective strategy to improve free throw performance of some basketball players. Further research in this area should involve controlled group examination using a larger sample size across a variety of tasks.

ACKNOWLEDGEMENTS

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The author also wishes to recognize coach Bruno Colavecchia and the 3 volunteers from the Lakehead University men's basketball team for their time and assistance.

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INTRODUCTION

Statement of the Purpose

The purpose of this thesis was to assess the effects of the implementation of mental imagery in practice and in competition on the free throw shooting performance of varsity basketball players.

Significance of the Study

Several authors have advocated the use of cognitive interventions to improve performance in athletics (Rushall, 1981; Veally, 1986). There have been many studies done connecting different forms of mental imagery with skill performance in sport. Feltz and Landers (1983) analyzed a combination of independent studies (N=60) in which mental practice was the conceptually similar variable. The statistical tool they employed was a meta-analysis. This technique entails the examination of a survey of studies from a specific research area allowing characterization of the tendancies of the research and yielding information about the magnitude of any differences between conditions. The findings of this "meta-analysis" indicated that mentally practicing a motor skill influences performance somewhat better than no practice at all and studies employing cognitive tasks had on the average greater improvement than those employing motor and/or strength tasks. Many of the studies examined in the meta-analysis were non-sports-specific and situationally unrelated to actual game-like performance. Although other studies have employed the motor task of free throw shooting (Hall & Erffmeyer, 1983 ; Hamilton & Freemouw, 1985) there has been little research conducted encompassing an entire season of play including the practice and game performance data of the subjects. In this study, the author wanted to observe the progression of the effects of imagery from the perspective of both a practice and a competition situation.

At the intercollegiate level of competition, 20-25% of a basketball team's total point output comes from unobstructed, uncontested free throws (Smith, 1981). Further, rules and strategies of basketball encourage a greater percentage of free throws to be attempted near the most critical or outcome determining stage of the game. Highly skilled players should perform this simple 15 foot shot with a high degree of success (80% or better). However, many players have difficulty with this skill which can mean the difference between a winning and losing team performance.

An analysis of the research indicates that mental imagery can be effective in improving skill performance; however, few attempts have been made to study this cognitive intervention with high performance athletes in competitive situations. Furthermore, the literature does not indicate that practice performance will necessarily result in a game performance increase. An unfamiliarity with the concept of mental imagery coupled with perceived practice time priorities has caused many coaches to disregard this cognitive intervention.

A few investigations have specifically studied the effectiveness of mental imagery on basketball skill performance. Hamilton and Fremouw (1985) tested 3 male college basketball players in free throw shooting during competition. They used a cognitive behavior training program that included: (1) deep muscle relaxation, (2) identification of negative self-statements, (3) development of positive self-statements, and (4) in vivo rehearsal during team practices. Although all subjects showed marked percentage improvement in limited game data, no practice data was kept. Meyers, Schleser, and Montgomery Okwumabua (1982) examined changes in both free throw and field goal percentages after cognitive behavioral training for two women college players. Results were mixed with increase in foul shooting percentages for one subject and field goal percentage for the other. Further, Hall and Erffmeyer (1983) tested 10 highly skilled female basketball players to find the effect of Visuo-Motor Behavior Rehearsal (VMBR) with videotaped modeling on free throw accuracy. Although they found significant improvement in the VMBR (modeling) group, their subjects were tested for only 5 days in a noncompetitive practice situation.

As a university and high school basketball coach for the past 12 years, this researcher has worked with high school teams that shoot free throws at 55% and college teams that shoot free throws at 60%. It is interesting that athletes sometimes have more difficulty with unobstructed free throw shooting when the time clock is stopped, when compared to shooting the basketball during the other more physically demanding game situations. The results of this study could prove to be potentially beneficial to coaches. This writer tested the feasibility of using mental imagery as a cognitive intervention to aid in the performance of free throw shooting.

The present study investigated the free throw shooting performance of 3 players during both practice and game conditions while experiencing a mental imagery intervention. The study encompassed a complete 14 week competitive season training program including 32 games and 50 practice sessions.

Delimitations

Three male intercollegiate basketball players (ages 21-24) were tested at Lakehead University during the 14 week, 1986-87 competitive season.

The dependent variable was the percent successful free throws in practice and game conditions. The independent variable was the intervention of mental imagery at certain points during the competitive season and for specific periods.

Limitations

This study was limited to the following assumptions:

a) the subjects could understand and employ learned strategies;

b) the subjects were fouled enough in game situations so that enough data could be collected;

c) a free throw was an appropriate skill for measuring the effectiveness of the imagery intervention;

d) the basketball season would continue long enough to complete the data collection period of this study.

Definitions

Foul A foul is an infraction of the rules that is charged and penalized.

Free Throw A free throw is the privilege given a player to score one point by an unhindered try for a goal from within the free-throw circle and behind the free-throw line. A free throw starts when the ball is given to the free thrower at the free-throw line or is placed on the line. It ends when: the try is successsful, or when the try touches the floor or any player, or when the ball becomes dead (I.A.B.O., rule 4, section 12, 1986).

Intervention Intervention refers to various cognitive and physiological strategies for altering existing levels of anxiety, arousal, and self-confidence (Cox, 1985).

Chapter 2

REVIEW OF LITERATURE

Many researchers have used different phrases to describe similar cognitive behavior interventions. A clear and precise definition of mental imagery is important in order to understand the purpose of the study.

Richardson (1967) referred to mental practice as "the symbolic rehearsal of a physical activity in the absence of any gross motor movements" (p. 95). According to Nideffer (1983) mental rehearsal when applied to competitive athletics is "systematically thinking about your performance in some past or future athletic endeavor" (p. 186). He indicates that rehearsal involves an actual studying of an image or series of images. Visualization can be referred to as "pictures/images/thoughts that go through our minds. The nature of these "visions" can have a tremendous effect on our performance in different situations" (Botterill, 1985, p. 2). To Veally (1986) imagery involves "using all the senses to recreate or create an experience in the mind" (p. 210). In the present paper imagery rehearsal will be thought of as systemic, cognitive performance rehearsal making imaginary use of associated senses to fashion an overt athletic situation in the mind.

Optimal Conditions for Imagery

Recently many researchers have presented information regarding the most productive conditions in which to create an experience in imagery. Rushall (1981) stated, "It is most likely that athletes who train and perform mental rehearsal consistently will achieve higher levels than athletes who only train" (p. 27). MacKay (1981) developed a theory which infers an organized hierarchy of nodes (one or more interconnecting neurons) governs mental and muscle movement. The theory predicts that mental practice of a skill will be effective only when the muscle movement nodes for expressing the skill have been formed and highly practiced. It is most desirable that mental imagery be performed with physical practice. Further, Ryan, Blakeslee and Furst (1986), when testing the neuromuscular feedback hypothesis, found that without corrective feedback provided by actual practice, the learner is unable to pick out and correct errors. This finding lends some support to Suinn (1980) and Mumford and Hall (1985) who contend that mental practice can be very effective with highly skilled performers. A physically skilled athlete should understand both the mechanics and the kinesthetic "feeling" of the correctly executed movement.

Researchers believe that the ability to rehearse in "real time " is a critical part of top level performance. Real time is that length of time for rehearsal corresponding to that length of time for the actual activity. Coordination and timing suffer and our internal clocks are disrupted when exposed to pressure and anxiety. Nideffer (1985) suggested, "When individuals are capable of rehearsing in real time, anxiety is much less likely to disrupt performance and they seem to have a greater tolerance for pressure" (p. 35). This "real time" rehearsal should not be confused with slow motion learning progressions that are often used by researchers to produce a clearer, more vivid visualization (Tutko & Tosi, 1976).

The self-efficacy theory proposed by Bandura (1977) states that, "even in the enactive treatment, perceived self-efficacy proved to be a better predictor of behavior toward unfamiliar threats than did past performance" (p. 211). Self-efficacy, which is defined as "the strength of a person's conviction that he or she can successfully execute a behavior, carry out a task, or handle the responsibilities necessary to produce a desired outcome, is a situationally specific form of self-confidence" (Carron, 1984, p. 116). Bandura's work indicates that the greater the basketball free throw shooter's perception of performance success, the greater will be the actual success.

Gould, Weinberg and Jackson (1980) found that visualizing a successful trial outcome produced better performance than did either attentional focus or two control conditions on a leg-kick task requiring muscular strength, explosive power and endurance. A confirmation of the degradation of performance in the conditions employing negative outcome imagery occurred when Woolfolk, Murphy, Gottesfeld and Aiken (1985) investigated imagery instructions on the motor skill accuracy test of putting a golf ball. The above studies indicate that imagery rehearsal of a successful outcome may result in improved performance.

It is a common belief among investigators that the successful performance of a motor skill in competitive situations depends on an athlete's optimal level of arousal. Researchers have often used relaxation techniques such as progressive relaxation (Jacobson, 1976) and deep breathing (Tutko & Tosi, 1976) in combination with imagery rehearsal as a cognitive intervention in an attempt to control arousal levels of athletes . An athlete's optimal level of arousal is that state of stimulation/nonstimulation that is ideal for the task at hand. Duffy (1962) discusses arousal in terms of the degree of excitement of the organism and the degree of activation of the organs that are under the control of the autonomic nervous system. The relaxation technique of deep breathing physiologically affects the body by decreasing heart rate, decreasing oxygen consumption and decreasing muscle tension (Cox, 1985) . Also with the conscious effort of deep breathing, many unneccessary distracting and irrelevant cues can be ignored allowing for greater task concentration.

This narrowing of the attentional focus, occurring as arousal increases, allows the relevant environmental cues to remain. At an ideal level of arousal, performance should be at its best. If arousal increases too much, attention continues to narrow, and relevant cues will be gated out causing a performance decrement. This effect becomes more relevant when dealing with the situational change in basketball from one of high physical intensity to the narrow attentional focus of the foul shot. Hamilton and Fremouw (1985) and Hall and Erffmeyer (1983) used relaxation techniques and found empirical support for its use in their studies with intercollegiate free throw shooters.

Two possible imagery perspectives as related to sport performance have been identified by researchers. The first type, external imagery, is considered to be primarily visual in nature. This type of imagery occurs when athletes see themselves perform from the outside as if they are viewing themselves on a film or a videotape. The second type of imagery is internal imagery and it is primarily kinesthetic in nature. Athletes imagine being within their own bodies while performing (Cox, 1985). They experience feelings and sensations associated with executing the task. Mahoney and Avener (1977) concluded that first-person or internal type imagery was favored by elite gymnasts (N=13). Recently Harris and Robinson (1986) studied beginning and advanced karate students (N=36) to determine if individuals of different skill levels utilizing both internal and external imagery perspectives demonstrated different amounts of muscular activity. The results of this investigation indicated that internal imagery produces more electromyographic activity (EMG) than external imagery. However, Epstein (1980) reported that neither perspective is superior in dart-throwing performance. Many subjects have reported a random changing of imagery perspectives during visualization. It seems reasonable to assume that some type of guided combination of both visual and kinesthetic imagery may be most beneficial.

Two theoretical probabilities have been advanced to explain the process of imagery in movement activities. The psychoneuromuscular theory suggests that minimal neuromuscular impulses during imagined movement should be similar to those impulse patterns occurring during the same overt movement. Suinn (1980) monitored the electrical activity in a skier's leg muscles as he imagined the downhill run and found that the printout of muscle firings mirrored the terrain of the ski run. Further, Harris and Robinson (1986) found that higher skilled karate students had more EMG activity in the task specific deltoid muscles during imagery. Whether athletes overtly perform movements or vividly imagine performing them, similar neural pathways to the muscles may be used. Through imagery, athletes may actually strengthen the neural pathways for certain movements in their sport.

The cognitive-symbolic learning theory submits that imagery gives the performer the opportunity to rehearse the sequence of movements as symbolic components of the task. Thus imagery facilitates performance by helping individuals to code movements, thereby making them more automatic (Feltz & Landers, 1983).

Task Characteristics

The cognitive-symbolic learning theory seems more plausible in view of research findings by Minas (1978); Ryan and Simons (1981); and Wrisberg and Ragsdale (1979). In their studies, mental practice improved performances on cognitive tasks, such as dial-a-maze or sequence learning, but did not affect "motor" tasks, e.g., stabilometer, that were low in cognitive or symbolic elements. Foul shooting has consistently been shown to improve with the use of an imagery rehearsal intervention (Clark, 1960; Hall & Erffmeyer, 1983; Hamilton & Fremouw, 1985; Meyers, Schleser & Montgomery

Okwamabua,1982) and while it might be highly cognitive in nature, it could also be due to of the quality of the instructional cues, the type of imagery used and the amount of time spent practicing the intervention.

The issue of greater improvement using mental practice with cognitive tasks was further examined by Paivio (1985). According to Paivio, such concepts as post-game strategy rehearsal and the

subject's knowledge of what happens during a task are useful cognitive components aiding mental practice performance. He gives the example of the knowledge of angles in billiards. One must know where the cue ball must hit the object ball so that each will end up where the striker wants them to. Further, Paivio notes that task specificity has certain implications for the kind of imagery rehearsal that would be most effective. Archery, golf, darts and snooker are examples of tasks with stationary targets and stationary performers. At the other continuum, we have complex motor skills such as diving and gymnastics that do not require the performer to react to a specific target. Task differences between nonreactive and reactive perceptual motor skills have implications for the kind of imagery rehearsal that would be most effective. Basketball free throw shooting is a nonreactive target task in Paivio's view and it seems likely that performers could very effectively imagine themselves responding to such a stationary target, in this case a basket.

Imagery Ability

Ryan and Simons (1981) and White, Ashton and Lewis (1979) indicate that the ability of some subjects to image a motor skill in an experiment varies within each individual. It is very difficult to control the individual's ability to use visual imagery. Indeed there are individual differences in imagery and these differences may influence experimental results.

Generally imagery ability has been measured using subjective self-report questionnaires or objective behavioral type tests. Mixed results cloud the appropriateness of imagery questionnaires. While testing 24 swimmers in an action-reaction swimming start White, Ashton and Lewis (1979) looked for a possible correlation of improvement scores of subjects who used mental practice, with their total scores on Sheehan's 1967 version of the Questionnaire Upon Mental Imagery. They did not obtain significant correlations. Ryan and Simons (1982) tested subjects on a stabilometer. The subjects reporting strong visual images showed more improvement than those with weak visual images and those reporting strong kinesthetic images were superior to those with weak kinesthetic images.

Housner and Hoffman (1981) and Walsh, Russell, and Imanaka (1980) suggested that imagery ability can interact with instructions regarding the use of mental imagery to influence motor memory performance. However an affinity between imagery ability and movement performance has not always been shown. Hall, Pongrac and Buckolz (1985) suggest that one reason why this relationship has not consistently appeared is because the tests used to measure imagery ability have not been concerned with movement. Another reason may be that in their concern to test for visual imagery ability, many researchers have omitted examining the possible relationship between kinesthetic imagery ability and motor performance. Hall (1985) suggested that it is possible that subjects with low visual imagery ability can compensate by using high kinesthetic ability, or vice versa.

Application of An Imagery Program

It is evident that a critical factor in administering this cognitive intervention is the researcher's method of application. Many researchers have administered their interventions in progressive phases (Hamilton & Fremouw, 1985; Hall & Erffmeyer, 1983) . The phases of the imagery rehearsal intervention in this study include the following: a) the conceptualization phase, b) the training phase, and c) the implementation phase. The conceptualization phase is a learning process during which the components of imagery rehearsal are discussed. An attempt is made to enlighten the subjects as to the performance aiding possibilities of imagery rehearsal. As Veally (1986) states, "Imagery only works for athletes if they believe in it." (p. 215). The objective of a training phase is to ensure that the subject develops the capacity to cope with various contingencies. Meichenbaum (1985) in stress innoculation training begins his training phase (skills acquisition and rehearsal phase) with relaxation training. During the implementation phase of the cognitive intervention subjects should be encouraged to implement coping responses in day-to-day practice and game situations. A systematic program of imagery rehearsal must be adapted to an athlete's individual routine. The objective of the imagery rehearsal intervention is to effect generalized change over an indefinite period of time (Veally, 1986; Meichenbaum,1985).

Research indicates that to gain optimal results from an imagery program, certain guidelines should be followed. The way these guidelines are administered depends on the type of athletic challenge to be improved. Free throw shooting is an excellent example of a nonreactive competitive basketball skill in which a cognitive intervention such as imagery rehearsal may prove helpful.

Chapter 3

METHODS AND PROCEDURES

Subjects

Three male basketball players from Lakehead University Norwesters Varsity Basketball Team were selected to take part in the study. They were interested, reliable subjects who exhibited neither an abnormally high or low free throw shooting ability and who played enough to guarantee game free throw data. Subject A was a 22 year old third year player, Subject B was a 20 year old second year player, and Subject C was a 24 year old second year player. The subjects were tested in practice situations in the gymnasium of the C. J. Sanders Fieldhouse and in game situations both at home and away.

Procedures

A single subject multiple baseline design across subjects was implemented (see figure 1). A measure of causality can be inferred if there is a change in free throw shooting performance among each of the three subjects when the intervention is applied during different times in the baseline. The use of a multiple baseline design allows the researcher to observe any effects or noneffects in motor performance without having to return to the baseline state. Also, consistent changes may be seen among higher skill performers even though some may not improve a great deal from the pretraining level. Further, the single subject design allows detection of successful effects for certain individual subjects which otherwise might be generalized into a nonsignificant group design (Woolman,1986). "Logical generalizations" can be made upon study replication providing the subjects in the homogeneous group and the individual in question is similar (Hersen & Barlow, 1976). The design consists of two different stages:

1. Baseline stage. Free throw performance of each subject was recorded. " A minimum of three separate observation points, plotted

on the graph, during this baseline stage are required to establish a trend in the data" (Barlow & Hersen, 1973, p. 320). When observation of this plotted pattern reveals minor variation or a constant rate of performance occurs, stability has been reached in the baseline stage.

2. Intervention stage. The first subject that stablized his baseline performance began the intervention while the remaining two subjects continued in the baseline stage. When stability in the baseline data was evident for Subjects B and C, Subject B proceeded to the intervention stage. After Subject B was in the intervention stage for a period of time, then Subject C began the intervention stage. Data was recorded by the researcher during each observation day for every subject. As the intervention was implemented for each subject at different times, change in the graphically represented data was attributed to the treatment.

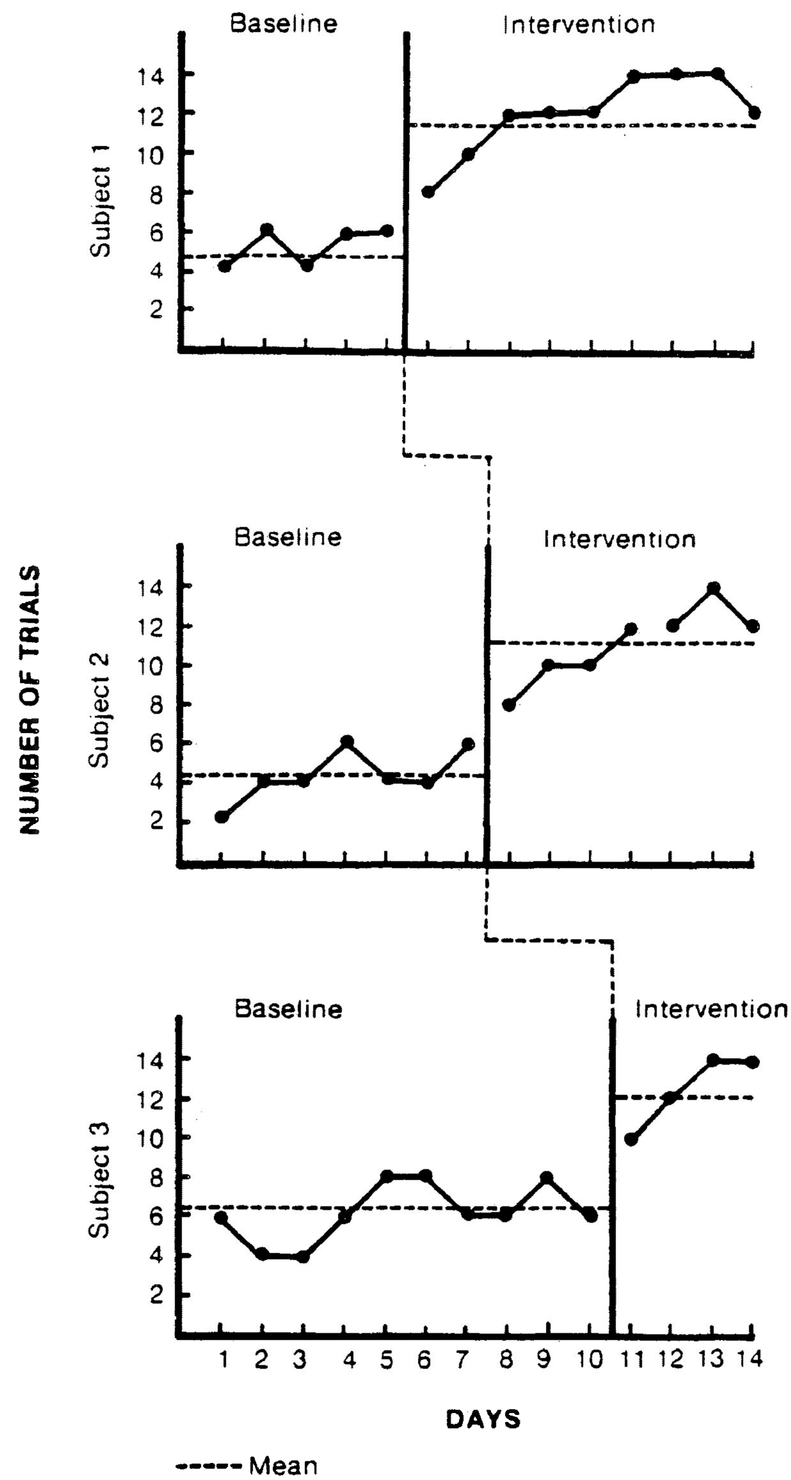


Figure 1. An example of a single subject multiple baseline design graph.

Independent and Dependent Variables

The independent variable was a program of imagery rehearsal. The imagery and relaxation training began in a laboratory of the C. J. Sanders Fieldhouse and continued on the basketball court. The initial four sessions of the structured imagery training program encompassed 190 minutes per subject. Approximately 15 minutes of every practice was devoted to the skill of free throw shooting (the dependent variable). Each subject used his imagery and relaxation training every day during physical practice and every day for five minutes at home. The team practiced five times per week. The phases in the procedure included:

1. A conceptualization phase during which each subject was introduced to anecdotal and researched information describing how and why this cognitive technique can work. A coaching module tape depicting two elite athletes (Dwight Stones and Alain Larocque) mentally rehearsing prior to performance was observed. Both the researcher and the subject had content input into discussions during

the conceptualization phase.

2. A training phase during which each subject was instructed in a relaxation technique of deep breathing and in visualizing shooting foul shots (Tutko & Tosi, 1976, p. 126-129).

3. An implementation phase during which each subject combined the imagery rehearsal treatment with his physical practice technique in the gymnasium setting (see Appendix A). Modeling of free throw specific competition type situations, allowed the subjects to sequence their coping strategies into a game-like time frame (see Appendix B for a detailed description for each phase).

Controls

Each subject was pretested and tested under the same conditions which were: a) practice (done with a partner, jogging and passing between baskets, the subjects took two free throws then changed baskets), and b) game-competition. All free throw attempts were recorded in groups of 10 during practice sessions. Following each observation day during the intervention period, a question sheet was completed by each subject (see Appendix C). This self-report measure was recorded to monitor adherence of imagery rehearsal. After every two practice sessions the subjects were asked if any adjustments to their strategies were required. Conceptualization phase time, training phase time, and implementation phase time was consistent for each subject.

Data Analysis

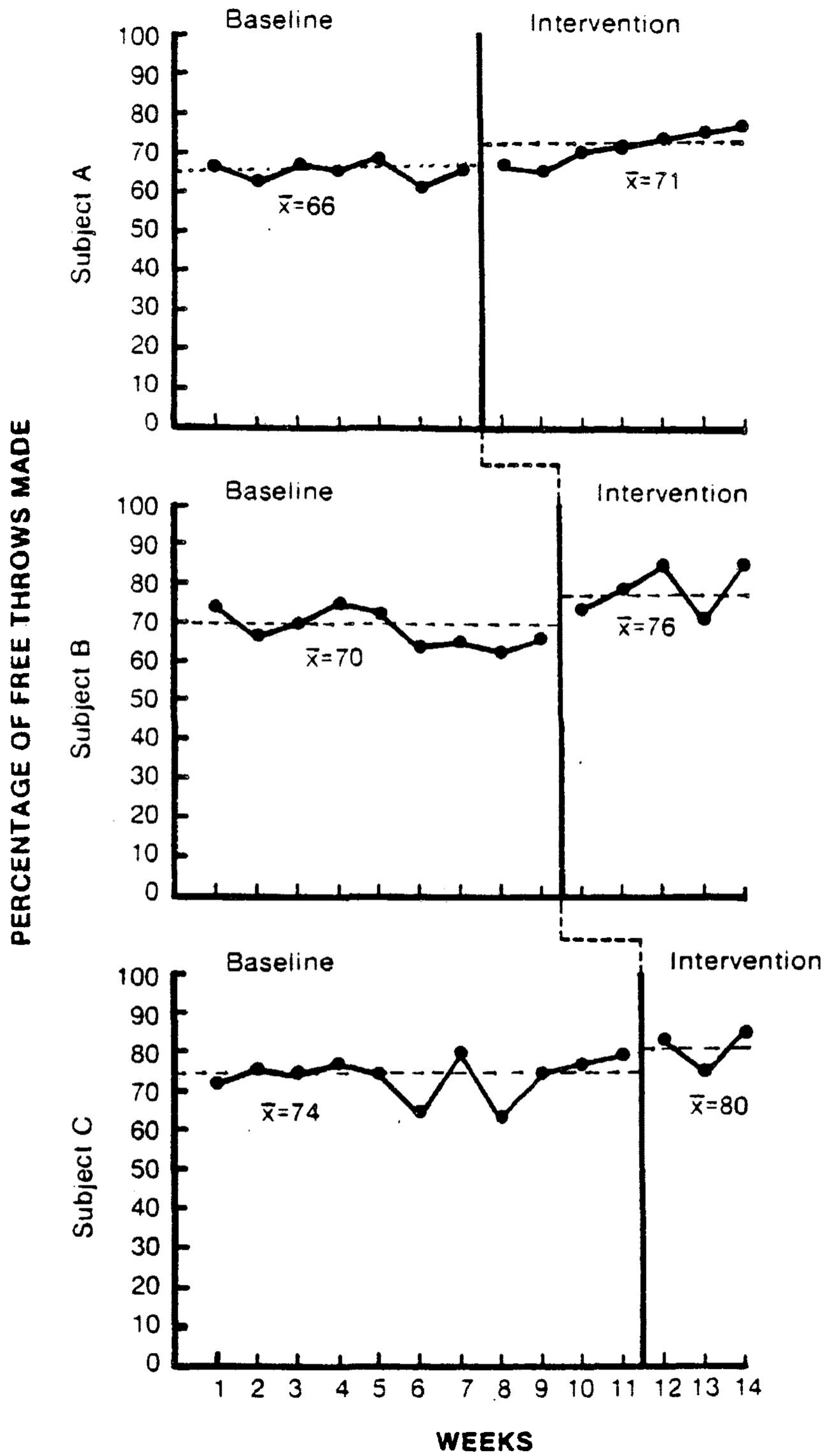
Practice and game data were graphed and evaluated visually. Differences were assessed according to their significance for both basketball coaches and athletes.

Chapter 4

RESULTS

Changes in athletic performance from baseline to intervention during practice are represented in Figure 2. Subject A's mean practice free throw percentage improved by 5% during the intervention. Subject B's mean practice free throw percentage improved by 6% during the intervention. Subject C's mean improved 6% during the intervention stage (overall improvement from baseline to intervention in the practice condition was 5.3%).

Changes in athletic performance from baseline to intervention during game competition are represented in Figure 3. Subject A's mean game free throw percentage improved by 14% during the intervention. Subject B's mean game free throw percentage improved by 15% during the intervention. Subject C's mean game free throw percentage decreased by 3% during the intervention (overall mean improvement from baseline to intervention for the game condition was 10.6%).



<u>Figure 2.</u> **Practice free throw shooting percentage per subject by week.**

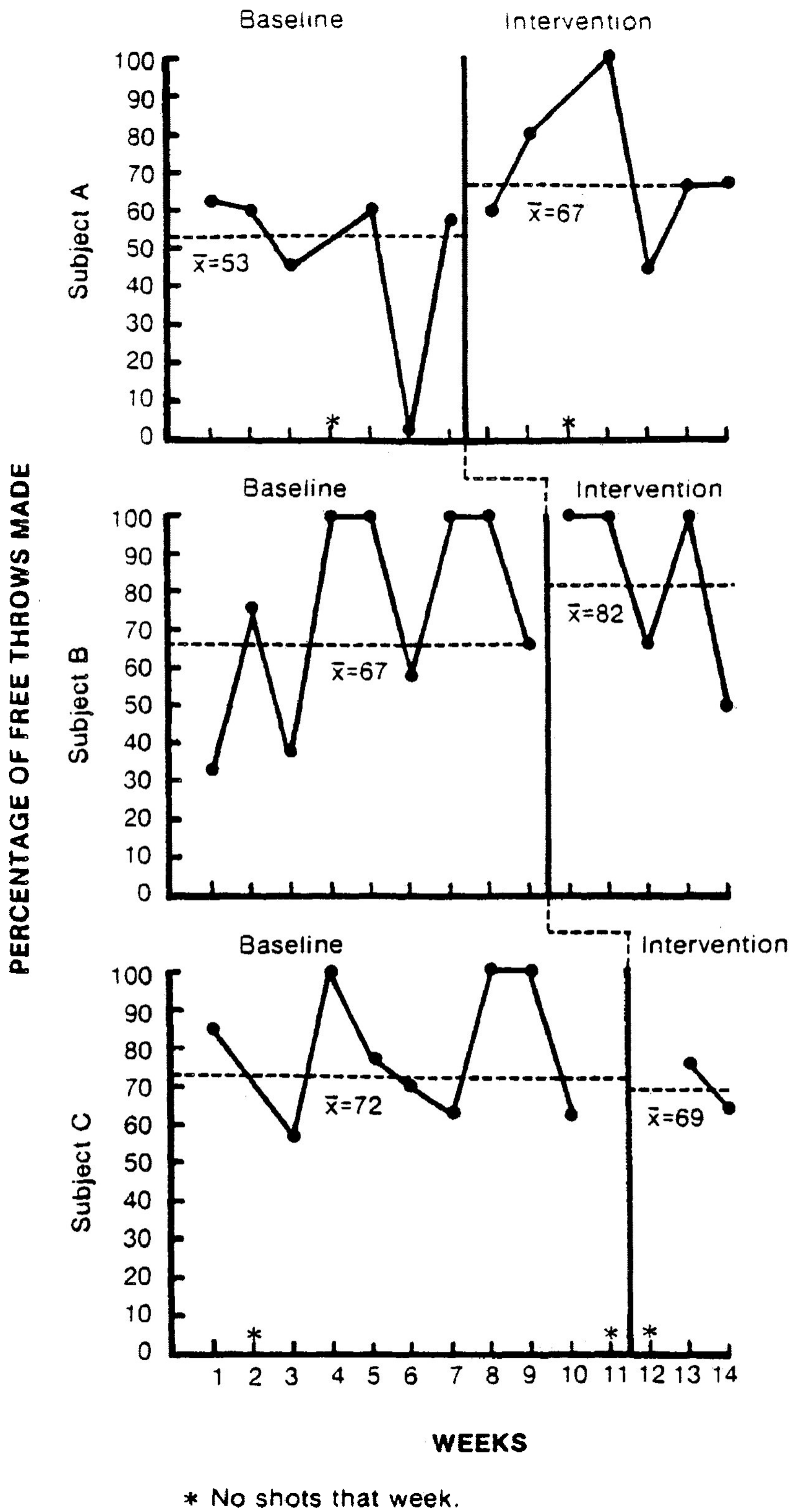


Figure 3. Game free throw shooting percentage per subject by week.

Figures 4 and 5 represent changes in athletic performance from baseline to intervention during each practice and each game competition. As each observation day is separately plotted, a more detailed comment can be made on the trend of the data.

It is important to note on Figures 3 and 5 that performance variation, i.e. 0% to 100%, is due to the fact that fewer free throws were taken in competition versus practice. For example a subject who shoots two free throws in competition and is successful both times, is 100% accurate for that game. However, if he misses one of the two free throws, he drops to 50% accuracy, and if he misses both he is 0% accurate. Data therefore, for practice performance (Figures 2 and 4) is visually more consistent because considerably more shots are represented per data point.

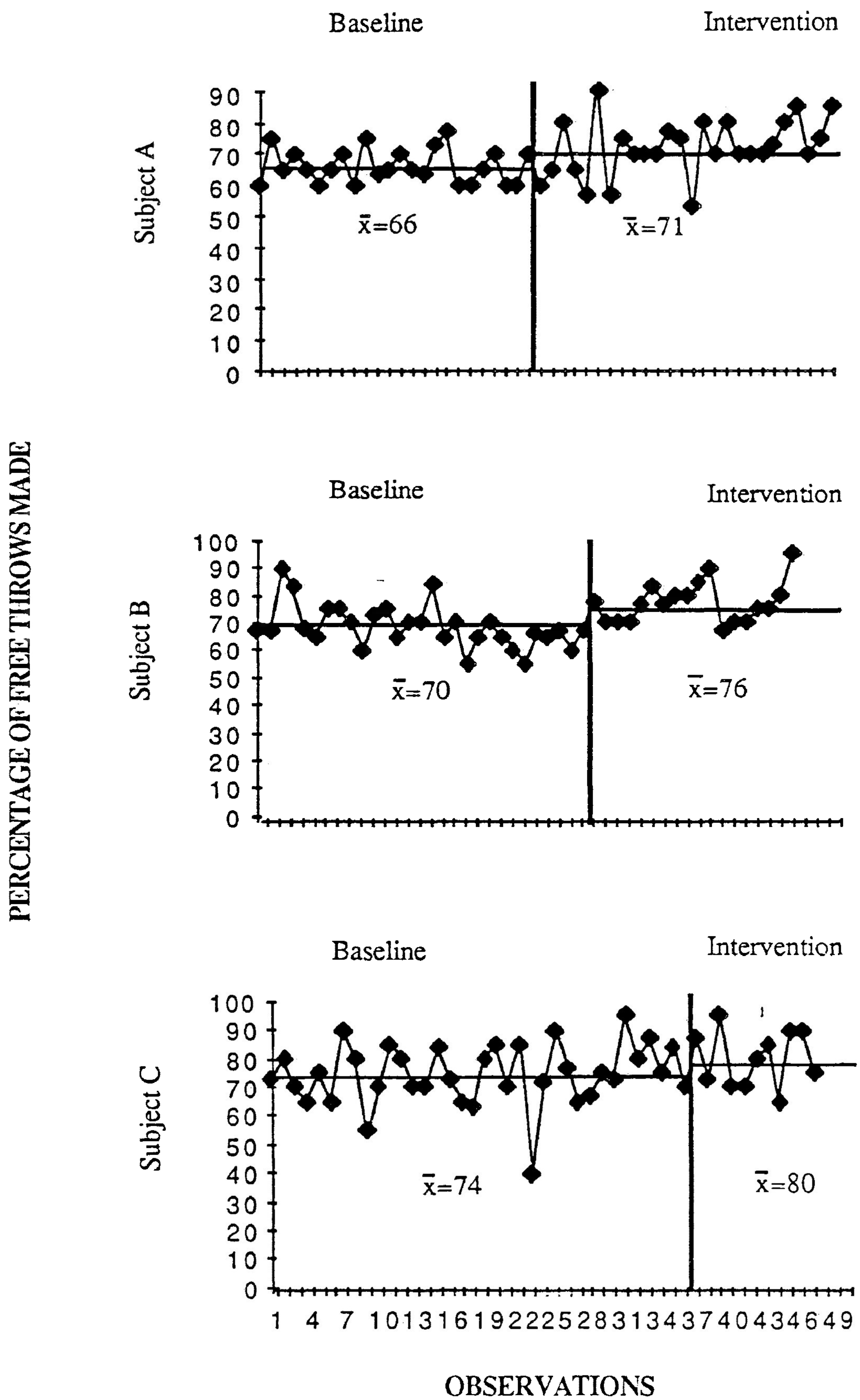


Figure 4. Practice free throw shooting percentage per subject by observation.

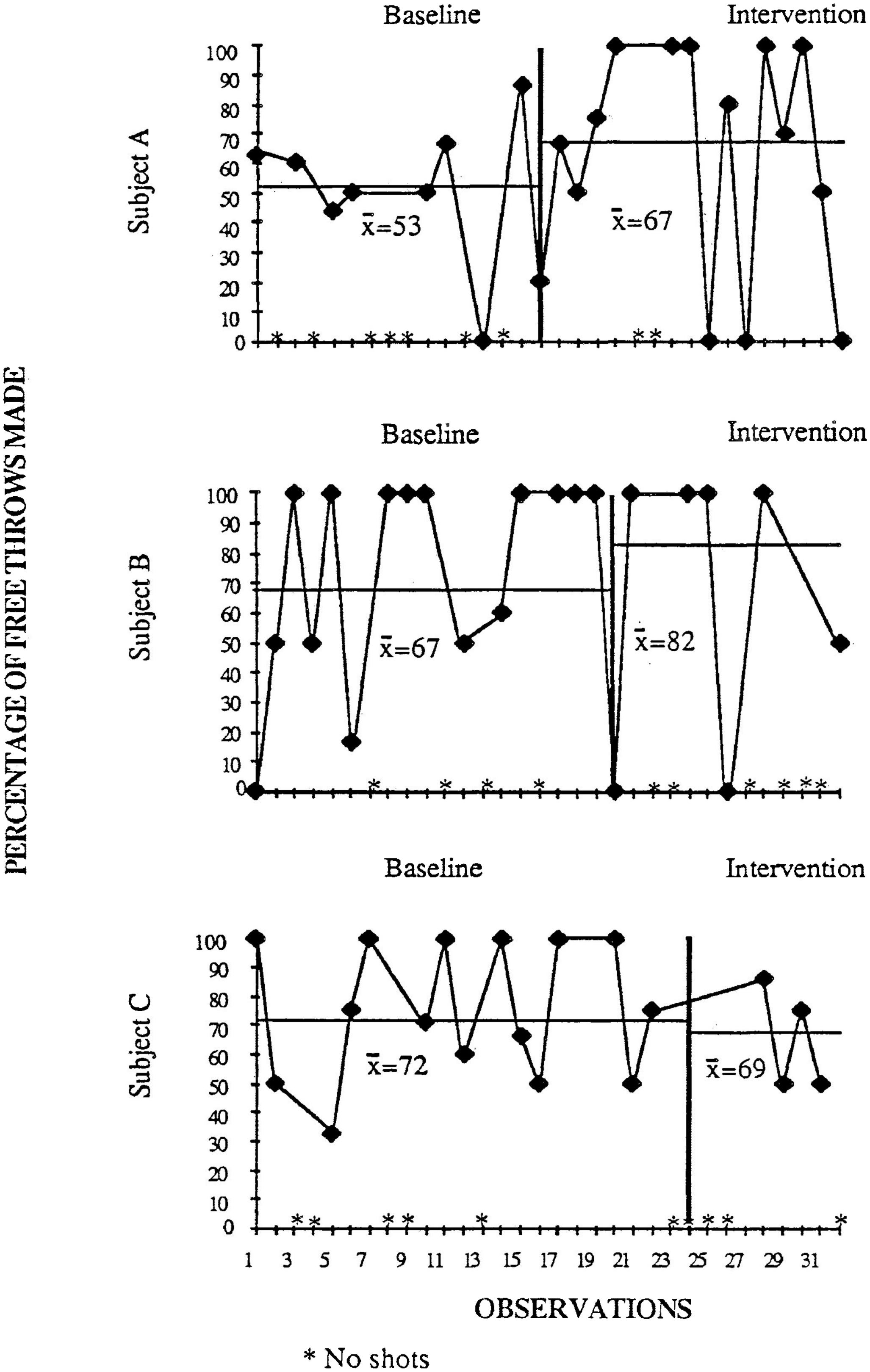


Figure 5. Game free throw shooting percentage per subject by observation.

Chapter 5

DISCUSSION

The present experiment replicated earlier case studies demonstrating that mental rehearsal interventions are associated with improvements in the performance of high performance athletes. This study extended these findings to male college basketball players and demonstrated a specificity of response to intervention and to practice and game situations.

When interpreting the findings of this study it is important to consider some of the limitations of the single subject design. Failure to control for an athlete's expectancy of improvement under intervention demands and small sample sizes prohibit generalizing the results to other populations. However, replications of this study across different groups of basketball players may, in time, lead to conclusions regarding the effects of mental imagery on free throw performance.

Following the intervention for Subject A, the free throw percentage shows an improvement. The same occurred for Subject B with exception to the fourth week. A performance improvement also occurred for Subject C following the implementation of the intervention but three data points necessitates caution in declaring a consistent trend in data for this subject.

All three subjects increased their free throw percentages by 5-6% in practice while adopting the mental rehearsal intervention over the course of the basketball season. This trend is particularly important in view of previous research by Bandura (1977), which indicates that an accurate predictor of task success is the self-efficacy of the subject. Self-efficacy, which arises because of practice performance accomplishments, may lead to game performance increase. Therefore game performance increase could be due to an increased level of confidence exhibited by the subject as a direct result of practice performance success. If imagery training did begin a success pattern during practice, the subsequent increase in self-efficacy could have led to game performance success.

The extreme fluctuation in some data points represented by Figure 3 can be explained by the nature of the game and the limitations restricting how many free throws are awarded each individual. Subject A attempted only 2 free throws during week 6 and because he failed to complete any, the graph shows 0% for that week. Similarily Subject B made 2 of 3 free throws during week 12 in the intervention thus dropping this graphed data point from 100% to 67%.

Further examination of the graphed data during competition (Figure 5) for Subjects A and B yields some positive results from the perspective of a coach. During 9 possible game observations while attempting 43 free throws in the baseline stage, Subject A was never 100% accurate whereas in the intervention stage in 5 out of 14 game observations while attempting 46 free throws he was 100% accurate. Similarly, Subject B improved his perfect free throw games from 9 out of 16 during 40 attempts in the baseline stage to 4 out of 6 during 11 attempts in the intervention stage.

Specific free throw situations in certain games tend to elicit greater pressure or anxiety among certain individuals. Free throws attempted near the end of close games where the outcome is in doubt could effect the success of those attempts. As the Lakehead team was battling for its first conference win in 2 seasons, the closely played games in weeks 12 and 14 became very important. A possible explanation for the corresponding drop in the data percentages in week 12 for Subjects A and B could be perceived situational pressure of winning the game. A similar situation in week 14 could be an indicator of the free throw percentage drop for Subjects B and C.

Free throw game data was affected by limitations such as playing time, team strategies and the number of times each subject was fouled. However, the 15% mean increase in game free throws for Subjects A and B tend to agree with the research findings of Hamilton and Freemouw, (1985) and Meyers et al, (1982) in which a cognitive behavioral program resulted in improvements in game free throw percentage. Subject C's baseline game free throw performance was a very respectable 72% so effect expectations were not as great.

Possible explanations for the decrease in performance during the intervention were nonadherence to the program or simply lack of enough game data to garner valid results as Subject C attempted only 16 free throws during his 3 week intervention stage. This lack of game data due to the completion of the competitive season forces us to examine the intervention results of Subject C with guarded optimism.

Some 1200 free throws were attempted over a 14 week period during practice. Further, each subject mentally rehearsed 20 minutes per day for 5 days a week during the competitive season. The indicated trends found among all 3 subjects during practice concurs with those of Feltz and Landers (1983) who suggested that for a motor task having less obvious symbolic or cognitive elements, more time needs to be spent in mental practice (both in minutes and number of trials) than for tasks that are high in cognitive elements.

During the conceptualization phase of the mental rehearsal intervention the subjects observed how easy it was to produce a visual image of themselves reenacting the stationary target task of free throw shooting and how difficult it would be to use this technique in a reactive decision making game situation. However, as noted by Paivio (1985) "task differences must have implications for the kind of imagery rehearsal that would be most effective" (p. 25S). The concept of post game situational rehearsal is more cognitive in nature and consequently mental rehearsal of common specific game reactions could prove even more beneficial.

Further, commentary by the subjects regarding the deep breathing relaxation technique of the training phase emphasized the within subjects differences and task differences for achieving an optimal arousal level. In the training phase Subject A stated, "After a lot of repetition of the breathing progressions in the relaxation technique I often feel sleepy." Each subject had to tailor his quantity of deep breaths with his particular optimal level of arousal to produce maximum performance. Ideal levels of arousal for each individual was a function of trial and error by each subject. Subject B emphasized it was important to him that he did exactly two sets of breathing progressions after getting fouled and one set while entering the free throw circle before beginning his imagery. Subject C used breathing progressions randomly before focusing in on the basket with his imagery routine. Subject C stated, "As long as I'm physically slowed down I can more easily do imagery. Depending on the game situation it might take three sets of breathing progressions or only one. I can feel when I'm ready." As Cox (1985) suggests, if arousal increases too many relevant cues will be gated out causing performance decrement. Likewise, if the subject is too relaxed free throw performance will decrease.

Perhaps the most critical stage of the mental rehearsal technique was the implementation phase. During this phase a modeling situation was repeated that affirmed a constant sequence of events prior to every practice and game free throw. As free throw performances increased a confidence in the patterned sequence grew and as Bandura (1977) predicted, more success occurred.

In an attempt to gage adherence to this mental rehearsal intervention, a self-report questionnaire was completed by all the subjects immediately following each session of free throws (see

Appendix B). In 10 out of 14 or 71% of Subject A's competition sessions, visual rehearsal always occurred. Of the remaining four sessions, visual rehearsal occurred sometimes on two occasions and never on two occasions. Subject B reported that four out of six or 67% of his competition sessions were always mentally rehearsed and in the remaining two, mental rehearsal never occurred. In four out of five or 80% of Subject C's competitive sessions visual rehearsal took place, while in the remaining session it never occurred.

During practice in 16 out of 26 or 62% of Subject A's sessions visual rehearsal always occurred and in the remaining 10 sessions or 38% of the time it sometimes occurred. Subject B reported that 9 out of 18 or 50% of his practice sessions were always mentally rehearsed and in the remaining 9 sessions or 50% of the time mental rehearsal sometimes occurred. In 6 out of 11 or 55% of Subject C's practice sessions visual rehearsal took place, while in the remaining 5 sessions or 45% of the time visual rehearsal sometimes occurred. All three subjects reported that at no time during any practice session did they "never" visually rehearse.

Among all subjects a strong coincidence existed between reported adherence to the visual rehearsal intervention and successful and unsuccessful free throw attempts during competition. Of the five reported nonadherence sessions, three sessions were completely unsuccessful and the other two were 50% successful. Of the 18 adherence sessions where "always" was reported, 9 sessions were 100% successful and 4 sessions were above 80% successful. It appeared that poor free throw performance coincided with a lack of visual rehearsal adherence and good free throw performance coincided with adherence to the program.

Implications for Coaching

During games, 20-25% of a basketball team's total point output comes from free throws. Many games are won and lost through success or failure from the free throw line. Free throws are particularly important in the closing minutes of the game for two reasons:

1. The rules of college basketball allow free throw attempts after the 7th team foul during each 20 minute half of running time.

These "bonus" free throws inevitably occur near the end of the first half or the final half of the game.

2. When behind in the score with time running out, a normal strategy used by losing teams to reduce the deficit is to intentionally foul their opponents thereby stopping the clock. The players from the team who is ahead in the score must make their free throws while the time is stopped or risk having their winning margin reduced. Therefore, a team with a better free throw percentage has a decided advantage over an opponent. Indeed one successful free throw from one player can mean the difference between winning and losing a game.

One interesting observation was the manageability and practicality of the intervention. Many coaches are caught up in time restrictions and priorities during the competitive season. They balk at the idea of substituting valuable physical practice time with mental practice. From the standpoint of efficiency, the administration of this intervention was ideal (see Appendix C). No more than two hours of each subject's time was taken out of the confines of the regular practice schedule. Further, the implementation phase was accomplished during the common on-floor practice time and the easy to teach relaxation-breathing-visualization repetitions were done at home at the subject's convenience. Coaches utilizing imagery rehearsal during practice and games can improve individual free throw performance. Thus it may improve team results.

Following the experiment the subjects were asked to comment on their impressions of the mental imagery intervention. All three subjects indicated that they felt more relaxed and more confident while shooting free throws in the intervention stage. The three subjects adamantly expressed their assurance that imagery rehearsal was now a part of their free throw shooting routine.

Chapter 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to assess the effects of mental imagery in practice and in competition on the free throw shooting performance of varsity basketball players. Three male university basketball players were used as subjects.

While implementing a single subject multiple baseline design, three replications of single case experiments used alternating treatments of the imagery rehearsal intervention. The intervention was applied to each subject at different times during the baseline stage. As there was a change in the free throw shooting performance among each subject after the intervention was initiated, a measure of causality was inferred.

The intervention stage was divided into three separate phases. The conceptualization phase educated each subject about this cognitive technique. The training phase instructed each subject in the relaxation technique of deep breathing and in visualizing shooting foul shots. Finally, the implementation phase combined each subject's physical free throw technique with the imagery rehearsal treatment. The subjects sequenced their coping strategies into a game-like time frame as they modelled their free throw technique during simulated competitive situations.

This program of mental imagery improved the free throw shooting performance of all three subjects in a practice setting. In the game situation Subjects A and B improved their performance .

Conclusions

1) Mental imagery can be an effective strategy to improve the performance of free throw shooting for some basketball players during practice.

2) Mental imagery can be an effective strategy to improve the competitive game performances of free throw shooting for some basketball players.

3) Based on the time commitment and ease of teaching, mental imagery is a feasible strategy to improve free throw performance of high performance basketball players.

Recommendations

The results of this experiment offer tentative controlled case study support for the effectiveness for improving basketball free throw shooting performances using a mental rehearsal strategy. Additional controlled group experimentation using a larger sample size across a variety of tasks is needed to examine the generalizability of similar interventions. Studies comparing nonreactive and reactive target tasks using a mental imagery intervention would lend further evidence to the cognitive behavioral approach to sports.

If possible, the mental rehearsal intervention used in this study should be implemented over a longer period of time. A longer competitive season or even 2 seasons would provide a greater amount of practical game data.

A further investigation examining self-efficacy and its relationship to free throw shooting would prove useful. Research directed towards establishing the conditions in which positive imagery produces an increment in performance and towards the effects underlying the impact of negative imagery are worthy of future examination.

REFERENCES

Bandura, A. (1977). Self efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Barlow, D. H., & Hersen, M. (1973). Single case experimental designs: Uses in applied clinical research. Archives of General Psychiatry, 29, 319 -325.

Botterill, C. (1985 , December). Visualization - What you see is what you get. Sport Talk , 2-3.

Carron, A. V. (1984). Motivation: Implications for coaching and teaching. London, Ontario: Sport Dynamics.

Clark, L. V. (1960). Effect of mental practice on the development of a certain mental skill. Research Quarterly, 37, 560-569.

Cox, R. H. (1985). Sport psychology. Dubuque, Iowa: Brown.

Davis, J. R. (Ed.) (1986). International association of basketball officials. Mission, Kansas: National Collegiate Athletic Association.

Dewitt, D. J. (1980). Cognitive and biofeedback training for stress reduction of university athletes. Journal of Sport Psychology, 2, 211-220.

Duffy , E. (1962). Activation and behavior. New York: Wiley.

Epstein, M. L. (1980). The relationship of mental imagery and mental rehearsal to performance of a motor task. Journal of Sport Psychology, 2, 211-220.

Feltz, D. L., & Landers, D. M. (1983). The effects of mental practice on motor skill learning and performance: A meta-analysis. Journal of Sport Psychology, 5, 25-57.

Gould, D., Weinberg, R., & Jackson, A. (1980). Mental preparation strategies, cognitions and strength performance. Journal of Sport Psychology, 2, 329-339.

Hall, C. R. (1985). Individual differences in the mental practice and imagery of motor skill performance. Canadian Journal of Applied Sport Science, 10, 175-215.

Hall, C. R., Pongrac, J. & Buckolz, E. (1985). The measurement of imagery ability. Human Movement Science, 4, 107-118.

Hall, E. G., & Erffmeyer, E. S., (1983). The effects of visuo-motor behavior rehearsal with videotaped modeling on free throw accuracy of intercollegiate female basketball players. Journal of Sport Psychology, 5, 343-346.

Hamilton, S. A., & Fremouw, W. J. (1985). Cognitive behavioral training for college basketball free-throw performance. Cognitive Therapy and Research, 9, 479-483.

Harris, D. V., & Robinson, W. J. (1986). Effects of skill level on EMG activity during internal and external imagery. Journal of Sport Psychology, 8, 105-111.

Hersen, M. & Barlow, D. H. (1976). Singles case experimental designs: Strategies for studying behavior change. Toronto: Pergamon Press.

Housner, L., & Hoffman, S. J. (1981). Imagery ability on recall of distance and location information. Journal of Motor Behavior, 13, 207-223.

Jacobson, E. (1976) . You must relax. New York: Henry Holt and Co.

Mackay, D. G. (1981). The problem of rehearsal on mental practice. Journal of Motor Behavior, 4, 274-285.

Mahoney, M. J., & Avener, M. (1977). Psychology of the elite athlete: An exploratory study. Cognitive Therapy and Research, 1, 115-141, 1135-141.

Meichenbaum, D. (1985). Stress innoculation training. New York: Pergamon.

Meyers, W., Schleser, R., & Montgomery Okwumabua, T. (1982). A cognitive behavior intervention for improving basketball performance. Research Quarterly for Exercise and Sport, 4, 344-347.

Minas, S. C. (1978). Mental practice of a complex perceptual motor skill. Journal of Human Movement Studies, 4, 102-107.

Mumford, C., & Hall, C. (1985). The effects of internal and external imagery on performing figures in figure skating. Canadian Journal of Applied Sport Science, 10, 171-177.

Nideffer, R.M. (1985). Athletes' guide to mental training. Champaign, Illinois: Human Kinetics.

Nideffer, R. M. (1983). The inner athlete. San Diego. California: Enhanced Performances.

Oxendine, J. B. (1968). Psychology of motor learning. New York: Meredith.

Paivio, A. (1985). Cognitive and motivation functions of imagery in human performance. Canadian Journal of Applied Sport Science, 10, 22S-28S.

Richardson, A. (1967). Mental practice: A review and discussion (Part 2). Research Quarterly, 38, 95-107.

Rushall, B. (1981). Coaching theory level 3. Ottawa: Coaching Association of Canada.

Ryan, D., Blakeslee, T., & Furst, D. (1986). Mental practice and motor skill learning: An indirect test of the neuromuscular feedback hypothesis. International Journal of Sport Psychology,17, 60-70.

Ryan, D. E., & Simons, J. (1981). Cognitive demand, imagery and frequency acquisition of motor skills. Journal of Sport Psychology, 3, 35-45.

Sheehan, P. W. (1967). A shortened form of Bett's Questionnaire Upon Mental Imagery. Journal of Clinical Psychology, 23, 386-389.

Smith, D. (1981). Basketball multiple offence and defense. New Jersey: Prentice-Hall.

Suinn, R. M. (1980). Psychology in sports. Minneapolis, Minnesota: Burgess.

Tutko, T., & Tosi, U. (1976). Sports psyching. Los Angeles: Houghton Mifflin.

Veally, R. (1986). Imagery training for performance enhancement. In J.M. Williams (Ed.), Applied Sport Psychology (pp. 209-231). Palo Alto, Calilfornia: Mayfield.

Walsh, D., Russell, D., & Imanaka, K. (1980). Memory for location and distance information and imagery ability. Acta Psychologica, 44, 117-130.

White, K. D., Ashton, R., & Lewis, S. (1979). Learning a complex skill: effects of mental practice, physical practice and imagery ability. International Journal of Sport Psychology, 10, 71-78.

Woolfolk, R. L., Murphy, S. M., Gottesfeld, D., & Aiken, D. (1985). Effects of outcome on motor skill performance . Journal of Sport Psychology, 7l, 191-197.

Woolman, N. (1986). Research on imagery and motor performance: Three methodological suggestions. Journal of Sport Psychology, 8, 135-138.

Wrisberg, C. A., & Ragsdale, M. R. (1979). Cognitive demand and practice level: Factors in the mental rehearsal of motor skills. Journal of Human Movement Studies, 5, 201-208.

APPENDICES

APPENDIX A

Subjects Personal Free Throw Description

Subject A

- good grip on the ball
- a few dribbles to relax
- ball is kept out in front
- knees loose and slightly bent
- elbow in, ball just above line of sight on rim
- smooth high arc

Subject B

- find the hole in the circle
- spread my feet on each side
- the hole is directly under my nose
- take 2 or 3 dribbles, no more, no less
- spread my hand wide over seams of ball
- tuck my elbow in below my chin
- concentrate on the front of the rim
- bring the ball up so the index finger almost touches my nose
- bend my knees, keep heels on ground
- release ball with flick of my wrist
- watch the ball from the time it leaves my hand till it goes through the hoop
- feeling of great relief when ball goes through net
- it's like I have unloaded a great amount of weight off my back

Subject C

- line my feet up slightly more than shoulder width before I get the ball
- look at the rim before I get the ball
- take a couple of deep breaths as I receive the ball
- look at the floor and line the ball up with the seams parallel to the free throw line
- bounce ball four times
- bring the ball up and feel the ball smooth on my fingertips
- line the thumb up on the seam, four fingers between seams
- with a light grasp, my elbow in, my arm feeling it is in line with the basket, I release the ball, pointing my fingers at the basket and snapping the wrist smoothly
- back off the line right foot first

APPENDIX B

Phases of an Imagery Rehearsal Intervention as an Aid in Basketball Free Throw Performance

Conceptualization Phase

1. Coach-player rapport has been established.
2. Discuss possible reasons for poor performance.
3. Introduce the notion of imagery in collaborative way, including the player's previous knowledge and definitions.
4. Convince the player that imagery is a proven psychological technique by using anecdotal information from known performers, videotapes, research findings. Explain the two major theories of how imagery can work. The athlete must believe this intervention can work.

Training Phase

1. Relaxation in the form of deep beathing with an explanation of why this technique slows the body down.
2. Practice relaxation skills. Breathing progressions to count of breath-hold-release air (4-4-4, 4-1-4, 1-1-4). Expel air with positive self talk , keying on the "feeling " of being in a relaxed state (Tutko and Tosi, 1976).
3. Visual rehearse body mechanics of free throw shooting in slow

motion, with player's written description, normal speed, adjust description to include experienced feelings. Practice imagery.
4. Combine deep breathing with imagery in preferred sequences.
5. Explain the possibility of initial performance reduction due to the new free throw shooting format (learning curve) (Hull, cited in Oxendine 1968).

Implementation Phase

1. Without a ball, go through imagery training sequence, modelling, movement.
2. In gymnasium setting using imagery rehearsal sequence, shoot free throws.
3. Increase situation specificity by having the player move in a game-like manner then perform under the intervention.
4. Add coping strategies for other game occurrences (eg. time outs).
5. Practice entire imagery rehearsal sequence during every practice and game opportunity.

A Time-Framed Agenda for Imagery Rehearsal in Free Throw Shooting for Basketball

Session #1	30 minutes	conceptualization phase
	10 minutes	training phase
	10 minutes	breathing and visualization at home
	10 minutes	during physical practice
Session #2	20 minutes	conceptualization phase
	15 minutes	training phase
	10 minutes	breathing and visualization at home
	10 minutes	during physical practice

Session #3	5 minutes	conceptualization phase
	15 minutes	training phase
	5 minutes	implemention phase
	10 minutes	breathing and visualization at home
	10 minutes	during physical practice
Session #4	10 minutes	training phase
	10 minutes	imagery at home
	10 minutes	during physical practice

Constant monitoring of the imagery rehearsal intervention in the form of verbal communication and program adherence forms enhance results. Visual feedback in the form of graphs or post practice/post game data serves to motivate the player. The player is encouraged to practice the intervention at home and during every practice and game free throw.

APPENDIX C

Adherence Sheet

Date:
Name:

Did you visually rehearse during this free-throw practice? (circle one)

sometimes   always   never

Did you visually rehearse during this game? (circle one)

sometimes   always   never

Did you visually rehearse another time during the day? (circle one)

yes   no

If yes, for how many minutes?

If no, why not?

APPENDIX D

Practice Observations

Subject A	Subject B	Subject C
% FTS. Made	% FTS. Made	% FTS. Made
18/30 = 60	20/30 = 67	22/30 = 73
15/20 = 75	20/30 = 67	16/20 = 80
13/20 = 65	16/20 = 80	14/20 = 70
14/20 = 70	25/30 = 83	13/20 = 65
26/40 = 65	27/40 = 68	15/20 = 75
12/20 = 60	13/20 = 65	13/20 = 65
13/20 = 65	15/20 = 75	27/30 = 90
21/30 = 70	15/20 = 75	16/20 = 80
18/30 = 75	12/20 = 60	21/30 = 70
19/30 = 63	22/30 = 73	17/20 = 85
13/20 = 65	15/20 = 75	16/20 = 80
14/20 = 70	26/40 = 65	28/40 = 70
26/40 = 65	21/30 = 70	21/30 = 70
19/30 = 63	21/30 = 70	25/30 = 84
22/30 = 73	25/30 = 84	22/30 = 73
23/30 = 77	13/20 = 65	13/20 = 65
12/20 = 60	21/30 = 70	19/30 = 63
18/30 = 60	11/20 = 55	16/20 = 80
13/20 = 65	13/20 = 65	17/20 = 85
14/20 = 70	14/20 = 70	14/20 = 70
12/20 = 60	13/20 = 65	17/20 = 85
12/20 = 60	12/20 = 60	8/20 = 40
14/20 = 70	11/20 = 55	36/50 = 72

intervention
12/20 = 60
13/20 = 65
8/10 = 80
13/20 = 65
17/30 = 57
18/20 = 90
17/30 = 57
30/40 = 75
28/40 = 70
14/20 = 70
14/20 = 70
23/30 = 77
30/40 = 75
16/30 = 53
16/20 = 80
21/30 = 70
24/30 = 80
14/20 = 70
7/10 = 70
21/30 = 70
22/30 = 73
16/20 = 80
17/20 = 85
14/20 = 70
15/20 = 75
17/20 = 85

33/50 = 66
13/20 = 65
20/30 = 67
12/20 = 60
20/30 = 67
intervention
31/40 = 78
28/40 = 70
14/20 = 70
14/20 = 70
23/30 = 77
33/40 = 83
23/30 = 77
8/10 = 80
24/30 = 80
17/20 = 85
9/10 = 90
20/30 = 67
21/30 = 70
14/20 = 70
15/20 = 75
15/20 = 75
16/20 = 80
19/20 = 95

18/20 = 90
23/30 = 77
13/20 = 65
20/30 = 67
30/40 = 75
29/40 = 73
19/20 = 95
16/20 = 80
26/30 = 87
30/40 = 75
25/30 = 84
14/20 = 70
intervention
26/30 = 87
22/30 = 73
19/20 = 95
7/10 = 70
21/30 = 70
24/30 = 80
17/20 = 85
13/20 = 65
19/20 = 90
18/20 = 90
15/20 = 75

APPENDIX E

Game Observations

Subject A	Subject B	Subject C
%FTS. Made	% FTS. Made	% FTS. Made
5/8 = 63	0/1 = 0	6/6 =100
3/5 = 60	1/2 = 50	1/2 = 50
4/9 = 44	2/2 =100	1/3 = 33
1/2 = 50	1/2 = 50	3/4 = 75
1/2 = 50	2/2 =100	1/1 =100
2/3 = 67	1/6 = 17	5/7 = 71
0/2 = 0	2/2 =100	2/2 =100
6/7 = 86	4/4 =100	3/5 = 60
1/5 = 20	2/2 =100	2/2 =100
intervention	1/2 = 50	6/9 = 67
2/3 = 67	3/5 = 60	1/2 = 50
1/2 = 50	2/2 =100	2/2 =100
6/8 = 75	2/2 =100	1/1 =100
2/2 =100	1/1 =100	2/4 = 50
1/1 =100	2/2 =100	3/4 = 75
2/2 =100	0/1 = 0	intervention
0/4 = 0	intervention	0/1 = 0
4/5 = 80	2/2 =100	6/7 = 86
0/1 = 0	2/2 =100	1/2 = 50
2/2 =100	2/2 =100	3/4 = 75
7/10 = 70	0/1 = 0	1/2 = 50
2/2 =100	2/2 =100	
1/2 = 50	1/2 = 50	
0/1 = 0		