Behavior Modification in Sport and Physical Education: A Review

Janet A. Donahue, Jacqueline H. Gillis, and Karen King
The University of North Carolina at Greensboro

This paper reviews published research on behavior modification in sport and physical education. Following an introduction and some general information concerning operant technology, the actual review covers three areas: (a) behavior modification and coaching/teaching behavior, (b) behavior modification in physical education and sport environments, and (c) behavior modification and skill development. The studies reviewed document the significant value of using reinforcement principles to create or sustain specific coaching, teaching, and participant behaviors germane to sport and physical education.

The aims of this paper are to focus attention on operant technology, a component of behavior modification, as an effective technology with potential uses in sport and physical education and to provide a review of selected literature which focuses on its practical use in this area. Throughout the literature on behavior modification, there is a great deal of information concerning motivation and sport (e.g., Alderman, 1974; Kane, 1973), achievement needs and sport participation (e.g., Willis & Bethe, 1970), skill development (e.g., Bilodeau & Bilodeau, 1969), motor learning and athletic performance (e.g., Singer, 1968), and personality and the athlete (e.g., Carron, 1975). These writings have limited practical value for physical educators or coaches who want to effectively and efficiently develop specific sport and skill behavior. Sport practitioners wonder how they can best conduct their classes or team practices, enhance specific skill development among groups of varying abilities and levels of motivation, as well as optimize team and individual performance standards. Research in behavior modification demonstrates that operant conditioning techniques may contribute answers to those questions, and therefore, may have immediate application value to physical educators and coaches. Thus, it would benefit sport practitioners to increase their awareness and understanding of this approach and how it can be used to facilitate sport participation and skill development.

Reprint requests should be sent to Karen King, School of Health, Physical Education and Recreation, The University of North Carolina at Greensboro, Greensboro, NC 27412.
The basic premise of operant technology is that any behavior is strengthened or suppressed on the basis of its consequences in the environment, that is, the events following that behavior. These consequences of behavior, called reinforcers or punishers, either increase or decrease the probability of a response occurring again (Kazdin, 1975). Operant psychology has as a major concern the discovery and analysis of the desirable and undesirable consequences influencing the frequency or form of a particular behavior for a given individual or group (Rushall & Siendentop, 1972). The concept of an operant, that is, a behavior which is developed, maintained or suppressed by the events following it, is vital to understanding operant conditioning, whether it be in sport or any other area which focuses on specific target behavior. For example, the 100 m freestyle can be considered an operant: Competitors who lower their time every occasion they swim this event are reinforced with improved time and possibly winning the event. If swimming the event results in such positive reinforcement, it is probably true that such competitors will strive to continue gaining such positive reinforcers. Positive reinforcement is only one of several operant strategies applicable to the sport context. Research could also be done to demonstrate the functional use of shaping, modeling, stimulus discrimination, or punishment in sport situations.

Because the recent literature provides no systematic presentation of applications of behavior modification to sport and physical education it is the specific purpose of this paper to review empirical studies which have examined the effects of using operant conditioning programs to develop specific skill or sport behavior. In presenting this review and discussion, the following terminology germane to operant technology, as defined by Craighead, Kazdin, and Mahoney (1976), will be used. Reinforcement is any event following a behavior which increases the probability of occurrence of the behavior in the future. Reinforcement schedule describes the manner in which consequences follow behavior. When each instance of a response is reinforced, the schedule is called continuous; intermittent reinforcement occurs when reinforcement is provided only after some instances of a fixed or varied response. Target behavior refers to the behavior to be developed, changed, or suppressed. Punishment refers to the presentation of an aversive stimulus or event, or the removal of a positive event after a response decreasing the probability of that response.

Behavior Modification and Coaching/Teaching Behaviors

Behavior Assessment

While much of the behavioral sport research generally has focused on the effects of applied behavioral techniques on athletes, an increasing number of behavioral sport researchers are directing their attention to analyzing the effects of coaching/teaching behavior on participants. Because coaching behavior is considered to be an important factor in sports, it is necessary to analyze in a systematic fashion the specific effects of particular coaching behaviors on the development of, and change to, appropriate sport behaviors by athletes.
As a first step in describing coaching behaviors, it is necessary to devise a system to objectively determine the actual rate(s) of these particular behaviors. This is usually done by observing predefined coaching behaviors. One of the more systematic approaches to behavioral observation of coaches has been the recent work of Smoll, Smith, and Hunt (Note 1). Based on initial observations, Smith, Smoll, and Hunt (1977) described 12 discrete coaching behaviors which together formed the Coaching Behavior Assessment System (CBAS). In all of their research, the interrater reliability for the CBAS was high, ranging in two studies from +.62 to +.99 with mean coefficients of +.88 and +.96 respectively (see Smith, Smoll, & Hunt, 1977). These reliability studies clearly show that observers can be trained in the objective assessment of coaching behaviors.

Three behaviors delineated in the CBAS—positive reinforcement, ignoring, and punishment—are specific operant techniques which when used in nonathletic environments have been shown to affect behavioral change. While the nine remaining behaviors do not represent particular operant strategies, they are objectively behavioral in nature. Because the studies by Smith, Smoll, and Hunt (1977) document that these coaching behaviors are distinctly objective and discretely countable, researchers could employ these behaviors to empirically study if using such coaching practices has reinforcing effects.

**Behavior Modification**

Once the methodological problems associated with behavioral assessment are solved, the task of the behavioral researcher is to formulate a research design and select the type (or combination) of operant(s) to be employed. Table 1 summarizes the type of designs commonly employed (e.g., control group, multiple baseline, reversal, etc.), as well as the variety of treatments/reinforcers that have been used in this research. However, it is beyond the scope of this review to describe these research designs; instead, the reader is referred to Craighead, Kazdin, and Mahoney (1976) and to Kazdin (1975).

Using a multiple-baseline research design, Hughley (1973) investigated the use of directed information feedback in teacher education as to its effectiveness in helping two physical education student teachers to acquire desirable teaching behaviors. Directed information feedback was comprised of the following four elements: (a) instructions on the nature of the eight behavior categories (dependent variables), (b) graphic feedback on the number of events during class periods, (c) cueing and reinforcement, and (d) goal setting.

The feedback intervention was effective in producing desirable behavior change for three of the eight target behaviors. Using one basketball coach and four team players, Mertler (1975) conducted a multiple-baseline study to assess the functional value of the directed information feedback approach with the same four elements Hughley (1973) used. The results of this study showed that the use of applied behavior analysis techniques modified coaching and team player behavior in a desired direction. While directed information feedback was effective in modifying some aspects of the coach's behavior, the study did not demonstrate that general changes in coaching behavior would affect team
behavior. To produce desirable changes in player behavior, the coach's modified behaviors were used as systematic intervention. In another feedback study, Ziegler (1978) found that factual feedback, alone and with social reinforcement, could be used contingently to influence in a desirable direction a coach's use of positive interactions, positive interactions with task feedback, and on-task practice behaviors. In addition, an analysis of the athletes in the Ziegler study revealed a corollary increase in the number of positive interactions from baseline to treatment.

Rushall (1975) has reported the results of a variety of studies demonstrating the application of applied behavioral analysis in the coaching and teaching arenas. Using the Dalhousie Teacher Observation Schedule (DTOS) with seven behavior categories, MacEachern (cited in Rushall, 1975) demonstrated that the behaviors of eight student teachers changed in a desirable direction when given factual feedback about performance. By using a reversal design, the researcher showed that when the intervention was removed, the behaviors began to regress back toward baseline.

In another study analyzing the effects of applied behavior analysis, Smith (cited in Rushall, 1975) used the Dalhousie Coach Observation Scale (an adaptation of the DTOS) in an attempt to assess a coach's ability to change his own behavior in a desired direction. By monitoring his own behaviors, receiving feedback on performances, and being reinforced for appropriate behaviors, the coach's behaviors markedly changed in a positive direction. Several months after intervention stopped, it was found that the new behaviors persisted. As a part of this study, Rushall (1975) reported further results demonstrating the beneficial results of self-monitoring selected target behaviors. In this case, the subject/coach used a self-checking technique to monitor the types of positive verbal behaviors used in a coaching setting. By using this technique, the coach not only expanded the numbers of positive behaviors, but also learned to use the new behaviors contingent upon specific target behaviors of participant athletes. Self-monitoring and fading/leaning were used contingently in a multiple-baseline study by Rushall and Smith (1979) to increase a swimming coach's verbal use of reward responses, feedback responses, and feedback contingent upon reward responses. While this modification study increased a coach's contingent use of performance-dependent verbal behaviors, it was also found that the numbers of correcting, explaining, and informing verbal behaviors decreased.

Studies reported in this section have provided sport researchers with two advantages. First, they have clearly defined some discrete and observable coaching behaviors during practice and competitive settings. Reported interrater reliability coefficients for such behaviors are of acceptable research standards. Secondly, with the use of single subject and multiple-baseline research designs, the investigators have demonstrated that coaches can be trained to use specific, discretely observable coaching behaviors. Although these contributions are of significant and practical value, there is another research problem in this area that warrants resolution. Behavioral sport researchers need to document whether the observable coaching behaviors defined by Smith, Smoll, and Hunt (1977) or
<table>
<thead>
<tr>
<th>Study</th>
<th>Sex</th>
<th>Activity</th>
<th>Target behavior</th>
<th>Treatment/Reinforcers</th>
<th>Design</th>
<th>Summary of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bell (1977)</td>
<td>M</td>
<td>Swimming</td>
<td>Decrease times for 10 X 100's</td>
<td>Self-monitoring v. graded practice v. both v. neither</td>
<td>Control group</td>
<td>Self-monitoring and graded practice increased significantly compared to control; both increased but not significantly</td>
</tr>
<tr>
<td>2. Birdsong &amp; McCune (Note 5)</td>
<td>F</td>
<td>Basketball</td>
<td>Increase running speed</td>
<td>Public recording</td>
<td>Multiple-baseline</td>
<td>Free time produced faster times though not statistically significant.</td>
</tr>
<tr>
<td>3. Darden &amp; Madsen (1972)</td>
<td>M</td>
<td>Weight lifting</td>
<td>Decreasing number of weights left on floor</td>
<td>Signs</td>
<td>Multiple-baseline</td>
<td>Group time-out (closing weight room early) was the most effective procedure.</td>
</tr>
<tr>
<td>4. Heward (1978)</td>
<td>M</td>
<td>Baseball</td>
<td>Increase Offensive Efficiency Average</td>
<td>Money</td>
<td>Reversal</td>
<td>Team EA increased from .681 to .831 during reinforcement; EA dropped in baseline and increased again in reinforcement. Six players had EAs higher in reinforcement than baseline and 4 followed classic reversal pattern. Classic pattern emerged for average number of times hit by pitched ball.</td>
</tr>
<tr>
<td>5. Hughley (1973)</td>
<td>F</td>
<td>Student teachers</td>
<td>8 specific teaching behaviors</td>
<td>Directed information feedback</td>
<td>Multiple-baseline</td>
<td>Three of the 8 behaviors changed in a positive direction.</td>
</tr>
<tr>
<td>6. Jones (Note 3)</td>
<td>F</td>
<td>Basketball</td>
<td>Increase specific game behaviors</td>
<td>Tokens</td>
<td>Reversal</td>
<td>Mean points scored were: Tokens—89.5; No Tokens—57.6; Traditional—46.5. Tokens increased the occurrence of specifically identified game behaviors substantially more than other conditions.</td>
</tr>
<tr>
<td>7. Kau &amp; Fisher (1974)</td>
<td>F</td>
<td>Jogging</td>
<td>Increase frequency and amount of jogging</td>
<td>Money</td>
<td>Changing criterion</td>
<td>A rapid initial increase was followed by consistent progress toward jogging goals.</td>
</tr>
<tr>
<td>Study</td>
<td>Sex</td>
<td>Activity</td>
<td>Target behavior</td>
<td>Treatment/Reinforcers</td>
<td>Design</td>
<td>Summary of results</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----</td>
<td>------------</td>
<td>------------------------------------------------------</td>
<td>-------------------------------</td>
<td>------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8. Komaki &amp; Barnett (1977)</td>
<td>M</td>
<td>Football</td>
<td>Execution of 3 specific game plays</td>
<td>Feedback with checklist</td>
<td>Multiple-baseline</td>
<td>Percentage of proper execution increased substantially after intervention. Following intervention, execution fell below 60% only once.</td>
</tr>
<tr>
<td>9. MacEachern (cited in Rushall, 1975)</td>
<td>F</td>
<td>Student</td>
<td>Dalhousie behaviors</td>
<td>Factual feedback</td>
<td>Multiple-baseline</td>
<td>Changes occurred in a desirable direction but reversed when baseline conditions were reinstated.</td>
</tr>
<tr>
<td>10. McKenzie &amp; Rushall (1974)</td>
<td>M/F</td>
<td>Swimming</td>
<td>Increase work output</td>
<td>Public self-reporting</td>
<td>Reversal</td>
<td>Marked increase in work output for all subjects under experimental and postcheck conditions (average increase was 27%). Workout reduced upon return to traditional coaching. Program still worked after 12 months.</td>
</tr>
<tr>
<td></td>
<td>M/F</td>
<td>Swimming</td>
<td>Reduce absenteeism, late arrival and early leaving</td>
<td>Public self-reporting</td>
<td>Multiple-baseline</td>
<td>Frequencies of absenteeism and late arrival were reduced 45% and 63% respectively. Early departure was completely suppressed.</td>
</tr>
<tr>
<td>11. Mertler (1975)</td>
<td>F</td>
<td>Basketball (Coach)</td>
<td>7 coaching behaviors</td>
<td>Directed information feedback</td>
<td>Multiple-baseline</td>
<td>Three of 7 target behaviors changed in desirable direction.</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Basketball (Players)</td>
<td>8 team behaviors</td>
<td>Specific coach's behavior applied contingently</td>
<td>Multiple-baseline</td>
<td>All behaviors increased in a positive direction.</td>
</tr>
<tr>
<td>12. Mohlman et al. (1973)</td>
<td>M</td>
<td>PE class</td>
<td>Increase on-time attendance</td>
<td>Exercise punishment contingency</td>
<td>Multiple-baseline</td>
<td>Median on-time percentage increased from 59.8% to 94.8%. Postcheck at two weeks demonstrated on-time behavior to be equal to or greater than during intervention.</td>
</tr>
<tr>
<td>Study</td>
<td>Sex</td>
<td>Activity</td>
<td>Target behavior</td>
<td>Treatment/Reinforcers</td>
<td>Design</td>
<td>Summary of results</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----</td>
<td>----------------</td>
<td>-----------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>13. Pierce &amp; Risley</td>
<td>M/F</td>
<td>Recreation</td>
<td>Reduction of disruptive behaviors</td>
<td>Amount of recreation time</td>
<td>Multiple-baseline</td>
<td>Continuous reinforcement was immediately effective in reducing the percent of time three specific rule violations occurred.</td>
</tr>
<tr>
<td>(1974)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Rolider</td>
<td>M</td>
<td>Basketball</td>
<td>Increase number of positive statements</td>
<td>Teacher modeling Instruction Grade incentive</td>
<td>Multiple-baseline</td>
<td>All three treatment conditions were effective in this order: grade incentive, teacher modeling, and instruction.</td>
</tr>
<tr>
<td>(1978)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Rushall</td>
<td>M</td>
<td>Coaching</td>
<td>Dalhousie behaviors</td>
<td>Self-monitoring baseline</td>
<td>Multiple-direction.</td>
<td>Behaviors changed in a positive</td>
</tr>
<tr>
<td>(1975)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Control group</td>
<td></td>
</tr>
<tr>
<td>16. Rushall &amp; Pettinger</td>
<td>M/F</td>
<td>Swimming</td>
<td>Increase work volume in number of laps</td>
<td>Coach's attention Candy Money</td>
<td></td>
<td>Candy and money were significantly better than coach's attention for total subjects. No significant difference was observed when younger and older subjects were grouped. The trend was that candy was as effective in reinforcement value as money. Coach's contingent use of performance dependent verbal behaviors increased.</td>
</tr>
<tr>
<td>(1969)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Rushall &amp; Smith</td>
<td>M</td>
<td>Swimming (Coach)</td>
<td>Increase use of verbal reward, feedback, and feedback reward responses</td>
<td>Self-monitoring and fading/leaning</td>
<td>Multiple-baseline</td>
<td>All 5 variables increased</td>
</tr>
<tr>
<td>(1979)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Siedentop &amp; Dawson</td>
<td>M/F</td>
<td>Basketball</td>
<td>Increase in 5 practice variables</td>
<td>Points on public display</td>
<td>Multiple-baseline</td>
<td>Changes occurred in a positive direction after self-monitoring and reinforcement. Behaviors persisted after reinforcement was stopped.</td>
</tr>
<tr>
<td>(Note 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Sex</td>
<td>Activity</td>
<td>Target behavior</td>
<td>Treatment/Reinforcers</td>
<td>Design</td>
<td>Summary of results</td>
</tr>
<tr>
<td>---------------</td>
<td>-----</td>
<td>---------------------------</td>
<td>------------------------------------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>20. Wysocki et al. (1979)</td>
<td>M/F</td>
<td>Exercise</td>
<td>Increase in aerobic points earned</td>
<td>Return of personal possessions</td>
<td>Multiple-baseline</td>
<td>7 of 8 subjects increased number of aerobic points during program; 12-month follow-up indicated level remained above baseline.</td>
</tr>
<tr>
<td>21. Young (1973)</td>
<td>M/F</td>
<td>Stunts &amp; tumbling</td>
<td>Increase in number of skills</td>
<td>Free play</td>
<td>Reversal</td>
<td>An increase in number of skills did not hold through reversal.</td>
</tr>
<tr>
<td></td>
<td>M/F</td>
<td>Stunts &amp; tumbling</td>
<td>Increase in appropriate behavior</td>
<td>Additional PE class</td>
<td>Reversal</td>
<td>Appropriate behavior increased through use of positive reinforcement although individual students did not react to the contingency.</td>
</tr>
<tr>
<td>22. Ziegler (1978)</td>
<td>F</td>
<td>Volleyball (Coach)</td>
<td>Use of positive interactions, positive interactions with task feedback, &amp; on-task behaviors</td>
<td>Factual feedback and factual feedback with social reinforcement (ABCA)</td>
<td>Reversal</td>
<td>Factual feedback, alone and with social reinforcement, caused increases in all 3 behaviors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volleyball (Players)</td>
<td>Interaction &amp; on-task behaviors</td>
<td>Concomitant changes in coach's behavior</td>
<td>Reversal</td>
<td>Positive interactions only increased.</td>
</tr>
</tbody>
</table>
Rushall (1975) can in fact be systematically used to bring about desirable team behaviors and correspondingly appropriate skilled behaviors.

**Behavior Modification in Physical Education and Sport Environments**

Behavior modification strategies in educational situations have been successful in reducing disruptive behaviors, increasing attentive behaviors, and controlling classroom behaviors (Hall, Lund, & Jackson, 1968; Hall, Panyon, Rabon, & Broden, 1968; Marholin & Steinman, 1977; Solomon & Wahler, 1973). In the physical education and sport setting, several studies have shown the effectiveness of the operant approach in changing behaviors concomitant to sport skill development. Specifically, increasing practice attendance, peer encouragement, and appropriate gymnasium behavior have been studied.

Employing a multiple-baseline design, McKenzie and Rushall (1974) confirmed the effects of publicly recording attendance to reduce absenteeism, late arrival, and leaving early from swimming practices. After ascertaining a baseline attendance rate, three attendance board conditions were imposed, and the researchers cited reductions in specific attendance problems. In the first condition, absenteeism was reduced by 43%. Tardiness was reduced by 63% in the second condition, followed by a complete suppression of leaving early problems. While concluding that the attendance board was effective in reducing team attendance problems, the investigators cautioned that the board alone may not have been responsible for attendance changes. Another possible explanation was the vicarious reinforcement potential of both coach and teammate verbal reinforcement of swimmers for attendance records.

Mohlam, Wade, and Collins (cited in Fox, Copeland, Harris, Rieth, & Hall, 1973) used an operant strategy to increase on-time behavior in a boys' high school physical education program. The contingency was that if every student was on time, the class would do 10 repetitions of an exercise, but if one or more persons were late, students would do 50 repetitions. A multiple-baseline across classes design was used, introducing the contingency in each of five classes at 4-day intervals. On-time behavior increased after, and not before, the contingency was applied in each class. Median percentage of students on time increased from 59.8% before intervention to 94.8% during the contingency program. Postchecks made 2 weeks later demonstrated on-time behavior to be equal to or higher than during the intervention, indicating the effectiveness of the program.

To increase the number of positive statements given by college men to teammates in a basketball class, Rolider (Note 2) examined the effectiveness of three treatment interventions. The conditions were teacher modeling, instruction, and grade incentive. With teacher modeling, the teacher made many positive statements to players. Under the instruction intervention, the teacher emphasized the importance of making encouraging statements to teammates during play. In the grade-incentive condition, the teacher explained that additional grade points would be awarded for peer encouragement. It was found that all three treatment
interventions resulted in higher rates of positive statements than baseline conditions. Grade incentive was the most powerful intervention creating a 128.8% increase in encouraging statements. Teacher modeling produced an increase of 51.9% over baseline. Instruction was least effective with an increase of 21.1% reported.

Several investigators have shown effects of various reinforcers in increasing other behaviors in the gymnasium setting. Rule-following in a recreation center was increased when a loss of recreation time was used as the reinforcer (Pierce & Risley, 1974). In a similar study by Darden and Madsen (1972), the clean-up behavior of students using a weight room was improved when the privilege to use the room was contingent upon the weights being properly put away. Young (1974) also used a variety of reinforcers to effectively increase the number of appropriate behaviors exhibited by second graders in a physical education class.

In the research cited previously, it was documented that desirable behaviors concomitant to sport skill development can be changed contingent on applied techniques like self-recording and the administration of a variety of positive reinforcers. Although the reviewed studies were well-structured, further investigation is necessary to identify other changeable behaviors as well as other effective reinforcers.

Behavior Modification and Skill Development

A variety of operant strategies have been successful in modifying specific sport skill behaviors. Skills from both individual and team sports, at varying skill levels, have been examined. Populations ranging from second grade through college age, and both single-sex and mixed-sex groups have been studied. Some investigations have examined the effectiveness of a single reinforcer, whereas others have compared the effects of several reinforcement strategies. The programs reported involved at least one of the following classes of reinforcers: (a) public recording, (b) token systems, (c) attention/information, and (d) desirable activities/objects.

Two investigations used public display as the only reinforcement contingency. McKenzie and Rushall (1974) assessed the effectiveness of program boards (on which a swimmer could check off completed work units) on increasing swimming work output. Subjects were eight members of an age-group swimming team, and the dependent variable was the number of laps swum per minute in a series of uninterrupted swims. A reversal design was used, and a postcheck measure was made 3 weeks following the last observation of the second intervention. It was found that all eight swimmers had greater work output in both intervention phases and at the postcheck than during baseline. Output of seven subjects decreased during the second baseline phase, indicating the effects of the intervention. Range of improvements from averaged baseline to averaged treatments was from 20% to 31%. It was noted that the intervention also acquired both social and self-reinforcing properties.

Siedentop and Dawson (Note 3) conducted an investigation in which a
public-recording contingency program was instituted to modify selected practice behaviors of junior high school students. Following baseline observations over four practice sessions, points were awarded daily and displayed on a bulletin board. Lay-up shooting efficiency increased from 68% in baseline to 80% in intervention, jump shot efficiency from 31% to 51%, and free throw efficiency from 59% to 67%. Expressions of encouragement increased from an average of 13 to 65 per practice session, and only a few instances of a lack of hustle were identified during the intervention. The validity of these effects is not known because a reversal to baseline conditions was not made.

Two investigators also reported that programs using token-type systems changed sport skill behaviors. Jones (Note 4) used an operant strategy to modify selected sport behaviors of participants in a basketball camp. A point-award system was established for specific game behaviors. Three treatments were used: (a) for each 20 points the team was awarded, each team member was awarded an “Olympic ring,” redeemable for food or an award; (b) the same point-award system, but no rings awarded; (c) regularly scored games. It was found that the mean number of points was highest for the point/Olympic ring contingency and lowest for the regularly scored games, indicating that the operant strategy was effective in modifying the target behaviors.

Individual and team offensive production of nine members of a professional baseball team were the target behaviors in a study which used money as a token system (Heward, 1978). An Efficiency Average (EA) was developed as a measure of offensive efficiency, and served as the criterion measure. A reversal design was used, and the intervention consisted of monetary rewards to the three players with the highest EAs each week. During the first intervention, six players’ EAs were higher than baseline. Four players’ EAs dropped during the return to baseline, and these same four increased again during the second intervention. Team EA increased from baseline during the first intervention, decreased during the reversal and, contrary to prediction, decreased again during the second intervention.

Attention and informative feedback were used as reinforcers in an investigation by Komaki and Barnett (1977). The researchers used a performance checklist to modify the execution of three offensive football plays by five members of a youth football team. Each play was broken down into five components, and an observer recorded whether or not each component had been successfully completed. The intervention consisted of the coach providing feedback about correct performance and verbal praise for successful execution of the play. A multiple-baseline design across plays was used, and the results indicated that performance improved after, and not before, each intervention was introduced.

Several reported investigations involved the use of the fourth class of reinforcers, that is, desirable activities or objects. Wysocki, Hall, Iwata, and Riordan (1979) conducted a program designed to increase exercise behavior of a group of eight college students. The intervention consisted of the subjects depositing items of personal value with the experimenters which would only be
returned if an exercise-contract contingency, based on the Cooper aerobics system, was reached. A multiple-baseline design across subjects was used, with baseline activity rates established for 1- or 3-week periods. It was found that seven of eight subjects increased in the number of aerobic points earned per week. Also, a follow-up 12 months later indicated that exercise rates were higher than baseline, substantiating the long-term effectiveness of the intervention.

In a similar investigation involving a single subject, Kau and Fischer (1974) demonstrated the efficacy of an operant program to increase jogging behavior. This behavior was defined and graded according to the Cooper aerobics system. For the first 4 weeks of the program, the reinforcers were (a) engaging in social activities if and only if jogging was done every day of the preceding week, and (b) an award of 25¢ immediately following jogging. Beginning with the fifth week, the 25¢ award was dropped and a minimum number of aerobic points per week became the behavioral criterion for social activity. It was found that following an initial sharp increase from baseline, progress towards the established goal continued to increase. However, the intervention was stopped before the goal was reached, as a satiation level of the reinforcer had been reached, and natural reinforcers (e.g., loss of weight) began to take over. Because natural reinforcers began to maintain the desired behavior, the program was judged to have been successful.

Using a modified reversal design, Young (1974) conducted an operant program with a second grade physical education class. The contingencies were that each student could earn a free play period by successfully performing the skills in the week's activity program. The reversal procedure revealed that there was no improvement due to the intervention. Although the mean number of skills performed per student increased from baseline to intervention, this performance level was maintained when the contingencies were removed.

Investigations comparing the effectiveness of several interventions have been reported by several authors. Rushall and Pettinger (1969) examined the effects of four reward contingencies on the swimming work volume of 32 members of an age-group swimming team. The target behavior was the number of laps swum in each of four practice periods. The four contingencies applied were: (a) coach's attention, in which a coach gave comments and encouragement as each work unit was completed; (b) candy, in which one M & M candy was awarded for each lap swum; (c) money, in which 1¢ was awarded for each lap swum, and (d) control, in which no predetermined reinforcement was presented. It was found that the candy and money contingencies both resulted in significantly greater (p < .05) lap production than the coach's attention and control contingencies. Also, the number of laps completed in the candy and money conditions did not differ from each other, nor did the coach's attention and control.

Bell (1974) examined the effects of graded practice and self-monitoring of daily practice times on performances of collegiate swimmers. Target behavior was the mean time for a set of 100-yard repeats. Each subject was assigned to one of four conditions: (a) self-monitoring only, (b) graded practice only, (c) self-monitoring and graded practice, or (d) neither condition (control). It was found
that self-monitoring only and graded practice only produced significantly greater performance increments than either the control group or the two treatments together. It was concluded that self-monitoring can strongly enhance swimming performance.

The effects of three different reinforcement contingencies on running performance of female basketball players as a part of a preseason conditioning program were studied by Birdsong and McCune (Note 5). The target behaviors were mean times on a series of 110- and 220-yard interval runs. In the public recording contingency, times were posted on a board immediately following performance. In the free time contingency, the last set of intervals was not run if runners matched the performance of the previous day. No planned reinforcement was given in the no-reward contingency. Mean performance for the 110-yard intervals was .2 sec faster under free-time contingency than both public recording and no reward, but this difference was not statistically significant. The mean performance of the 220-yard intervals was .9 sec faster under the free time contingency than public recording and 1.2 sec faster than no reward. These differences were significant ($p < .01$) and indicative of the efficacy of the experimental treatment.

The results of these studies indicate that operant strategies are effective and efficient techniques for developing and maintaining sport skills. Only one of the reviewed studies (Young, 1974) failed to produce definitive results in the desired direction. Across a wide variety of reinforcement contingencies, sports, and subject populations, effective behavior change has been accomplished in a relatively short amount of time. Objective feedback obviates guesswork about learning or performance results. Operant strategies enable the coach or teacher to set specific, realistic goals and establish effective reinforcement contingencies for individual athletes. These studies have shown a wide variety of reinforcers to be effective. Further investigation is necessary to determine which of the reinforcers and strategies are the most universal, that is, which are the most generally applicable.

It must also be noted that many of the positive results reported in the reviewed studies were obtained in spite of methodological weaknesses in the investigations themselves. Several investigations employing reversal designs demonstrated particular problems. Siedentop and Dawson (Note 3) did not use a reversal phase to demonstrate the reliability of the effect obtained, and Young (1974) found that the effect of the intervention did not disappear during reversal, weakening the validity of the effect. Heward (1978) found it was not possible to completely remove the intervention during the reversal phase. When reversal designs are employed, attention must be given to the use of complete designs to determine the reliability of the intervention effects and to reversal phases that are true returns to baseline conditions.

With the exception of the study by Kau and Fischer (1974), the studies reviewed used continuous as opposed to intermittent reinforcement. Although continuous reinforcement can produce behavior change quickly, the desired behavior will also disappear quickly when the intervention is removed. On the
other hand, intermittent reinforcement maintains behavior more effectively because there is a tendency to shift from external to internal controls (Kazdin, 1975). The use of postchecks and studies of longer duration would help to demonstrate these effects.

In addition, the only operant strategy that has so far been applied to sport skill behaviors is positive reinforcement. The use of shaping, modeling, and negative reinforcement has yet to be examined in the sport skill setting. Because positive reinforcement has been demonstrated to be effective in so many different situations, there is no reason to doubt the potential applicability of this and other strategies to virtually any sport behavior. Researchers must now examine these possibilities empirically.

Conclusion

It can be readily noted that the use of statistical inference in behavioral research is very limited. This situation can be best explained as an historical phenomenon rather than a disavowal of statistical analysis. Because there are two criteria by which the effectiveness of an intervention can be judged, that is, practical and statistical, behavioral researchers must select the most appropriate criterion. When research in the behavioral domain was first undertaken, there was greater concern over demonstrating that an intervention did change behavior rather than over any statistical evaluation of this change. Also, few statistical techniques were available that could accommodate the small number of subjects and the dependent nature of successive observations. Thus, early researchers tended to favor a nonstatistical means of evaluation.

In recent years, however, several researchers have developed methods of analysis appropriate for investigations which involve few subjects, or even a single subject (Edgar & Billingsley, 1974; Gentile, Roden, & Klein, 1972; Kazdin, 1976). Procedures for time series analyses which take into account the dependency between data points have also been proposed (Algina & Swaminathan, 1979; Jones, Vaught, & Weinrott, 1977; Simonton, 1977, 1979). With these developments, both statistical and practical judgments of an intervention's effectiveness can be made in many investigations. Behavioral research would be strengthened by the simultaneous use of practical and statistical judgments whenever possible. The use of statistical analysis in the domain of physical education and sport seems particularly appropriate, for the effectiveness of various interventions is relatively unexplored and the situations examined tend to have many natural, uncontrolled sources of variability.

Throughout this review, a number of studies document the value of using positive reinforcement strategies to create or sustain the practice of target coaching, teaching, and participant behaviors such as: coaches using positive feedback (Mertler, 1975); coaches giving stimulus cues (Hughley, 1973); students reporting to class on time (Mohlan, Wade, & Collins, cited in Fox et al., 1973); increasing practice attendance (McKenzie & Rushall, 1974); giving peer encouragement (Rolider, Note 2); producing offensive baseball skills (Heward,
1978); increasing lay-up shooting efficiency (Siedentop & Dawson, Note 3); and increasing swimming work volume (Rushall & Pettinger, 1969). Different reinforcers, like money, social praise, positive encouragement, free time, and points have been used on a systematically contingent basis to develop and maintain desirable sport and physical education class behavior. Table 1 summarizes the major variables studied in each reviewed article as well as pertinent findings.

The works of Dickinson (1977) and Presbie and Brown (1977) are valuable contributions to the behavioral sport literature because they summarize the operant sport research information into a proposed theoretical framework. Both works document the empirical basis for the use of positive reinforcement in the sport and physical education domains. They further theorize that other operant strategies such as shaping, modeling, stimulus discrimination, and punishment can and should be used. The literature review in this paper demonstrates, however, that empirical research to demonstrate the efficacy of such strategies has not yet been conducted.

Also, a perusal of the reviewed studies demonstrates that operant research in the sport area has focused on very few sports and physical education activities (e.g., basketball, swimming, baseball, football, and jogging). If a strong operant basis is ever to be applied to sport, researchers must examine operant strategies in other sport areas, like track and field, gymnastics, and hockey. The issue of the generalizability of particular operants could then at least be initially evaluated. Behaviors other than those like on-time behavior to physical education class, rule-following behavior, and increases in work load need to be investigated in the physical education setting. While writers such as Rushall and Siedentop (1972), Dickinson (1977), and Presbie and Brown (1977) claim the use of systematically applied operant strategies can enhance skill learning, documentation of such suppositions needs careful research consideration.

At present operant sport researchers have limited their investigative inquiries to very few sports and physical education behaviors. Considering the demonstrated efficacy of the operant principles reported in the limited number of preceding studies, it seems necessary that researchers in sport and physical education engage in additional empirical study of operant technology and its applied, functional use in sport settings and the gymnasium. While operant technology is not to be regarded as a panacea for all of sport and physical education, it certainly provides behavioral principles and strategies that could be used effectively to develop, maintain, or change target sport and physical education behaviors.

Reference Notes


References


Hughley, C. Modification of teaching behaviors in physical education (Doctoral
Wysocki, T., Hall, G., Iata, B., & Riordan, M. Behavioral management of exercise: Contracting for aerobic points. Journal of Applied Behavior Analysis, 1979, 12, 55-64.
Young, R.M. The effects of various reinforcement contingencies on a second-grade
physical education class (Doctoral dissertation, Ohio State University, 1973). 
*Dissertation Abstracts International, 1974, 34, 485A.* (University Microfilms No. 74-03363)

Ziegler, S.G. The effects of factual feedback and factual feedback with social reinforce- 
ment on a volleyball coach's behavior (Doctoral dissertation, West Virginia Univer-

*Manuscript submitted: 10/2/79*

*Revision received: 7/7/80*