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Publicly Posted Feedback with Goal Setting to Improve Tennis Performance

Gretchen Mathews

University of South Florida

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Publicly Posted Feedback with Goal Setting to Improve Tennis Performance

by

Gretchen Mathews

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Applied Behavior Analysis
College of Graduate Studies
University of South Florida

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Keywords: behavior analysis, athletic performance, sports, children, corners

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Dedication

This thesis was inspired by Erick Chall, who supported me throughout graduate school from the decision to apply to the University of South Florida, through the papers, presentations, exams, practicum, and thesis experiences, to graduation. These have been exciting, stressful, wonderful, terrible, amazing times. The completion of this thesis marks the beginning of another set and the score is love all.

"It feels amazing.... This is why you work so hard. These moments don't happen very often. I'm taking it in, and it's feeling pretty good." –Andre Agassi
Acknowledgements

I would like to thank the McMullen Tennis Complex for allowing me to use their facilities for my thesis site. Thanks to the athletes and their parents who allowed me to track their tennis performance. I would also like to thank my wonderful research assistants Victoria Fogel and Tyler Lott. I couldn't have asked for more dedicated, professional, outstanding assistants. Both of you will go far in this field. Finally, I would like to thank my thesis committee members Dr. Mowery and Dr. van Haaren, and my major advisor, Dr. Stokes, who provided critical insight, encouragement, and inspiration throughout the thesis process. Thank you all.
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ABSTRACT

A review of the literature regarding Applied Behavior Analysis within various sports settings shows that behavioral coaching is more effective than traditional coaching methods. Specifically, goal setting and publicly posted feedback improved the athletic performance of college level football players in two studies, and high school soccer players in one study. The present study found goal setting and publicly posted feedback improved tennis performance for six participants. A multiple baseline across participants design was used. Specifically, the participants improved their corner hitting ability, which is an important competitive shot in tennis. The participants improved their corner hitting ability from an average of 11.8% in baseline to 19.6% in intervention.
Chapter One

Introduction

Traditionally, coaches are known to use coercive strategies to improve their athletes sport performance. This might include yelling at a player for making a mistake,威胁ing to take the player out of the game, forcing excessive exercise, or denying the athlete water. Bobby Knight, the men’s basketball coach at Texas Tech, is one of the most controversial coaches of all time. After coaching for the Army, Knight coached at Indiana University and received numerous awards and recognitions, including being elected to the Basketball Hall of Fame. However, after a student alleged that Knight was abusive towards him, Knight was relieved of his coaching duties and took a job coaching at Texas Tech. Other Knight controversies include an arrest for assaulting a police officer, throwing a chair during a game to protest the referee's call, lashing out at his players during practice, allegedly kicking his son during a game, berating an NCAA volunteer at a news conference, and being restrained by a police officer during a game because of a heckling fan (Wikipedia, 2007). While Knight has had many successes in his coaching career, this type of abusive and negative behavior is not appropriate and should not be tolerated. While this coaching style may be effective in improving athletic performance, there are ethical considerations regarding treating people humanely. Coaches admire Bobby Knight for his achievements, and may imitate his coaching style in hopes of
achieving similar results. In contrast to Knight’s style, behavior analysis has proposed a more positive style, characterized as “Effective behavioral coaching,” which has six characteristics including: 1) measurement of athletic performance, 2) distinction between developing and maintaining behavior, 3) encouragement to improve against performance, 4) emphasis on coaching as a science, 5) behavior modification for the coach, and 6) social validation (Martin & Hrycaiko, 1983).

Applied Behavior Analysis in Sports

In the 1960’s behavior analysis made its entrance into the sports world (Donahue, Gillis, & King, 1980). Early research by Allison and Ayllon (1980) showed that applied behavior analytic tools are more effective than traditional coaching methods in the acquisition and improvement of athletic skills among football players, gymnasts, and tennis players aged 11-35. In three studies, Allison and Ayllon (1980) pioneered a behavioral package which included five factors including: 1) executing the skill, in which the athlete performed the skill; 2) judging correct execution, in which the coach yelled the word, “freeze!” if the athlete performed the skill incorrectly; 3) describing the incorrect position, in which the coach identified and provided descriptive feedback regarding what the athlete was doing incorrectly; 4) modeling the correct position, in which the coach would perform the skill correctly; and 5) imitating the correct position, in which the athlete would imitate the coach. Allison and Ayllon demonstrated the effectiveness of this package with three sports in three studies: football,
gymnastics, and tennis (1980). This study was successfully replicated (Anderson & Kirkpatrick, 2002; Fitterling & Ayllon, 1983).

The first study described by Allison and Ayllon (1980) examined the efficacy of the behavioral package in facilitating the acquisition of blocking skills in a second string youth football team. A block contained the following components: 1) the body must be behind the line of scrimmage; 2) the stance must be a 4-point stance with the toes and the fingertips on the ground, heels of the feet off the ground, head up, feet spread at least 18" apart to form a solid base; 3) there must be no movement until the snap when movement must be immediate; 4) the player must spring up, hitting the opposing player in the chest, shoulder pad to shoulder pad, with his head between the opposing player’s head and the ball, and his arms must be folded to his chest; 5) his arms can be thrust away from the body in the folded position but they must not unfold; 6) the player cannot grasp the opponent with his hands nor about the opponent’s body with his head; 7) the player’s feet must be in continuous driving motion, and he must drive his opponent away from the direction of the ball and the direction of the play; and 8) the player must maintain body contact with his opponent until the whistle blows. The participants were five males ages 11 and 12 identified by their coaches as, “completely lacking fundamental football skills.” Four of the boys were included in a multiple-baseline design while an ABAB design was used for the fifth participant. In standard coaching, the coaches yelled at and ridiculed the boys if their blocking was incorrect. As part of the intervention, the researcher taught the coaches to yell “freeze” if the participant performed the block
incorrectly. Then the coach identified the problem and positively corrected the participant. The results of the first study were excellent. All of the boys improved nearly tenfold in blocking skills.

The second study examined the efficacy of the behavioral package in facilitating the acquisition of gymnastic skills. The participants included six girls ages 13 and 14 on the non-varsity gymnastics team of a high school. A multiple baseline across participants and behaviors with reversals design was used. The skills included “backward walkovers,” “front handsprings,” and “reverse kips.” Backward walkovers were operationally defined as 1) as the gymnast walks over, the lead foot should touch down on the floor 18 to 24 inches behind the hands; 2) the knee of the lead leg may be bent at no greater than 22.5 degrees, in the angle made by the calf and the thigh at the inner juncture of the knee; 3) the following leg must be in the air, straight, and the toe pointed; 4) the arms must be straight; and 5) the head must be between the arms and faced back toward the legs, not toward the floor. “Front handsprings,” were operationally defined as 1) as the gymnast lands from the handspring, the feet must be parallel to each other; 2) the gymnast must land on the two feet simultaneously, without taking additional steps; 3) the angle of the thigh and the calf at the inner knee must be 90 degrees or greater (straighter) on landing; 4) the arms must be extended upward and straight on either side of the head; and 5) the back may be slanted back up to 22.5 degrees from the vertical but no more. “Reverse kips,” were operationally defined as 1) the body must remain in a kip position until the hips of the gymnast return to a position level with the bar on the way back to an upright
position; 2) at this level position, the gymnast may unfold her kipped position, increasing the angle of the upper torso with the legs from 22.5 degrees to 180 degrees; 3) the hips must return to the position level with the bar in a circular motion, with the same distance of the hips from the bar at this follow-through point as they are at the initiation of the skill; the hips must not touch the bar until after this point; 4) the arms must be straight; 5) the legs must be straight, and 6) the toes must be pointed. As in the first study, coaches yelled, “freeze,” if the skills were executed incorrectly. The coach would positively identify and correct the problem. Then the coach correctly modeled the position and the participant imitated the coach. Baseline levels were at or near zero for all participants and all skills. The results of the behavioral coaching phases show that all participants improved to approximately 70% across all targeted skills in the behavioral coaching phases. Return to baseline phases dropped to near baseline levels for all participants, indicating that the behavioral coaching package was the key element to the acquisition of the skills, and also that maintenance was not being achieved. The five component package was the same format used in the football study; therefore, it was unclear what the effects were of each component.

The third study by Allison and Ayllon (1980) utilized the same five component behavior package but applied it to tennis. The participants included 3 males and 9 females ranging in age from 18-35. The skills included serve, forehand, and backhand. The serve was defined as: 1) the grip must be any of the standard forehand grips or an Eastern backhand grip; 2) the left foot of a right-hander or the right foot of a left-hander should be within three to four inches
of the baseline or closer but not touching the baseline at about a 45 degree angle
to the baseline; 3) at the finish the opposite foot must be either pointed toward
the back of the court or one step into the court; 4) if the former, the weight must
be on the front foot; if the latter, the weight is on the foot that stepped into the
court; 5) the knees must be slightly bent; 6) the hips should be parallel to the net;
7) the racket arm must be straight and aligned with the body; 8) the racket must
be on the opposite side of the body from the racket arm (left side for right-
handers); 9) the racket should come to rest pointing down at the court or slightly
behind the body pointing toward the back of the court; and 10) the racket face
should be parallel to the net plane. The forehand was defined as: 1) the grip must
be either the standard Eastern forehand, the Continental, or the Australian; 2) the
left foot of a right-hander must be stepping toward the net while the opposite foot
must be 180 degrees behind it pointed toward the back of the court; 3) the weight
must be on the front foot; 4) the front knee must be bent; 5) the toe only of the
back foot must be touching the court; 6) the hips must be within 45 degrees of
being parallel to the net; 7) the elbow of the racket arm must not be bent more
than 20 degrees; 8) the rim of the racket must be pointing straight ahead into the
opposite court; 9) the racket must be above waist level; 10) the racket head must
not be lower than the wrist; and 11) the face of the racket must be perpendicular
to the court. The backhand was defined as: 1) the grip must be the standard
Eastern backhand grip or the Continental grip; 2) the right foot of a right-hander
or the left foot of a left-hander must be stepping toward the net while the opposite
foot must be 180 degrees behind it pointed toward the back of the court; 3-11)
the same elements as the forehand. A multiple baseline across behaviors and individuals was used. All the participants fell below 40% accuracy in baseline. The results of the behavioral coaching phase showed improvement across all participants and skills. Maintenance was tested intermittently with standard coaching “probes.” The results of these probes show that maintenance was not achieved early in the intervention phase. However, the probes did show maintenance of the skills in the absence of the behavioral coaching after extended training in the treatment phase (after approximately 42 trials).

These three studies show that behavioral coaching effectively improved skill acquisition across football, gymnastics, and tennis skills with 23 male and female athletes ranging in age from 11-35. This suggests that behavioral coaching techniques are more effective than traditional methods of coaching.

Fitterling and Ayllon (1983) replicated these findings with four female participants in classical ballet. The dependent variables were four bar exercises called “dégagé,” a movement or position in which the working leg is lifted off the floor; “frappé,” the working foot rests lightly on the ankle of the supporting foot, throw the working leg forcefully out to a dégagé position so that it strikes the floor 1/3 of the way out, hold the leg out as long as possible, returning it to its initial position at the last moment; “developpé,” a movement in which the working leg is drawn up to the knee of the supporting leg and from there smoothly out to a position in the air at 90 degrees (parallel to the floor); and “grand battement,” a "kick" in which the working leg is raised as high as possible while keeping the rest of the body still. "Kick" is in quotes because the battement should be a
controlled lift, not a throwing of the leg into the air, and the leg must be controlled while coming down. During the intervention, the behavioral coaching package was implemented when the participant incorrectly executed the target skill. The coach said, "freeze", then described the incorrect position. Next the coach modeled and described the correct position. Next, the instructor physically guided the participant from the frozen position into the correct position, in which she stayed frozen (this was a slight variation to Allison and Ayllon’s behavioral coaching package). The instructor then described the improved condition, and the participant was instructed to try the position again. All sessions were videotaped and scored for correct skill execution percentage. Within a multiple baseline design the results of this study showed an improvement of performance from 13% in baseline to 88% mean correct skill execution.

In an attempt to partially replicate this and Allison and Ayllon’s (1980) studies, Anderson and Kirkpatrick (2002) investigated the effects of a behavioral treatment package on inline roller speed skaters. The participants in this study were one female and three male competitive inline roller speed skaters ranging in age from 12-16 years. The targeted skill in this study was a “relay tag.” During relay races, skaters had to exit the center relay box when a designated teammate rounded one end of the rink. The skater preparing for the tag then accelerated in the interior of the next turn until he or she passed the corner pylon, at which point the skater entered the traffic lane directly in front of his or her partner in order to receive a push and thereby complete the tag. The skater making the push then exited the floor, and the athlete who had entered the track
completed the requisite number of laps before encountering another teammate exiting the relay box and entering the traffic lane to make the next tag. To be correct, the relay tag had to occur before a mark that was placed on the floor 5 m past the designated corner pylon. In addition, the tag had to be properly completed. If the skaters met but failed to execute a “push,” or if one of the skaters fell upon making the tag, the trial was recorded as incorrect.” Each participant reported difficulty in acquiring this skill despite verbal instruction and modeling.

The behavioral treatment package was implemented in two phases: verbal praise, in which the experimenter (a former competitive speed skater) shouted “good tag,” or something similar along with the participant’s name after each correct relay tag; visual feedback of correct tags in the form of his or her scores for the day; and verbal instruction for performance improvement in the form of specific instructions for executing correct tags. The first phase utilized a multiple baseline across participants design. Results in the first treatment phase indicated substantial improvement of the target behavior for two of the three original participants. Results for the third participant were only assessed for three sessions, two of which showed improvement, one of which showed a decrease in performance. Therefore, not enough data were recorded to establish stability.

The second phase was originally intended to be a follow-up phase, but maintenance was not achieved for any of the participants. A fourth participant was added for replication purposes. A second baseline was established and treatment was re-implemented at the same time for the original three participants.
and in a multiple baseline design for the fourth participant. Results in this phase showed a substantial increase in mean performance; however, there was so much variability (ranging from 0-100% with general downward trends) for the original three participants that these results should be viewed skeptically. For the fourth participant, the data showed a substantial increase in mean performance comparable to the other three participants; however, the data showed a rapid downward trend. Furthermore, no follow-up data were taken after the second phase. The results of this study indicate a behavioral coaching treatment package can be used to facilitate acquisition of athletic skills, though maintenance of these skills should be addressed alternatively.

Scott, Scott, and Goldwater (1997) used shaping to improve the athletic performance of a 21 year old male competitive pole vaulter. The participant was having trouble extending his arms properly while “planting” the pole, which was necessary to achieve full height of the vault. Baseline data reported a mean hand height of 2.25m.

The investigators successfully achieved an improved stable hand height by implementing a photoelectric beam at the desired hand height, which would beep if the participant attained the height. The “beep” became a conditioned reinforcer because it indicated to the participant he reached the desired hand height. Additionally, he was given the verbal prompt, “reach” by the investigator at take off. When the participant reliably met the goal hand height, the photoelectric beam height was increased in a changing-criterion design by 0.05m increments. Each time the criterion changed, a marked difference occurred in the
participant's skill level, indicating experimental control of the design. After 18 months, the shaping treatment resulted in a .25m increase.

In another study of tennis skills, stimulus cueing, a form of self-instructional verbalization out loud, was shown to be effective in increasing the acquisition of forehand and backhand skills with twenty-four beginner level tennis players (Ziegler, 1987). In this study, fourteen females and ten males ranging in age from 19-31 years participated. All participants had none to minimal experience playing tennis. The setting was a two-court indoor facility at an urban university. The participants were divided into three groups and a multiple baseline design across participants was used.

The skills targeted for acquisition were the forehand and backhand returns. The forehand was defined as: 1) racquet head above wrist, 2) stepped forward on opposite leg (right-handed player steps out on left foot), 3) ball contacted on racquet side of body, 4) nonracquet hand pointed toward ball, 5) contact off forward knee, 6) follow-through toward opponent (machine), 7) assume ready position, and 8) ball crossed net and landed in the backcourt area (between the service line and the end line) within the singles court boundary. The backhand was defined as: 1) racquet head above wrist, 2) stepped forward on opposite leg, 3) racquet arm scapula pointed toward ball, 4) ball contacted on nonracquet side of body, 5) contact off forward knee, 6) follow-through toward opponent (machine), 6) assume ready position, and 7) same as for the forehand return.

Data were collected on whether the participant performed the skills correctly, and whether or not the ball was returned to the backcourt successfully.
The treatment phase consisted of stimulus cueing, in which the participant was instructed to verbalize each step of the point. The participant was to say “ready,” when they were in the “ready position.” As the ball was fired from the ball machine, they were to say, “ball.” When the ball bounced, they were to say, “bounce.” Finally, when the ball hit the racquet, they were to say, “hit.” Then the process was repeated for thirty forehands and thirty backhands. During this phase, the instructor would remind them to “cue” every five balls (during baseline they were instructed to “concentrate” or “keep their eye on the ball” after every five balls). Feedback was not given during data collection sessions, although each participant got skill instruction during regularly scheduled training outside this study’s procedures.

The results of this study show that forehand and backhand skills increased significantly during the treatment phase. Each group made minimal progress through their baseline sessions. With the introduction of the stimulus cueing procedure each group’s mean performance increased by 44%, 43%, and 49%. Individual participant forehand and backhand skills improved at levels consistent with the group mean. This study shows that stimulus cueing is more effective than traditional methods of coaching forehand and backhand tennis skills. However, no data were collected on whether the skills generalized to game settings, which is an important factor in sports settings. No further studies on stimulus cueing in sports could be found for replication of this study’s findings.

Behavioral coaching was shown effective in improving athletic performance by Allison & Ayllon (1980). Three studies applied a behavioral
coaching treatment package to football, gymnastics, and tennis. The coaching package included several behavior analytic tools including: verbal instructions and feedback, positive and negative reinforcement, positive practice, and time out. This study was successfully replicated with four bar exercises in classical ballet by Fitterling and Ayllon (1983). In a less effective study, Anderson and Kirkpatrick (2002) applied a behavioral treatment package with inline roller speed skaters. Unfortunately, they were unable to achieve maintenance of the targeted skill. Shaping is a technique commonly used with beginner level athletes. However, Scott, Scott, and Goldwater (1997) used a shaping intervention with a competitive pole vaulter. The vaulter’s hand height performance improved from 2.25m to 2.5m over a period of 18 months. Ziegler (1987) utilized stimulus cueing with beginner level tennis players to effectively facilitate the acquisition of forehand and backhand returns. The players were cued by the coach on a fixed-ratio five ball schedule to say, “ready, ball, bounce, hit” for thirty balls. The intervention improved the participant’s performances by approximately 45%.

In two studies mentioned, tennis performance was improved by utilizing Applied Behavior Analytic techniques. Behavioral coaching and stimulus cueing were more effective than traditional coaching methods in improving the serve, forehand, and backhand.

Goal Setting and Publicly Posted Feedback

In a review of 30 years of research, goal-setting and feedback have been shown to be effective in improving athletic performance (Martin, Thompson, & Regehr, 2004). It has been evidenced that "specific, difficult, and self-generated
goals” have favorable results on performance over “easy goals, no goals, or do your best” goals (Locke & Latham, 1990).

According to Fellner and Sulzer-Azaroff (1984), “A goal is a stimulus that precedes behavior. When the antecedent goal reliably accompanies a reinforced response it acquires 'discriminative control,' increasing the probability it will cue the individual to repeat the behavior. Also, attainment of a goal can function as a reinforcing stimulus” (p. 35). Contingency-specifying statements (CSS) are discriminative stimuli that evoke a goal setting response (Huber, 1986). Examples of CSS’s that evoke goal setting are: announcement of a contingency, an incentive statement, goal setting statements made by others, and normative information that implies contingencies between performance levels and consequences. According to Huber, CSSs that specify type and amount of the consequence are more likely to be effective than those which do not (1986). Also, if the consequence for the response is not comparable to the task effort, the goal statement will have no impact on performance.

Locke (1991) found that goal-setting is an effective strategy in improving athletic performance in over 500 studies. Goal-setting and feedback have been shown to be effective in improving athletic performance (Brobst & Ward, 2002; Smith & Ward, 2006; Ward & Carnes, 2002).

Ward and Carnes (2002) reported a 29% mean performance increase over baseline when utilizing a treatment package including goal-setting and publicly posted feedback with a college football team. The participants in this study were five male linebackers on a Division II college football team. The
linebackers were chosen by their coach as being likely starters that year even though they demonstrated poor target skills in practice and games the previous year.

There were three targeted skills included in the multiple-baseline across-behaviors design. First, the linebacker was to get in position to cover an area of the field during a pass or run. This was called a correct “read.” Second, the linebacker was to get into position as a response to the positioning of the offense. This was called a correct “drop.” The final dependent variable measured whether or not the participant tackled the ball carrier, stopping his run. Data were videotaped during practices and games and scored later based on percentage of correct or incorrect execution of skills.

Each participant scored correctly between 60% and 80% during baseline. Then, they were instructed to set a goal higher than their baseline performance; they each chose 90%. The coaches were unaware of their goals. The results of practice performance were publicly posted next to each player’s name. If the goal was met, a Y was posted, if the goal was not met, an N was posted. No performance chart was posted for game performance.

The results of this study show that reads, drops, and tackles improved for all participants from less than 80% to at least 90% in practices and games. The improvement in game performance indicated generalization of the skills to game settings as a result of the goal-setting plus publicly posted feedback treatment package.
Brobst and Ward (2002) showed that public posting, goal setting, and oral feedback improved the athletic performance of three female high school soccer players during the course of one season. Each participant had five years soccer experience, regularly attended scheduled practices, and the coach identified the players as likely to play in at least half of each game. Data were collected via videotape during ten games and 27 practice scrammages. Event recording data were based on percentage of opportunities.

The dependent measures included three targeted skills labeled “movement with the ball,” which were occasions on which a player received the ball from a partner and then dribbled the ball for at least 5 s without losing possession to either another player or as a result of unforced error; “movement during restarts,” which were occasions during a soccer game on which the game was stopped and restarted. At these times players must move to an open space to receive a ball kicked or thrown to them; and “movement after the player passed the ball,” which were occasions on which a player moved to a supporting position after having passed the ball. Each of these skills were recorded whenever the team had possession of the ball. The skills were coded correct if the skills matched their operational definitions or incorrect by forced or unforced error. A multiple baseline design across behaviors was utilized.

The intervention consisted of goal setting, public posting, and oral feedback. Prior to the intervention the coach set the goal at 90% correct performance. Before each practice session, data from the previous practice were posted beside the field where water breaks were taken. Additionally, the
investigator met with participants individually prior to each practice session to review the data. If the goal was met, praise was provided, if the goal was not met, encouragement was provided. Data taken from game sessions were evaluated for generalization purposes only, therefore these data were not posted or discussed with the players.

Results indicated a positive change across behaviors and participants. Each participant met and exceeded the 90% goal in several practice sessions. The intervention generalized to game settings with "movement of the ball," however the other two targeted skills remained near baseline levels in game settings. The authors suggested the skills may not have generalized because scrimmage and game settings were dissimilar; however, this was not analyzed experimentally. Maintenance was achieved with "movement of the ball," when the intervention was removed; however, the other two targeted skills did not maintain, perhaps because of the dissimilarity between scrimmage and game settings, or because of the lack of coach interaction during game settings. Also, "movement of the ball" had higher baseline levels, which may indicate higher baseline skill levels are more likely to achieve maintenance when the intervention is withdrawn.

The authors suggested the goals may have been set too high. While the players' performances improved noticeably, they did not always reach criterion. The authors suggest future researchers set goals based on baseline levels of performance. The author's stated it would have been more appropriate to set modest goals based on the previous day's performance.
In a similar study, Smith and Ward (2006) showed that goal-setting plus publicly posted feedback were effective in improving the performance of three Division II college football players. The three participants were all wide receivers which the coach identified as executing three target skills poorly during practices and games. The first dependent variable measured whether or not the participant blocked the defensive player legally and effectively. The second skill measured whether or not the participant ran the route outlined in the playbook contingent on the defending team’s strategy for that play. Thirdly, a release from the line of scrimmage was scored correct if the participant effectively avoided contact with a defensive player and ran the route established by the playbook. An ABACA B+C multi-treatment withdrawal design was utilized. All phases of the design included error correction and verbal feedback during practices. Data were recorded by a video camera and scored later based on percentage of correct and incorrect releases, blocks, and routes.

Baseline results showed that percentages of correct execution of skills ranged from 50%-80% (with the exception of one occurrence of 90% accuracy) during practices. Game performance ranged between 60%-80%.

The first treatment phase publicly posted the results of the day’s practice on a performance chart next to the locker room. This phase resulted in an increase of performance between 80%-100% during practices and 90%-100% during games. During the second baseline, all behaviors returned to original baseline levels during practices; however, game performances stayed 10% higher.
The second treatment phase utilized a goal-setting procedure. The goals were set at 90%, which was considered reasonable by the coach and investigators. Before each day's session, the investigator verbally informed the participants of their results from the previous day's practice. The exact results were not reported for this phase; however, the authors stated the results were better for at least one dependent variable for each participant and similar to the public posting phase for the other dependent variables. Baseline levels returned to the original baseline levels again, and the game performances remained 10% higher than the original baseline.

The third treatment phase included publicly posted feedback and goal setting. This phase resulted in 90%-100% accuracy during practices and 100% accuracy during games. This study, like Ward and Carnes (2002) shows that goal-setting plus publicly posted feedback is an effective strategy to improve the performance of male Division II college football players.

Ward and Carnes (2002), Brobst and Ward (2002), and Smith and Ward, (2006), showed goal-setting with publicly posted feedback was effective in improving soccer and football skills among high school and college level athletes. No experimentally controlled, peer reviewed studies could be found applying goal-setting with publicly posted feedback to the sport of tennis.

The Present Study

The purpose of the current study is to evaluate the effectiveness of goal-setting plus publicly posted feedback on athletic performance applied to the sport of tennis, with players demonstrating potential for hitting the ball to the outside
corners of the court on the baseline and sideline, which is an important competitive shot according to tennis professionals. When a corner is hit during the rally of a tennis match, the opponent must move away from the center of the court, leaving the court open.
Chapter Two

Method

Participants

Three male and three female competitive tennis players aged 8-15, participated in this study. The participants consisted of four Caucasians, one Asian, and one African American. Three participants were right handed and three were left handed. Inclusion criteria for participants included: the participant had at least one year of tennis experience, the coach identified the participant as having potential to play tennis professionally, the participant stated an interest in playing tennis on a professional level in the future, the participant had a state ranking within his or her age/gender division, and the participant had high attendance records (at least 90%). See Table 2.1 for demographic and experience information. Each participant and their parent(s) signed informed consent forms approved by the University of South Florida's Institutional Review Board (IRB) (see Appendices A and B). Each participant participated in training clinics five days per week from 4:30-7:30pm. The clinics consisted of at least three professional tennis coaches and 12-30 players.

The head professional tennis coach was a 32 year-old male with a Bachelor of Science degree in Sports Management. He was certified by the United States Tennis Association and coached tennis for 15 years. His supervisor reported he was one of most proficient coaches she worked with.
Informal interviewing of many players and their parents indicated the coach was well received by players and their parents.

Table 2.1.

Demographics and Experience.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Race</th>
<th>Handed</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodger</td>
<td>15</td>
<td>Male</td>
<td>Asian</td>
<td>Left</td>
<td>1.5 years</td>
</tr>
<tr>
<td>Rafael</td>
<td>11</td>
<td>Male</td>
<td>Caucasian</td>
<td>Right</td>
<td>1.75 years</td>
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<tr>
<td>Maria</td>
<td>10</td>
<td>Female</td>
<td>Caucasian</td>
<td>Right</td>
<td>3 years</td>
</tr>
<tr>
<td>Ana</td>
<td>13</td>
<td>Female</td>
<td>African-American</td>
<td>Right</td>
<td>1.25 years</td>
</tr>
<tr>
<td>Novak</td>
<td>10</td>
<td>Male</td>
<td>Caucasian</td>
<td>Left</td>
<td>4 years</td>
</tr>
<tr>
<td>Jelena</td>
<td>8</td>
<td>Female</td>
<td>Caucasian</td>
<td>Left</td>
<td>4 years</td>
</tr>
</tbody>
</table>

Setting

The present study took place at the McMullen Tennis Complex which was honored by national, regional, and state tennis and recreation organizations, including the United States Tennis Association (USTA) Technical Committee (Schmidt & Miller, Fall 2001). Tennis Industry named the site “Court of the Year Winner” in 2001 (Francesconi, 2001). There were seven hard courts and eight clay courts. This study utilized one hard court (10.973 m x 23.774 m including double’s alleys), made from a mixture of concrete and asphalt, covered with rubber.

Apparatus

A Playmate ball machine was utilized in this study. This ball machine was capable of: speed control, feed rate control, elevation control, a two speed random oscillator, wireless remote control, and a ball capacity of 200.
Procedure

Each participant had been in training with the coach for at least one year. They participated in practice clinics daily, private lessons weekly, and competed in frequent tournaments. Each participant's tennis schedule remained consistent throughout the study. Prior to the present study, the coach used shaping, modeling, positive reinforcement, time out, and a variety of games on the court to teach tennis. Players reported he was loud, outgoing, and fun in interactions.

Baseline singles corners 1 and 2 were targeted in this study. Corner 1 was a right angle triangle located on the baseline and sideline of the deuce court (on the right side when serving). Corner 2 was located on the baseline and sideline of the ad court (on the left side when serving). The dimensions of the corners were as follows: 1m on the baseline, 2m on the sideline, 2.24m hypotenuse. According to the head professional tennis coach, the rationale for being able to hit a corner was that balls hit to corners consistently were typically very difficult to return. Therefore, the player hitting the corner was considered “in control” of the point and that was more likely a “winner” (point winning shot).

Baseline. Data were collected in 10-20 minute sessions three times per week. The sessions took place during the regularly scheduled clinic hours. Sessions consisted of each participant hitting 100 balls from the ball machine, divided into sets consisting of 20 balls followed by a 30 second break. Prior to each session, the participant was instructed to aim for corners 1 and 2 alternately. Each participant was assessed for how many corners 1 and 2 they hit.
out of 100. The ball machine was programmed to feed the balls randomly without topspin from far right, right, center right, center left, left, and far left at 30mph.

The Principal Investigator collected data on site. Each ball hit was scored as 1, if corner 1 was hit; 2, if corner 2 was hit; In, if the ball was hit “in bounds” but not in a corner; Out, if the ball was hit out of bounds over the net; Net, if the ball was hit into the net; or -, if the participant missed or miss-hit the ball entirely. After each session, the data sheets presented in Appendices C and D were tallied by the Principal Investigator and feedback was given verbally.

Typically, the coach gave descriptive feedback and praise throughout practice sessions. However, during tournament settings, the participants were not allowed to receive any kind of coaching during a game. Therefore, the coach was not allowed to give feedback during sessions. Following each session, the participants usually informed the coach and everyone else around of their results and he provided praise. The participants were not given any specific instructions as to whether or not they should share their results.

*Intervention.* During the Intervention phase, in addition to the baseline procedures, the principal investigator asked the participants to set a goal for how many corners they wanted to hit out of 100 prior to each session. The participants were reminded of their score from the previous session and allowed to choose their own goal. Without additional instruction, some participants set goals based on other participant’s results, i.e., “I want to beat Rodger.” Additionally, without additional instruction, some participants set intermediate goals, i.e., “I want to hit 10 out of 20 this set.” Following the session last baseline
session and each subsequent intervention session, feedback was posted in bar
graph format on the "Wall of Champions," where tournament and ranking
information was typically posted. This wall was one side of the clubhouse located
in a public spot outside of the clubhouse near the locker rooms. It was frequently
looked at by the players, their parents, and the coaches. The bar graphs showing
the goals and results were displayed on green poster board with the participants'
names spelled out in glitter letters at the top. Results from each day were added to
previous day's results so the graph displayed changes over time. Additionally, a
Y or N was placed below the session results to indicate whether the participant
reached his or her goal.

Alternative dependent measures. In addition to the clinic sessions, data
were collected in tournament sessions to assess generalization. In tournament
sessions, each ball return was scored by percentage of corners over
opportunities. An opportunity was defined as any ball return (the serve was
excluded as the serve is hit to the service box). In addition, although it was not
the main focus of this study to improve state ranking or win/loss ratios, data were
collected to evaluate whether the participants' ranking and/or win/loss records
improved. Ranking and win/loss information was found on the USTA website.

Design

This experiment utilized a multiple baseline across participants design. Participants were introduced to the intervention in a sequential manner, such that
three participants experienced the intervention after approximately three clinic
baseline sessions (when data appeared stable) and three participants
experienced the intervention after approximately eight baseline clinic sessions (when those data appeared stable).

Interobserver Agreement

Interobserver agreement (IOA) data were collected by having a graduate level research assistant record whether each ball hit corner 1, corner 2, In, Out, Net, or -- concurrent but independent from the principal investigator. The data collectors were trained by the principal investigator to recognize where the ball hit the court or net. IOA was calculated in two ways, by corner agreement and by total agreement. Corner agreement was calculated by dividing the number of agreements on corners by the number of disagreements on corners plus agreements on corners and multiplying by 100%. Total agreement was calculated by dividing the number of total agreements by the number of total disagreements plus total agreements and multiplying by 100%.

During clinics, IOA scores were assessed in 58.34% of sessions. Corner IOA scores in clinics were a mean of 73.94% and a range from 34.78%-100%. During clinics, total IOA scores were a mean of 92.54% and a range from 82%-99%. Fifty percent of Rodger’s clinic sessions were scored for IOA. Rodger’s corner IOA were a mean of 81.25% and a range from 70.59%-90.91%. Rodger’s total IOA were a mean of 94% and a range from 91%-96%. Fifty percent of Rafael’s clinic sessions were scored for IOA. In clinics, Rafael’s corner IOA scores were 63.74% and a range from 34.78%-80%. In clinics Rafael’s total IOA scores were a mean of 89.25% and a range from 82%-95%. Fifty-five percent of Maria’s clinic sessions were scored for IOA. Maria’s corner IOA scores were a mean of 84.77% and a range from 78.94%-91.74%. Maria’s total IOA scores were a mean of 95.25% and a range from 91%-96%.
mean of 68.37% and a range from 45.45%-89.47%. Maria’s total IOA scores were a mean of 91.67% and a range from 89%-95%. Fifty-five percent of Ana’s clinic sessions were scored for IOA. Ana’s corner IOA scores were a mean of 80% and a range from 68.42%-100%. Ana’s total IOA scores were a mean of 95.2% and a range from 90%-98%. Sixty-seven percent of Novak’s clinic sessions were scored for IOA. Novak’s corner IOA scores were a mean of 74.74% and a range from 57.14%-93.75%. Novak’s total IOA scores were a mean of 91.67% and a range from 90%-93%. Sixty-four percent of Jelena’s clinic sessions were scored for IOA. In clinics, Jelena’s corner IOA scores were a mean of 75.51% and a range from 57.14%-94.12%. In clinics, Jelena’s total IOA scores were a mean of 93.43% and a range from 88%-99%.

During tournaments, corner IOA scores were assessed in 17.86% of sessions. IOA scores were a mean of 60.06% and a range from 25%-100%. In tournament sessions, Rafael’s mean corner IOA score was 34.69%. In tournament sessions, Jelena’s mean corner IOA was 100%. IOA was not assessed during tournament sessions for Rodger, Maria, Ana, or Novak.

Social Validity

A questionnaire was given to each participant at the end of the study. It asked the participant to rate on a 5-point likert type scale how much they agreed with statements presented in Appendix E which relate to the dimensions of social validity regarding ability to hit corners, tennis playing ability, goal setting, publicly posted feedback.
Chapter Three

Results

The results, presented in Figure 3.1 and Appendix F, show that in comparison to baseline measures, goal setting with publicly posted feedback improved each participant’s ability to hit corners in clinic sessions. Baseline means in clinics ranged from 7%-17% with an overall mean of 11.8%, while intervention means ranged from 12%-29% with an overall mean of 19.6%.

Rodger’s clinic score improved from a baseline mean of 10% and range of 10%-10% to a mean of 21% and a range of 13%-29%. Rodger’s baseline data show stability at 10%. Rodger’s intervention data do not overlap his baseline bandwidth and trend upwards with some variability. Rafael’s clinic score improved from a baseline mean of 15% and a range of 15%-15% to a mean of 21.5% and a range from 17%-28%. Rafael’s baseline data show stability at 15%. Rafael’s intervention data do not overlap his baseline bandwidth and trend upward with some variability. Maria’s clinic score improved from a baseline mean of 12.3% and a range of 10%-14% to a mean of 16.5 and a 12%-23% range. Maria’s baseline data show a downward trend. Maria’s intervention data have variability, show some overlap of her baseline data, and trend upward slightly. Ana’s score in clinics improved from a baseline mean of 10.3% and a range of 8%-15% to a mean of 18% and a 16%-19% range. Ana’s baseline data show a downward trend and are stable at 8% prior to the intervention phase. Ana’s
intervention data do not overlap her baseline bandwidth, show a clear change during the intervention phase, and trend down slightly. Novak’s clinic score improved from a baseline mean of 13.6% and a range of 12%-16% to a mean of 20.5% and an 18%-23% range. Novak’s baseline data show stability. Novak’s intervention data do not overlap his baseline bandwidth and trend upward.

Jelena’s clinic score improved from a baseline mean of 11.1% and a range of 7%-17% to a mean of 20.7% and a 17%-24% range. Jelena’s baseline data show a trend upward. Jelena’s intervention data slightly overlap her baseline bandwidth and trend down slightly.
Figure 3.1 Percentage of corners hit by participants across conditions
Table 3.1 shows that tournament results were a mean of 6.6% and a range from 0%-26%. Five participants improved their state ranking and three participants improved their win/loss ratio.

Rodger's tournament score in baseline was a mean of 5.7% and a range from 0%-11%. No tournament data were collected in the intervention phase for Rodger. Rodger's state ranking improved from 354 to 316 in the boys 16 division. His win/loss ratio decreased from 2-8 (20%) to 3-14 (18%). Rafael's tournament score improved from a baseline mean of 7.2% and a range from 4%-15% to a mean of 9.3% and a 7%-14% range. Rafael's state ranking improved from 129 to 115 in the boys 12 division. His win/loss ratio remained consistent from 22-31 (42%) to 25-35 (42%). Maria's baseline tournament score was 6%. No tournament data were collected for Maria during the intervention phase. Maria's state ranking improved from 143 to 139 in the girls 10 division. Her win/loss ratio increased from 4-6 (40%) to 5-7 (42%). Ana's baseline tournament score was a mean of 2.8% and a range from 1%-7%. No tournament data were collected for Ana during the intervention phase. Ana's state ranking improved from 657 to 624 in the girls 14 division. Her win/loss ratio increased from 11-20 (35%) to 13-27 (67%). Novak's baseline tournament score was a mean of 9.25% and a range from 6%-13%. No tournament data were collected for Novak during the intervention phase. Novak's state ranking dropped slightly from 31 to 32 in the boys 10 division. His win/loss ratio decreased from 40-18 (69%) to 45-22 (67%). Jelena's baseline tournament score was a mean of 7% and a range from 0%-26%. No tournament data were collected for Jelena during the intervention.
phase. Jelena’s state ranking improved from 120 to 74 in the girls 10 division.

Her win/loss ratio increased from 7-7 (50%) to 11-8 (58%).

Table 3.1.

Tournament Results.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Phase</th>
<th>Set</th>
<th>Outcome</th>
<th>Corner 1</th>
<th>Corner 2</th>
<th>Freq/Opp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodger</td>
<td>1</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 3-6</td>
<td>2</td>
<td>3</td>
<td>5/46=11%</td>
</tr>
<tr>
<td>Rodger</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 0-6</td>
<td>2</td>
<td>2</td>
<td>4/66=6%</td>
</tr>
<tr>
<td>Rodger</td>
<td>3</td>
<td>Baseline</td>
<td>Pro</td>
<td>Lost 1-8</td>
<td>0</td>
<td>0</td>
<td>0/50=0%</td>
</tr>
<tr>
<td>Rafael</td>
<td>1</td>
<td>Baseline</td>
<td>1</td>
<td>Won 6-2</td>
<td>6</td>
<td>2</td>
<td>8/80=10%</td>
</tr>
<tr>
<td>Rafael</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>Won 6-2</td>
<td>3</td>
<td>4</td>
<td>7/46=15%</td>
</tr>
<tr>
<td>Rafael</td>
<td>3</td>
<td>Baseline</td>
<td>1</td>
<td>Won 6-2</td>
<td>3</td>
<td>1</td>
<td>4/104=4%</td>
</tr>
<tr>
<td>Rafael</td>
<td>4</td>
<td>Baseline</td>
<td>2</td>
<td>Won 6-1</td>
<td>2</td>
<td>2</td>
<td>4/99=4%</td>
</tr>
<tr>
<td>Rafael</td>
<td>5</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 0-6</td>
<td>3</td>
<td>1</td>
<td>4/81=5%</td>
</tr>
<tr>
<td>Rafael</td>
<td>6</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 0-6</td>
<td>1</td>
<td>1</td>
<td>2/45=4%</td>
</tr>
<tr>
<td>Rafael</td>
<td>7</td>
<td>Intervention</td>
<td>1</td>
<td>Won 6-2</td>
<td>11</td>
<td>8</td>
<td>19/132=14%</td>
</tr>
<tr>
<td>Rafael</td>
<td>8</td>
<td>Intervention</td>
<td>2</td>
<td>Lost 3-6</td>
<td>5</td>
<td>4</td>
<td>9/124=7%</td>
</tr>
<tr>
<td>Rafael</td>
<td>9</td>
<td>Intervention</td>
<td>3</td>
<td>Lost 5-7</td>
<td>13</td>
<td>3</td>
<td>16/242=7%</td>
</tr>
<tr>
<td>Maria</td>
<td>1</td>
<td>Baseline</td>
<td>Pro</td>
<td>Lost 2-8</td>
<td>2</td>
<td>3</td>
<td>5/85=6%</td>
</tr>
<tr>
<td>Ana</td>
<td>1</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 1-6</td>
<td>0</td>
<td>1</td>
<td>1/74=1%</td>
</tr>
<tr>
<td>Ana</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 1-6</td>
<td>0</td>
<td>1</td>
<td>1/101=1%</td>
</tr>
<tr>
<td>Ana</td>
<td>3</td>
<td>Baseline</td>
<td>Pro</td>
<td>Lost 2-8</td>
<td>1</td>
<td>1</td>
<td>2/99=2%</td>
</tr>
<tr>
<td>Ana</td>
<td>4</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 1-6</td>
<td>2</td>
<td>2</td>
<td>4/60=7%</td>
</tr>
<tr>
<td>Ana</td>
<td>5</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 0-6</td>
<td>1</td>
<td>1</td>
<td>2/59=3%</td>
</tr>
<tr>
<td>Novak</td>
<td>1</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 3-6</td>
<td>4</td>
<td>5</td>
<td>9/112=8%</td>
</tr>
<tr>
<td>Novak</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 1-6</td>
<td>4</td>
<td>5</td>
<td>9/97=10%</td>
</tr>
<tr>
<td>Novak</td>
<td>3</td>
<td>Baseline</td>
<td>1</td>
<td>Won 6-0</td>
<td>1</td>
<td>4</td>
<td>5/39=13%</td>
</tr>
<tr>
<td>Novak</td>
<td>4</td>
<td>Baseline</td>
<td>Pro</td>
<td>Won 8-4</td>
<td>2</td>
<td>2</td>
<td>4/72=6%</td>
</tr>
<tr>
<td>Jelena</td>
<td>1</td>
<td>Baseline</td>
<td>1</td>
<td>Won 6-0</td>
<td>2</td>
<td>5</td>
<td>7/27=26%</td>
</tr>
<tr>
<td>Jelena</td>
<td>2</td>
<td>Baseline</td>
<td>2</td>
<td>Won 6-0</td>
<td>1</td>
<td>0</td>
<td>1/39=3%</td>
</tr>
<tr>
<td>Jelena</td>
<td>3</td>
<td>Baseline</td>
<td>1</td>
<td>Won 6-0</td>
<td>1</td>
<td>0</td>
<td>1/21=5%</td>
</tr>
<tr>
<td>Jelena</td>
<td>4</td>
<td>Baseline</td>
<td>2</td>
<td>Won 6-0</td>
<td>0</td>
<td>0</td>
<td>0/34=0%</td>
</tr>
<tr>
<td>Jelena</td>
<td>5</td>
<td>Baseline</td>
<td>1</td>
<td>Lost 2-6</td>
<td>3</td>
<td>3</td>
<td>6/126=5%</td>
</tr>
<tr>
<td>Jelena</td>
<td>6</td>
<td>Baseline</td>
<td>2</td>
<td>Lost 0-6</td>
<td>1</td>
<td>0</td>
<td>1/35=3%</td>
</tr>
</tbody>
</table>
Table 3.2.

Ranking and Win/Loss Results

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline Ranking</th>
<th>Results Ranking</th>
<th>Baseline Win/Loss</th>
<th>Results Win/Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodger</td>
<td>354</td>
<td>316</td>
<td>2-8</td>
<td>3-14</td>
</tr>
<tr>
<td>Rafael</td>
<td>129</td>
<td>115</td>
<td>22-31</td>
<td>25-35</td>
</tr>
<tr>
<td>Maria</td>
<td>143</td>
<td>139</td>
<td>4-6</td>
<td>5-7</td>
</tr>
<tr>
<td>Ana</td>
<td>657</td>
<td>624</td>
<td>11-20</td>
<td>13-27</td>
</tr>
<tr>
<td>Novak</td>
<td>31</td>
<td>32</td>
<td>40-18</td>
<td>45-22</td>
</tr>
<tr>
<td>Jelena</td>
<td>120</td>
<td>74</td>
<td>7-7</td>
<td>11-8</td>
</tr>
</tbody>
</table>

Social Validity

Social Validity questionnaires were administered to the participants when data collection was complete. Overall, participants found the procedures helpful in improving their tennis performance. Social Validity was rated on a 1-5 Likert type scale, with a score of 1 indicating strong disagreement, and a score of 5 indicating strong agreement. The results were as follows: 1) This study improved my ability to hit corners: 4.8. 2) This study made me a better tennis player: 4. 3) Goal setting was a major part of my success: 4.5. 4) Public feedback was a major part of my success: 4. 5) I enjoyed participating in this study: 4.8. 6) I would recommend this study to a friend: 4.2.
Chapter Four

Discussion

This study showed that the use of goal setting and publicly posted feedback improved the ability to hit corners on the tennis court. The results add to the research supporting goal setting and publicly posted feedback applied to athletic performance. Prior research found that goal setting with publicly posted feedback improved skill level to around 90%. The present study found that the same procedures improved skill level to around 20%. Several differences between the studies could explain this discrepancy. First, previous research applied the procedures to soccer and football among high school and college level athletes. The present study examined these procedures applied to tennis among younger athletes. Also, it could be argued the skills in the present study were more difficult than the skills measured in previous research. In previous research, the participants had higher baseline levels, while baseline levels in the current study were around 12%. It was difficult to know whether the improvement was significant, as previous research has not addressed corner percentage.

Strengths

Each participant’s score improved from baseline. A moderate sample size was used, indicating the procedures were likely to show generalizability to other participants. The procedures took place during regularly scheduled clinic hours, which was convenient for the participants and their parents. The goal setting
procedure took very little time and did not cost any money. The public posting of feedback required the creation of the charts requiring minimal regular maintenance and was cost effective. The procedures were simple and data could be collected by coaches or even parents hoping to help the player improve their game. The participants seemed to enjoy the procedures, and the social validity results were high. Total IOA scores were high. The data collection took place on site, which allowed the feedback to be immediate.

Weaknesses

More session data could have indicated further improvement. The principal investigator was unable to continue collecting data as school concluded for the summer and the clinics at the tennis academy ended. Also, this precluded follow-up data collection to assess skill maintenance.

The corners were very difficult to hit as they were quite small for this age/ability group. Professional players could be expected to hit corners this size approximately 90% of the time; however the participants in this study were not ready for this corner size. A national player within this age group participated in one session identical to baseline procedures and scored 36%. Had the corners been larger, more improvement may have been seen.

On average, the participants hit corner 2 64% of the time. For right handed players, Corner 2 is the backhand, which is generally considered harder to hit than the forehand.

Corner IOA scores were less than desirable at 74% average. Data were collected by eyesight only, and sometimes it was difficult to tell whether or not a
corner was hit as there was no indication on the court of the corner dimension. This could have been improved had the data collection taken place on a clay court, where the court could have been marked to indicate the corner dimensions.

The tournament data should be viewed with consideration of a variety of confounding variables, such as the participant and/or his or her opponent could have had a particularly good or bad day, not representative of his or her ability. More tournament data should have been collected. It is important to note here that the last two tournament’s scheduled for the present study were cancelled due to none of the participant’s signing up for the tournaments. It was expected the tournament data would be much lower than the clinic data, as not every return was appropriate for hitting a corner; however, it was expected the tournament data would improve over time. The tournament data showed no effects. Had the procedures carried on longer, more effects may have been seen. Rafael was the only participant with tournament data in the intervention phase and his tournament data were highly unreliable. During tournaments, reliability data were not collected for four participants.

When a corner was hit during tournaments, often the opponent mistakenly called the ball out. It was possible the opponent really thought the ball was out, or the opponent could have been cheating. Either way, the participant’s corner hitting may have been punished.

The clinic data took place on a hard court, while each tournament took place on clay courts. The court surface should have remained consistent from
clinic to tournament sessions. The court surface made a difference in the way the ball bounced. The clay slowed the ball down, giving the athlete more time to hit the ball; therefore, if a corner were hit on a clay surface, the opponent would have been more likely to return the ball. Also, on clay, the corner should have been easier for the participant to hit as he or she had more time to get set up to hit the ball.

**Future Research**

Future researchers should continue to apply behavior analytic techniques to improve tennis performance. The data collection procedures in this study could be applied to improving a variety of shots on the tennis court including the serve, forehand, backhand, volley, etc. Additionally, behavior analytic techniques could be used to improve non-athletic behaviors maladaptive to the athletic performance such as negative self talk, rushing the serve, negative body language, etc.

Future researchers could apply behavior analytic techniques to reduce miss-calls. Miss-calls were observed in tournament sessions frequently. It was unknown to the principal investigator whether the miss-calls were done intentionally (cheating) or unintentionally. It is possible miss-calls would decrease if the participants were told miss-calls would be recorded by the data collector (reactivity).

The present study examined corners 1 and 2 out of six potential corners. Future researchers could collect data on all six corners. Future researchers could change the size of corners according to the ability level of the participant. As
previously suggested, a shaping procedure could be used to improve corner hitting ability.

Future researchers could use clay courts for clinic data collection, as the court could be marked in such a way the data collectors could see the corner dimensions and the participant could not. The participant should not be able to see the corner marks as this could put corner hitting under stimulus control of the marks, decreasing the likelihood of generalization from clinic to tournament sessions. Future researchers could also utilize video taping for reliability scoring purposes.

Future researchers could modify the data collection procedures in this study to a variety of sports. Behavior analytic techniques are under-studied in athletics. Behavior analysis is clearly effective in improving sport performance, and applying behavior analysis to sports could be a vehicle to introduce behavior analysis to people who enjoy playing or watching sports. This could increase awareness and improve public relation of behavior analysis in general and improve its standing with those who equate behavior analysis of today with behavior modification of yesterday.

Conclusion

Goal setting with publicly posted feedback was effective in improving corner hitting ability during clinic sessions with intermediate-level tennis players aged 8-15.

This study took an Antecedent-Behavior-Consequence (ABC) approach, as behavior analytic theory suggests is the most effective way to change
behavior. The goal setting acted as a stimulus, or an antecedent to the corner hitting behavior, while the publicly posted feedback acted as the consequence. It would be interesting to know whether the goal setting would have been effective without the consequence and/or whether the publicly posted feedback would have been effective without the antecedent. Typically, the participants did not meet their goals, but this seemed irrelevant. The fact that a goal was set seemed more important than reaching the goal.

The site for this thesis, McMullen Tennis Complex, continues to utilize the procedures in a modified fashion. The athletes are instructed to set goals for themselves during practice and tournaments, and match results are posted to the “Wall of Champions.”
References


complex basketball skills. *Journal of Sport & Exercise Psychology, 10*, 408-417.


Schmidt, K., & Miller, R (Eds.). (Fall, 2001). *Fun in the Sun: The City of Clearwater Parks & Recreation Program Guide*. Clearwater, FL: City of Clearwater Parks & Recreation Department.


Appendices
Appendix A: Parental Informed Consent.

Parental Informed Consent to Participate in Research
Information to Consider Before Taking Part in This Research Study

IRB Study #_____________________

Researchers at University of South Florida (USF) are asking you to allow your child to take part in a research study to improve tennis performance.

We are asking you to take part in a research study that is called: Will Goal Setting and Publicly Posted Feedback Affect Tennis Performance?

The person who is in charge of this research study is Gretchen Mathews. This person is called the Principal Investigator. Gretchen is advised by Dr Trevor Stokes at USF.

The research will be conducted at McMullen tennis Complex.

Why is this research being done?
We hope to improve your child’s tennis performance by setting goals and giving feedback through coaching about hitting corners on the tennis court.

Should your child take part in this study?
This form tells you about this research study. After reading through this form and having the research explained to you by someone conducting this research, you can decide if you want your child to take part in it.

You may have questions this form does not answer. If you do have questions, feel free to ask the study doctor or the person explaining the study, as you go along.

- Take your time to think about the information that has been provided to you.
- Have a friend or family member go over the form with you.
- Talk it over with someone you trust.

This form explains:
- Why this study is being done.
• What will happen during this study and what your child will need to do.
• Whether there is any chance your child might experience potential benefits from being in this study.
• The risks of having problems because your child is in this study.
• How the information collected about your child during this study will be used and with whom it may be shared.

It is up to you. If you choose to let your child be in the study, then you should sign the form. If you do not want your child to take part in this study, you should not sign the form.

Why is your child being asked to take part?
We are asking your child to take part in this research study because he or she is a good tennis player who may benefit from these procedures designed to improve tennis performance.

What will happen during this study?
During coaching we will observe how often your child hits corners while using the ball machine. We will then provide an opportunity for your child to set goals and receive feedback on their performance, which will be posted on the “wall of champions.” These procedures are consistent with currently accepted good coaching practices. These procedures will continue for up to three sessions a week for six weeks. Six players will be invited to participate in this study.

What other choices does my child have if he/she does not participate?
You have the alternative to choose not to allow your child to participate in this research study. The alternative choice is coaching as usual.

Will your child be paid for taking part in this study?
No payment will be received for participating in this study.

What will it cost you to let your child take part in this study?
There is no cost involved in addition to the usual cost of participating in the coaching.

What are the potential benefits to your child if you take part in this study?
Your child may benefit by improving their tennis performance by being able to hit more corners, which may benefit their competitive tennis performance.

What are the risks if your child takes part in this study?
There are no known risks to your child should she/he take part in this study.

The treatment might not help.
Right now we do not know for sure if it will help.
There may be side effects.
There are no foreseen side effects of these procedures, which are consistent with current coaching practices.
What if your child gets sick or hurt while you are in the study?

If your child needs emergency care:

- Go to your nearest hospital or emergency room right away. Call 911. It is important that you tell the doctors at the hospital or emergency room that your child is participating in a research study. USF does not have an emergency room or provide emergency care.

If you do NOT need emergency care:

- Go to your child’s regular doctor. It is important that you tell your child’s regular doctor that she/he is participating in a research study. If possible, take a copy of this consent form with you when you go.
- The USF Medical Clinics may not be able to give the kind of help your child needs. You may need to get help somewhere else.

If your child is harmed while taking part in the study:

If you believe your child has been harmed because of something that is done during the study, you should call Gretchen Mathews at 850-212-1924 immediately.

University processes and procedures regarding human research are in place to help prevent any injuries during the course of studies. Should you believe, however, that you have been hurt or if you get sick because of something that is done during the study, you should call Gretchen Mathews at 850-212-1924 immediately.

Please understand that the University of South Florida is unable to pay for the cost of any care or treatment that might be necessary because your child gets hurt or sick while taking part in this study. If treatment cost is incurred, it could be paid by either the sponsor of the study (if they have agreed) or you. Also, the University may not pay for any wages you may lose if you are harmed by this study. The University of South Florida is a state agency and, as such, may not be sued in some instances. If, however, it can be shown that a USF employee or agent, such as your child’s study doctor, is negligent in performing the study in a way that harms your child during the study, you may be able to sue, but the amount of damages (money) you could recover would be limited by state law.

Medical costs that result from research-related harm may not qualify as regular medical costs. The University of South Florida may not be allowed to bill your child’s insurance company, Medicare, or Medicaid for such costs. You should ask your insurer if you have any questions about your insurer’s willingness to pay under these circumstances. The costs related to your child’s care and treatment because of something that is done during the study will be your responsibility.

You can also call the USF Self-Insurance Programs (SIP) at 1-813-974-808 if you think:

- Your child was harmed because s/he took part in this study.
- Someone from the study did something wrong that caused your child harm, or did
not do something they should have done.

- Ask the SIP to look into what happened.

**How will you keep my child’s information confidential?**

There are federal laws that say we must keep your child’s study records private. We will keep the records of this study private by keeping records in locked filing cabinets at the McMullen Tennis Complex.

We will keep the records of this study confidential by not revealing participants identities in any discussion of this study.

However, certain people may need to see your child’s study records. By law, anyone who looks at your child’s records must keep them completely confidential. The only people who will be allowed to see these records are:

- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. These include the University of South Florida Institutional Review Board (IRB) and the staff that work for the IRB. Individuals who work for USF that provide other kinds of oversight to research studies may also need to look at your records.

- Other individuals who may look at your records include: the Department of Health and Human Services (DHHS) and from the Office for Human Research Protection (OHRP). This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.

**What if new information becomes available about the study?**

During the course of this study, we may find more information that could be important to you. This includes information that, once learned, might cause you to change your mind about having your child be in this study. We will notify you as soon as possible if such information becomes available.

**What happens if you decide not to let your child take part in this study?**

You should only let your child take part in this study if both of you want to. You or child should not feel that there is any pressure to take part in the study to please the research staff.

You can decide after signing this informed consent document that you no longer want your child to take part in this study. We will keep you informed of any new developments that might affect your willingness to allow your child to continue to participate in the study. However, you can decide if you want your child to stop taking part in the study for any reason at any time. If you decide you want your child to stop taking part in the study, tell the study staff as soon as you can. Your child can continue in the regular coaching program.
Even if you want your child to stay in the study, there may be reasons we will need to take him/her out of it. Your child may be taken out of this study if:

- Your child is not coming for coaching sessions.

You can get the answers to your questions, concerns, or complaints.

If you have any questions, concerns or complaints about this study, call Gretchen Mathews at 850-212-1924.

If you have questions about your child’s rights, general questions, have complaints or concerns, or questions about your child’s rights as a person taking part in this study, call the Division of Research Integrity and Compliance of the University of South Florida at (813) 974-9343.

If your child experiences an adverse event or unanticipated problem call Gretchen Mathews at 850-212-1924

Statement Of Participation in Research

It is up to both parents to decide whether you want your child to take part in this study. If you want your child to take part, please read the statements below and sign the form if the statements are true.

I freely give my consent to let my child take part in this study. I understand that by signing this form I am agreeing to let my child take part in research. I have received a copy of this form to take with me.

_____________________________                             __________________________
Signature of Parent of Child Taking Part in Study                     Date

_____________________________
Printed Name of Parent of Child Taking Part in Study

_____________________________                             __________________________
Signature of Parent of Child Taking Part in Study                     Date

_____________________________
Printed Name of Parent of Child Taking Part in Study

Signatures of both parents are required unless one parent is not reasonably available, deceased, unknown, legally incompetent, or only one parent has sole legal responsibility for the care and custody of the child. When enrolling a child participant, if only one signature is obtained, the person obtaining the consent must check on of the reasons listed below:

The signature of only one parent was obtained because:

☐ The other parent is not reasonable available. Explain: __________________________________________

48
☐ The other parent is unknown
☐ The other parent is legally incompetent
☐ The parent who signed has sole legal responsibility for the care and custody of the child

______________________________    ____________________
Signature of Witness                Date

______________________________
Printed Name of Witness

**Statement of Person Obtaining Informed Consent**

I have carefully explained to the person taking part in the study what he or she can expect.

I hereby certify that when this person signs this form, to the best of my knowledge, he or she understands:

- What the study is about.
- What procedures/interventions/investigational drugs or devices will be used.
- What the potential benefits might be.
- What the known risks might be.
- How the information collected about the person will be used.

I also certify that he or she does not have any problems that could make it hard to understand what it means to take part in this research. This person speaks the language that was used to explain this research.

This person reads well enough to understand this form or, if not, this person is able to hear and understand when the form is read to him or her.

This person does not have a medical/psychological problem that would compromise comprehension and therefore makes it hard to understand what is being explained and can, therefore, give informed consent.

This person is not under any type of anesthesia or analgesic that may cloud their judgment or make it hard to understand what is being explained and, therefore, can be considered competent to give informed consent.

______________________________    ____________________
Signature of Person Obtaining Informed Consent                Date

______________________________
Printed Name of Person Obtaining Informed Consent
Appendix B: Child Assent.

Assent to Participate in Research
University of South Florida
Information for Individuals under the Age of 18 Who Are Being Asked To Take Part in Research Studies

Will Goal Setting and Publicly Posted Feedback Affect Tennis Performance?

WHY AM I BEING ASKED TO TAKE PART IN THIS RESEARCH?
You are being asked to take part in a research study about tennis performance. You are being asked to take part in this research study because you are a good tennis player who could benefit from additional instruction. You are eligible for this study because you are aged 7-17, you are in the top 100 in your age/gender division, and your coach identified you as having potential to play professional tennis in the future. If you take part in this study, you will be one of about six people in this study.

WHO IS DOING THE STUDY?
The person in charge of this study is Gretchen Mathews (PI) of The University of South Florida. She is being guided in this research by Trevor Stokes, PhD. of The University of South Florida.

WHAT IS THE PURPOSE OF THIS STUDY?
By doing this study, we hope to learn whether goal setting and publicly posted feedback will improve your ability of hitting corners 1 and 2.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?
The study will take place at The McMullen Tennis Complex. You will be asked to come to McMullen three times per week for six weeks during the study. Each of those visits will take about 20 minutes. The total amount of time you will be asked to volunteer for this study is six hours over the next six weeks.

WHAT WILL I BE ASKED TO DO?
Using a ball machine, you will be asked to aim for corners 1 and 2 alternately for 200 balls. Research Assistants will calculate how many corners you hit. Every week you will be asked to set a goal for how many corners you can hit. After each session, the number of corners you hit will be posted on the “Wall of Champions” for everyone to see.
WHAT THINGS MIGHT HAPPEN THAT ARE NOT PLEASANT?
To the best of our knowledge, the things you will be doing will not harm you or cause you any additional unpleasant experience.

WILL I GET BETTER IF I TAKE PART IN THIS STUDY?
We cannot promise you that anything good will happen if you decide to take part in this study.

DO I HAVE TO TAKE PART IN THE STUDY?
You should talk with your parents or anyone else that you trust about taking part in this study. If you do not want to take part in the study, that is your decision.
You should take part in this study because you really want to volunteer.

IF I DON’T WANT TO TAKE PART IN THE STUDY, WHAT WILL HAPPEN?
If you do not want to take part in the study, you can continue to participate in clinic sessions as usual.

WILL I RECEIVE ANY REWARDS FOR TAKING PART IN THE STUDY?
You will not receive any reward for taking part in this study.

WHO WILL SEE THE INFORMATION I GIVE?
Your information will be added to the information from other people taking part in the study so no one will know who you are. Your results will be posted with your name on the “Wall of Champions.”

CAN I CHANGE MY MIND AND QUIT?
If you decide to take part in the study you still have the right to change your mind later. No one will think badly of you if you decide to quit. Also, the people who are running this study may need for you to stop. If this happens, they will tell you why.

WHAT IF I HAVE QUESTIONS?
You can ask questions about this study at any time. You can talk with your parents or other adults that you trust about this study. You can talk with the person who is asking you to volunteer.
If you think of other questions later, you can ask them.

Assent to Participate
I understand what the person running this study is asking me to do. I have thought about this and agree to take part in this study.

Name of person agreeing to take part in the study _____________________________ Date __________

Name of person providing information to subject _____________________________ Date __________
Appendix C: Tennis Thesis Clinic Data Collection Sheet.

Date: ______  Participant: ____________  Data Collector: ____________  Goal: ______

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# Appendix D: Tennis Thesis Tournament Data Collection Sheet

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Total 2: ___________  Total Out: ___________  Total ----: ___________

53
Appendix E: Social Validity Questionnaire

Indicate how much you agree with each statement from 1-5 with five meaning strongly agree, and one meaning strongly disagree.

1. This study improved my ability to hit corners:
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

2. This study made me a better tennis player:
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

3. Goal setting was a major part of my success
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

4. Public feedback was a major part of my success
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

5. I enjoyed participating in this study
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

6. I would recommend this study to a friend
   1 2 3 4 5
   Strongly Disagree Neutral Strongly Agree

What could have been done to improve this study? __________________________________________
__________________________________________________________

What did you like most about this study?
__________________________________________________________
__________________________________________________________

Additional Feedback: ________________________________________
__________________________________________________________

54
Appendix F: Clinic Session Data

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About the Author

Gretchen Mathews is a Master of Arts Degree student of Applied Behavior Analysis at the University of South Florida. She lives in Clearwater, Florida.