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EFFECTS OF STIMULUS CUEING ON THE ACQUISITION OF GROUNDSTROKES BY BEGINNING TENNIS PLAYERS

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A multiple baseline design was used to examine the effects of stimulus self-cueing on the acquisition of forehand and backhand returns by beginning tennis players ($N = 24$). A four-step verbal cueing program was introduced during intervention. Both the use of the technique and the successful number of returns were recorded. Each group showed an acceleration in skill acquisition during intervention, with both forehand and backhand returns improving over 45% from baseline conditions. Implications for the teaching of beginning tennis skills are discussed.

DESCRIPTORS: physical activity, sports skills

The acquisition of physical skills in sports is of concern to physical educators, coaches, and weekend athletes. How to best facilitate the development of new skills has been addressed in the sports literature for years in terms of learning styles, instructional strategies, teacher behaviors, and learning environments. Research related to the application of behavioral principles to skill acquisition in physical activity has been limited. However, interest in the use of behavioral principles in behavioral acquisition and change dates back to 1969, when Rushall and Pettinger (1969) investigated the use of various reinforcers to improve swimming performance. Following this early work, Rushall and Siedentop (1972) coauthored the first major book on behavioral approaches to sport. This concern for the proper application of applied behavior analysis to physical activity has continued, with several major books and articles addressing the principles and processes used in behavioral change (Dickinson, 1976; Kirschenbaum, 1984; Martin & Hrycaiko, 1983a, 1983b; Rushall, 1980; Ziegler & Callahan, 1978).

Since the mid 1970s, the use of applied behavioral principles has begun to emerge in sport and physical skill acquisition research and has been focused in three areas: behavioral coaching, error correction, and changing coaching behavior. Research in behavioral coaching has included a variety of physical activities and sports, including track, soccer, basketball, football, gymnastics, tennis, classical ballet, and swimming. Intervention techniques in behavioral coaching have included verbal instruction, differential reinforcement, feedback, and time-out (Allison & Ayllon, 1980; Rush & Ayllon, 1984; Shapiro & Shapiro, 1985), self-recording and monitoring checklists (Hume, Martin, Gonzalez, Cracklen, & Genthan, 1985; Komacki & Barnett, 1977; McKenzie & Rushall, 1974), and avoidance training (Fitterling & Ayllon, 1983). Research directed on error correction has focused on the effects of positive reinforcement and ignoring errors (Buzas & Ayllon, 1981), freeze commands, feedback and modeling (Allison & Ayllon, 1980), and physical prompting and instruction during training and skill maintenance (Koop & Martin, 1983). Finally, behavioral assessment and change of coaching behaviors have been addressed in several studies. The coding of coaching behaviors and providing feedback for change have been addressed by Smith, Smoll, and Hunt (1977) and Ziegler (1980).

Past research has addressed primarily skill acquisition gained via the addition of information given to the athlete by the coach during intervention (feedback, praise, modeling, prompting). However, a void exists in understanding the behavioral change process that is possible when the intervention is self-directed by the performer. In the majority of studies reviewed, the focus of the intervention was on the addition of feedback or reward to the performer; the present study's emphasis is on the the actual focus of the performer at the time of skill execution.

The concept of attentional focus is an intriguing one in sport performance because, in most activities, the performer is asked to focus on an object (e.g., ball, puck, racquet, goal) or on a person (e.g., competitor, coach). Feedback on how to focus may be equally as important as the question of the object on which to focus. Many sports are considered open sports. The environment is constantly changing, as is the position of the object on which the athlete is to focus (e.g., basketball, football, tennis). Other sports are considered closed tasks in that the environment and the critical object remain relatively stationary (e.g., bowling, archery). The open sports, with constantly changing cues, greatly complicate the process of feedback from a coach on focusing during skill execution. It is important, then, in these sports that an athlete can be self-directed in learning to focus on the significant cue(s).

This study was designed to determine the effects of a self-directed stimulus cueing technique on the skill acquisition of beginning tennis players. Two tennis skills, the forehand and the backhand returns, were described in behavioral terms and the cueing technique was systematically used to test the validity of attentional training on the acquisition of the targeted skills.

METHOD

Subjects

Fourteen females and 10 males between the ages of 19 and 31 ($M = 20$) volunteered to participate in this investigation. All subjects were members of the beginning tennis classes offered as part of the physical education service program at an urban university. Only subjects with no prior playing experience, or who rated themselves as "no experience beginners," were included in the investigation. Of the subjects 71% had never attempted to play a game of tennis prior to this class and the remainder had minimal experience (less than five games) and rated their skills as "very poor." Using a table of random numbers, subjects were assigned to group A, B, or C after the first day of the class.

Setting and Personnel

The tennis classes met twice per week for 10 weeks in an enclosed two-court, domed facility. Personnel included the investigator, who was the course instructor, and two assistants who supervised the ball machine station. The instructor provided all of the basic skills information throughout the sessions. The assistants monitored cueing during the intervention, recorded scores, and served as reliability checks for skill execution.

Balls were "served" to the subjects by a Model 24578 Little Prince ball projection machine. The estimated ball speed from this machine ranged from 45 to 75 feet per second (natural fluctuations in the speed of the ball occur due to timing of machine and newness of the balls).

Behavioral Definitions

The skills selected for study were the forehand and the backhand returns. The behavioral criteria used in observation were not as stringent as those used by Allison and Ayllon (1980) because the use of the freeze technique for skill analysis was not the focus in this study. However, basic behavioral criteria were used by the observers in their recording of successful task completion.

Forehand return. Criteria consisted of (a) racquet head above wrist, (b) stepped forward on opposite leg (right-handed player steps out on left foot), (c) ball contacted on racquet side of body, (d) nonracquet hand pointed toward ball, (e) contact off forward knee, (f) follow-through toward opponent (machine), (g) assume ready position, and (h) ball crossed net and landed in the backcourt area (between the service line and the end line) within the singles court boundary.

Backhand return. Criteria consisted of (a) racquet head above wrist, (b) stepped forward on opposite leg, (c) racquet arm scapula pointed toward ball, (d) ball contacted on nonracquet side of body, (e) contact off forward knee, (f) follow-through toward opponent (machine), (g) assume ready position, and (h) same as for the forehand return. These behavioral criteria were taught to the class and reviewed daily. The average delay between

"served" balls was between 5 and 7 s. This factor was randomly determined by the machine and was not under absolute control of the instructor.

General Instructions

On the first day of class, students were given information on the various teaching and practice stations that would be used in the class, including large group skill presentation by instructor, partner work, two practice sessions per class at the ball machine, and individual assistance by the instructor. The instructor explained the mechanics of the ball machine and indicated that the purpose of the station was to provide for more consistent practice time than the students would normally get by hitting with a partner of comparable or lesser skill. The two assistants were introduced and it was explained that their role was to supervise the ball machine station and to aid in class rotation. Subjects were advised to "concentrate" or "keep their eye on the ball" before each attempt at hitting the ball at this station. Subjects were positioned on the baseline, across the net from the machine. Subjects hit two sets of 30 balls each day for a total of 32 observation sessions.

Stimulus Cueing

After a stable baseline had been established, the instructor discussed with Group A the importance of attention in hitting a ball. The stimulus cueing technique was then explained. It consisted of the following steps:

1. Focusing on the source of the stimulus. This step consisted of instructing the subjects about the importance of watching the opponent and early tracking of the ball (stimulus). Subjects were to vocalize quietly the word "ball" when they saw the ball fired from the machine.

2. Focusing on the pathway of the ball. Subjects were to vocalize the word "bounce" as the ball contacted the surface of the court.

3. Focusing on contacting the ball with the racquet. Subjects were to vocalize the word "hit" when they observed the ball contacting the racquet.

4. Preparing for the next ball. Subjects were to vocalize the word "ready" to prepare physically for the next ball and to refocus on the source of the stimulus (look at chute of machine).

General Procedure

A multiple baseline design across subjects was used to assess the effects of the stimulus cueing technique on the execution of forehand and backhand returns. The intervention for Group A began after a stable baseline had been achieved, which was after the fifth set of balls. Intervention was initiated for Group B after Set 10 and for Group C after Set 16. Following the instructor's explanation of the cueing process, the assistants were in charge of that station. The two assistants monitored the station for each group during both baseline and intervention phases. The assistants cued the subjects after every five hits to either "concentrate" (baseline condition) or to "cue" (intervention). Skill feedback and reinforcement were not given at the ball machine station. However, subjects were given skills instruction (not related to ball station) during the group and individual instructional sessions.

Observation and Recording

Two assistants independently recorded successful performance on each forehand and backhand return. To be recorded as a successful hit, all behavioral criteria had to be met and the ball returned into the designated backcourt area. Performance was assessed by counting the number of successful hits for each daily session (30 forehand and 30 backhand). The subject's percentage of successful hits was calculated by dividing the number of correct hits by the number of hits attempted. Reliability was assessed daily, with two observers continually evaluating each subject at the ball station. The number of agreements between the observers was divided by the number of agreements plus the number of disagreements. The results were then multiplied by 100. The mean interrater reliability score ranged from 86% (backhand) to 100% (M = 92.4%). In addition to observing the performance of the subjects, the observer closest to the subject recorded the number of times vocalization

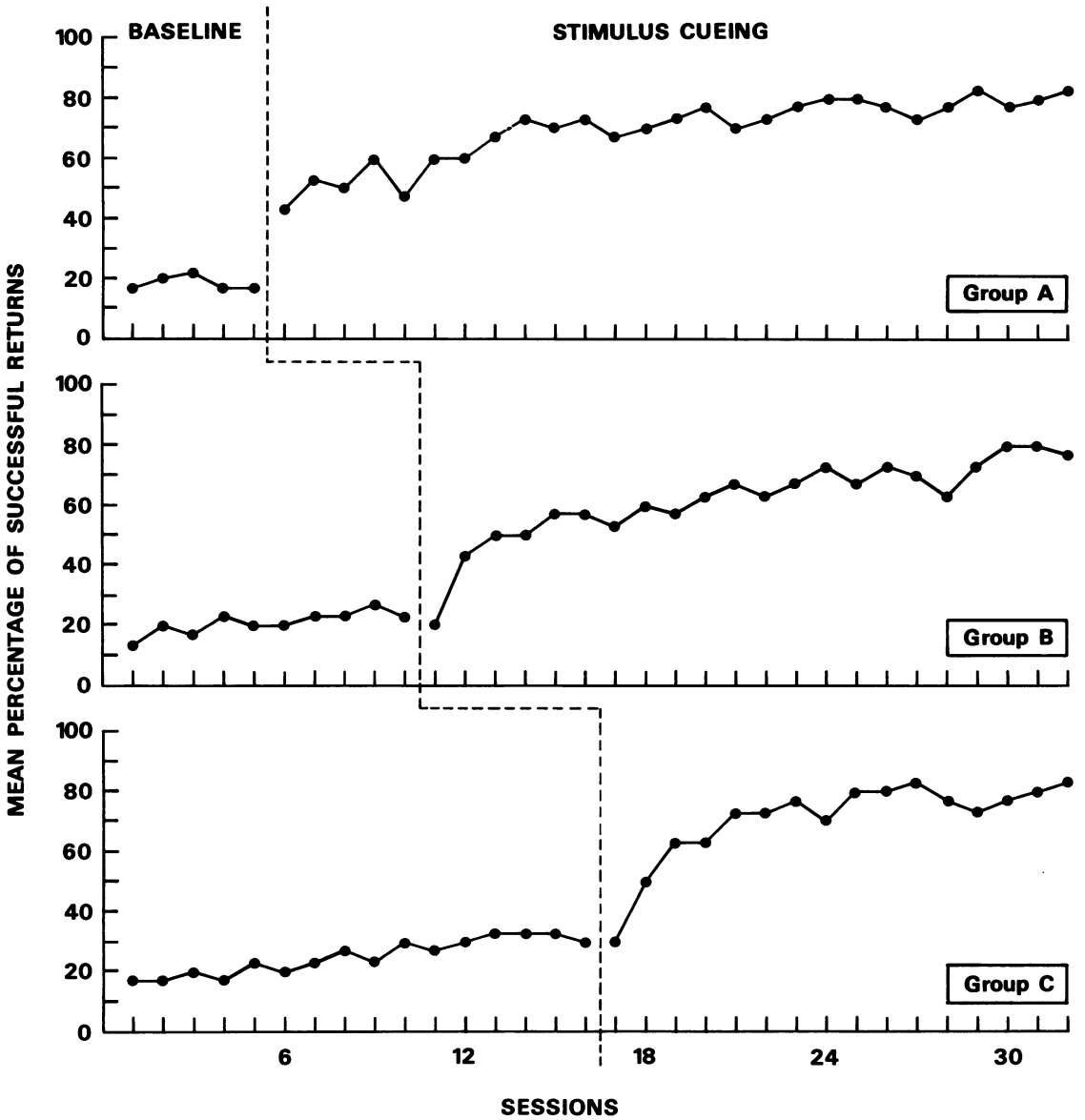

Figure 1. Mean percentage of successful returns per session for groups A, B, and C.

of cues was used during the intervention phase. Results indicated that subjects used cueing during intervention 93% of the time.

RESULTS

Significant increases in the number of forehand and backhand returns were obtained during intervention (see Figure 1). Baseline scores for Group A ranged from 17% to 22% (M = 20%). Treatment scores for this group ranged from 43% to 83% across the intervention (M = 64%). Baseline scores for Group B ranged from 13% to 27% (M = 21%), whereas scores throughout the intervention ranged from 43% to 80% (M = 64%). Finally, Group C achieved scores that ranged from 17% to 33% (M = 25%) during baseline to intervention scores that ranged from 50% to 83% (M = 74%).

Data were also analyzed to determine the differential effects of the stimulus-cueing technique on

Table 1
Mean Frequency of Forehand and Backhand Returns (*n*) and Mean Percent Accuracy (%) per Session During Baseline and Stimulus Self-Cueing Conditions

	Baseline						Stimulus cueing					
	Forehand		Backhand		Total		Forehand		Backhand		Total	
Subjects	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
						Group A						
1	6	20	4	13	10	17	14	47	12	40	26	43
2	8	27	3	10	11	18	19	63	17	57	36	60
3	9	30	7	23	16	27	22	73	19	63	41	68
4	8	27	3	10	11	18	23	77	16	53	39	65
5	7	23	4	13	11	18	16	53	15	50	31	52
6	6	20	6	20	12	20	25	83	25	83	50	83
7	7	23	5	17	12	20	22	73	24	80	46	77
8	10	33	5	17	15	25	23	77	17	57	40	67
Mean	7.6	25.14	4.6	15.4	12.2	20.4	20.5	68.3	18.1	60.4	38.6	64.4
						Group B						
1	8	27	1	3	9	15	18	60	15	50	33	55
2	10	33	3	10	13	22	25	83	20	67	45	75
3	7	23	5	17	12	20	19	63	17	57	36	60
4	5	17	3	10	8	13	14	47	12	40	26	43
5	9	30	4	13	13	22	22	73	16	53	38	63
6	9	30	7	23	16	27	24	80	20	67	44	73
7	6	20	8	27	14	23	22	73	16	53	38	63
8	11	37	4	13	15	25	25	83	23	77	48	80
Mean	8.1	27.1	35	14.5	12.5	20.9	21.1	70.3	17.4	58.0	38.5	64.0
						Group C						
1	7	23	5	17	12	20	17	57	13	43	30	50
2	9	30	7	23	16	27	24	80	23	77	47	78
3	5	17	5	17	10	17	20	67	21	70	41	68
4	10	33	7	23	17	28	21	70	22	73	43	72
5	8	27	9	30	17	28	24	80	25	83	49	82
6	11	37	8	27	19	32	26	87	22	73	48	80
7	12	40	8	27	20	33	27	90	23	77	50	83
8	6	20	5	17	11	18	23	77	23	77	46	77
Mean	8.5	28.4	6.8	22.6	15.3	25.4	22.8	76.0	21.5	71.6	44.3	74

the forehand and backhand returns for each individual. Subjects' mean scores for forehand and backhand returns across baseline and stimulus-cueing conditions are shown in Table 1.

Although minimal group improvement was achieved during baseline conditions, ranging from 5% for Group A to 23% for Group C, a significant increase in performance was not evident until the introduction of the stimulus-cueing intervention. It was interesting to note that continual work with the ball machine during baseline conditions, applying traditional practice and instructional methods, yielded minimal and gradual performance gains; however, an accelerated rate of stroke production was evident only with the introduction of self-cueing.

DISCUSSION

The use of stimulus cueing to direct a performer's attentional focus has been recommended in the popular literature. Gallaway (1977) proposed such a technique in his book *Inner Tennis*. However, what has been lacking in sports research literature is an investigation of this cueing process. Previous studies done in the area of attentional cueing have

focused on the attentional style of the performer (Etzel, 1979; Nideffer, 1976; Turner & Gilliland, 1977; Vallerand, 1983; VanSchoyck & Grasha, 1981). Few have explored the behavioral process of self-cueing.

The focusing of attention in inital skill development is of paramount importance in skill acquisition. This study has taken a very pragmatic view of attentional training. By analyzing the sequence of events that occurs in the development of good stroking behavior in tennis, the following behavior analysis emerged to provide the framework for this study. The antecedent was the approaching ball, the behavior was poor preparation, and the consequence was the ball not being returned into the proper area. This study used stimulus self-cueing to assist the subjects in focusing on the ball as a form of preparation for skill execution.

Results of this study demonstrated a functional relationship in beginning tennis players between the introduction of stimulus self-cueing when hitting the ball and successfully performing both forehand and backhand returns into the backcourt area of a tennis court. These results are instructive for the planning and teaching of ball-related skills. Demonstration of the use of behavioral criteria and self-cueing techniques in skill execution further expands the validity of research in the area of behavioral coaching and teaching of physical skills. The focus on subject control (self-cueing) in skill acquisition is a step forward in the behavioral coaching literature.

The study extends the work of Koop and Martin (1983) and Shapiro and Shapiro (1985). These researchers used physical prompts (cueing) provided by the instructor (e.g., tapping the shoulder of a swimmer with a paddle if three errors in technique occurred while swimming laps) to help establish correct skill performance. The current study focused on the subjects' self-cueing during the four critical attentional phases of the returns. Use of the observers to both remind each subject to "concentrate" (baseline) or "cue" (intervention) and to record the subject's verbalization at each step of the process during intervention further strengthens the validity of this technique in accelerating skill acquisition.

The usefulness of stimulus self-cueing was demonstrated in this study. Future investigations should focus on expanding the cueing technique to the acquisition of other basic tennis skills such as the serve, the volley, or identifying and adjusting to the ball rotation (e.g., topspin). Once basic skills have been acquired, the usefulness of cueing in actual game playing is unknown. Future investigations should consider the constantly changing cues associated with a rally and the speed at which cue responses need to be made. The strength of the cueing technique may be in accelerating initial skill acquisition and not in reacting to the more complex demands in the actual competitive tennis environment. The generalization of the stimulus self-cueing technique to other sport activities should also be explored.

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