

*BEHAVIORAL COACHING IN THE DEVELOPMENT
OF SKILLS IN FOOTBALL, GYMNASTICS, AND TENNIS*

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A review of the literature indicates that methods of skill acquisition based on the operant paradigm have been scientifically validated with many motor behaviors. However, these procedures have been limited to the use of positive reinforcement for correct performance when applied to the acquisition of complex sports skills in natural settings. To find complementary procedures to enhance skill acquisition, a coaching method involving several behavioral techniques was developed that focused on remediation of errors. This coaching method combined the following components: (1) systematic use of verbal instructions and feedback, (2) positive and negative reinforcement, (3) positive practice, and (4) time out. Three sports, football, gymnastics, and tennis, were selected to determine the effectiveness and generality of this behavioral coaching method. A total of 23 male and female subjects, ranging in age from 11 to 35, was included in this study. Baseline data were first collected for each sport under standard coaching conditions. Next, the behavioral coaching method was evaluated depending on the sport in either a multiple baseline or a reversal design. The behavioral dimensions selected were blocking in football; backward walkovers, front hand springs, and reverse kips in gymnastics; and the forehand, backhand, and serve in tennis. Behavioral coaching was immediately effective in increasing the correct execution of complex skills in all three sports. Gains of up to 10 times the baseline performance were achieved in each sport. In football, behavioral coaching resulted in an increase in correct blocking performance from a baseline average of 5% to 51.3%. Gymnasts' performances increased from baseline averages of 2.7% to 52.6% across the three skills. In tennis, standard coaching produced an average of 6% correct performance which increased dramatically under behavioral coaching to 57% across the three strokes. The success of the behavioral coaching package used here suggests that a technology of behavior may offer additional and complementary strategies to the acquisition of motor skills in the natural environment.

DESCRIPTORS: standard vs. behavioral coaching, sports skills, natural consequences, functional analysis, physical education, athletic environments

Operant techniques have been used extensively to develop and improve motor behaviors. They have been used with gross motor behaviors in physically and mentally handicapped populations as well as with intermediary and fine motor skills in normal populations. Where the physical disability is severe, operant procedures have established motor control in cerebral-palsied

children (Foss, 1966; Rice, McDaniel, & Denney, 1968) and participation in progressive resistance exercises in quadri- and paraplegic adults (Trotter & Inman, 1968). Similarly, mentally retarded children have been taught to walk on crutches (Horner, 1971) and to walk rather than crawl (O'Brien, Azrin, & Bugle,

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1972). Mentally ill and retarded individuals have learned work skills through behavioral techniques such as the token economy (Ayllon & Azrin, 1968). Gross motor behavior of a simplified nature has also been developed in normal adults. In two studies using portable operant apparatus, the posture of adults was improved from a slouching position to a proper postural position (Azrin, Rubin, O'Brien, Ayllon, & Roll, 1968; O'Brien & Azrin, 1970). Further progress in utilizing operant procedures for developing gross motor skills in a normal population was made by Hardiman, Goetz, Reuter, and LeBlanc (1975) with a preschool child (walking longitudinally through a ladder, climbing stairs, sliding down a board, rolling on the ground, climbing a ladder, and walking on a balance board). Operant conditioning procedures have also been used to develop and improve fine motor skills, such as writing (Schwarz & Hawkins, 1970), and freehand printing in young children (Brigham, Finrock, Breunig, & Bushell, 1972; Miller & Schneider, 1970; Salzberg, Wheeler, Devar, & Hopkins, 1971).

Applying the growing technology of the operant model to teaching complex sports skills appears to be a logical extension of such research, as Rushall and Siedentop (1972) have noted. Thus far, however, there have been few applications of the operant model to sports.¹ For example, in swimming, reinforcement has been used to increase attendance at practice and increase number of laps swum by the individuals involved each day (McKenzie and Rushall, 1974; Rushall & Pettinger, 1969). The procedures included written instructions and self-recording on "program boards" with opportunities for social reinforcement such as attention and praise from coaches and peers. Similarly, in football, reinforcement, in the form of checklists and praise,

was employed to increase instances of correct play execution by members of the offensive backfield (Komaki & Barnett, 1977).

These studies show that athletic performance can be increased through contingent reinforcement in the form of knowledge of results and social attention. A complementary behavioral tactic to maximize performance might be to reduce performance errors directly through response contingent consequences. The reduction and elimination of a variety of unwanted responses have been achieved through various behavioral procedures. Among these are: extinction (Griffin, Locke, & Landers, 1975; Pinkston, Reese, LeBlanc, & Baer, 1973; Sajwaj, Twardosz, & Burke, 1972); time out (Bostow & Bailey, 1969; Burchard & Barrera, 1972; Clark, Rowbury, Baer & Baer, 1973; White, Neilsen, & Johnson, 1972); and response cost (Burchard & Barrera, 1972; Doty, McInnis, & Paul, 1974).

Recently these and other behavioral techniques have been integrated into complex "packages" that maximize their overall inhibiting effects on undesirable behaviors and facilitate self-corrective ones. For example, the technique of "over-correction" (Foxy & Azrin, 1972, 1973) and positive practice have been found to be effective for a variety of applied problems (Azrin & Foxy, 1971; Webster & Azrin, 1973). The over-correction procedures in these studies have combined a number of factors which singly, or in combination, may contribute to behavior change. Among these factors are feedback, time out, punishment, and negative reinforcement (Epstein, Doke, Sajwaj, Sorrell, & Rimmer, 1974).

Influenced by Azrin's tactics of eliminating unwanted responses and facilitating self-corrective ones, the effort in the present study was to design a behavioral package to be used by the coach without interfering with the ongoing activities of athletic practice. Indeed, any drastic departure from standard procedures most likely would have prompted resistance and challenging by the coaches and the athletes in training. Therefore, it was felt the procedure should pos-

¹Although ingenious behaviorally based procedures have been reported (Suinn, 1976), the emphasis has been on the use of imaginal rehearsal of athletic skills to minimize anxiety and to facilitate performance under actual competitive conditions. This novel approach to maintain sports skills in accomplished athletes still awaits full experimental validation.

sess face validity in the context of training, take no more time than that typically spent by coaches giving feedback, rely on no other additional personnel than the regular coaching staff, and allow quantification to determine the specific effects of the procedure on well-defined athletic performance.

The present research examined the effectiveness of a coaching "package" of behavioral methods in facilitating skill acquisition in football, gymnastics, and tennis.² Clearly the "package" explored in this study does not exhaust the potentially effective "packages" that could be derived from the same behavioral techniques.

STUDY 1: FOOTBALL

Subjects

Five males, ages 11 and 12, participated. The subjects were from an original number of eight (three dropped out of football) on the "second string" of a team in a citywide youth football program. The entire second string was selected because they completely lacked fundamental football skills, according to the coaches.

Setting and Personnel

Football practice was held three times weekly for 90 min each time on the athletic field of a large suburban park. Additionally, a game against other selected teams was played each week in the same park. Personnel included a coach, a second coach who served as reliability observer, and an experimenter who served as primary observer-recorder. The coach carried out all procedures investigated in the present study, as instructed by the experimenter. At no time did the experimenter interact with the players or instruct or correct the coach in front of the players.

Behavioral Assessment and Recording

The behavioral dimension selected for study was blocking, defined as follows:

²For additional information on subject populations and behavioral dimensions and designs, see Allison (unpublished).

Block. To be correct, the block must contain the following elements: (a) the body must be behind the line of scrimmage; (b) 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; (c) there must be no movement until the snap when movement must be immediate; (d) 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; (e) his arms can be thrust away from the body in the folded position but they must not unfold; (f) the player cannot grasp the opponent with his hands nor about the opponent's body with his head; (g) 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 (h) the player must maintain body contact with his opponent until the whistle blows.

Reliability

In football, reliability was assessed by having a second observer simultaneously with the experimenter but independently, record each trial for each subject as either correct or incorrect. The records were compared trial by trial and percentage agreement calculated by dividing the total number of agreements by the number of agreements plus disagreements and multiplying by 100 for each dimension.

Method of Evaluation

Behavioral coaching was evaluated by a multiple baseline across four subjects and a reversal (ABAB) with one other.

General Procedure

Each player was given the opportunity to exhibit blocking in football in sets of 10 trials. Ordinarily, a practice session allowed a minimum of one set and a maximum of four. The block was recorded as correct or incorrect on each trial, and the data were graphed as percent-

age correct out of 10 trials for each set of 10 trials. Baseline conditions consisted of the coaches' own standard method of instruction.

Description of Standard Coaching

The method of coaching football used by the football coach in this study began with the coach verbally instructing the players in what he wanted them to do and having them try the skill. If they were correct, the coach intermittently said "good" or "that's better." When block execution was incorrect, the coach loudly informed the player and, at times, commented on the player's stupidity, lack of courage, awareness, or even worse. If the players continued to block incorrectly, the coach sometimes modeled the play or just made verbal corrections while having the players run the play or execute the skill over and over again. Continued errors sometimes resulted in his requiring that the player run laps or move on to a different skill or play without having perfected the initial one.

Procedure for Behavioral Coaching

The experimenter taught the football coach a specific format to ensure consistency in coaching each player. The coach proceeded through the following steps:

1. *Executing the play.* This consisted of the coach's instructions to the athlete regarding the specific play and the consequences. For example, the coach would say, "When I blow this whistle, I want you to block Myron. If you screw up, I'm going to yell 'freeze,' and I want you to freeze—stop exactly in the position you're in and do not move until I tell you. I'm going to try to see what you're doing wrong so I can help you to learn to block better. If you do it right, I'll let you know and you don't have to freeze. O.K.?"

2. *Judging correct execution.* In this step, the coach decided whether or not the block was "thrown" correctly. If so, he allowed the player to complete the play, blew the whistle and told the player, "great," "right," "way to go," or a similar brief phrase. The player was then instructed to run the play again. If the block was

judged to be incorrect, the coach yelled "freeze," and then might add "hold it right where you are" or "don't move" and similar instructions if the player did not instantaneously freeze.

3. *Describing the incorrect position.* This step consisted of the coach's specific descriptions of the player's errors while the player remained in the frozen position. For example, the coach might say, "It's no wonder you're not getting any power behind that block. Your feet are so close together you don't have a stable base from which to spring. Also your elbows are down and in close to your body so that you can't prevent Myron from getting around you and throwing your block." ("Throwing" a block in football terminology means the offensive player escapes or breaks away from the defensive player who is attempting to block him.)

4. *Modeling the correct position.* At this point, the coach himself assumed the correct blocking position to facilitate imitation of the topography of his behavior. He also described the way in which it was correct and how it differed from the player. "Now stay frozen but look at me while I show you how to do this. Notice how my feet are wide enough apart to form a good base and my elbows are out but with hands into my chest. Then you can spring out and really 'hold' your block."

5. *Imitating the correct position.* The coach now had the player, himself, assume the proper blocking position during which time the coach verbally described the way in which it was correct. "Try to feel the patterns in your muscles. Notice how you have a stable base, your weight is forward, your knees are bent for driving, and your elbows are parallel to the ground. Now that's a good position that will help you to keep your opponent from throwing your block." The coach then started the sequence again from "running the play." Overall, the procedure took about 45-60 sec per trial.

RESULTS

The general findings indicate that behavioral coaching was effective in improving the execu-

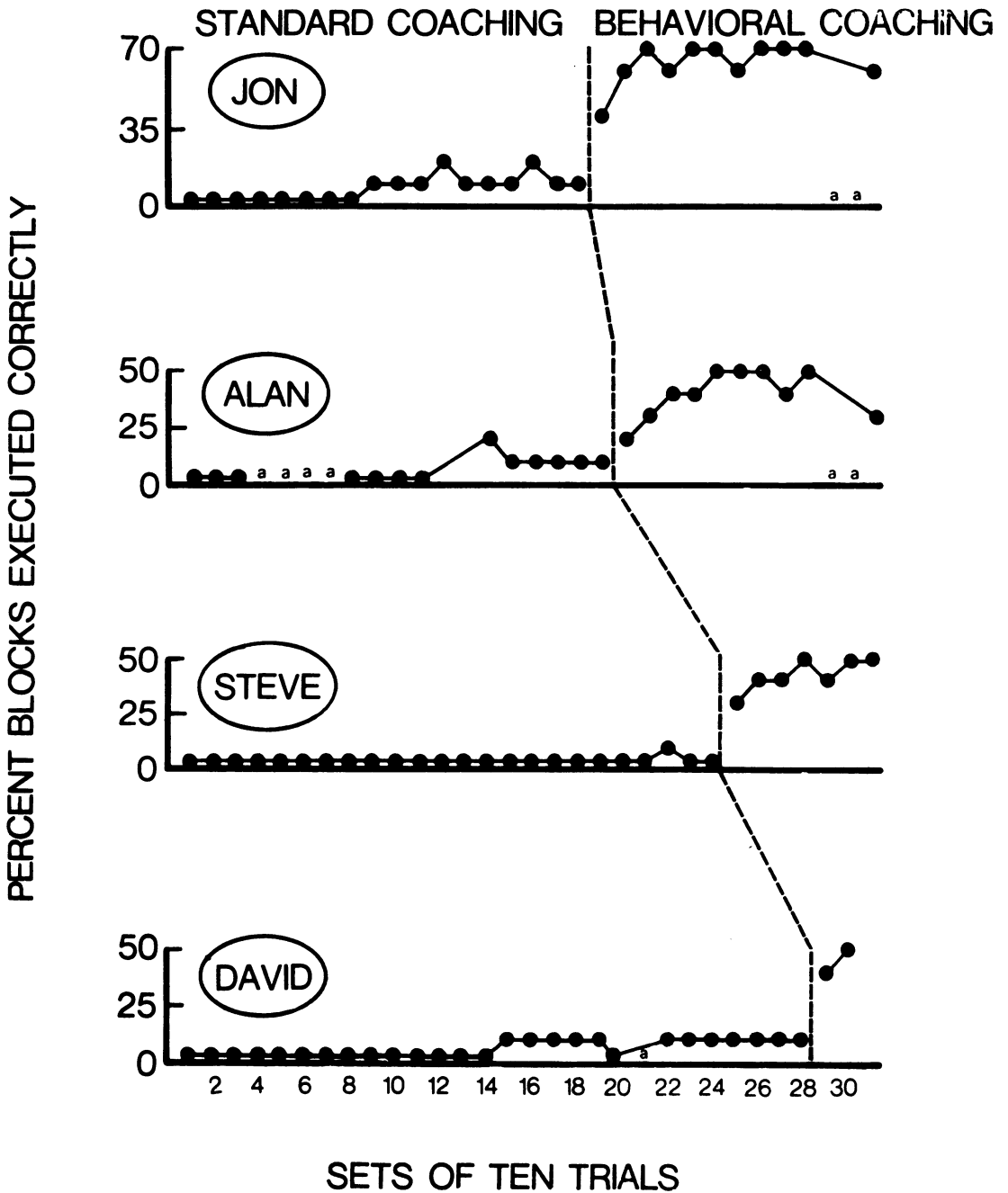


Fig. 1. The percentage of trials in which football blocks were executed correctly as a function of standard coaching and behavioral coaching. A multiple baseline across four individuals is shown.

tion of blocking with all five players in football. Observer reliability on blocking performance averaged 90% with a range of 84 to 94%.

Figure 1 illustrates the results of the multiple baseline across subjects instituting the behavioral

coaching procedure sequentially across four of the five boys. The skill execution of each player changed successively at the point that the experimental procedure was applied to blocking for all four players. Behavioral coaching increased

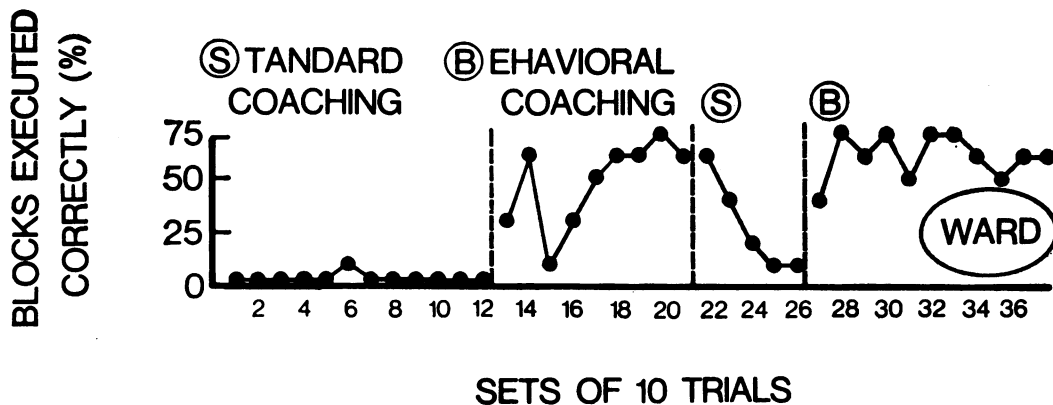


Fig. 2. The percentage of trials in which football blocks were executed correctly as a function of standard coaching (S) and behavioral coaching (B). A reversal for one individual, Ward, is shown.

performance almost tenfold for each player.

Figure 2 details the blocking performance for the remaining player. Under standard coaching conditions, Ward averaged 8.3% correctly executed blocks. Upon introduction of behavioral coaching, Ward improved to an average 48% correct which declined to about 10% under a reversal of conditions. Reintroduction of behavioral coaching again improved Ward's blocking to an average of 60% correct.

DISCUSSION

In this study, the behavioral coaching package was shown to be immediately effective in generating and improving the performance of blocking in football by five 11- and 12-year-old boys who had been selected by the coach as having severe difficulty with blocking.

The two behavioral designs (multiple baseline across four players and a reversal design with the remaining player) show the functional relationship between the behavioral coaching and the increased performance in blocking.

STUDY 2: GYMNASTICS

Football and gymnastics are highly competitive sports. In gymnastics, individual perfection is stressed in practice sessions, and team competition is stressed in meets with other schools.

However, before assessing the generality of the findings of behavioral coaching from football to gymnastics, several methodological issues had to be resolved. Perhaps the major issue was that involving the definition and recording of a gymnastic routine. The typical routine includes a series of movements in space in a smooth or blended manner which seem to defy efforts to reduce this whole into its components. This is further complicated by the inclusion of poise and grace as integral elements of the performance. Not surprisingly, in practice, these difficulties are reflected in the disparate ratings sometimes given by judges observing the same performance. The complexity of the gymnastic routine was therefore reduced into components that allowed greater specification of the movements involved in a given skill. In so doing, an acceptable level of interobserver agreement was achieved.

METHOD

Subjects

Six subjects were chosen from the B-team (nonvarsity) members of a high school girls' gymnastics team in a large suburban high school. All of the subjects were 13 and 14 years of age and exhibited a range of proficiency levels of from 0% to no higher than 20% correct on the execution of each of the following skills:

backward walkovers, front handsprings, and reverse kips. The coach deemed all of the girls to be ready to learn these skills by virtue of their performances on prerequisite skills. The remainder of the girls on the team were judged by the coach to be unprepared to work on all three of these skills.

Setting and Personnel

Gymnastics practice was held 4 to 5 times per week for 2 hr and 15 min per time in the gymnasium of the high school the girls attended. The gym was equipped with numerous tumbling mats, floor mats, and "crash pads," a horse for vaulting, two sets of uneven bars, two full size balance beams and several smaller practice beams, and other equipment unrelated to girls' gymnastics. Personnel included the coach and the experimenter. Two additional observers were present to assess reliability of observations.

Behavioral Assessment and Recording

Three dimensions were selected for study: backward walkovers, front handsprings, and reverse kips. To be considered correct, each of the following elements of the execution of the skill follow-through must be observed.

1. *Backward walkovers.* (a) As the gymnast walks over, the lead foot should touch down on the floor 18 to 24 inches behind the hands; (b) the knee of the lead leg may be bent no greater than $22\frac{1}{2}^{\circ}$, in the angle made by the calf and the thigh at the inner juncture of the knee; (c) the following leg must be in the air, straight, and the toe pointed; (d) the arms must be straight; and (e) the head must be between the arms and faced back toward the legs, not toward the floor.

2. *Front handsprings.* (a) As the gymnast lands from the handspring, the feet must be parallel to each other; (b) the gymnast must land on the two feet simultaneously, without taking additional steps; (c) the angle of the thigh and the calf at the inner knee must be 90° or greater (straighter) on landing; (d) the arms must be extended upward and straight on either side of the head; and (e) the back may be slanted

back up to $22\frac{1}{2}^{\circ}$ from the vertical but no more.

3. *Reverse kips.* (a) 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; (b) at this level position, the gymnast may unfold her kipped position, increasing the angle of the upper torso with the legs from $22\frac{1}{2}^{\circ}$ to 180° ; (c) 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; (d) the arms must be straight; (e) the legs must be straight; and (f) the toes must be pointed.

Measures of the execution of the above three skills were collected in sets of 10 trials for each skill and for each gymnast. One to two sets of 10 trials per skill were run each day, but every skill was not performed every day because of time and stamina limitations. An observer with a clipboard and recording sheet sat on the gym floor, where he or she could observe the relevant skill from a profile position, and recorded each execution of the skill as either correct or incorrect. A skill was scored incorrect when one or more parts of the definition were executed incorrectly. Each data point consisted of the percentage of each block of 10 trials that the skill was executed correctly. Reliability was assessed by having one or the other of the two reliability observers simultaneously with the experimenter, but independently, record each trial for each gymnast as either correct or incorrect. The records were compared trial by trial and percentage agreement was calculated on both the "occurrence" and the "nonoccurrence" of behavior for each skill.

Reliability was assessed separately with two different observers. With one observer reliability ranged from 87.5 to 100% averaging 91.38% on backward walkovers. The range was 86.7 to 100% and the average was 91.25% on front handsprings. For reverse kips reliability ranged from 88.1 to 100% and averaged 95.65%.

With the second observer the reliability ranged from 74.5 to 100% (90.12% average) on backward walkovers, from 74.5 to 100% (91.25% average) on front handsprings, and from 82.3 to 93.5% (89.1% average) on reverse kips. Reliability was assessed on 20 of the 44 data points, distributed evenly throughout the entire study.

Method of Evaluation

Behavioral coaching was compared to standard gymnastics instruction using a combination multiple baseline across individuals and skills with reversal designs with each behavior for each of the six gymnasts. The introduction of the experimental procedure on the three dimensions was varied to counterbalance for any order effects of perfecting a certain skill before initiating the procedure with another skill. The procedure was also introduced following varying lengths of baseline to assess the effects of extended practice under standard coaching conditions.

Description of Standard Coaching

During the standard coaching conditions of baseline in the present study, the coach verbally instructed the gymnasts in the proper execution of the skills. She sometimes modeled or had other students model the correct follow-through of a skill, and she gave verbal feedback on the gymnasts' errors. She sometimes threatened the girls with not letting them work on a skill if they did not try harder, and she praised them when they executed a skill very well. She often provided physical guidance through the skill performance. Many other techniques were involved in her overall method of instruction but were not used with the particular skills examined in the present study as they were not relevant to these skills.

Procedure for Behavioral Coaching

The experimenter taught the coach a specific format to ensure consistency in coaching each gymnast. The 5-step format was the same as the one used in football; i.e., executing the skill, judging correct execution, describing the incor-

rect position, modeling the correct position, imitating the correct position. Each step was applied to gymnastics in the coach's own words. For example, in executing the skill the coach instructed the gymnast regarding the specific skill and the consequences. "We are going to work on front handsprings. If you do it incorrectly, I'm going to say 'freeze,' just as you land on the mat, and I want you to stay in that position. Do not move until I tell you. I'm going to try to see what you're doing wrong so I can help you to learn front handsprings better. If you land off balance and fall, freeze like that. If you do a good front handspring, I won't say 'freeze' and you don't have to freeze. Let's get started. O.K.?"

RESULTS

The findings in gymnastics indicate that the behavioral coaching package was effective in generating and improving the execution of backward walkovers, front handsprings, and reverse kips in all six gymnasts.

The order of introduction of the experimental procedure to the three dimensions of behavior was varied from subject to subject, to rule out the possibility of order effects accounting for the results. This resulted in varying lengths of baseline conditions. It can be seen that the particular dimension for each subject changed precisely at the point where behavioral coaching was introduced. When behavioral coaching was discontinued, and standard coaching reinstated, the behaviors dropped dramatically. These findings show that all gymnasts improved relative to baseline levels on each behavior with the initial introduction of behavioral coaching. All gymnasts' performances declined with the first reversal to standard coaching. However, Becky, Gail (on reverse kips), and Christie maintained 30% correct execution during this reversal as opposed to a 0% correct execution during initial baseline. When behavioral coaching was introduced a second time on each behavior, all six girls again increased in correct execution of the three behaviors. With the second reversal, the six gymnasts again declined in performance but

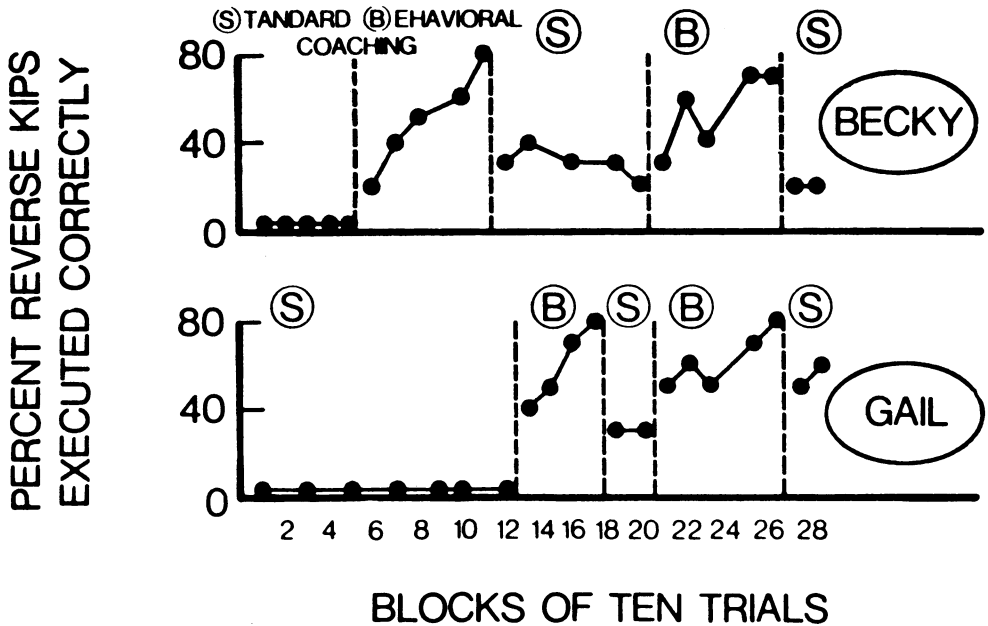


Fig. 3. The percentage of trials in which reverse kips were executed correctly as a function of standard coaching (S) and behavioral coaching (B). Reversal designs with two individuals, Becky and Gail, are shown.

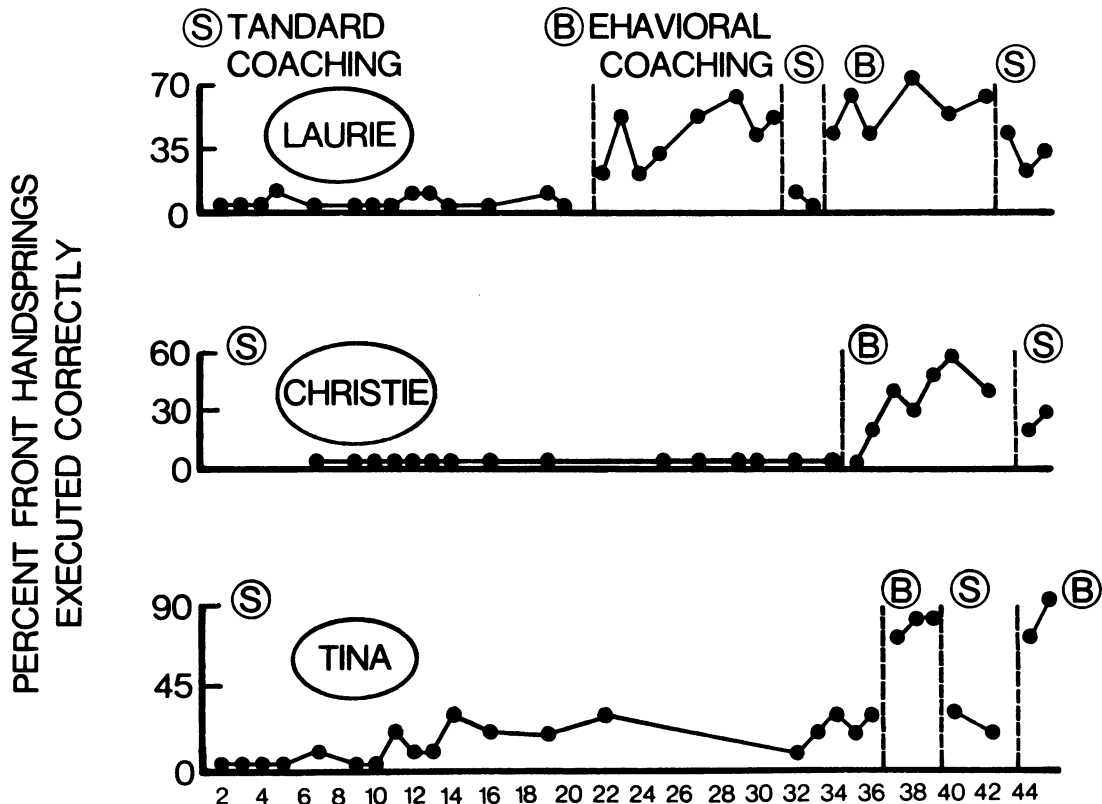
not to the extent of the first reversal. Indeed, on some skills Gail and Eileen maintained 55% correct execution. Laurie maintained 30% correct as opposed to 3 to 5% correct during baseline and first reversal. The gymnasts with lower levels of baseline performance (Becky, Eileen, and Christie) did not improve as rapidly nor to the extent that the gymnasts with more correct performances during baseline did. Figure 5 is presented to illustrate the combination of the multiple baseline across behaviors with the reversals. Eileen's and Gail's acquisition of correct execution of this skill are representative examples of the patterns for the six gymnasts.³

DISCUSSION

In gymnastics, the behavioral coaching procedure was immediately effective in both generating and improving the correct performance of backward walkovers, front handsprings, and re-

verse kips of 13- and 14-year-old females on a high school gymnastics "B-team." Through a series of designs combining multiple baselines with reversals, behavioral coaching was demonstrated to be much more effective than the standard coaching of baseline. Although the findings in football and gymnastics validate the effectiveness of behavioral coaching, the fact that both studies involve children, 11 to 14 years, limits its generalization to sports where adults are involved. Further, as both studies stressed characteristics that blended individual and team effort, one could argue that the absence of the team characteristic in an individually oriented sport might influence the effectiveness of the procedure. In the first case, children are likely to be under the control of an adult's instructions to the extent that they will obey even if the instructions seem absurd. Adults might play havoc with the procedure seeing through it or refusing to do it, calling it inconvenient or humiliating. This form of behavioral coaching might have the opposite effect under these conditions. In the second case, an individually oriented sport, the subjects may not be under peer pressure to perform well. So-

³As used in this paper, "standard" coaching is a generic term to describe what these coaches did and includes comments, admonitions, praise and variations on the same typically employed by them in their training-teaching interaction with their trainees.



BLOCKS OF TEN TRIALS

Fig. 4. The percentage of trials in which front handsprings were executed correctly as a function of standard coaching (S) and behavioral coaching (B). Reversal designs with three individuals, Laurie, Christie, and Tina, are shown.

cial motivators could mask individual reactions to the procedure. To explore the scope of the effectiveness of this behavioral coaching strategy, a third study was conducted with adults in the individually oriented sport of tennis.

STUDY 3: TENNIS

A third study was conducted with adults in tennis to attempt to answer remaining questions concerning the generality of the present behavioral coaching method.

METHOD

Subjects

Twelve students enrolled in tennis instruction at a large urban university participated in this

study. Of the 12 students, 3 were male and 9 were female. Their ages ranged from 18 to 35 years. All 12 students fell below 40% correct on the execution of each of the following strokes: the forehand, the backhand, and the serve.

Setting and Personnel

The tennis class was held on an indoor tennis court. Personnel included a tennis instructor (who carried out all procedures), an experimenter, and a reliability observer.

Behavioral Assessment and Recording

Three dimensions were selected for study: the forehand, the backhand, and the service. The

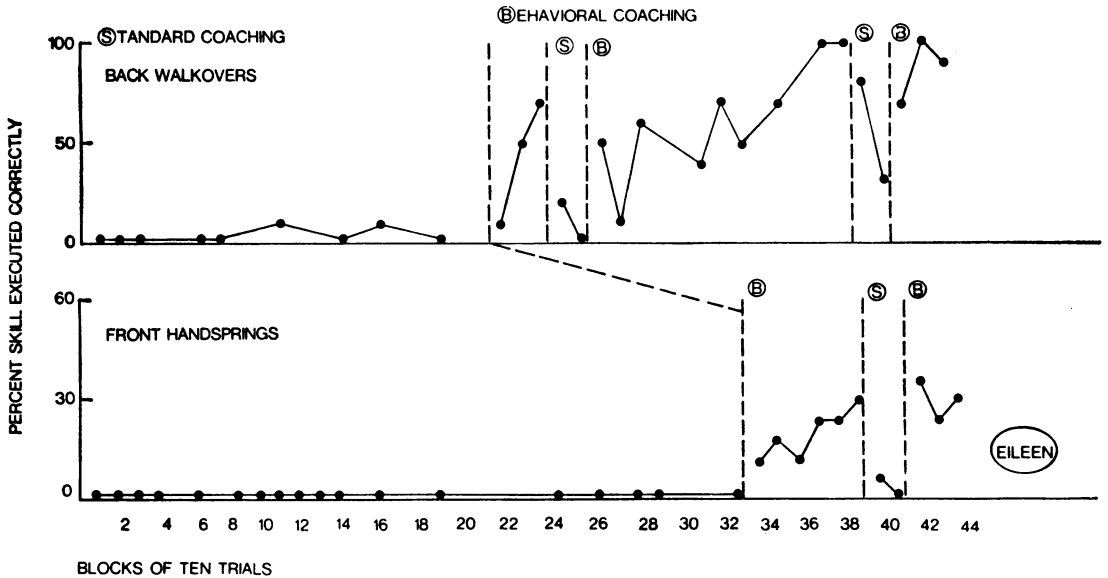


Fig. 5. The percentage of trials in which backward walkovers and front handsprings were executed correctly as a function of standard coaching (S) and behavioral coaching (B). A combination multiple baseline across behaviors with reversals within behaviors design is shown for Eileen.

definitions of these dimensions were in terms of a correct stroke finish. To be considered correct each of the following elements of the strokes had to be observed.

1. *Forehand.* (a) The grip must be either the standard Eastern forehand, the Continental, or the Australian (details available on request); (b) the left foot of a right-hander or the right foot of a left-hander must be stepping toward the net while the opposite foot must be 180° behind it pointed toward the back of the court; (c) the weight must be on the front foot; (d) the front knee must be bent; (e) the toe only of the back foot must be touching the court; (f) the hips must be within 45° of being parallel to the net; (g) the elbow of the racket arm must not be bent more than 20°; (h) the rim of the racket must be pointing straight ahead into the opposite court; (i) the racket must be above waist level; (j) the racket head must not be lower than the wrist; and (k) the face of the racket must be perpendicular to the court.

2. *Backhand.* (a) The grip must be the standard Eastern backhand grip or the Continental grip (details available upon request); (b) 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° behind it pointed toward the back of the court; (c-k) the same elements as the forehand.

3. *Service.* (a) The grip must be any of the standard forehand grips detailed above or an Eastern backhand grip; (b) the left foot of a right-hander or the right foot of a left-hander should be within 3 to 4 inches of the baseline or closer but not touching the baseline at about a 45° angle to the baseline; (c) at the finish the opposite foot must be either pointed toward the back of the court with the toe only touching the court or one step into the court; (d) 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; (e) the knees must be slightly bent; (f) the hips should be parallel to the net; (g) the racket arm must be straight and aligned with the body; (h) the racket must be on the opposite side of the body from the racket arm (left side for right-handers); (i) the racket should come to rest pointing down at the court or slightly behind the body pointing toward the

back of the court; and (j) the racket face should be parallel to the net plane.

Reliability

In tennis, reliability was assessed by having a second observer simultaneously with the experimenter, but independently, record each trial for each subject as either correct or incorrect. The records were compared trial by trial and percentage agreement calculated on both the "occurrence" and the "nonoccurrence" of behavior. The percentage agreement on "occurrence" of the behavior was calculated by dividing the total number of agreements that a correct execution occurred by the total number of agreements that a correct execution occurred plus the number of disagreements that a correct execution occurred. The percentage agreement on "nonoccurrence" of the behavior was calculated in a similar manner for incorrect executions of the skills. These figures were then multiplied by 100, added together, and divided by 2 for each dimension. Reliability during behavioral coaching ranged from 73.2 to 96.6% for the forehand and averaged 92.3%. For the backhand, the range was 74.7 to 100%, with an average of 91.1%. Reliability on the serve ranged from 49.7 to 100% and averaged 89.4%. During probe conditions, reliability averaged 98.6%, 91.3%, and 93.4% for the forehand, backhand, and serve, respectively. Reliability was assessed at least once every five data points for a total of 10 times during behavioral coaching and 5 times during probes.

Method of Evaluation

Behavioral coaching was compared to standard tennis instruction using two types of multiple baseline designs: across behaviors and across individuals. The multiple baselines were counterbalanced for the sequential presentation of behavioral coaching on the three dimensions of forehand, backhand, and serve. Intermittently, the behavioral coaching package was briefly discontinued and replaced by the standard coaching

procedure to probe for maintenance of skill performance.

General Procedure

Each subject was given the opportunity to exhibit the forehand, the backhand, and the serve in sets of 10 trials. A session usually allowed a minimum of one set and a maximum of four. The skill was recorded as correct or incorrect on each trial, and the data were graphed as percentage correct out of 10 trials for each set of 10 trials. Intermittently, the coach was instructed to reinstate the standard coaching procedure for a set of 10 trials to assess skill maintenance in the absence of the behavioral procedure. At such times, the coach informed the students that on the subsequent set of trials they would not be required to "freeze."

Description of Standard Coaching

The method of instruction used by the tennis coach involved mainly verbal instruction, often with rationale and elaboration, modeling the skill, and verbal feedback. The coach usually pointed out the errors in execution at the completion of a stroke while the student stood in a relaxed manner. She then made suggestions for improvement and sometimes modeled the correct stroke. The session often ended with the coach comforting the student by saying, "Just practice and eventually you will be able to do it."

Procedure for Behavioral Coaching

As in football and gymnastics, the experimenter taught the coach the same 5-step format adapted to tennis to ensure consistency in coaching each subject. For example, in "describing the incorrect position," the coach might say, "First of all, look where your racket is. No, don't move, just look. You stopped it out to the side the moment you contacted the ball and did not follow-through. The face is pointed straight up so it would be natural for the ball to sail up and out of the court. Then notice how your body is facing the net and your weight is on the wrong

foot." After completion of all five steps, the coach then restarted the sequence from "executing the skill." The entire sequence took about 45-60 sec per trial.

RESULTS

The findings in tennis indicate that behavioral coaching was effective in increasing the correct execution of the forehand, the backhand, and the serve for all 12 students. Figures 6 and 7 demonstrate that each behavior of the particular athlete involved changed successively at the point where behavioral coaching was introduced, thus making it possible to determine its differential effects on each subject and each skill. Initial probes indicate that skill improvement was not maintained in the absence of the experimental procedure but later probes, after more extended training, indicate that the skills began to maintain in the absence of the behavioral coaching procedure.

Figure 6 shows Greg's tennis skills on a multiple baseline across three dimensions, first the serve, second the backhand, and finally the forehand. It can be seen that Greg's serve execution improved from a baseline average of 0% correct

to 55% correct under behavioral coaching. During probes, he initially executed 10% correct, then 30%, and finally 50%. Similarly, his backhand increased from an average 8 to 64% correct. During probes, he performed at 40, then 50% correct. Greg's forehand improved from an average of 16 to 64% correct. During the final probe, he executed the forehand at 60% correct.

Figure 7 shows similar results using a multiple baseline across three individuals, Susan, Vicky, and Ginny, on two dimensions, the forehand and the backhand. Standard coaching probes also show similar results.

DISCUSSION

The behavioral method was, again, demonstrated to be more effective than standard coaching. This effectiveness was obtained with both sexes, with all ages represented in the study, and with each tennis skill selected for evaluation. The sequence of introduction of behavioral coaching on each skill had no differential effect on acquisition. Maintenance of the skill in the absence of behavioral coaching was evaluated and found to occur after repeated introduction and withdrawal of behavioral coaching.

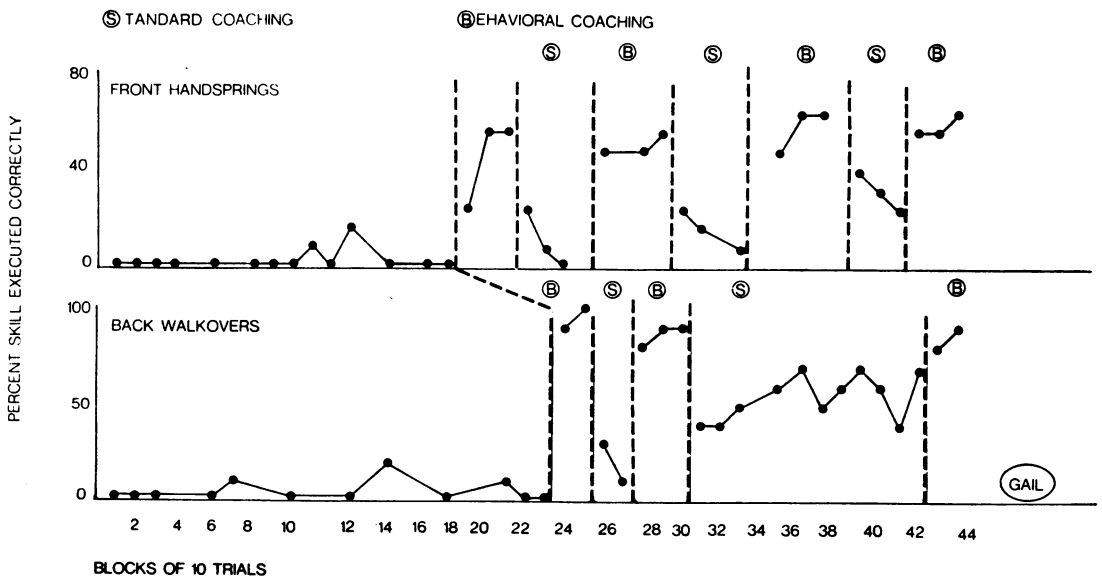


Fig. 6. The percentage of trials in which backward walkovers and front handsprings were executed correctly as a function of standard coaching (S) and behavioral coaching (B). A combination multiple baseline across behaviors with reversals within behaviors design is shown for Gail.

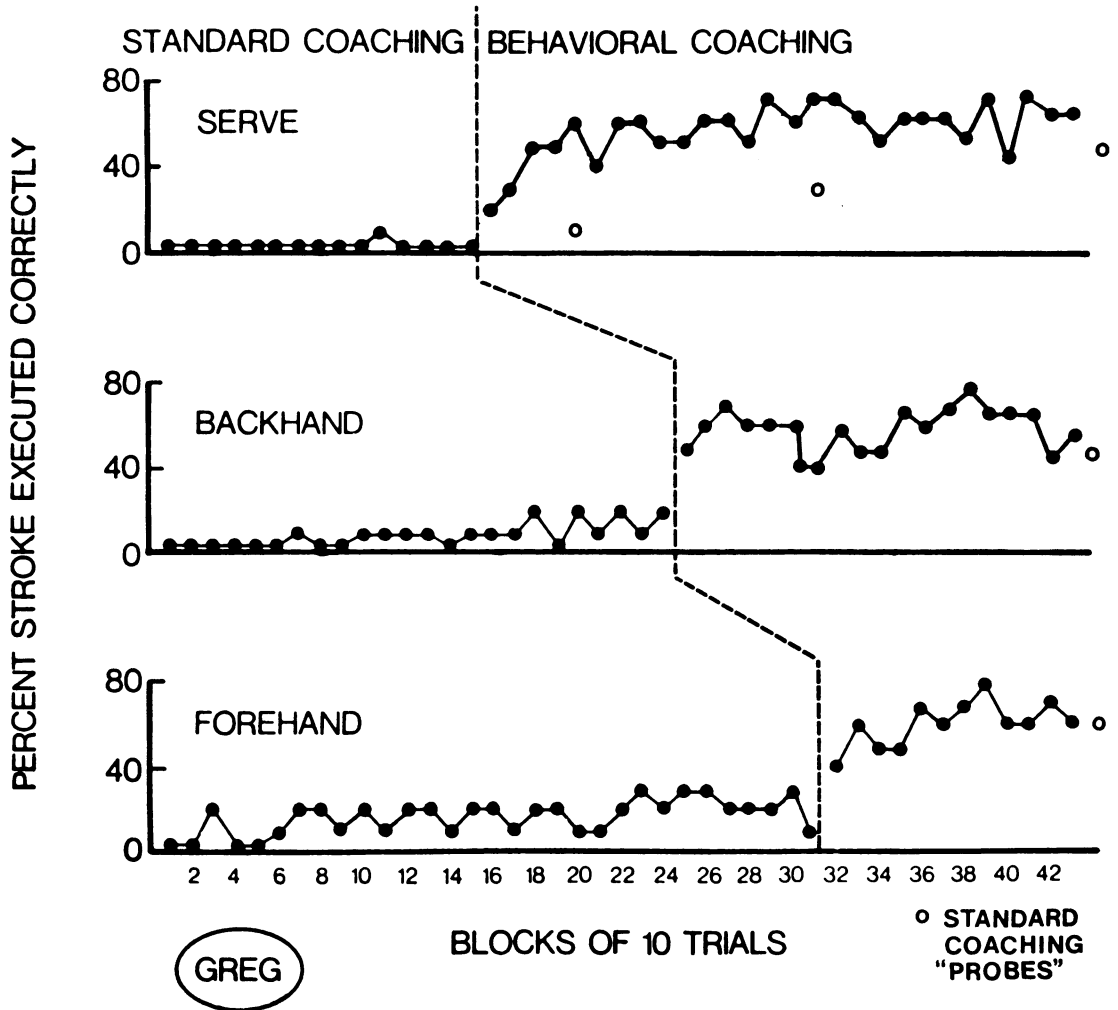


Fig. 7. The percentage of trials in which strokes were executed correctly as a function of standard coaching and behavioral coaching. A multiple baseline across three strokes, serve, backhand, and forehand, is shown for Greg. Intermittent probes under standard coaching conditions are shown.

GENERAL DISCUSSION

Although the behavioral coaching package employed in the present study was immediately effective in increasing the correct execution of complex sports skills in three different sports, it is possible that other variables, singly or in combination, may account for these effects. These variables include the type of sport, the sex of the individual involved, age, previous experience with the sport, and a "novelty effect" from the coach's new behavior patterns. However, the effects were demonstrated in three

sports with great differences in the topography of the skills, in the amount of feedback their execution provided to the athlete, and in the orientation toward team or individual effort. Neither the sex of the participants nor their age appeared to affect the results differentially. Athletic skills did not increase despite lengthy periods of exposure to the sport during baseline. Only when the behavioral procedure was introduced did these skills increase and then they did so rapidly.

It may be argued that the effects are an artifact of the novel character of the coaches' newly

adopted behavioral procedures. However, this view is made less tenable when the immediate, systematic, and repeated effects of the introduction of the package are noted. Methodologically, an ABA or reversal design would appear to be a suitable design to evaluate the variables accounting for change. However, there are serious limitations in using the reversal design in this study. If the level of skill performance declines, a functional analysis of the dependent and independent variables has been demonstrated, but generalization has not. If skill performance does not decline upon reversal to baseline conditions, demonstration of a functional relationship has not been accomplished, but generalization may have occurred. One possible solution may be a combination of a multiple baseline and a reversal design. The multiple baseline may demonstrate a functional relationship while the reversals probe for maintenance. In the present study, this combination of designs was employed with the behavioral coaching package. In summary, then, the relationship between the improved skill performance and the present behavioral coaching package appears to be a functional one. The exact contribution of each component of the package remains to be investigated.

Following varying periods of training under the behavioral coaching package, some of the participants evidenced maintenance of performance gains when probes were conducted under standard coaching conditions. For others, behavioral coaching was limited in its enduring effects. Evidence in the applied literature is abundant that consequences generate behavior, but their effects may be temporary if they are withdrawn. In the present series of studies, the participants could perfectly discriminate the condition changes because the coaches told them that they would not have to freeze on the next series of skill executions. It follows that if the execution of the skill in a correct form did not receive more reinforcement or could be done with less response cost than the incorrect execution, performance would decline. Participants who maintained gains may have been at the stage of ac-

quisition where built-in feedback and intrinsic reinforcement were sufficient for maintenance, whereas others may have not yet reached the same level of accomplishment and therefore could not maintain their gains. Until such a level is achieved, it may be necessary for coaches to continue systematic skill training. It should be noted that the sport skills being taught were relatively complex for many of these athletes as they had been chosen because their skills remained unimproved despite their coaches' efforts. It may be that the applicability of the present package would be limited, in terms of coaches' usage, to athletes experiencing special problems in skill acquisition, i.e., a "sports learning disability."

It is possible that the increase in correct execution of skills may be related directly to the increased attention involved in the behavioral procedure employed here. Although no systematic recording of the frequency and content of interaction between the coach and the athlete was conducted, the amount of interaction (attention) did not appear to vary from baseline to intervention. The athlete's errors appeared to command the coach's attention for feedback just as much during baseline as during the behavioral coaching procedure. The question then is why should the behavioral coaching package be more effective than the standard one? Possibly, because the standard coaching procedure was oriented toward correcting errors largely by verbal means which appear to lead the athlete to "tune out" the verbal reprimand, either by looking away, actively not listening to the coach's scolding, or by developing what the coach regards as a "bad attitude." On the other hand, the behavioral coaching package was not limited to verbal means to correct the athlete's errors. The stress was on requiring the athlete to follow his or her errors by adopting postures relevant to the skill at issue, eliminating the opportunity for reprimands from the coach and excuses from the athlete. Because of response competition, the athlete could not both adopt the "freeze" position and complain or "tune out" the coach. Once the ath-

lete had experienced the "freeze" position, he or she could avoid it only by correctly executing the skill on the next trial. From an experimental viewpoint, stopping in mid-run, waiting for the coach to analyze the error, listening to the coach's correction, remaining immobile while asked to watch the correct move possibly caused sufficient discomfort, inconvenience, impatience, or embarrassment, to motivate the individual to avoid the "freeze."

Comments from the coaches and athletes involved in the studies indicate how the procedure was experienced from their points of view. After

the football coach used the behavioral procedure, he stated, "It's a very good procedure, all right. It really helps them to learn the fundamentals. It could become an integral part of teaching basic skills." The players themselves did not seem to care for the procedure, making comments like, "Oh no, not that freeze again," "This is fruity," and "You don't know how tiring this is." The gymnastics coach stated that it was very hard to do; it strained her muscles a fair amount, embarrassed her a little, but did help her students learn the skills "a fair amount." She would recommend the procedure to other

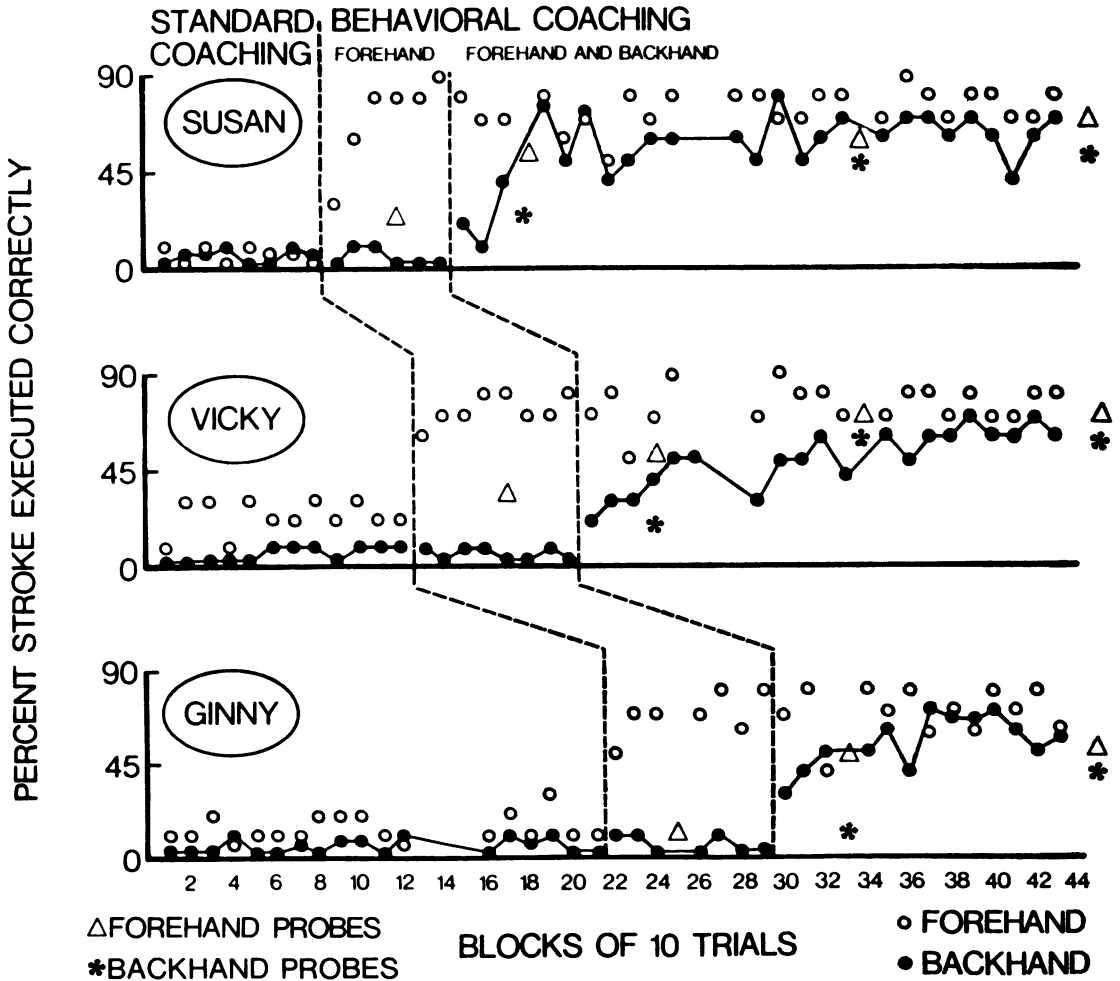


Fig. 8. The percentage of trials in which strokes were executed correctly as a function of standard coaching and behavioral coaching. A multiple baseline across three individuals, Susan, Vicky, and Ginny, and two strokes, forehand and backhand, is shown. Probes under standard coaching conditions for each stroke for all individuals are shown.

coaches to use with certain skills; i.e., reverse kips, front walkovers, other kips on bars, and back handsprings. Typical gymnasts' comments were, "It was uncomfortable in the 'frozen' positions, but it helped me learn a lot." and "It helped me to see what I did wrong."

The tennis coach called the procedure, "one of the best aids to teaching strokes I have used. It enables you to see exactly what they're doing wrong and then analyze it in a concentrated manner. Then, they practice a correct stroke, too. All the parts of this procedure are definitely important." Many of the students made comments such as, "It really helps me learn the strokes," "I can see for the first time what I'm doing wrong," and "I feel like it's really helped my forehand."

The present study employed only one of the many potentially effective behavioral coaching packages. Exploratory research in the area of the application of behavioral procedures to sport and physical education has been scarce. Emerging from a technology of behavior, new ways of arranging athletic environments can be formulated to maximize effective learning of sports skills and facilitate the physical as well as the mental and social development of the individual.

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