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A BEHAVIORAL COACHING STRATEGY TO REDUCE SWIMMING STROKE ERRORS WITH BEGINNING AGE-GROUP SWIMMERS

by

Sandra J. Koop

A Dissertation

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Abstract

Although behavioral techniques have been successfully applied to a large number of areas with individuals who differ greatly on a variety of variables, it is mainly within the last decade that such techniques have begun to influence the area of sports and physical education in general, and the coaching of competitive sports in particular. To date, the majority of literature on this topic consists of recommendations based on a behavioral philosophy, which have not yet been empirically investigated. However, the research that does exist supports the contention that behavioral procedures are highly applicable to the coaching of competitive sports--especially to the development, maintenance and/or motivation of athletic skills.

This research investigated the effectiveness of a behavioral error correction package which was designed to decrease errors in swimming strokes with four beginning age-group swimmers. The package included the systematic use of the following components: (1) instructions; (2) modeling of correct and incorrect behaviors; (3) self-instruction; and (4) reinforcement and/or feedback. The procedure consisted of two phases: (1) a training phase, in which subjects were trained to criterion in a small pool; and (2) a maintenance phase, in which prompts and feedback were given under normal practice conditions, and then faded out.

The error correction package was evaluated using a multiple baseline across subjects design, with a reversal or follow-up component.

In addition, for two subjects, a multiple baseline across swimming strokes design was utilized. The implementation of the error correction package resulted in: (1) a significant decrease in errors for all subjects on all six trained strokes during training sessions; (2) generalization of improved performance to the practice pool by the end of the training phase for three subjects on five of the six trained strokes; (3) a significant decrease in errors during the first maintenance phase for the subject who had not shown generalization during training, as well as maintenance of improved performance for the other three subjects throughout this phase; and (4) continued low error rates during the second maintenance phase on all five trained strokes for the three subjects who experienced this phase. Follow-up assessments revealed that long-term generalization of correct performance occurred for subjects on three of the six trained strokes. Although two subjects exhibited a gradual return to baseline error rates over a five-week follow-up, remedial prompting reduced these error rates immediately and substantially. Only one subject (on one stroke) failed to exhibit long-term maintenance of the correct behavior.

Finally, the error correction package was efficient in that it did not disrupt practice, require excessive amounts of the coach's time, or necessitate the use of cumbersome apparatus. In addition, the procedures had social validity in that both the coach and the subjects considered them to be effective, and expressed their willingness to participate in them again in the future.

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Introduction

The Operant Conditioning Model

In its most specific context, the term "operant conditioning" refers to the process through which the probability of the occurence of a particular behavior can be modified by its consequences. The term is also commonly used in a more general sense in reference to an entire approach within psychology to the scientific study of behavior. This approach is derived largely from the laboratory findings of Skinner (1938, 1953, 1969). Although it consists of a number of assumptions about environmental influences on behavior, it does not adhere to any particular theory of learning or motivation. Instead, Skinner (1972) has argued that scientific progress may be accelerated by research which is not designed to test a specific theory. Such research should collect data which shows reliable changes that characterize the learning process, and relate these data to the independent variables that were manipulated. The following are three salient characteristics of the operant approach: (1) it places strong emphasis on defining problems in terms of behavior which can be measured in some way, and accepting changes in the behavioral measure of the problem as the best indicator of the extent to which the problem is being helped; (2) its methods and rationales can be described precisely; and (3) its techniques stem from basic laboratory research in the field known as experimental psychology (Martin & Pear, 1983). To summarize, the operant conditioning model is not characterized by its adherence to any particular theory, but by its methodology which involves an experimental analysis of the environmental variables which control behavior.

The applied branch of experimental analysis of behavior is the field of applied behavior analysis. Research within this framework is specifically directed at behaviors which are of practical concern to individuals or are considered by society to be significant (Baer, Wolf & Risley, 1968). Because of this emphasis on socially important behaviors it is especially crucial that such research be analytical (Baer et al., 1968). That is, the experimenter must provide a convincing demonstration that the independent variables manipulated were indeed responsible for the change in behavior. The effectiveness of these procedures has typically been evaluated using single subject research designs which emphasize the establishment of experimental control over the behavior of a small number of subjects by systematically manipulating independent variables over repeated trials. This approach has been successful in the development of effective treatment strategies in applied settings (Kazdin, 1978).

Applied behavior analysis research, utilizing single subject research designs, has produced a variety of treatment procedures. Some treatments involve the manipulation of only one or a few variables, whereas others are comprised of a "package" of behavioral procedures. This latter approach has been recommended by Azrin (1977) who argues that treatment programs in applied settings should include as many treatment components as appear necessary to achieve the desired behavioral changes. This "outcome-oriented" approach measures success in terms of the following criteria: "speed of the effect, percentage of patients benefited, degree of benefit, cost, durability over time, and social acceptability" (p. 145). If a package treatment proves to be successful, component analysis research may be considered. As will be described later, the research presented here utilized the package approach.

Applications. Behavioral procedures derived from the operant conditioning model have been empirically shown to have widespread applicability. For example, behavior therapy has achieved beneficial results in the areas of neurotic and psychotic disorders, sexual dysfunctions and deviance, marital discord, addictive behaviors, childhood disorders, and mental retardation (Kazdin & Wilson, 1978). Behavioral procedures have also been used to control problem behaviors in the classroom situation (Drabman, 1976); in the control and/or treatment of problem behaviors among institutionalized "mentally ill" patients (Atthowe, 1976); in energy conservation, littering control and other community applications (Martin & Osborne, 1980); and in the control and rehabilitation of prison inmates (Kennedy, 1976). Many other examples of the applications of behavioral procedures could be cited (e.g., see reports in the *Journal of Applied Behavior Analysis*, 1968-1982). To summarize, behavioral techniques have been demonstrably effective with individuals who differ greatly on a variety of variables such as age, level of functioning, situational variables, and type of behavior exhibited.

Behavioral applications to sports and physical education. In spite of the large number of successful applications of behavioral techniques to other areas, it is mainly within the last decade that these techniques have begun to influence the area of sports and physical education (McKenzie & Rushall, 1973). Rushall (1977a) pointed out that those countries exhibiting rapid improvements in the status of their international athletes (e.g., Bulgaria and East Germany) tend to utilize more input from "scientific support systems" (i.e., expertise from the physical and social sciences) in addition to standard coaching techniques. However, Western countries have been slower to access potentially relevant contributions from behavioral psychology. Instead, until recently, most psychological contributions to the field of sports have stemmed from more traditional areas in psychology. A number of authors have drawn a distinction between "traditional" and "behavioral" approaches to coaching (Dickinson, 1977; McKenzie & Rushall, 1974; Rushall, 1976, 1978b, 1979). The differences identified by these authors will be summarized in the following section.

Traditional Approaches to Coaching

Assumptions. It has been argued that traditional coaching approaches rely heavily on trait theory to explain athletic behavior (e.g., see Butt, 1976; Carron, 1980; Tutko & Richards, 1971; Woods, 1971). That is, underlying personality structures, which are presumed to be relatively stable across time and situations, are assumed to influence physical performance (for a more thorough description of trait theory see Carron, 1980; Mischel, 1971). For example, the success of an athlete in a given sport might be explained by references to his/her "self-confidence", "tough-mindedness" or "enthusiasm" (e.g., see Butt, 1976). Consistent with the trait approach, most psychological research in the area of sports has investigated personality variables exhibited in athletes (Carron, 1980; Rushall, 1978a).

Coaching behaviors. Various authors (Dickinson, 1977; McKenzie & Rushall, 1974; Rushall, 1976, 1979; Tutko, 1976) have claimed that traditional coaching approaches are characterized by some or all of the following features. Firstly, some coaches tend to utilize a type of "home-spun" philosophy when working with athletes, as opposed to giving advice which has empirical support (Rushall, 1976). For example, Rushall (1979) reported the following examples of how superstitious and illogical training procedures are utilized prior to serious comeptition, even by coaches of elite athletes: "The hiring of an astrologer to help in the preparations of the Oakland Athletics baseball team; the open use of a pyramid totem by the Toronto Maple Leafs' coach...; (this same coach's) use of spraying 'negative ions' from an aerosal can...; and the consumption of monkey meat by one team at the World Cup soccer tournament..." (p. 12).

Secondly, it has been reported that many coaches tend to treat all athletes in a similar fashion by having them go through identical training programs (McKenzie & Rushall, 1974; Rushall, 1978b). Thus, instead of the program being tailored to the specific needs of the individual athlete, he/she must conform to the program.

Thirdly, traditional approaches are primarily concerned with the physical aspects of training (Rushall, 1979). "Psychological" preparation for competition is often neglected. Even those coaches who recognize the importance of such variables generally do not have structured or systematic programs for training these skills to their athletes.

Fourthly, Tutko (1976) suggested that the feedback given by many coaches is predominantly negative. That is, many coaches respond negatively to errors made by the athlete far more than they provide positive feedback when he/she exhibits correct performance. However, recent research (Rushall, 1981; Smoll, Smith, Curtis & Hunt, 1978) has demonstrated that this purported dominance of negative feedback may only be characteristic of certain sports (e.g., swimming). These studies will be described in more detail later.

Fifthly, many coaches function mainly in a supervisory capacity (McKenzie & Rushall, 1974), relying heavily on verbal instructions to direct the athletes. Thus the athletes have relatively little control over their rate of progress, since they must wait for instructions from the coach before continuing with their training program.

Finally, traditional approaches to coaching tend not to deal with variables which might influence the coach's behavior (e.g., see Dickinson, 1977). Instead, the implicit assumption (inferred from the relative absence of literature on this topic) is that the coach is entirely in control of his/her own managerial behavior.

In summary, a number of characteristics of traditional coaching approaches have been identified in the literature. However, it is important to note that these are based primarily on casual observations, and that very little empirical evidence currently exists to support their validity. More research, such as that conducted by Rushall (1981) and Smoll et al. (1978) is needed to determine if coaches in various sports actually exhibit these characteristics and, if so, to what degree. In addition, research should be conducted to identify relevant variables (e.g., type of sport, age of athlete, level of athletic skill, etc.) which might influence the relative effectiveness of one coaching style over another.

A Behavioral Approach to Coaching

Assumptions. A behavioral approach to coaching would reject the trait conception that underlying personality variables are responsible for an individual's behavior. Kazdin (1980) summarized the criticisms which have been leveled at the trait approach as follows: (1) the appeal to personality traits to explain behavior constitutes a circular explanation, since traits must first be inferred from the behavior; (2) research has shown that much of behavior is situation specific, that is, individuals do not always perform consistently in different situations or across time; (3) research has demonstrated that various behaviors which might be expected to constitute a trait are often not highly correlated; and (4) the etiology of the traits themselves is not explained. Instead of appealing to personality traits, the behavioral approach emphasizes the role of environmental factors when explaining an individual's behavior. Although biological differences in athletes are recognized, it is the environmental, situational and social factors that are potentially manipulable by the coach. This basic difference in assumptions is reflected in the type of coaching model which would be advocated by a behavioral approach.

A general behavioral approach for attempting to modify any type of behavior has been summarized as having three stages (Hersen & Bellack, 1976; Martin & Pear, 1978). The first is the assessment phase, which involves identification of the specific target behaviors (or objective measures of these behaviors) that are to be changed. Some sports-related examples of these dependent measures include: the time it takes a sprinter to run a quarter of a mile; the topography of a swimming stroke; the force with which a golfer hits a golf ball; and the number of laps per training session that a swimmer practices a particular stroke. This phase may also include a task analysis, in which the target behavior is subdivided into smaller components. For example, the butterfly swimming stroke may be further divided into specific body movements which comprise one entire stroke.

The second phase of a behavioral approach to modifying a specified behavior is the selection and implementation of an intervention program. A number of the intervention procedures which have been recommended for modifying athletic behaviors will be reviewed later in this paper. Finally, the third phase involves an evaluation of the effectiveness of the program. That is, it assesses whether or not the intervention actually changed the target behavior significantly in the desired direction.

An Overview of the Available Literature Relevant to Behavioral Coaching

The available literature dealing with the application of behavioral techniques to coaching can be classified into the following two categories: (1) recommendations based on a behavioral philosophy, but which have not been investigated empirically in the area of sports or physical education; and (2) actual research on the effectiveness of these techniques when applied to a variety of athletic behaviors. Of all the published articles in the general area of behavioral sports psychology that were reviewed for this paper, over 80% fall into the first category. That is, the quantity of empirical research on behavioral applications to sports lags far behind that of literature which advocates this approach.

A number of important books on these applications to both sports and physical education have appeared during the last decade. The first of these, authored by Rushall and Siedentop (1972), is entitled The Development and Control of Behavior in Sport and Physical Education. This book classifies the teaching of those behaviors relevant to competitive athletes into the following two categories: (1) the development of skilled behavior by shaping or modifying existing behaviors; and (2) the maintenance of skilled behavior at the desired level and rate. Behavioral principles and teaching models for each category are presented.

A second book, Every Kid Can Win, by Orlick and Botterill (1975) identifies and challenges the validity of commonly held assumptions regarding the purpose and value of sports for children. For example, they criticize the distorted emphasis society places on winning as the most important aspect of sports. Instead, they recommend a shift in emphasis from specific outcome oriented measures of success, to process aspects. A strong concern for the "social and psychological well-being of the (children)" (p. xiii) is viewed as a primary goal. The procedures they recommend for effecting such changes are very behaviorally oriented. For example, they state that the role of both coach and parents is two-fold: (1) to model appropriate behavior (e.g., good "sportsmanship"); and (2) to reinforce such behaviors in children. They also provide many valuable suggestions for increasing the probability that a child will both participate in and enjoy sports, such as ensuring that the child's initial contact with sports is highly reinforcing, as well as emphasizing individual goals and reinforcing progress toward these.

A third book, Developing Teaching Skills in Physical Education (Siedentop, 1976), presents a behavioral approach for helping teachers to improve their teaching skills, specifically in the area of physical education. Teaching, defined in terms of specific changes in the student's behavior, can be assessed both by direct observation of teacher behaviors (performance assessment) and by changes in the behavior of students (consequence assessment). The model outlined by Siedentop emphasizes: (1) the identification of specific teaching goals; (2) continuous monitoring of data on both teacher and student behaviors; (3) the use of these data as feedback for modifying teaching behaviors; and (4) the maintenance of teaching skills once goals have been reached. In addition, the adaptation of this approach to a variety of teaching areas (e.g., classroom management, planning for instruction, etc.) is discussed.

Presbie and Brown's (1977) book, Physical Education: The Behavior Modification Approach, also deals with the application of behavioral techniques to the teaching of physical education. Echoing Siedentop's (1976) assumption, they argue that teaching skills are learned behaviors, as opposed to traditional conceptions of teaching as an "art." Thus they are subject to scientific analysis, on the basis of which a technology can be developed to produce empirically based teaching and evaluation procedures that are "practical, concrete, objective, and most importantly, effective" (p. 14). According to Presbie and Brown, the goal of physical education is to promote lifelong physical fitness and sound health practices. Their book, therefore, deals with behavioral procedures for: (1) teaching physical and athletic skills; and (2) maintaining these skills on a long-term basis. In addition, they include a chapter on self-modification procedures for developing and maintaining physical fitness.

A fifth book, A Behavioral Analysis of Sport, was written by Dickinson (1977). Using Skinner's (1948, 1953, 1971) analyses of various aspects of society (e.g., of government and law, religion, education, etc.) as a model, this author attempted to extend such an analysis to the area of sports. The book seeks to identify "the environmental contingencies of reinforcement and punishment which lead to participation in sports, the effect of these contingencies on the acquisition of skills and the social behaviors with which sports are associated" (p. x).

Rushall (1979), in his book Psyching in Sport: The Psychological Preparation for Serious Competition in Sport, proposed that coaches develop and train their athletes to emit both the covert, as well as the overt behaviors exhibited by elite athletes. Arguing that "psychological training" should be equally as important as physical training in the development and maintenance of skilled behaviors, his book describes a model for training athletes in psychological coping for both precompetitive and competitive situations.

In addition, a variety of books on sports psychology briefly mention, or have entire sections devoted to, the application of behavioral techniques to athletic performance, although their orientations are not primarily behavioral (e.g., Alderman, 1974; Butt, 1976; Carron, 1980; Klavora & Daniel, 1979; Klavora & Wipper, 1980; Knapp, 1963; Lawther, 1972; Massengale, 1975; Nideffer, 1976, 1981; Oglvie & Tutko, 1966; Sage, 1971; Suinn, 1980; Tutko & Richards, 1971; Tutko & Tosi, 1976). Numerous articles which relate behavioral techniques to coaching strategies have also appeared in a variety of journals (e.g., Athletic Journal; Behavior Modification; Behavior Therapy; Canadian Journal of Applied Sport Sciences; Coaching Review; International Journal of Sports Psychology, Journal of Applied Behavior Analysis; Journal of Health, Physical Education, and Recreation; Journal of Sports Medicine and Physical Fitness; Journal of Sports Psychology; Medicine and Science in Sports; The Physical Educator; Research Quarterly; Scholastic Coach; Swimming Technique). Often these articles describe behavioral procedures for helping specific problems related to athletic coaching (e.g., the use of reinforcement to increase "motivation" of athletes, as in Tutko, 1976). However, as stated previously, very few provide supporting data for their recommendations. The next section will review the available literature on the application of behavioral techniques to the coaching of competitive sports. This review will include both those recommendations which have not yet been empirically tested, as well as actual research reports.

Literature Review on Behavioral Applications to Coaching

The knowledge base that contributes to effective coaching has become extremely broad and complex. For example, coaches are expected to perform a wide variety of functions that involve little or no contact with athletes, such as coordinating activities with officials and volunteers, fund raising, organizing road trips, and so on. Organizational psychology and public relations expertise can contribute to these aspects of coaching. In addition, the biomechanics of body movement are important for the identification of specific skills to be taught. Knowledge of exercise physiology and nutritional programming are relevant to the development of individualized fitness training programs for athletes. Finally, coaches must teach new skills as well as motivate and/or maintain athletic behavior in practice and competitive situations. Educational and psychological procedures in general, and behavioral psychology in particular, are especially relevant to these latter two areas. However, the application of behavioral procedures requires that the coach emit particular coaching behaviors. Some strategies for studying specific behaviors of coaches have also been developed. The following section will review behavioral applications in the following areas: (1) the development of athletic skills; (2) the maintenance and/or motivation of athletic behavior; and (3) the modification of the behavior of the coach.

Development of Athletic Skills

Specific behavioral procedures are available for effectively developing observable athletic skills. Behavioral techniques have also been applied to modify the cognitive or covert behaviors of athletes. Behavioral scientists have also begun to develop strategies for effectively dealing with the wide variety of behaviors that generally fall under the rubric of precompetition and competition preparation. These three subsections will now be reviewed.

Procedures for training overt behaviors. Operant shaping techniques can be applied either to the development of new sports skills, or to the topographical modification of existing skills (Dickinson, 1977; Rushall & Siedentop, 1972). The shaping procedure involves: (1) identification and operational definition of the target response (e.g., a correct golf swing); (2) identification of a starting response currently in the behavioral repertoire of the athlete which approximates the target response, or some component of it; (3) identification of a hierarchy of responses, ranging from the initial to the target response, each of which more closely resembles the target response; (4) a criterion for deciding when a particular item in the hierarchy has been learned; and (5) a procedure for dispensing reinforcement contingent on performing the required response (see Martin & Pear, 1978; Rushall & Siedentop, 1972). Assessment is an integral part of this procedure since it is necessary to: (1) identify the current level of skills exhibited by the athlete; and (2) continuously monitor progress throughout the duration of the program, as his/her performance increasingly approximates the final behavior.

Rushall (1970) used a shaping procedure to modify the butterfly stroke of an advanced swimmer. Successive approximations to target behaviors were identified, and correct performance was maintained by contingent feedback (i.e., a light was turned off when the stroke was being performed correctly at the specified level). Although no data are presented, performance improvements were reported. Other than this case report, no examples of the systematic application of shaping strategies to the development and/or modification of sports skills could be found in the literature. Although coaches undoubtedly utilize procedures which loosely resemble the shaping process, no literature could be found indicating that they do so in a manner which is precise enough to meet the actual requirements of the definition. It is probable that for many coaches, the use of more exacting shaping procedures would result in higher acquisition rates, although this remains an empirical question.

Chaining is a second strategy for developing skilled behavior which involves: (1) a task analysis of the target response in which this behavior is subdivided into smaller component responses; (2) the training of each component in the chain to some learning criterion; and (3) the linking together of separate components of the chain. Three major procedures for linking these components together are: (1) total task presentation, in which all steps are trained on each trial until all reach criterion; (2) forward chaining, in which the first step is trained to criterion, then the second is added to it and trained to criterion, and so on until the entire sequence is learned; and (3) backward chaining, in which the last step is trained to criterion, and so on until all steps have been added (in a reverse order) and are at criterion. Variations on these procedures have also been described (e.g., see Naylor, Note 1). The chaining format which is most effective for developing athletic behavior may vary depending on factors such as: the type of skill being trained; the current level of performance exhibited by the athlete; and his/her individual rate of learning. Rushall and Siedentop (1972) suggested that highly segmented motor behaviors should be taught in discrete units and then linked together (in either a forward or backward fashion). Other motor behaviors are better performed as whole units (e.g., a somersault).

Very little research has been conducted which compares different types of chaining formats for training athletic behaviors. O'Brien and Simek (Note 2) compared a "behavioral" (backward chaining) procedure to a traditional (forward chaining) procedure for teaching golf shots to novice golfers. The traditional group received training employing modeling, verbal instructions, visual aids, and feedback regarding correct grip, stance and swing. Since this was accomplished by actually playing through a golf course, the first task required by the student on each hole was to hit an approximately 250-yard drive. Each consecutive swing had progressively shorter amounts of distance to cover, eventually terminating in putting responses. The backward chaining group also received modeling and verbal instruction, but the golf swings were taught in a reverse sequence and combined with a "mastery-based learning approach." That is, training began with 10- and 16-inch putts, and the distance required for each swing was progressively increased after the criterion specified for a step was reached.

Dependent measures taken at post-test included: (1) the average score per group on 18 holes; (2) the number of shots holed when given three shots per hole at 14 different distances; and (3) proximity to the "sweet spot" (i.e., ideal spot) on the clubhead, when given three shots with each of six clubs.

Results over two separate studies suggested that backward chaining was superior to the traditional procedure, although these differences were not significant in the first experiment. However, the strength of these conclusions is limited for the following reasons: (1) no reliability measures were conducted on any of the dependent variables; (2) the possibility of experimenter bias cannot be ruled out, since the same instructor trained both groups and took all dependent measures; and (3) very small sample sizes (six subjects per group) were utilized in both studies.

For both shaping and chaining procedures, each approximation or step should be trained utilizing behavioral prompting procedures such as specific verbal instructions and physical guidance (e.g., see Martin & Pear, 1978). The use of such prompts should be gradually faded out as performance proficiency increases. No research investigating the relative effectiveness of various prompting procedures used to teach sports skills could be found in the literature.

Feedback has been defined as "information generated about a response that is used to modify the next response" (Siedentop, 1976, p. 9). Its appropriate use is a crucial element when teaching any behavior (e.g., see Dickinson, 1977; Sage, 1971; Paese, Note 3). Rushall and Siedentop (1972) emphasized the distinction between "intrinsic" and "artificial" ("extrinsic") feedback. Intrinsic feedback is inherent in the task itself and includes visual, tactile or auditory feedback, as well as the normal organic sensations which accompany a response. Artificial feedback refers to supplemental aids (generally provided by the coach) that are not usually available in the response itself such as verbal feedback, reinforcement, physical prompts, and any additional prosthetic aids (e.g., blinders which are worn by basketball players to train them to dribble without looking at the ball). As mentioned previously, Rushall (1970) used a visual feedback technique for modifying the butterfly stroke of a highly skilled swimmer by standing at one end of the pool with a light beam torch directed at the swimmer's eyes. The light was turned off when the stroke was being performed correctly. Its presence, however, indicated an error. If the error was not corrected within three consecutive strokes, the swimmer stopped for further instruction. This procedure resulted in the rapid acquisition of correct performance.

Many other studies have demonstrated that, for a variety of motor tasks, extrinsic feedback facilitates performance acquisition (e.g., see Battig, 1954; James, 1971; Malina, 1969; Paese, Note 3). The degree of precision or specificity of feedback may also enhance learning (e.g., see Fueyo, Saudergas & Bushell, 1975; Shapiro, 1977). Although immediacy of feedback is often assumed to be important, some research suggests that delayed feedback may be equally effective, as long as the next response has not occurred in the interim (e.g., see Bilodeau & Bilodeau, 1958; Magill, 1977, 1980; Sage, 1971).

Coaches have been criticized for relying predominantly on negative types of verbal feedback to control athletic behavior (Dickinson, 1977; Tutko, 1976; also see Skinner, 1968, for a discussion of the emphasis on aversive control in most environments). In addition, Rushall and Siedentop (1972) described how many students in physical education classes receive very little verbal feedback of any type, due to typically large athlete-coach ratios.

More recent research efforts have attempted to directly assess the feedback provided by coaches in actual sports environments. Smoll et al. (1978) used the Coaching Behavior Assessment System (CBAS, developed by Smith, Smoll & Hunt, 1977) to investigate the interactional patterns between 51 male coaches and 542 players in three Little League Baseball programs. They found that positive coaching behaviors (e.g., reinforcement, general technical instruction and general encouragement) accounted for approximately 67% of all observed behaviors, while the proportion of punitive behaviors was very low by comparison (i.e., less than 10%).

Rushall (1981) conducted observations of coaching behaviors in a variety of sports and physical education environments using the Coach Observation Schedule (COS, developed by Rushall, 1977b). He found that certain sports (e.g., swimming and physical education) were characterized by a high proportion of negative feedback, whereas for others (e.g., basketball and volleyball), positive control was dominant. However, the total amount of feedback (either negative or positive) given by the coach in all of these activities was low.

Further research is needed to directly assess coaching behaviors across many different types of sporting situations. A number of authors have recommended that the ratio of positive to negative verbal feedback should be at least four to one (Martin & Pear, 1978; Presbie & Brown, 1977; Rushall, 1980; Siedentop, 1976; Valeriote, 1981). In addition, some research in other areas supports this contention (Madsen & Madsen, 1974; Stuart, 1971). Once it has been determined that feedback deficiencies exist for a coach in a given sport, specific remedial coaching strategies can be implemented. A study which exemplifies this approach was conducted by Buzas and Ayllon (1981). They assessed the number of negative and positive statements made by a tennis coach while training three students on the forehand, backhand and serve behaviors. During baseline, the ratio of negative to positive statements was greater than four to one. A program was then implemented in which the coach was instructed to give praise for correct or "near-correct" performance, and refrain from commenting on incorrect performance. This manipulation reduced the percentage of negative comments to 7% from a baseline of 25%, and increased the frequency of positive comments up to eight times that of baseline. Performance improvements were also exhibited by all three students, with correct execution of the three skills increasing from two to four times over baseline measures.

Other strategies for maximizing the frequency of individual feedback have been suggested (e.g., see Van Houten, 1980a, 1980c). For example, a checklist of components for a specific skill could be developed, and the coach could use this to assess and provide feedback for athletic performance on a regular basis.

The goal of any training program is for the target response to be eventually controlled solely by intrinsic feedback. Much research has been conducted in a variety of areas to identify methods for transferring control of the target behavior from extrinsic sources of reinforcement (e.g., social approval, edibles, tokens, etc.), to existing reinforcers already available in the natural environment (e.g., see Stokes & Baer, 1977). Consequently, an effective technology of generalization is developing (e.g., see Martin & Pear, 1978; Stokes & Baer, 1977). Research is now needed to extend these findings to the field of sports. In addition, some research exists on the use of behavioral contracting to develop physical activity programs (Kau & Fischer, 1974; Keefe & Blumenthal, 1980). Results suggest that this procedure is useful for maintaining behavior during the initial stages of a program. However, with time, other sources of reinforcement become more salient until the contracting is no longer necessary. In spite of the success of generalization for the types of feedback or reinforcement strategies mentioned above, methods for transferring control from other types of artificial feedback, such as prosthetic devices, to intrinsic or naturally occurring feedback variables, have met with limited success (Rushall & Siedentop, 1972). Further research is needed to: (1) assess the usefulness of these types of feedback; and (2) develop appropriate generalization procedures for them, if their usefulness is demonstrated.

A few studies have investigated the effects of a behavioral package approach to improving performance in a variety of sports. Komaki and Barnett (1977) developed a program to teach offensive backfield skills to five members on a Pop Warner football team consisting of nine- or ten-year old males. Three frequently run plays were identified and task-analyzed into five separate phases. Next, the responses to be performed during each phase were operationally defined and checklists were developed to identify correct or incorrect performance for each phase of each play. A multiple baseline design across plays was used to evaluate this strategy. Baseline data were taken on performance under the coaching procedures which had previously been utilized. These consisted mainly of verbal descriptions of the plays by the coach (often with reference to diagrams), as well as verbal feedback (usually for errors) during practice sessions. Intervention consisted of an initial explanation of the checklist for the play which was currently being trained, as well as a rationale for each of the five phases. Other components included: modeling of correct performance by the coach; behavior rehearsal, as subjects walked through the plays first alone and later with the other players; immediate feedback regarding both correct and incorrect performance, as well as social approval following each play during practice sessions; and delayed reinforcement and feedback during game situations (which were given at the next practice session).

Results showed that performance increased an average of 20% following the introduction of the intervention procedure for each of the three plays, thereby demonstrating the effectiveness of this coaching strategy. Because this was a package of behavioral procedures, it was not possible to identify the relative effectiveness of its individual components (e.g., explanation of checklists, feedback, increased social approval, etc.). The following positive features of this approach were identified: (1) the techniques did not require extensive time or equipment and could thus be readily utilized by the typical coach; (2) the coach reported that the behavioral specification involved in the task analysis enabled him to better explain the plays to the players; (3) the checklists allowed each player to immediately evaluate his own performance after a play or game; (4) the checklists facilitated the delivery of both positive and corrective consequences by making correct and incorrect components more immediately obvious; and (5) this procedure provided alternative measures of performance, other than the relatively insensitive measure of winning or losing a competition.

Allison and Ayllon (1980) developed a behavioral coaching strategy which focused on error correction to enhance skill acquisition, and assessed the effectiveness of this procedure across three sports (football, gymnastics and tennis), various age groups (from 11 to 35 years), and both sexes. This coaching method was evaluated in either a multiple baseline (across subjects or behaviors) design or a reversal design, depending on the particular sport. The general procedure used for all three sports can be summarized as follows. Target behaviors were selected and operationally defined. These consisted of: (1) blocking in football; (2) backward walkovers, front hand springs and reverse kips in gymnastics; and (3) the forehand, backhand and serving behaviors in tennis. Baseline measures were taken on the standard method of coaching utilized up until that time. The behavioral coaching procedure consisted of these components: (1) the systematic use of verbal instructions and feedback; (2) both positive and negative reinforcement procedures; (3) positive practice; and (4) time out; and was implemented as follows. Firstly, the athlete received instructions from the coach regarding the specific target behavior desired, as well as the consequences for correct and incorrect performance. Secondly, an evaluation was made by the coach as to whether or not the behavior was executed correctly. If correct performance occurred, social approval was given. However, if the behavior was judged to be incorrect, it was stopped as closely as possible to the point where the error occurred. That is, the coach yelled "freeze" and the player was expected to hold whatever position he/she might be in at that point. While the player remained "frozen" the coach would proceed to: (a) give explicit verbal feedback regarding the error, and (b) model the correct position himself/herself. Finally, the player would be required to imitate the correct position. This procedure was repeated for a block of 10 trials.

Results showed the behavioral coaching procedure to be immediately effective in increasing the correct execution of skills up to 10 times that of baseline performance in all three sports. As in the Komaki and Barnett (1977) study, the relative effectiveness of the separate package components can not be evaluated. Although this procedure was both effective and easy for the coach to apply, dissatisfaction was expressed by a few of the athletes who stated that they found the "freeze" position somewhat aversive. A limitation of this study was that observations, during both standard and behavioral coaching phases, were made only when the coach was attending to the athletes. Since most subjects showed a substantial increase in errors when behavioral coaching was replaced by standard coaching, it is reasonable to assume that errors also increased during all experimental phases when the coach was attending to other players. This failure to record relevant data weakens the study's conclusions about the superiority of behavioral coaching.

These two studies on behavioral coaching packages indicate that such procedures offer considerable promise for further applications to the area of sports. However, more research is necessary to assess their long-term effects, extend the application of these procedures to other sports, "streamline" package components, and so on. Additional research in this area will be presented later in this paper.

Procedures for training cognitive behaviors. Although coaches have traditionally relied on the use of "external manipulation" to establish control of the overt (or motor) behavior of athletes, there is a developing interest in the training of covert (or cognitive) responses as well (Botterill, 1980; Lane, 1980; Powers, 1979; Rushall, 1979; Tutko & Tosi, 1976). Since the covert behaviors which are rehearsed should be well established in an athlete's overt behavioral repertoire, this procedure is more effective with highly trained than with beginning athletes (Rushall, 1979). Cognitive training may be valuable because: (1) it prepares the athlete for activity in two response modalities (cognitive and motoric); and (2) it facilitates the maintenance of attentional control on task-relevant variables (Rushall, 1979).

A procedure called "visuo-motor behavior rehearsal" (VMBR) has been advocated by sports psychologists including Lane (1980), Suinn (1977, 1980) and Kolonay (Note 4). This is basically the same procedure as that described by Rushall (1979), except that the athlete first receives training in progressive relaxation until he/she learns to relax completely within seconds. This is thought to enhance the vividness of the imagery experienced by the athlete. Following relaxation, imagery is used to practice specific skills.

Kolonay (Note 4) investigated the effectiveness of VMBR for increasing the foul-shooting percentages of male college basketball players. A component analysis of VMBR training was conducted in which it was compared to three other procedures: (1) additional training in relaxation techniques only; (2) additional training in imagery techniques only; and (3) normal training procedures which did not include VMBR or any component thereof. Results showed that only the VMBR group improved significantly after training. Kolonay concluded that both relaxation and imagery exercises were necessary components of the VMBR procedure.

Desiderato and Miller (1979) described a case report in which a cognitive behavior modification procedure was utilized to improve the performance of a 35-year old female amateur tennis player. The procedure included both VMBR as well as self-instructional training (e.g., see Meichenbaum & Turk, 1976). The percentage of competitive deuce games won increased from an initial baseline of 21% to 45% when self-monitoring of verbalizations was added. Following additional training with VMBR as well, the player was winning 60% of all competitive games.

A number of other articles cite case-history evidence for the effectiveness of VMBR. For example, Suinn (1980) described a skier who was exhibiting inconsistent performance while preparing for the Olympic competition. This athlete was instructed to task analyze the ski course into a chain of skills and activities. Next he was asked to use VMBR to ski an easy part of the course. After accomplishing this he practiced progressively more difficult parts, until eventually he was mentally rehearsing a successful ski run over the entire course. In the actual Olympic competition he performed exceptionally well, moving his team from twelfth to eighth place.

Kirschenbaum and Bale (1980) described a technique, "brain power golf," which is purported to facilitate golf performance. Components of this procedure include: muscle relaxation; reviewing a behavioral checklist prior to each shot; mental rehearsal of each shot; self-monitoring of positive behaviors throughout a game; and positive instructional self statements (as advocated by Meichenbaum, 1977). Only anecdotal evidence was offered in support of this procedure.

Although these cognitive procedures appear to have potential value, more research is needed to evaluate their effectiveness. If they are included as a component in training programs to develop athletic skills, it becomes the coach's responsibility both to teach athletes how to use cognitive techniques, as well as to monitor their performance of these skills. Rushall (1979) outlined procedures which should be followed for the successful execution of mental rehearsal. These include: (1) practice of mental rehearsal in the performance environment in order to identify relevant features, important cues and possible distractors; (2) performance of the entire skill, as opposed to only one component of it; (3) rehearsal of only successful performances; (4) imagination of the behavior at a rate which approximates that of the actual performance; and (5) imagination of proprioceptive and kinesthetic cues which accompany the actual performance. Rushall suggested that a coach can monitor an athlete's mental rehearsal skills using the following two methods: (1) the athlete can recite what is being rehearsed in the presence of the coach; and/or (2) the athlete can tape record his/her private recitation during mental rehearsal and give this to the coach for evaluation. Once the value of mental rehearsal has been demonstrated empirically, research efforts may profitably be directed at appropriate strategies for teaching athletes to employ cognitive techniques.

Training for competition. Since successful performance during actual competitions is the ultimate training goal for most athletes and coaches, it is logical that training programs be structured to include plans for coping with all identified variables which may affect performance in the competitive situation. A number of behavioral considerations in this area are described next.

Generalization from the training to the competitive environment will be facilitated to the extent that both situations are similar on a number of relevant variables (Dickinson, 1977; Rushall, 1979). Possible competition stressors (such as the presence of opponents or distractions from spectators) should be simulated in practice situations (Rushall, 1979). As mentioned previously, even cognitive skills (e.g., mental rehearsal) should be practiced in an environment which approximates the actual competitive environment.

As competition approaches, athletes experience an increase in both physiological and cognitive activity. The relationship between this arousal and performance has not been clearly identified as yet (Carron, 1980; Rushall, 1979; Singer, 1980). One theory, known as the "inverted-U hypothesis", indicates that an optimal arousal level exists for each specific task. Thus either an excessive, or an inadequate, amount of arousal will be detrimental to performance. However, other variables including type of task, complexity of task, degree of experience of the athlete, and individual susceptibility to arousal make this relationship less clearcut (e.g., see Carron, 1971). Moreover, for some types of tasks (e.g., those involving movement time), increases in arousal appear to be positively correlated with performance improvements. Although further research is needed to assess the effects of these variables on the arousal-performance relationship, certain implications regarding coaching strategies can be drawn. That is, the coach should train athletes to: (1) identify their optimal arousal level for a given sport; and (2) control their arousal level to achieve maximum performance. Rushall (1979) developed an arousal-level scale containing 23 items which are descriptive of arousal. He has suggested that, using this or similar measuring devices for feedback, the coach and athlete can work together to train the athlete to control his/her own level of arousal. However, the necessary procedures for achieving such control are not well specified. More research is clearly needed in this area.

Performance deficits may also occur when an athlete experiences excessive anxiety or inappropriate thought patterns. Rushall (1979) suggested that training in muscle relaxation will allow athletes to control their level of anxiety in competitive situations.

The entire day of the actual competition should be carefully planned (Rushall, 1979). All activities prior to the competition (as well as potential problems and their solutions) should be specified and rehearsed. Rushall described a wake-up procedure for the athlete to utilize on the day of competition, which involves the recitation of various positive self-statements. Again, this routine must be practiced in advance and should be part of the training program. From then until the time of the actual competition, the athlete is advised to carefully adhere to those activities specified in his/her plan. At this point the coach's role is to ensure that the athlete follows his/her plan, and that any problems are being coped with in the predetermined manner.

Behavior during the actual competition should also be carefully planned prior to the event. Rushall (1979) stated, "A major purpose behind planning a competition strategy is to develop sufficient information and mental activities to consume the time of the competition totally. This aims to maintain task-relevant concentration throughout the whole activity" (p. 87). A planning strategy for the actual competitive event includes: (1) segmenting the performance (if extended) into discrete units, each with its own goal; (2) mentally rehearsing each segment (as discussed previously); (3) identifying specific thoughts (both instructional and motivational) to consume the entire duration of the competition; and (4) identifying potential problems and mentally rehearsing solutions for each of these. This strategy must be thoroughly rehearsed prior to competition. Rushall advised that 20% of training time be spent learning the coping strategy.

No research was found to evaluate the utility of either precompetition or competition strategies such as those described by Rushall (1979). Component analyses, which attempt to sort out the relative effectiveness of the various procedures, are needed.

Maintenance and/or Motivation of Athletic Skill

Once an athletic skill is being performed correctly, the goal of the coach shifts from skill development to maintaining the skill in its correct form and at a given rate. No studies dealing specifically with topographical maintenance were found in the current review of the literature.

"Motivational" problems occur when an athlete fails to participate in a particular sport at a frequency or rate acceptable to the coach. A behavioral analysis of this problem would likely attribute its cause to an insufficient amount of reinforcement for participation and/or the fact that participation may result in punishing consequences (Dickinson, 1977; McClements & Botterill, 1980; Rushall & Siedentop, 1972). For example, Rushall (1978b) pointed out that, for endurance sports, the reinforcement-to-response ratio is very low. This is true with many sports which require extensive training for relatively few payoffs.

Some common punishing consequences cited by Dickinson (1977) include: (1) physical stress involved in the activity, which may be sufficiently aversive to decrease or prevent further responding; (2) stimuli associated with punishment for one sport may acquire conditioned punishing properties such that their presence results in the suppression of responding in other sports as well; (3) participation may be consequated with personal social punishers (e.g., the athlete's spouse does not approve of his/her participation); (4) failure to win may become aversive and prevent further participation; (5) verbal punishers may be provided for inferior performance, resulting in the suppression of future responding; and (6) participation in a particular sport may be subject to punishment from society in general (e.g., there may be social sanctions against women who play hockey or men who train for ballet). A coaching strategy for maintaining motivation among athletes is outlined below.

<u>Steps for motivating athletic behavior</u>. These guidelines have been extrapolated from a number of sources including Dickinson (1977), Martin and Pear (1978), Rushall (1980), and Rushall and Siedentop

(1972). The first step is to identify specific task-relevant behaviors that should be motivated, and the frequency or rate at which they should occur. These may include nonathletic, but desirable, behaviors (e.g., attendance at practice and attending to verbal instructions), as well as behaviors more directly related to the sport itself (e.g., swimming a given number of laps).

The second step requires identification of potential reinforcers available in the sporting environment that can be applied by the coach to motivate athletic behavior. Suggestions and guidelines for the identification of rewards and feedback strategies are available in the literature (e.g., see Hall & Hall, 1980; Rushall, 1978b; Van Houten, 1980a, 1980b; Youngblood & Suinn, 1980). Some examples of potentially reinforcing events include: praise and/or feedback from the coach or peers; charted performance; publicly displayed results; attendance at social functions; attainment of individual and/or team goals; badges, trophies, medals, etc.; travelling to competitions in other locations; and the introduction of novelty and variety into the practice routines.

The third step of the proposed coaching strategy for maintaining motivation requires that the coach deliberately plan and, where appropriate, communicate to the athletes the contingencies necessary to attain these rewards. Positive feedback should be given more frequently than negative feedback (Rushall & Siedentop, 1972; Siedentop, 1976). As mentioned previously, a minimum four-to-one ratio of positive-to-negative feedback has been recommended (Martin & Pear, 1978; Presbie & Brown, 1977; Rushall, 1980; Siedentop, 1976; Valeriote, 1981).

Some empirical evidence supporting this recommendation exists, although not in the area of sports (Madsen & Madsen, 1974; Stuart, 1971).

Goal-setting can also play an important role in this third step of the development of motivation (McClements & Botterill, 1980; Rushall, 1979). It has been found to increase work output as much as 50% over that achieved when no goals are set (Dimitrova, 1970). The following factors should be considered when setting individual or team goals: (1) training and competition goals should have a relatively high probability of success (Rushall, 1979); (2) although they must be achievable, the goals should be difficult enough that their attainment is positively reinforcing to the athlete (McClements & Botterill, 1980); (3) public disclosure of goals is recommended, as it often results in superior performance (Rushall,1979); and (4) the identification of multiple goals for any one performance is extremely beneficial, since it decreases the probability of "total failure" (e.g., an athlete may lose the race but improve on his/her own best time).

A fourth step for developing motivation is to gradually increase the amount of work output required to achieve a specific reinforcer (Rushall, 1970, 1980). Although skill acquisition occurs more rapidly under a schedule of continuous reinforcement, once the skill has been learned to some criterion the reinforcement schedule can gradually be made more intermittent. This will result in a persistent rate of responding (Martin & Pear, 1978; Rushall & Siedentop, 1972).

Rushall and Siedentop (1972) also suggested that athletic skills can be maintained by making the presentation of discriminative stimuli which control the behavior more intermittent. For example, if the sight of the coach is a discriminative stimulus in the presence of which an athlete performs (or increases the performance rate of) a specific skill, the coach could observe the athlete on a random basis to maintain the execution of this skill at a desirable rate.

Finally, the behavior of the athlete should eventually be controlled to a large extent by consequences other than those provided by the coach. Rushall (1980) suggested that peers can be trained to provide feedback and reinforcement for each other. Also, athletes can be trained to evaluate and provide reinforcing consequences for their own behavior. For example, Rushall (1975) described a device which was used to maintain both rate and consistency of lap swimming by competitive swimmers. This device was a "program board" which specified the number of laps for each particular stroke that should be performed by each swimmer. As the athlete completed each component of these instructions he/she would place a checkmark in the appropriate column, look at the next requirement, and continue to perform the specified behavior. All of this could be accomplished without verbal instructions from the coach. Self-recording is often reinforcing in itself (e.g., see Glynn, 1970) and may maintain the behavior at an adequate level without additional incentives. Self-monitoring devices similar to the one described for swimming by Rushall (1975) could be designed for other sports as well.

Behavioral research on the motivation of athletic behavior. A number of research studies have investigated the effectiveness of different behavioral procedures to motivate a variety of athletic behaviors. Allen and Iwata (1980) used a Premack group contingency to increase participation in physical fitness exercises by retarded adults. A baseline phase established that the average percent participation in games requiring comparable physical activity (to the exercise routines) was very high (97.5%) compared to participation in exercises (43.1%). However, when participation in games was made contingent on completion of exercises, exercise participation increased dramatically (84.3%). This study provides a good example of the use of readily available reinforcing events to motivate exercise behavior, by making them contingent on the desired behavior. A second implication is that it may be possible to make some physical exercise routines more inherently reinforcing, by incorporating them into game situations.

Some research has attempted to assess the relative effectiveness of various reinforcers used to maintain or increase athletic behavior. Rushall and Pettinger (1969) contrasted the effects of candy, money, coach's attention and an achievement board (control condition) as consequences for swimming laps in a set order and time period, for subjects in an age-group swimming club. Candy and money were found to generate more work output than the other two conditions, especially for younger swimmers. Swimmers who were 13 years old and over reacted more favorably to the coach's attention than to material rewards. This study indicates the importance of establishing the reinforcement value of a particular object or event for a specific individual.

Token reinforcement systems have not been extensively used in the area of sports and physical education. However, a few studies attest to their potential effectiveness. For example, Brock, Brock and Willis (1972) reported performance increases by two 15-year-old male pole vaulters, when they were contingently awarded points which could be exchanged for edibles. Also, tokens in the form of "Olympic rings" which could be exchanged for edibles were given to seven girls on a basketball team contingent on specific target behaviors during game situations (Jones, Note 5). Results showed that the number of points scored during token games was approximately double the number scored during games in which tokens were not awarded.

McKenzie and Rushall (1974) found that public marking of attendance of swimming team members (aged 9 to 16 years) was effective in reducing absenteeism, tardiness and early departures. The use of program boards (which were described previously) has also been demonstrated to be effective at increasing the number of laps swum during practice sessions (Bell & Patterson, 1978; McKenzie & Rushall, 1974). Heward (1978) used small amounts of monetary incentives, as well as public posting of each player's performance, in an attempt to increase the "efficiency average" of each player on a "barnstorming" baseball team. Although results suggested that this technique might be useful, due to confounding variables, strong conclusions cannot be drawn from this study.

Behavioral contracting procedures have been demonstrated to be effective at increasing and maintaining exercise behaviors. Kau and Fischer (1974) described a case report in which an adult woman successfully developed and maintained a jogging program through the use of a weekly contract in which prespecified reinforcers were administered by her husband. After 10 weeks the contracting procedure was eliminated since, at that point, the woman felt that her jogging behavior would be maintained without it.

Similar results were obtained by Keefe and Blumenthal (1980) in a study which utilized both stimulus control and "self-reinforcement" procedures to increase the exercise behavior of three middle-aged men. These men selected 10 reinforcers which they could earn over the course of one year by reaching their exercise goals. A two-year follow-up revealed that all three had continued to exercise at a high level, were in excellent physical condition, and were no longer programming extrinsic reinforcers for exercising.

Epstein, Wing, Thompson and Griffin (1980) compared the use of various types of contracts, a lottery procedure, and a no-treatment control group to evaluate their relative effectiveness at increasing participation in physical education classes by female university students. Both the contracting procedures and the lottery system produced significant increases in attendance, relative to the control group. Corresponding changes in physical fitness were correlated with the amount of exercise required under each condition. It is interesting to note that contracting was equally effective for high, as well as for low, exercise requirements.

Considering the studies which demonstrate that behavioral contracting has been effective in increasing and maintaining athletic behaviors, it could probably enhance many coaching programs. That is, the coach could recommend that individual athletes develop their own contracts for target behaviors, with or without involvement by the coach. Contracting may be especially applicable for facilitating adherence to a training program during its initial stages, until other sources of reinforcement become sufficient to maintain the desired behaviors.

Changing the Behavior of the Coach

The preceding literature review clearly indicates that behavior modification procedures have much to offer coaches for developing and maintaining behavior of athletes. A behavioral analysis of coaching suggests that those same procedures are also relevant to modifying the behavior of coaches since, as emphasized by Dickinson (1977), the coach is also a behaving organism. It is appropriate to ask a number of questions about the behavior of those coaches who attempt to implement behavioral coaching strategies, such as, Should a coach: (1) encourage athletes to set personal goals? (2) dispense more rewards than reprimands to players during practices? (3) correct errors in a way that is nonthreatening and not embarrassing to athletes? and/or (4) take the time to praise small improvements (even though overall performance may still need a lot of improvement)? A behavioral analysis suggests that coaches will perform these and other appropriate behaviors if they also receive frequent positive feedback for effective coaching behaviors, and corrective feedback for ineffective coaching behaviors.

Procedures for assessing and analyzing a variety of coaching behaviors in naturalistic settings have been developed, such as the COS (Rushall, 1977b) and the CBAS (Smith et al., 1977), which were discussed previously. Both involve direct observation of the coach's behavior, which is classified into various categories (e.g., feedback and rewarding; correcting and prohibiting; directing, explaining and informing; etc.). Such assessments could provide valuable feedback to the coach regarding his/her coaching style. If a coach wished to change certain coaching behaviors, periodic assessments using these or similar observational strategies would indicate the degree to which the coach was achieving his/her goals.

Behavioral checklists have also proven to be effective devices for maintaining a variety of behaviors at desirable levels (Yen & McIntyre, 1976), and these have been recommended for use by coaches as well (Rushall & Smith, 1979). For each of the three areas of coaching responsibility, comprehensive checklists could be developed identifying critical coaching behaviors in each area. These could be used by the coach and/or a trained observer to evaluate the coach's performance in each area. The frequency with which specific assessments would be conducted would vary, depending on the importance of the behaviors involved, as well as the relative frequency with which they should be emitted. Rushall and Smith (1979) described a self-recording procedure used by the coach of a swim team which was effective in increasing the rate with which he delivered reward and feedback to members of the team. Although this example involved a simple manipulation (relative to the comprehensive checklists which would be required to cover all the important job functions of a coach) it supports the suggestion that such techniques may be effective in increasing the rate of desirable coaching behaviors. Further research is necessary to determine if the use of these techniques alone will be sufficient.

Summary

Although behavioral procedures have been demonstrated to be effective in a wide variety of applied areas, it is only within the last decade that the behavioral approach has begun to influence the area of sports and physical education. This approach emphasizes the role of environmental factors on both athletic and coaching behavior. Although the existing research supports the contention that behavioral techniques are highly applicable to the coaching of competitive sports (e.g., see Allison & Ayllon, 1980; Komaki & Barnett, 1977), extensive research remains to be conducted in all of the areas reviewed above.

Purpose of this Research

Statement of the Problem

One area of amateur sports which has experienced considerable growth over the last few decades is the area of age-group swimming (McPherson, Marteniuk, Tihanyi, Rushall & Clark, 1980; Burke & Straub, Note 6). Burke and Straub (Note 6) reported that there were nearly one million boys and girls participating in age-group programs in the United States. Thus the area of age-group swimming is a prime candidate for the application of behavioral techniques. The purpose of this research was to investigate a behavioral coaching procedure to reduce swimming stroke errors with beginning age-group swimmers.

Rushall (1970) reported a case study in which visual feedback was used to modify the butterfly stroke of an advanced swimmer. However, it is likely that less advanced swimmers would require more extensive prompting regarding the target behaviors prior to receiving feedback on their performance. Although Allison and Ayllon (1980) demonstrated the effectiveness of a behavioral coaching procedure for decreasing errors with beginning athletes in three sports (football, gymnastics and tennis), no comparable studies have been reported for the sport of swimming.

When attempting to implement a behavioral error correction procedure for swimming strokes in a swimming environment, a number of factors must be taken into consideration. Firstly, although improvement was marked under the behavioral coaching procedures utilized by Allison and Ayllon (1980), many athletes exhibited poor performance when the standard coaching procedure was reimplemented. In addition, since the coach could only implement this procedure with one athlete at a time, the other athletes were probably instructed to practice on their own in the interim. Thus, although an athlete may have performed well in the presence of the coach, it is likely that he/she exhibited immediate performance decrements when the coach moved on to another athlete (i.e., when the behavioral coaching procedure was no longer in effect). It is desirable that the performance improvement be assessed under normal practice conditions, as well as when the coach is working specifically with one athlete. If the desired behavior does not generalize to the "natural environment" (i.e., to regular practice conditions) both during and after training, specific maintenance procedures should be implemented as a component of the behavioral coaching procedure.

A second factor to consider is the coach-swimmer ratio. During any given practice session a coach could be responsible for as many as 25 swimmers, all of whom may be swimming simultaneously, with between 6 and 10 swimmers per lane. Thus any procedure must be such that it does not disrupt other swimmers. In addition, it should not be time-consuming, require additional personnel or equipment, and it should be relatively easy for the coach to apply. Such practical considerations will increase the probability that a coach will actually implement the procedure.

Thirdly, the Allison and Ayllon coaching procedure required that subjects "freeze" when an error was committed. Obviously such a procedure is unworkable in a swimming situation.

Considering these factors, a behavioral error correction package designed to decrease errors in swimming strokes was developed. Azrin (1977) has outlined a strategy for applied research which involves: (1) identification of behavioral procedures which have existing empirical support as to their individual effectiveness; and (2) combination of as many of these as is practical and appear necessary to produce the most effective treatment strategy for the problem behavior targeted. In accordance with these guidelines, the present package was composed of a number of behavioral components whose efficacy has been demonstrated in other areas. The rationale for each component will be described briefly below.

Rationale for the Components of the Behavioral Error Correction Package

Instructions. When the presentation of instructions (e.g., spoken or printed words) precede a response that is occasionally reinforced, they become discriminative stimuli for that behavior (Martin & Pear, 1978). Instructions have been shown to be more effective when they are supplemented with the opportunity to practice the target behavior (e.g., see Kazdin, 1980). This error correction procedure used instructions in the form of explicit statements from the coach regarding incorrect and desired behaviors, as well as verbal feedback on the swimmer's performance in the training situation. Written instructions, in the form of a "correct behavior chart," were also utilized.

Modeling. Modeling is a procedure in which one individual (the model) engages in a specified behavior in the presence of the client, to increase the probability that he/she will imitate that behavior (e.g., see Bandura, 1977; Martin & Pear, 1978; Rosenthal & Bandura, 1978). The combination of instructions and modeling is likely to produce better results than the use of modeling alone (e.g., see Martin & Pear, 1978). Therefore, the coach modeled both correct and incorrect behaviors for the swimmer, with accompanying instructions. The swimmer was then asked to imitate both behaviors.

Self-instruction. O'Leary and Dubey (1979) define self-instruction as "verbal statements to oneself which prompt, direct, or maintain behavior" (p. 450). Like instructions, they may serve as discriminative stimuli which increase the probability of the occurrence of the target behavior. For example, Meichenbaum and Goodman (1969) found that covert self-instructions facilitated the developmental control of a motor behavior (i.e., finger tapping) for first-grade children, although for younger children (i.e., kindergarten age), the self-instruction was more effective if it was overt. In this experiment, brief verbal prompts which cued correct behavior were identified for each swimmer. He/she was first trained to repeat them overtly, and then instructed to repeat them covertly on each stroke while practicing.

Reinforcement and/or feedback. Feedback is an inherent component of any programmed reinforcement system, since reinforcement is presented contingent on correct responding. Social approval is a powerful reinforcer for most children, and one that is readily available in the swimming environment. Therefore, this was given by the coach following correct performance. In addition, the systematic use of informative verbal feedback regarding specific errors can facilitate response acquisition (e.g., see Allison & Ayllon, 1980; Dickinson, 1977; Fueyo et al., 1975). Consequently, this was provided at the end of each lap during training. For the same reason, feedback given during the maintenance phase was also response-specific. Finally, a procedure for administering immediate feedback for incorrect performance was incorporated into the training package. That is, feedback was administered before the occurrence of the next response (or stroke), as recommended by Sage (1971).

Method

Subjects

Subjects (Ss) were three female and two male swimmers, ranging from 7 to 12 years of age, who were members of the Manitoba Marlin Swim Club. More detailed S characteristics are given in Table 1. With the exception of S1, all had been swimming competitively for at least one year. All five Ss had been identified by their primary coach as exhibiting persistent errors in two or more swimming strokes.

Setting

Swimming practices were held during five morning and five afternoon sessions each week, with sessions ranging in length from 1 to 2½ hours. Individual swimmers could participate in 3, 6 or 10 of these practices per week. Of the seven coaches, between two and four were present at any given practice, depending on the number of swimmers who usually attended that particular practice, which generally ranged between 20 and 40. Practices were located in the swimming facilities of the Physical Education building at the University of Manitoba. The swimming pool was divided by a bulkhead into two sections: (1) a large (15.2 m X 25 m) shallow section; and (2) a smaller (15.2 m X 11.6 m) diving pool. Typically the more advanced swimmers utilized the large pool, with the smaller one being reserved for the newest swimmers.

Personnel

Behavioral observations were taken by a psychology professor, 12 university students, and the author. All observers, excepting the

Table 1

Subject Characteristics

Subject	Sex	Age	Years of Competitive Swimming
S1	female	10	1st
S2	male	7	2nd
S3	female	9	2nd
S4	male	9	2nd
S5	female	12	2nd

professor and the author, had had some formal swimming experience. For example, five had swum competitively in age-group competitions, two had previous coaching experience, and all had achieved at least the intermediate level of the Red Cross swimming classes. The 12 students were enrolled in an undergraduate course in Behavior Modification, and had chosen this option to fulfill a practicum requirement for that course. Their training was conducted in two phases. Firstly, they attended an orientation session during which data collection procedures were explained. In addition, they reviewed the correct form for three competitive swimming strokes (backstroke, breast stroke and freestyle), and watched a 10-minute film (Counsilman, Note 7) in which Olympic swimmers demonstrated each stroke. Secondly, each student spent at least two sessions at the pool observing nonexperimental swimmers and recording errors, along with the author or another previously trained observer. These practice sessions continued until a minimum interobserver reliability (IOR) level of 80% was obtained for at least three consecutive trials on each stroke. IOR calculation procedures are described later. Since students were trained sequentially in four separate groups, those groups trained first assisted with the training of later groups.

The behavioral error correction procedure was implemented primarily by one of the coaches who had been coaching with the Marlin team for six years, and who generally worked with first- and second-year swimmers. During an initial meeting with the author, the rationale for the error correction was explained and the coach agreed to implement it himself. However, since at times it was necessary for the coach to be absent or occupied with advanced swimmers, two Ss were trained on one stroke by one of the (female) university students (who was also a part-time swimming instructor), and one S was partially trained by the (male) psychology professor. The word "trainer" will therefore refer to the individuals who implemented the behavioral package. The specific trainer(s) for each S are identified in Table 2. Different trainers were used primarily in an attempt to reduce disruptions to the learning process, which may have resulted from lengthy time periods between sessions, due to the coach's absences. However, this procedural variation also permitted a systematic replication of the error correction strategy when implemented by various individuals who differed on variables such as age, sex and degree of coaching experience. All trainers practiced the error correction procedure prior to the commencement of their involvement in the research using nonexperimental swimmers. Practice continued until both the trainer and the author were satisfied with the consistency of application of the procedures.

Identification of Target Behaviors

Serious swimming stroke errors were selected as the target behaviors to be decreased for this experiment. These were identified in the following way: (1) a list of possible errors was compiled for each stroke, based on popular swimming instruction books (e.g., Bland, 1979; Counsilman, 1977); (2) these lists were distributed to four Marlin coaches, who independently rank-ordered the errors according to

Table 2

Descriptions of Target Behaviors Identified for each Subject, and Individuals who Conducted Training Sessions

Subject	Stroke	Error Number[a]	Description of Error	Trainer
S1	A (freestyle)	B2	Inappropriate arm recovery: Low elbow and straight arm, with arm swinging wide on both left and right arm recoveries.	coach
S1	B (backstroke)	B1	Incorrect pull: Straight arm pull through water exhibited on both arms.	university student
S2	A (freestyle)	A3	Short stroke: Arms did not reach full extent before entering water, or push back past hips in water.	coach
S2	B (breast stroke)	A7	Poor glide: S did not stretch body out completely during glide.	-
S3	A (freestyle)	B4	Cross over hand entry: When hands enter water, they cross well over midline of S's body.	university student
		A1	Low head: Head extremely low in water, such that entire face is completely submerged.	university student
S3	B (backstroke)	B1	Incorrect pull: Straight arm pull through water exhibited on both arms.	-
S4	A (freestyle)	B4	Cross over hand entry: When hands enter water, they cross well over midline of S's body.	coach

Table 2 (cont'd)

Subject	Stroke	Error Number[a]	Description of Error	Trainer
S4	B (backstroke)	C2	Lateral arm recovery: During arm recovery, both arms swing to side (rather than straight up and back, brushing S's ear).	coach + professor
S5	A (freestyle)	B2	Inappropriate arm recovery: Low elbow and straight arm, with arm swinging wide on both right and left arm recoveries.	-
S5	B (backstroke)	A2	Shoulders too flat: S's body remained flat during each arm recovery (rather than rolling 45° to side).	-

[a]See Appendix A.

their relative importance in detracting from swimming speed; (3) based on this feedback from the coaches the lists were further refined by deleting those errors on which there was marked disagreement among the coaches, as well as those which all coaches agreed to be relatively unimportant. The refined error lists, as they appeared on sample data sheets, are shown in Appendix A.

Not all of these errors were exhibited by all Ss. In addition, the specific errors exhibited differed from S to S. To identify problematic behaviors of potential Ss, eight swimmers were initially observed for instances of all identified errors. Based on both these observations and consultations with the coach, one or two of the most serious errors were identified for each S on two or more strokes. Since it appeared that relatively more practice time was spent on freestyle than on any one of the other three strokes, freestyle was selected as the first target stroke, and is hereafter referred to as "Stroke A." This was done to facilitate data collection. A decision not to collect data on the butterfly stroke was also made, because the coach thought many of the observed errors were due to insufficient muscular strength and/or poor conditioning of these young swimmers. Eventually five Ss were identified who exhibited at least one serious error on Stroke A, as well as on either the backstroke or breast stroke. This second target stroke is hereafter referred to as "Stroke B." The specific target behaviors or errors, identified for each S on both strokes, are shown in Table 2.

Most observations during baseline, training and follow-up were taken only on these selected behaviors. However, intermittent probe observations on all identified potential errors of target strokes (see Appendix A) were also conducted during baseline and after training, to assess the stability of the Ss' performances of these behaviors as well.

Behavioral Observation and Recording Procedures

Each S was observed from either the side or the front, depending on which location best facilitated observation of the specific target behavior being recorded (see Appendix A). When recording from the side, the observer walked along the pool deck beside the S for at least part of the observational distance. For frontal observations he/she stood on the bulkhead directly over the lane in which the S was swimming.

A "stroke" was defined as both right and left arm recoveries for freestyle and backstroke, or one complete pull with both arms for the breast stroke. Each trial consisted of 10 consecutive strokes. The observer counted the number of errors on the target behavior that were made during 10 strokes and recorded this number immediately following each trial (see the data sheets in Appendix A). If a targeted error was made on any part of the stroke (e.g., on the left arm recovery but not on that of the right), the whole stroke was recorded as an error. However, an error was not recorded if it was committed for any of the following reasons: (1) if the S bumped into another swimmer; (2) if the S touched or bumped into the side of the pool; and (3) if the coach interacted with the S either verbally, gesturally and/or physically (e.g., touched the S to signal him/her to stop for instructions). An error was counted if swimming was disrupted because the S turned his/her head and/or body to look at the observer.

Reliability

IOR checks on the error data collection were conducted by having a second individual who, independently and simultaneously with the primary observer, observed and recorded errors made by the same S. The percent IOR was calculated by dividing the total number of agreements that an error did or did not occur, by the total number of agreements plus disagreements, and multiplying this result by 100.

Procedural reliability measures were also taken on the trainer's behavior during each training session. As shown in Appendix B, a checklist was constructed to prompt the trainer when carrying out the procedures. In addition, an observer was present at all training sessions who, using the same checklist, independently recorded whether the trainer actually engaged in each specified behavior. The total number of possible trainer behaviors could vary among sessions, depending on factors such as the number of errors committed by a particular S during a training session. A percent compliance score was calculated from the observer's data by dividing the total number of correct trainer behaviors emitted, by the total number possible for that session, and multiplying this result by 100.

Behavioral Error Correction Procedure

The behavioral error correction procedure consisted of two distinct phases: (1) a training phase, in which sessions were conducted in the small (training) pool; and (2) a maintenance phase, in which specific interventions occurred under normal practice conditions in the large (practice) pool. These phases are outlined in Table 3, and are described in detail below.

Training. The training phase of the error correction procedure included the following behavioral components.

1. Preliminary description of correct performance. Checklists containing diagrams and instructions for correct behaviors on each stroke were constructed on 46 cm by 58 cm waterproofed boards and placed against the wall near the small pool during practices. Smaller samples of these checklists are shown in Appendix C. During a swimming practice the trainer would take the selected S over to the board which illustrated the target stroke. Then, with reference to the diagrams and instructions, he/she described one or more correct behaviors which the S was currently emitting, and gave social approval for these.

2. Intervention for incorrect performance. The trainer then identified the target behavior to be worked on during that training session, and continued through the following procedure with the S. Firstly, the trainer provided explicit instructions as to how the target behavior should be performed. Secondly, he/she modeled both the incorrect behavior exhibited by the S, as well as the desired behavior. He/she also provided concise verbal self-prompts for the correct behavior (e.g., "hands in front"), and repeated these while modeling the behavior. Thirdly, the S was asked to imitate both the incorrect and then the correct form of the behavior. The trainer then questioned

Table 3

Summary of the Behavioral Error Correction Package

I. Training (in small pool)

A. Out-of-pool

1. Describe 2 or 3 correct components of S's stroke and give social approval for these.
2. Identify target components, and describe correct performance.
3. Model the incorrect way that S was doing the target component, and then model the correct behavior, using appropriate self-prompts.
4. Ask S to imitate incorrect and correct behaviors, while repeating the self-prompts.
5. Ask S if he/she can feel the difference between incorrect and correct behaviors.
6. Have S practice correct behavior several times while repeating the self-prompts.
7. Instruct S to swim 6 laps in the small pool, while attempting to perform target behavior correctly, and while repeating the self-prompts to him/herself.
8. Explain consequences of correct and incorrect performance.

B. While S is swimming the six laps.

1. Provide positive verbal feedback immediately following each correctly swum lap.
2. Tap S on shoulder for each occurrence of an error on the target behavior.
3. If 3 consecutive errors occur, stop S at end of lap and give corrective feedback.

C. After S has completed six laps.

1. Provide social approval and feedback regarding his/her performance.
2. Provide a final verbal prompt to S to practice the correct behavior and use the self-prompts during regular practice.

II. Maintenance (two phases, in practice pool)

A. M1 (three practice sessions)

1. Give prompt to perform target behavior correctly before practice.
2. Provide at least two instances of feedback/reinforcement to S for correctly practicing target stroke.

B. M2 (three practice sessions)

1. Give prompt to perform target behavior correctly.

him/her, "Can you feel the difference?" A negative reply resulted in additional instructions and modeling. However, if the S replied "yes," he/she was requested to imitate the correct form of the behavior several times while repeating the self-prompt, until the trainer was satisfied that he/she was exhibiting correct performance.

3. Executing the stroke. The trainer then instructed the S to get into an outside lane of the small pool and to swim the stroke correctly for two trial lengths. These enabled the trainer to observe the S in action and ensure that he/she had covered all relevant features of the target behavior. Further prompts could be given following these two laps if the trainer considered these necessary. Next the S was instructed to swim six consecutive laps (i.e., a total distance of 91.2 m), while covertly repeating the self-prompt for the correct behavior once per stroke. The S was also informed as to the consequences of both incorrect and correct performance on the target behavior, as described next.

4. Consequences of incorrect performance. The trainer walked alongside the S on the bulkhead as he/she swam the six lengths. Each time an error on the target behavior occurred, he/she immediately tapped the S once on the shoulder with the padded end of a 1.3 m stick. If three errors occurred during one lap, the S was stopped at the end and given further instructional feedback before continuing with the next lap. Additional out-of-pool modeling and instructions could also be given at the trainer's discretion. If the S failed to perform the required six laps in 15 minutes, training was terminated for that session and

the S was asked to rejoin the other swimmers.

5. Consequences of correct performance. "Correct performance" was defined as less than two errors on the target behavior per lap. Correct completion of each individual lap, and of the entire six laps, was consequated in the following manner.

a. Individual laps. When the S touched the end of the pool, the trainer shouted, "Good!" (or made a similar positive comment) following each correctly swum lap. The S had previously been requested not to do tumble turns during these six laps in order to hear verbal feedback from the trainer.

b. Upon completion of six laps. The trainer provided verbal approval and feedback regarding the S's performance such as, "That's great! You're really getting that arm right--I only had to stop you twice. Super!" The coach also prompted the S to continue to practice the correct form of the behavior, as well as to repeat the self-prompt to himself/herself, during regular practice sessions.

Training was terminated for each S after his/her error rate on the target behavior had decreased to an average of 20% or less over three consecutive training sessions.

Maintenance. During the training phase, data on the target behavior were also recorded while the S swam in the practice pool, to see if any generalization had occurred. However, no extra feedback or prompts were given outside of training sessions. After training criterion was met, specific maintenance procedures were also implemented in the practice pool, as described next.

1. Maintenance phase 1 (M1). This phase lasted for the next three practice sessions after the S had reached training criterion, and was comprised of two components.

a. Initial prompt. At the start of each session the trainer would give a brief prompt to the S to correctly perform the newly trained behavior during that practice session. This prompt could consist of instructions and modeling such as:

> Remember what we were working on before? That's right--the way you lift your arms in freestyle. What were you doing wrong? What should you do? Right! And what do you say to yourself each stroke? That's right--"lift." Now, I want you to remember to lift those elbows during practice in the big pool too--OK? Good stuff!

Typically the prompts were much briefer, such as, "(S's name), remember to watch those elbows--OK?"

b. Feedback. At least two instances of feedback regarding performance on the target behavior were also given by the trainer while the S was swimming that stroke during regular practice. Feedback could consist of a brief positive comment if performance was good (e.g., "Nice high elbows--keep it up!"), or more specific feedback if errors were occurring (e.g., "That's much better. Most of the time you're lifting your elbows really nicely. But every now and then one of them swings wide. Remember, lift--not swing!").

2. Maintenance phase 2 (M2). For the three sessions following M1, only the initial prompt (as described above) was deliberately programmed.

During both maintenance phases the coach or trainer was cued by the author to administer the procedures. This ensured that the initial prompt and feedback procedures were implemented, and was done at the coach's request since he stated that he might forget to carry out the procedures. At no time throughout the entire experiment (including baseline) was the coach discouraged from providing feedback or prompts to any of the Ss. Thus the maintenance phases ensured that a minimum number of coach-S interactions pertaining to the target behaviors occurred. However, the coach was encouraged to interact "normally" with the Ss throughout the experiment.

Follow-up. During the follow-up phase the coach was no longer cued by the author to provide prompts or feedback to the Ss, and the other two trainers no longer interacted with their particular Ss. However, as stated above, the coach was not discouraged from interacting with any S. In fact, it was hoped that the maintenance procedures would increase the probability that the coach's behavior of giving response-contingent feedback on an intermittent basis would continue.

Remedial prompting. If error rates did not remain low during follow-up, a brief remedial prompting session by the practice pool was given. The S was asked to stand beside the pool while the trainer quickly described and modeled both incorrect as well as the correct behavior. The S then imitated the correct behavior several times while repeating the self-prompts, before returning to the large pool with a final prompt to "swim that way all the time."

Experimental Design

The basic research design was a multiple baseline across Ss design, with a reversal (i.e., follow-up) component (for a description of this design, see Kazdin, 1980; Martin & Pear, 1978). That is, baseline data were collected during regular practice sessions on both target behaviors of Strokes A and B for all five Ss. After the behavior of all Ss had stabilized, training on Stroke A was implemented for S1. Baseline data continued to be collected for Ss 2-5 during this time. In addition, data were recorded for S1 during both training sessions and regular practices to assess for generalization of the newly trained behavior. Once training criterion was reached with S1, her training sessions were discontinued and the first maintenance phase was begun. At this point, training sessions commenced with S2 for Stroke A. This procedure was continued until Ss 1-4 had sequentially experienced the training, maintenance and follow-up phases with regards to Stroke A. S5 served as a control S and did not receive training on either stroke.

In addition, a multiple baseline across behaviors (i.e., Strokes A and B) design was conducted with S1 and S4. That is, after each had received training on Stroke A, the error correction procedure was also applied to Stroke B. For Ss 2 and 3, Stroke B served only as a control behavior to assess whether generalization of procedural effects to different strokes occurred.

With a multiple baseline design, the influence of the independent variable (e.g., the error correction procedure) is demonstrated if a change in the dependent variable (e.g., a reduction in error rate) occurs for each S and/or target behavior shortly following the introduction of the independent variable, and not before. Significant results are judged in terms of the size and immediacy of effect, number of successful replications, and number of overlapping data points in adjacent experimental phases (Martin & Pear, 1978).

Social Validation

Not only must behavioral procedures be demonstrably effective in producing behavior change, but they should also exhibit social validity along several dimensions (Kazdin, 1977; Wolf, 1978). Firstly, the target behaviors selected should be ones that relevant individuals consider to be important. This aspect of social validity was attained by asking the coaches to identify the target behaviors. Secondly, the program should produce large enough behavior changes to be regarded as significant by all relevant individuals. Finally, the procedures used should be acceptable to all concerned individuals. These second and third aspects of social validity were evaluated in the following manner.

At the termination of the research the coach was asked to complete a questionnaire to determine the degree to which he considered the error correction package to be effective, useful, easy to implement, and so on. A copy of this questionnaire is shown in Appendix D. In addition, each of the four Ss who experienced the error correction package was interviewed to evaluate the degree to which he/she liked this training procedure and/or thought it was useful. The questions asked them are also shown in Appendix D. All interviews with the Ss were conducted following the research by one of the Marlin coaches who did not work with these Ss, and who was relatively naive regarding the experimental procedures. "Relatively" means that, although the procedures were never explained to her, she may have seen parts of training sessions while she was coaching her own swimmers. However, she was asked to conduct the interviews because: (1) the Ss were familiar with her and hopefully would be less inhibited than if questioned by a stranger; and (2) of all the coaches, she had the least contact with the experimental procedures.

Descriptive Data on Coach-Subject Interactions

Baseline data collection on swimming stroke errors occurred under normal practice conditions. During these practices the Ss swam in a lane with other children, under the supervision of the coach who provided instructions and feedback to various swimmers. Although under baseline conditions the coach did not single out or give special attention to the experimental Ss, they did receive feedback and instructions that were characteristically provided during a practice session. Since the behavioral error correction package was evaluated by comparing Ss' performances throughout its implementation to their baseline performances, this essentially provided a comparison of the behavioral package to the coach's existing supervisory style.

Azrin (1977), in his description of a strategy for applied research, argued that such experimental evaluations should make every effort to specify, in detail, the relevant characteristics of the baseline. In this experiment, the most pertinent baseline characteristic was the regular interaction between Ss and their coach. Therefore, with the permission of the coach who participated in this study, observers recorded data on the frequency and types of his interactions with each of the five Ss. If any of the other coaches interacted with an experimental S, that interaction was also recorded.

Observations were taken for one hour during each of 10 morning practice sessions throughout Weeks 9 to 13 of this experiment. During this time the experimental conditions across Ss varied from baseline to follow-up. The observer sat at the end of the practice pool and recorded any verbal interactions between the coach and any designated S, as well as the time each occurred. In addition, all comments were placed into one of the following categories.

1. Positive feedback.

a. General. These consisted of positive remarks such as: "good"; "you're working hard"; "nice try"; and so on, that did not specifically identify a feature of the S's stroke.

b. Specific. These consisted of positive remarks which identified a specific component of a stroke which merited approval. Examples include: "good kick"; "your arms are much better"; "nice long stroke"; and so on.

2. Negative feedback.

a. General. These consisted of negative remarks of a general nature such as: "OK, (S's name), quit goofing off"; "don't just stand there"; "next time I see you stopping, it's up in the stands"; and so on.

b. Specific. These consisted of comments which identified a specific component of a stroke which was being performed incorrectly. Examples include: "longer strokes, (S's name)"; "(S's name), your head is too low--get it up there"; "What kind of a kick is that? This is butterfly--not breast stroke!"

3. Other. This category consisted of any other types of interactions (e.g., general instructions to swim laps), which did not fall into the above four categories.

IOR checks were conducted on 30% of all observational sessions by having a second observer independently and simultaneously record and evaluate coach-S interactions. Reliability assessments were conducted for both the content and the type of interaction.

An agreement on the content of the interaction was defined as two recorded comments which were: (1) "similar" in wording and meaning (e.g., "Let's go, folks!" and "Let's go!" were considered similar in content); (2) recorded as being spoken by, and directed to the same individuals; and (3) recorded as occurring within a one-minute interval of each other. If disagreement occurred on any of these components, that total comment was defined as a disagreement.

Reliability checks on the type of interaction (i.e., positive, negative, etc.) were calculated only for those comments on which agreement was reached regarding the content (as defined above). Percent IOR for both content and type of interaction was calculated by dividing the total number of agreements per session, by the total number of agreements plus disagreements, and multiplying this result by 100.

Results

Reliability

IOR measures on the error data for Strokes A and B were taken on 44% of all trials, and assessed the target behaviors of all Ss during all phases of the experiment. The average IOR rating across Ss was 96%, with a range of 86% to 100%. Individual IOR averages for each S on both strokes are shown in Table 4. Procedural reliability measures were taken on 100% of all training sessions, with an average compliance rating of 96%, and a range from 78% to 100%. The average percent compliance scores for training sessions with each S are also depicted in Table 4.

Training Time

The number and total length of training sessions necessary for each S to reach training criterion are shown in Table 5. Four of the six trained strokes were trained to criterion in the minimum number of three sessions. The remaining two took four and seven sessions, respectively, to reach criterion. The average length of all training sessions was 7.9 minutes.

Effects of the Error Correction Procedure during the Training Phase

In the training pool. As Figure 1 illustrates, the behavioral error correction procedure effectively reduced errors on target Stroke A during training sessions. That is, for all Ss, errors decreased greatly during training sessions relative to their baseline performances

Table 4

Error Interobserver Reliability (IOR) and Procedural Compliance Data

		Error Data				Compliance Data	
Subject	Stroke[a]	Total no. of data collection trials	Percent trials with IOR checks	Average percent IOR score	Range	Average percent compliance rating	Range
1	A	273	51	95	86–100	94	91–100
1	B	154	58	97	91–100	96	91–100
2	A	253	26	96	92–100	91	78–100
2	B	137	34	98	94–100	–	–
3	A(B4)	289	51	96	88–100	96	83–100
3	A(A1)	133	32	95	90–100	–	–
3	B	91	57	99	98–100	–	–
4	A	212	42	94	86–100	100	100–100
4	B	139	45	96	88–100	97	96–100
5	A	262	40	97	92–100	–	–
5	B	111	46	97	92–100	–	–

[a]See Table 2 for a description of these behaviors.

Table 5

Number and Duration of Training Sessions Required by Each Subject on Each Trained Stroke

Subject	Stroke[a]	Error[a]	Number of training sessions	Total training time (minutes)	Average session length (minutes)
S1	A	B2	3	30	10.0
	B	B1	4	39	9.8
S2	A	A3	3	22	7.3
S3	A	B4 + A1	7	52	7.4
S4	A	B4	3	19	6.3
	B	C2	3	19	6.3

[a]See Table 2 for a description of these behaviors.

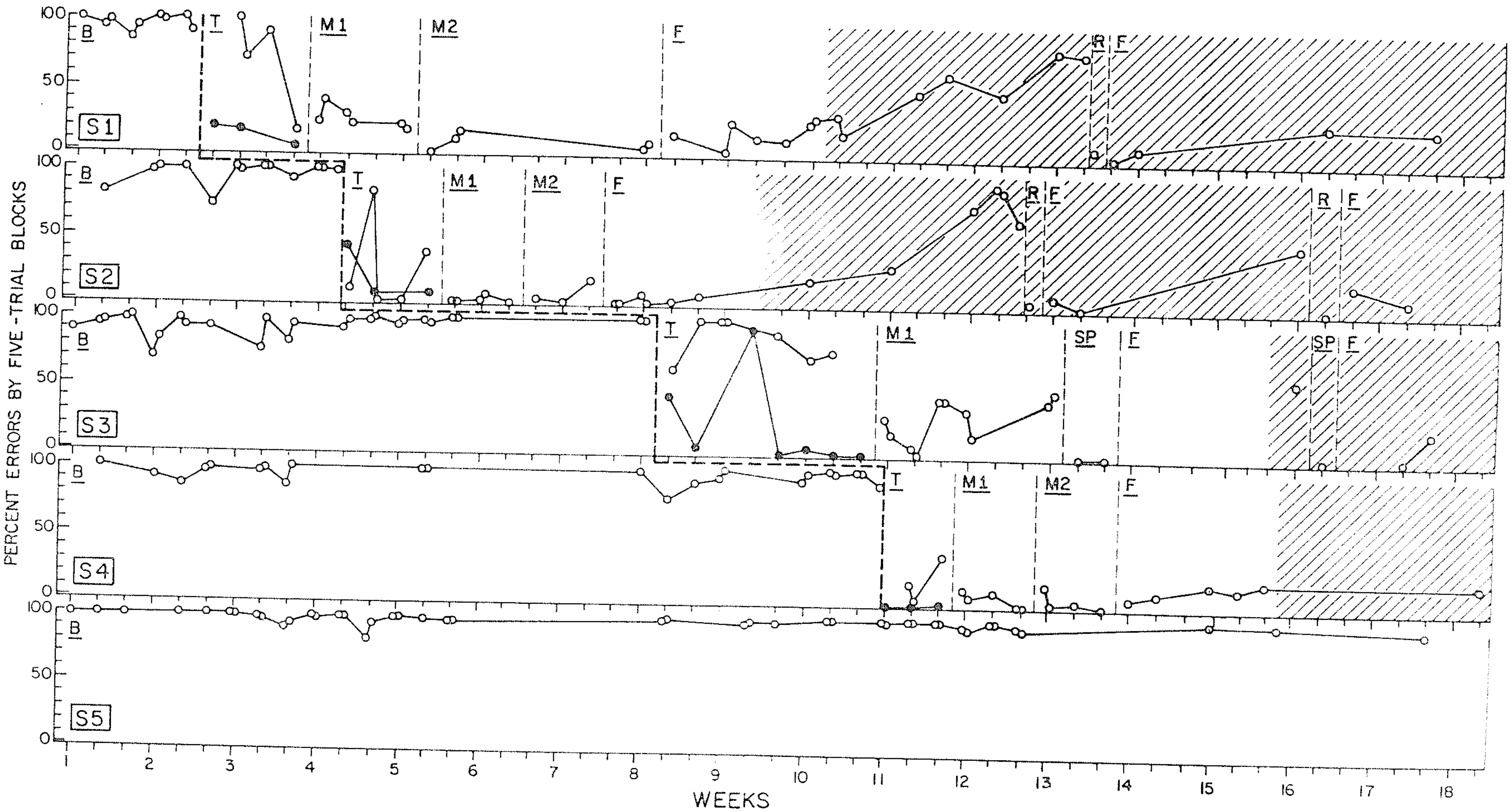


Figure 1. The percentage of errors in five-trial blocks, made on target behaviors of Stroke A (freestyle) by subjects (Ss) during all experimental phases (B = baseline, T = training, M1 = first maintenance phase, M2 = second maintenance phase, F = follow-up, R = remedial prompting, SP = special procedure used with S3). Darkened circles indicate training session data, and the shaded area depicts all data collected after the first two-week follow-up for each S.

under normal practice conditions. These results were also replicated in the multiple baseline across behaviors (i.e., Strokes A and B) design with S1 and S4 (see Figure 2). Although prior training on Stroke A did not affect the baseline error rate of Stroke B for either S, after the error correction procedure was also applied to Stroke B, errors on it decreased significantly as well.

In the practice pool. During the training phase, generalization of improved performance from the training to the practice pool was exhibited to varying degrees by all Ss. Figure 1 depicts this generalization data for Ss 1-4 on Stroke A, while Figure 2 shows this effect for Stroke B with S1 and S4 as well. By the end of the training phase, all Ss had exhibited substantial generalization of improved performance to regular practice conditions, with the exception of S3 on Stroke A.

Effects of the Error Correction Procedure during the Maintenance Phases

M1. As described above, generalization from the training to practice pool occurred during the training phase for three Ss on five of the six trained strokes. With the implementation of M1, these performance improvements were maintained. In addition, the only S who did not exhibit generalization during training (i.e., S3), showed large performance improvements in the practice pool under M1.

M2. Only three Ss experienced the second maintenance phase since S3 received a different procedure, which will be discussed later. For these three Ss, error rates on all trained strokes remained low throughout M2.

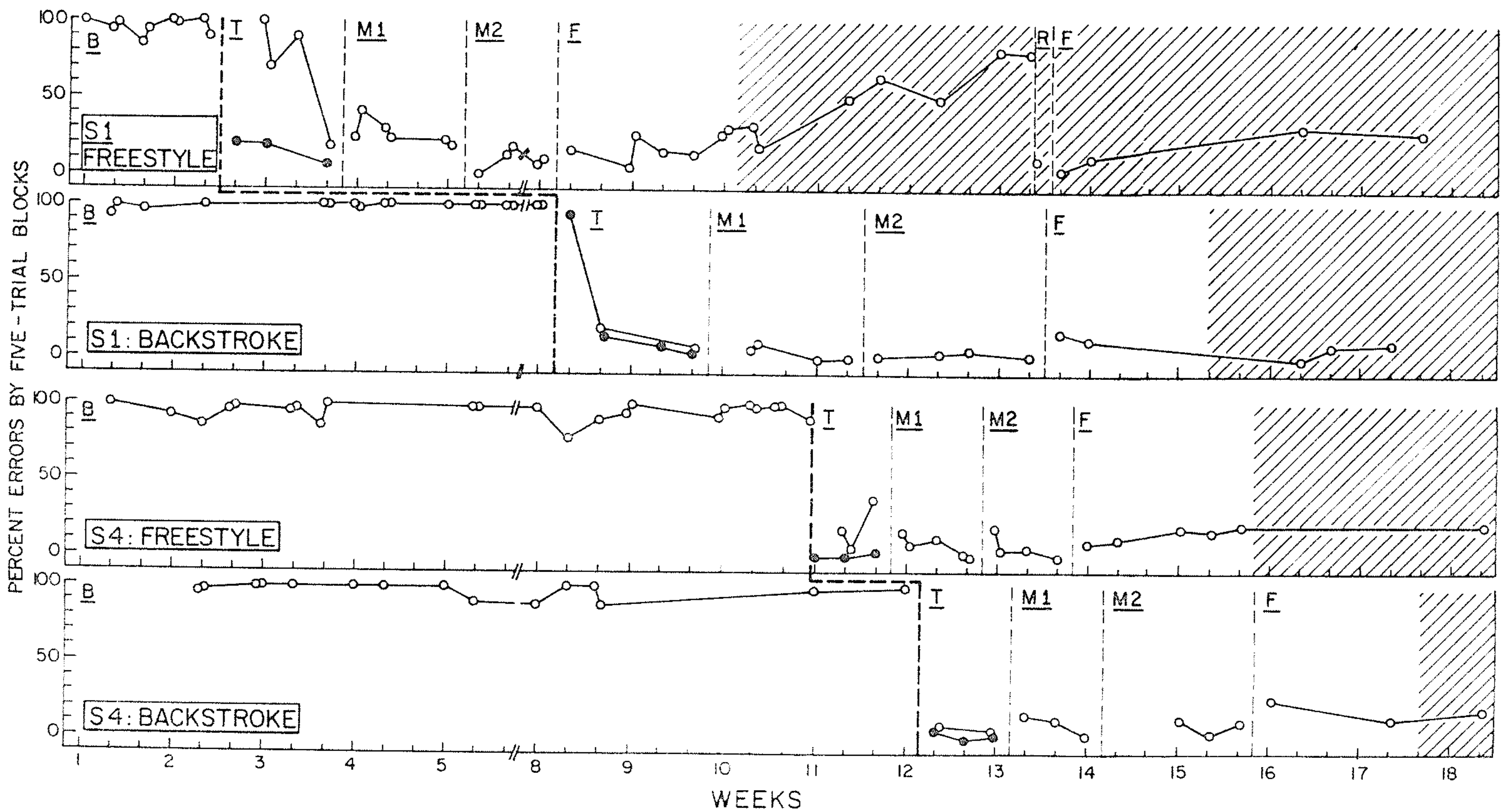


Figure 2. The percentage of errors in five-trial blocks, made on target behaviors of Strokes A and B (freestyle and backstroke), by Subjects 1 and 4 (S1 and S4) during all experimental phases (B = baseline, T = training, M1 = first maintenance phase, M2 = second maintenance phase, F = follow-up, R = remedial prompting). Darkened data points indicate training session data, and the shaded area depicts all data on each target behavior collected after the first two-week follow-up for each S.

To summarize the data to this point, the error correction package resulted in: (1) a significant decrease in errors for all four Ss on all six trained strokes during training sessions; (2) generalization of improved performance to the practice pool by the end of the training phase for three Ss on five of the six trained strokes; (3) a significant decrease in errors during M1 for the S who had not shown generalization during training, as well as maintenance of improved performance for the other three Ss throughout this phase; and (4) continued low error rates during M2 on all five trained strokes, for the three Ss who experienced this phase. These results are also illustrated in Table 6 which depicts the average percent errors emitted by each S under each experimental phase.

Control by the independent variable was demonstrated using a multiple baseline design, by the sequential implementation of the error correction package across Ss (see Figure 1) as well as strokes (see Figure 2), with errors on the target behavior decreasing only after experiencing the training procedure. Further, the control S (S5), who received no training on either stroke, exhibited no decrease in errors on target behaviors throughout the duration of this experiment (see Table 6 and Figure 1).

Two-Week Follow-up

As graphically depicted in Figures 1 and 2, error rates on all target behaviors for Ss 1, 2 and 4 remained low throughout a two-week follow-up (see also Table 6).

Extended Follow-up and Remedial Prompting

Generalization of improved performance was maintained for at

Table 6

Average Percent Errors Under Each Experimental Phase[a]

Subject	Stroke[b]	Base-line	Train-ing	Phase M1	Phase M2	Follow-up Two-week	Follow-up Two-four-week	Follow-up Greater than four week
1	A	95	70	27	9	20	55	81
	B	99	14	4	4	14	7	
2	A	95	27	2	7	5	53	82
	B	92						
3	A(B4)	94	86	29				
	A(A1)	98	98	36				
	B	99						
4	A	95	21	7	7	16		22
	B	98	7	11	9	19	18	
5	A	98						
	B	97						

[a]Data taken after remedial prompting are not depicted here.

[b]See Table 2 for a description of these behaviors.

least three to five weeks by Ss on three of the six trained strokes. As Figure 1 illustrates, S4's error rate on Stroke A remained low during a five-week follow-up. In addition, follow-up data on Stroke B were collected with S1 and S4, for four and three weeks respectively (see Figure 2). Error rates for both Ss remained low during this time.

Follow-up data on Stroke A were collected for five weeks following the termination of M2 for S1 and S2 (see Figure 1). Both Ss exhibited a gradual increase in errors after the second week until, by five weeks, their performances approached baseline error rates. Remedial prompting at this point produced immediate error reductions for both Ss. Four weeks later, S1's error rate remained low. Remedial prompting was reimplemented with S2 after a three-week follow-up assessment revealed a 50% error rate. At the termination of the research two weeks later, his average error rate was below 20%.

To summarize the follow-up results, long-term generalization was exhibited by Ss on three of the six trained strokes. Ss 1 and 2 exhibited a gradual return to baseline error rates over a five-week follow-up period. However, remedial prompting reduced their error rates immediately and substantially. S3's performance will be discussed in the following section.

Procedural Variations and Results with S3

During training. For a number of reasons, the procedures used with S3 deviated from those originally planned. Firstly, the target behavior identified for S3 on Stroke A (Error B4, see Table 2) was that her arms crossed over the midline of her body when entering the water. However, when training was implemented on B4, it became obvious that S3's head was also much too low in the water (Error A1, see Table 2), and that this was interfering with skill acquisition. It was not unusual for Ss to exhibit more than one identified error on a given stroke. As will be discussed in more detail under the section on probe data, the average percent error rate during baseline (of all Ss on both strokes) on all identified errors excluding target behaviors was 29%. However, with S3 it appeared that A1 was serious and correlated with performance on B4. Therefore, training was also introduced on A1 during the fourth session (see Figure 3). The initial out-of-pool prompts were expanded to include both errors (B4 and A1), and the number of laps swum was increased to nine. S3 was instructed to concentrate on B4 for the first three laps, A1 for the next three, and on both target behaviors for the final three laps. She met training criterion on both behaviors in seven sessions. As illustrated in Figure 3, generalization to the practice pool was not evident for either behavior during the training phase.

<u>During maintenance</u>. Although errors on both behaviors decreased relative to baseline rates during M1, overall improvement was less and variability greater than that exhibited by the other Ss in this phase. Further, S3 appeared to increasingly resent being prompted by the trainer in the presence of her peers. As described previously, her trainer was not the regular coach, but a university student (see Table 2). A telephone conversation between the coach and her parents

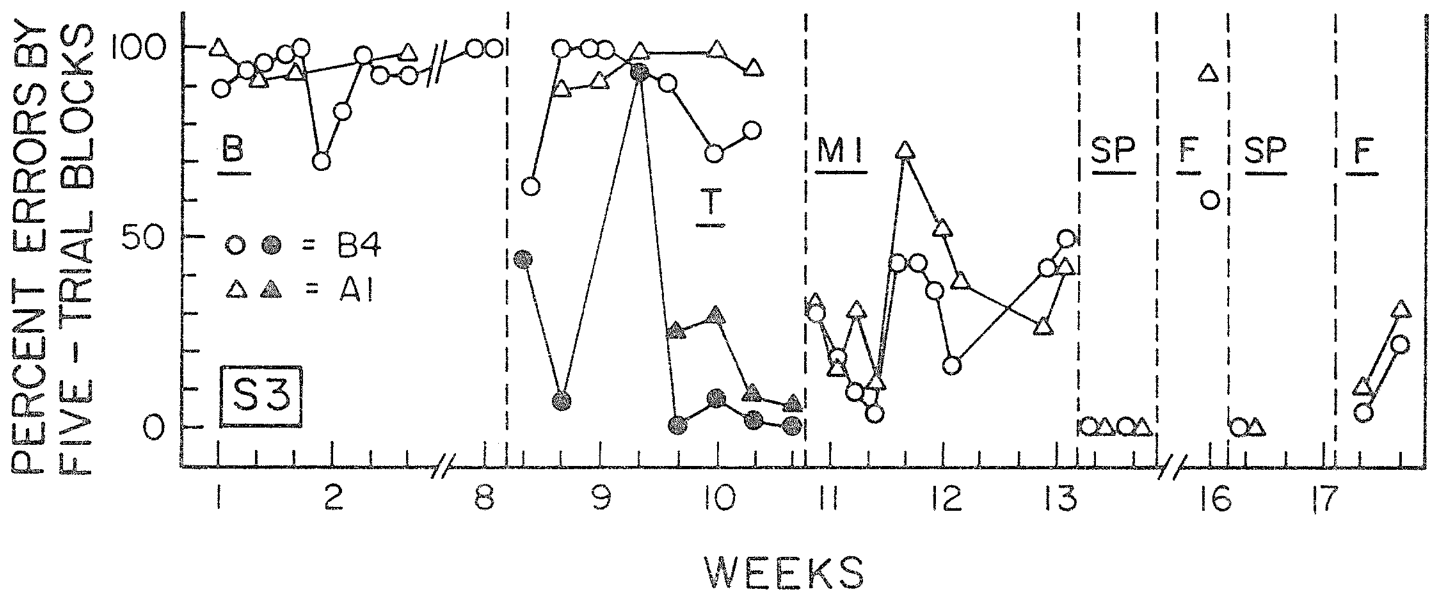


Figure 3. The percentage of errors in five-trial blocks, made on target behaviors B4 and A1 of Stroke A (freestyle) by Subject 3 (S3) across all experimental phases (B = baseline, T = training, M1 = first maintenance phase, SP = special training procedure, F = follow-up). Darkened data points indicate training session data.

revealed that she had complained to them that "university students," rather than the coach, were working with her. For these reasons, a special procedure (described below) was implemented for two sessions in an attempt to ascertain whether she would perform both behaviors correctly in the practice pool under certain conditions.

Special procedure (SP). The "university student" trainer's involvement was terminated and, since the regular coach was going to be away for a week, the SP was implemented by the psychology professor who assisted in data collection. He explained to S3 that the coach had asked him to work with her on her freestyle during the coach's absence. Her goal was to earn 10 points per practice in as few laps as possible. Points were distributed contingent on performance per lap as follows: (1) a "pretty good" lap (i.e., three or four errors on either target behavior) earned one point; and (2) a "very good" lap (i.e., two or fewer errors on either behavior) earned two points. The professor would stand at the end of the lane and raise either one or two fingers after each lap, depending on how many points she had earned. He was aided by a second observer who assessed performance on A1 from the side, and signalled to him the number of points S3 had earned for that behavior. Upon the coach's return, he would be informed as to how many laps it took her to earn 10 points during two practices.

Results. This manipulation was immediately effective in eliminating errors on both behaviors, as shown in Figure 3. It was reimplemented approximately two weeks later for one session when a follow-up assessment revealed that error rates on both behaviors were again high. After the second successful implementation, two follow-up observations were conducted before the research terminated. These showed error rates to be well below baseline levels.

Probe Data

Data from probe observations (taken on all identified potential errors on each target stroke) were averaged and a total percent errors score was obtained for each S on each stroke. These averages were calculated in two ways: (1) including data on target behaviors (see Figure 4); and (2) excluding data on target behaviors (see Figure 5). Specific training on one behavior did not result in detrimental effects on other stroke components, as indicated by the consistent decrease in total percent errors following training. As Figure 5 illustrates, even when differences due to target behaviors are excluded, all trained strokes showed substantial error decreases on subsequent assessments relative to baseline performances. For those control strokes which did not receive training, overall error rates either decreased slightly with time or remained approximately the same.

Coach-Subject Interactions

Observations of coach-S interactions occurred for 10 sessions during Weeks 9 to 13 of the experiment. IOR checks were conducted on 30% of all observational sessions. The average IOR rating regarding the content of the interactions was 86%, with a range from 60% to 100%; while the average IOR rating for type of interaction was 83%, with a range from 67% to 100%.

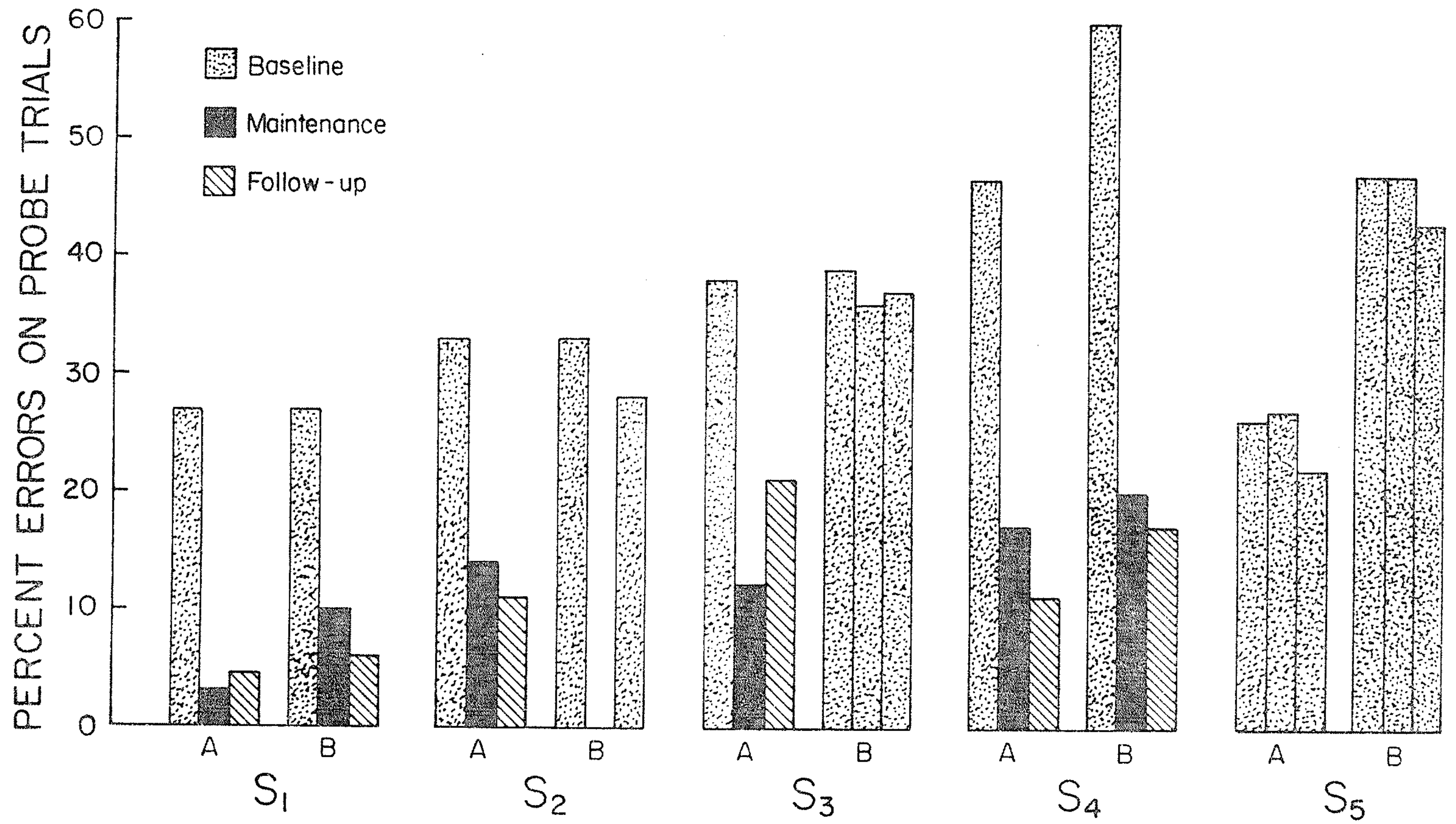


Figure 4. The percentage of errors from probe trials of all identified potential errors for Strokes A and B, for all subjects (Ss) during various experimental phases. (Note: Probe trials on strokes which did not receive training are depicted as baseline data.)

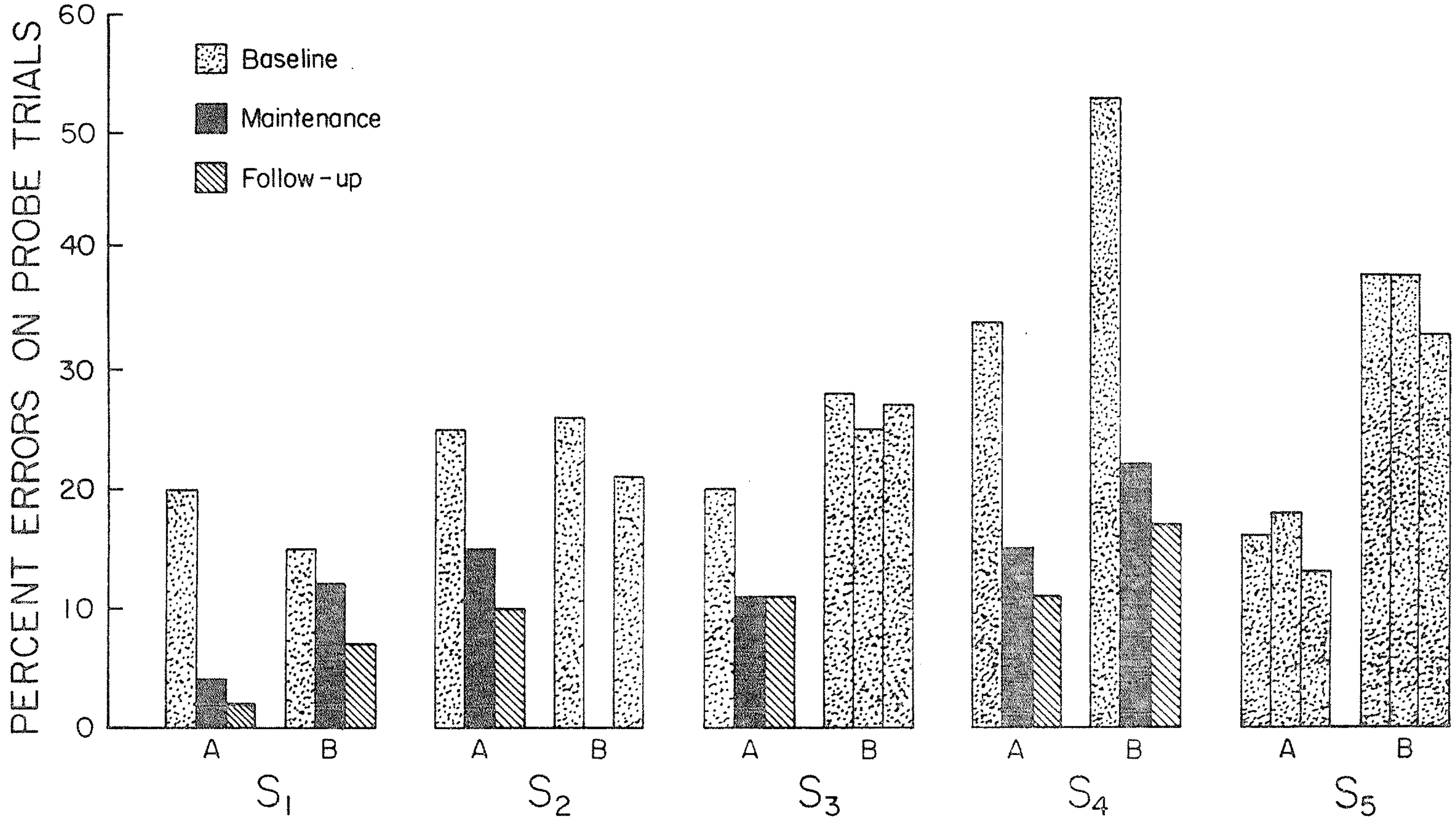


Figure 5. The percentage of errors from probe trials of all identified potential errors for Strokes A and B, excluding errors on target behaviors, for all subjects (Ss) during various experimental phases. (Note: Probe trials on strokes which did not receive training are depicted as baseline data.)

For each S, the average number of interactions per practice for each category of interaction is shown in Table 7. All Ss received some general positive feedback, with averages ranging from .1 to .5 instances per practice; and four Ss received some general negative feedback, ranging from .3 to 1.1 instances per practice. Two Ss received some specific positive feedback, and this was for target behaviors identified for this experiment. These occurred on an average of less than once per practice. No instances of response-specific negative feedback were observed. "Other" types of interactions ranged from .3 to 2.5 occurrences per practice across the five Ss.

Social Validation

Section 1 of the social validation questionnaire completed by the coach required that he rate the error correction procedure using a 7-point scale on characteristics such as: its disruptiveness to regular practice, ease of application, effectiveness, popularity with Ss, and so on (see Appendix D). Overall, he gave it 44 out of a possible 49 points for the most positive score (or 90%). He also indicated that all procedural components were useful, that none should be eliminated or changed, and that he would like to continue using this strategy in the future. In addition, he praised the structured form of the package, since this ensured consistency of application and decreased the likelihood of forgetting specific components. However, he doubted that he would remember to administer the maintenance prompts on his own.

All four Ss stated that they liked the training procedure.

Table 7

Average Number of Coach-Subject Interactions per Practice Session

Subject	Number of Observational Sessions	Type of Interaction: Positive Feedback		Negative Feedback		Other
		Specific	General	Specific	General	
S1	8	0	.4	0	.3	1.3
S2	9	.4	.3	0	1.1	2.3
S3	8	.6	.5	0	.8	2.5
S4	7	0	.1	0	.3	1.4
S5	9	0	.1	0	0	.3

However, two rated their amount of "liking" as 4 on a scale of 10, with the remaining two rating this 8 and 9. Two stated that the out-of-pool prompting was very helpful, while the other two preferred training to occur only in the pool. Three indicated that they found it difficult to perform the target response correctly. All agreed that the immediate feedback while swimming was very helpful, although one commented that it was "a bit scary at first." Finally, all Ss rated the overall helpfulness of the training procedure as 10, on a scale of 10, and all stated that they would like to receive similar training on other problem strokes.

Discussion

This research demonstrated that the behavioral error correction package resulted in: (1) a decrease in errors on swimming strokes to a low rate during training sessions; and (2) a generalization of improved performance with minimal prompting and feedback under normal practice conditions. In addition, for most Ss this improvement was maintained under standard coaching conditions during at least a two-week follow-up.

The efficacy of this procedure was assessed using three different trainers in a multiple baseline across four subjects design, as well as in a multiple baseline across two strokes design with two Ss. All trained strokes showed immediate and large performance improvements. Short-term durability of the effects during a two-week follow-up occurred for Ss on five of the six trained strokes (i.e., for all Ss except S3 on Stroke A). Longer term performance improvements of up to five weeks were exhibited by Ss on three of the six trained strokes.

During the training phase, generalization of the target behavior to regular practice conditions was assessed and the degree of improved performance was found to vary among Ss. S3 exhibited virtually no generalization, while S1 and S4 each showed large effects. This was particularly noticeable on Stroke B, which was trained secondly. Such variability highlights the necessity for: (1) assessment of generality in the natural environment; and (2) programming additional contingencies in the natural environment to enhance generalization of the target behavior across both settings and time.

Follow-up data were collected for five of the six trained strokes. In three instances, error rates remained low throughout this period. However, for both S1 and S2, error rates on Stroke A showed a gradual increase some time after two weeks. Observations of the coach's interaction with the five Ss were conducted during Weeks 9 to 13 of the experiment, and therefore occurred simultaneously with a large part of the follow-up phases for these two Ss (see Figure 1). An analysis of this interaction data reveals that S1 received no feedback from the coach related to the target behavior during eight observational sessions; while S2 received less than one instance of response-specific feedback per session ($\bar{x}$ = .4, see Table 7). Thus, in terms of extrinsic feedback, these Ss experienced what approximated an extinction phase. As Allison and Ayllon (1980) suggested, behaviors which have not reached a level of acquisition high enough to be maintained by intrinsic feedback and reinforcement, may show performance decrements where extrinsic sources of reinforcement are not available. These error rates did, however, remain low for at least the first two weeks of follow-up. This suggests that very little additional prompting or feedback from the coach, perhaps on an increasingly intermittent schedule, would be sufficient to maintain correct performance at a high rate.

When brief remedial prompting on Stroke A was given, both S1 and S2 exhibited immediate error reductions, and this improvement was maintained at a four-week follow-up for S1. With S2, an additional remedial prompting session was given three weeks later since performance appeared to be deteriorating. This emphasizes the need for intermittent assessment of target behaviors to ensure that they continue to be exhibited in their correct form. Also, although remedial prompting was highly effective, it may prove to be unnecessary if an intermittent feedback strategy were implemented.

The performance of S3 warrants additional discussion. Although the target skills did not initially appear to be in her behavioral repertoire, these were acquired during training sessions. However, generalization to practice sessions was minimal and, even when the maintenance contingencies were implemented, error rates remained high and quite variable relative to performances of the other Ss. Two possible reasons for this were identified. Firstly, she apparently found it somewhat aversive to be trained by someone other than her coach, especially in the practice pool. This was an unexpected development since other Ss (e.g., S1), who were not trained by the coach, seemed to enjoy working with their trainers. Also, when questioned later about the procedures, S3 responded quite positively.

A second reason may be that "swimming correctly" did not have any great reinforcing value for this S. Informal observations, as well as comments from the coach, suggested that she enjoyed swimming practices and competitions mainly because these provided opportunities to interact socially with her peers and the coaches. By contrast, she appeared to be relatively unconcerned with her actual swimming performance. It is reasonable to assume that some children participate in a sport for reasons other than to master a specific skill (e.g., because of parental pressure, to be with friends, etc.). That S3 had learned the target skills was evident from her perfect performance under the SP condition. However, in the author's opinion, it would be necessary to program strong extrinsic reinforcement contingencies to maintain correct behavior with this S. Most coaches would probably set a higher priority on working with those children for whom correct performance was already quite reinforcing.

This research also demonstrated that the effects of training are limited to the particular stroke being trained. That is, no performance improvements associated with training on Stroke A were observed on control Stroke B. However, as illustrated by the probe data, training one target behavior of a specific stroke did appear to have beneficial effects on other components of the same stroke.

It may be argued that improved performance was due, in some general way, to increased attention from the trainer, and not to the actual procedures utilized. However, it has been clearly demonstrated elsewhere that noncontingent and/or nontask specific attention or feedback do not produce rapid or durable changes in behavior (e.g., see Fueyo et al., 1975; Hart, Reynolds, Baer, Brawley & Harris, 1968).

Besides producing reliable decreases in errors on target behaviors, the error correction procedure also achieved social validity along the dimensions outlined by Kazdin (1977) and Wolf (1978). Firstly, since the coaches themselves identified the target behaviors, this ensured that important behaviors were selected for treatment. Secondly and thirdly, relevant individuals considered the changes produced by the package to be significant, and the procedures used to be acceptable. That is, post-experimental questioning established that both coach and Ss were very positive regarding the effectiveness of the error correction strategy. In addition, all Ss indicated that they would like similar training on other problem strokes, and the coach stated that he wished to continue using this strategy in the future.

The results of this experiment can also be discussed from the perspective of the motor learning literature. Research in this area has demonstrated that the acquisition of motor skills can be enhanced by variables such as the opportunity to practice the new behavior, and the timing and specificity of augmented feedback or "knowledge of results" (Magill, 1980; Sage, 1971). Each of these factors was present in this research. Firstly, since training occurred during regular practice sessions, the opportunity to engage in the new behavior was available on what approximated a distributed practice schedule. Research has shown distributed practice to be more effective and efficient than massed practice for motor skill acquisition, especially whem energy demands are high as is characteristic of the sport of swimming (Sage, 1971).

Secondly, when the swimmer made an error, feedback was given immediately and before the next response occurred. Thirdly, the verbal feedback dispensed during training and maintenance precisely specified correct and incorrect behaviors. All of these factors have been shown to facilitate motor skill acquisition (Magill, 1980; Sage, 1971). Therefore, although the present research did not deliberately manipulate any of these variables, both the procedures utilized as well as the results obtained were consistent with recommendations from the motor skill literature.

This research has immediate practical implications for swimming coaches, as well as some obvious limitations on the generalizations that can be drawn from its results. In addition, the results suggest that a number of follow-up research studies may be warranted.

Firstly, a major implication for swimming coaches is that these procedures can be effectively used to decrease error rates of swimmers who have persistently exhibited the same error for over a year. Further, the procedures are efficient in that errors can be decreased in a minimal number of training sessions. Correct performance can also be maintained following training during regular practice conditions, although some type of intermittent feedback is likely to be necessary for most swimmers. This feedback can be as minimal as once or twice per practice.

Some factors limit the generality of the results obtained from this experiment. Firstly, all subjects were relatively new and young swimmers. Thus implications regarding the effectiveness of these procedures with older individuals, who may have been swimming for many years, remain to be demonstrated. Secondly, it is possible that these results may not apply to all swimmers in the population sampled, since only four subjects received training in this study. A couple of procedural limitations may also be identified. Since training sessions were conducted in a different pool, it was necessary for a second person to supervise the other swimmers during the coach's absence. In addition, the coach required reminders from the author to administer the programmed feedback and prompts to swimmers during the maintenance phase. Thus, successful adoption of these procedures by a coach may require some additional environmental supports.

A number of future research investigations are suggested by this study. Firstly, the study could be replicated using older swimmers who have been exhibiting the same error for longer periods of time. Secondly, the social significance of the research could be extended by: (1) social validation of the target behaviors (i.e., errors) selected, to determine if a reduction in these errors will actually result in increased swimming speed; and (2) the development of more objective measurement techniques to assess the degree to which such procedures are acceptable to both coach and swimmers. A third area for future research could investigate generality of the behavior change from slow to high swimming speeds, as well as conditions under which the change will show generality over time. For example, self control strategies for maintaining long-term correct performance might be developed and tested. Finally, future studies could be profitably directed at researching methods whereby a typical coach, under typical coaching conditions, could implement this program on a regular basis with a larger group of swimmers. This might include the development and subsequent field testing of a self-instructional manual for coaches.

Summary

In summary, this error correction package was demonstrated to be effective at quickly decreasing targeted errors on swimming strokes that had not changed under standard coaching procedures. The package was efficient in that it did not disrupt ongoing practice, require excessive amounts of the coach's time, or necessitate the use of cumbersome apparatus. Generality of improved performance was achieved under normal practice conditions during the maintenance phases, as well as over two- to five-week follow-up assessments, for Ss on five of the six trained strokes (i.e., on all strokes with all Ss except for S3). In addition, the procedures had social validity in that both the coach and the Ss considered them to be helpful and indicated that they would participate in them again, if possible. Finally, conditions for enhancing longer-term maintenance of correct behavior, practical implications and limitations of this study, as well as suggestions for future research were discussed.

References

Alderman, R. B. Psychological behavior in sport. Toronto: W. B. Saunders, 1974.

Allen, L. D., & Iwata, B. A. Reinforcing exercise maintenance using existing high-rate activities. Behavior Modification, 1980, 4, 337-354.

Allison, M. C., & Ayllon, T. Behavioral coaching in the development of skills in football, gymnastics, and tennis. Journal of Applied Behavior Analysis, 1980, 13, 297-314.

Atthowe, J. M., Jr. Treating the hospitalized person. In W. E. Craighead, A. E. Kazdin, & M. J. Mahoney (Eds.), Behavior modification: Principles, issues, and applications. Boston: Houghton Mifflin Company, 1976.

Azrin, N. H. A strategy for applied research: Learning based but outcome oriented. American Psychologist, 1977, 32, 140-149.

Baer, D. M., Wolf, M. M., & Risley, T. R. Some current dimensions of applied behavior analysis. Journal of Applied Behavior Analysis, 1968, 91-97.

Bandura, A. Social learning theory. Englewood Cliffs, New Jersey: Prentice-Hall, 1977.

Battig, W. F. The effect of kinesthetic, verbal, and visual cues on the acquisition of a lever-positioning skill. Journal of Experimental Psychology, 1954, 47, 371-380.

Bell, K. F., & Patterson, M. R. A self-monitoring technique for enhancement of swimming performance. Swimming Technique, 1978, 14, 103-106.

Bilodeau, E. A., & Bilodeau, I. Variation of temporal intervals among critical events in five studies of knowledge of results. Journal of Experimental Psychology, 1958, 55, 603-612.

Bland, H. Competitive swimming. Wakefield, West Yorkshire, England: E. P. Publishing Ltd., 1979.

Botterill, C. Psychology of coaching. In R. M. Suinn (Ed.), Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Brock, S., Brock, D., & Willis, J. The effect of tangible and token rewards on the pole vaulting behavior of high school students. SALT: School Application of Learning Theory, 1972 (June), 43, 32-37.

Butt, D. S. Psychology of sport: The behavior, motivation, personality, and performance of athletes. New York: Van Nostrand Reinhold Company, 1976.

Buzas, H. P., & Ayllon, T. Differential reinforcement in coaching skills. Behavior Modification, 1981, 5, 372-385.

Carron, A. V. Reactions to 'anxiety and motor behavior'. Journal of Motor Behavior, 1971, 3, 181-188.

Carron, A. V. Social psychology of sport. New York: Wilcox Press, Inc., 1980.

Counsilman, J. E. The complete book of swimming. New York: Athenum, 1979.

Craighead, W. E., Kazdin, A. E., & Mahoney, M. J. Behavior modification: Principles, issues, and applications. Boston: Houghton Mifflin Company, 1976.

Desiderato, O., & Miller, I. B. Improving tennis performance by cognitive behavior modification techniques. The Behavior Therapist, 1979, 2, 19.

Dickinson, J. A behavioral analysis of sport. Princeton, New Jersey: Princeton Book Company, 1977.

Dimitrova, S. Dependence of voluntary effort upon the magnitude of the goal and the way it is set in sportsmen. International Journal of Sport Psychology, 1970, 1, 29-33.

Drabman, R. S. Behavior modification in the classroom. In W. E. Craighead, A. E. Kazdin, & M. J. Mahoney (Eds.), Behavior modification: Principles, issues, and applications. Boston: Houghton Mifflin Company, 1976.

Epstein, L. H., Wing, R. R., Thompson, J. K., & Griffin, W. Attendance and fitness in aerobics exercise: The effects of contract and lottery procedures. Behavior Modification, 1980, 4, 465-479.

Fueyo, U., Saudergas, R. A., Bushall, D., Jr. Two types of feedback in teaching swimming skills to handicapped children. Perceptual and Motor Skills, 1975, 40, 963-966.

Glynn, E. L. Classroom applications to self-determined reinforcement. Journal of Applied Behavior Analysis, 1970, 3, 123-132.

Hall, R. V., & Hall, M. C. How to select reinforcers. Lawrence, Kansas: H & H Enterprises, Inc., 1980.

Hart, B. M., Reynolds, N. J., Baer, D. M., Brawley, E. R., & Harris, F. R. Effect of contingent and non-contingent social reinforcement on the cooperative play of a preshcool child. Journal of Applied Behavior Analysis, 1968, 1, 73-76.

Hersen, M., & Bellack, A. Behavioral assessment: A practical handbook. New York: Pergamon Press, 1976.

Heward, W. L. Operant conditioning of a .300 hitter? Behavior Modification, 1978, 2, 25-40.

James, P. Video feedback in learning beginning trampoline. Perceptual and Motor Skills, 1971, 32, 669-670.

Kau, M. L., & Fischer, J. Self-modification of exercise behavior. Journal of Behavior Therapy and Experimental Psychiatry, 1974, 5, 213-214.

Kazdin, A. E. Assessing the clinical or applied importance of behavior change through social validation. Behavior Modification, 1977, 1, 427-451.

Kazdin, A. E. Behavior modification in applied settings. Illinois: The Dorsey Press, 1980.

Kazdin, A. E. History of behavior modification. Baltimore: University Park Press, 1978.

Kazdin, A. E., & Wilson, G. T. Evaluation of behavior therapy: Issues, evidence, and strategies. Cambridge, Massachusetts: Ballinger Publishing Company, 1978.

Keefe, F. J., & Blumenthal, J. A. The life fitness program: A behavioral approach to making exercise a habit. Journal of Behavior Therapy and Experimental Psychiatry, 1980, 11, 31-34.

Kennedy, R. E. Behavior modification in prisons. In W. E. Craighead, A. E. Kazdin, & M. J. Mahoney (Eds.), Behavior modification: Principles, issues, and applications. Boston: Houghton Mifflin Company, 1976.

Kirschenbaum, D. A., & Bale, R. M. Cognitive-behavioral skills in golf: Brain power golf. In R. M. Suinn (Ed.), Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Klavora, P., & Daniel, J. V. Coach, athlete, and the sport psychologist. School of Physical and Health Education, University of Toronto, 1979.

Klavora, P., & Wipper, K. A. (Eds.) Psychological and sociological factors in sport. Toronto: Publications Division, University of Toronto, 1980.

Knapp, B. Skill in sport: The attainment of proficiency. London: Routledge & Kegan Paul Ltd., 1963.

Komaki, J. Alternative evaluation strategies in work settings: Reversal and multiple baseline designs. Journal of Organizational Behavior Management, 1977, 1, 53-77.

Komaki, J., & Barnett, F. T. A behavioral approach to coaching football: Improving the play execution of the offensive backfield on a youth football team. Journal of Applied Behavior Analysis, 1977, 7, 199-206.

Lane, J. F. Improving athletic performance through visuo-motor behavior rehearsal. In R. M. Suinn (Ed.), Psychology in Sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Lawther, J. D. Sport psychology. Englewood Cliffs, New Jersey: Prentice-Hall, 1972.

Madsen, C. H., Jr., & Madsen, C. R. Teaching discipline: Behavior principles towards a positive approach. Boston: Allyn & Bacon, 1974.

Magill, R. A. Motor learning: Concepts and applications. Dubuque, Iowa: Wm. C. Brown Company, 1980.

Magill, R. A. The processing of knowledge of results for a serial motor task. Journal of Motor Behavior, 1977, 9, 113-118.

Malina, R. M. Effects of varied information feedback conditions on throwing and speed accuracy. Research Quarterly, 1969, 40, 134-145.

Martin, G. L., & Osborne, J. G. (Eds.) Helping in the community: Behavioral applications. New York: Plenum Press, 1980.

Martin, G. L., & Pear, J. J. Behavior modification: What it is and how to do it. Englewood Cliffs, New Jersey: Prentice-Hall, 1978 & 1983.

Massengale, J. D. (Ed.). The principles and problems of coaching. Springfield, Illinois: Charles C. Thomas, 1975.

McClements, J. D., & Botterill, C. Goal setting and performance. In R. M. Suinn, (Ed.), Psychology in sports: Methods and applications. Minneapolis, Burgess Publishing Company, 1980.

McKenzie, T. L., & Rushall, B. S. Effects of self-recording on attendance and performance in a competitive swimming training environment. Journal of Applied Behavior Analysis, 1974, 7, 199-206.

McKenzie, T. L., & Rushall, B. S. The neglect of reinforcement theory in physical education. CAHPER Journal, 1973, 39, 13-17.

McPherson, B., Marteniuk, R., Tihanyi, J., Rushall, B., & Clark, W. Age-group swimming: A multi-disciplinary review of the literature. Canadian Journal of Applied Sports Sciences, 1980, 5, 109-131.

Meichenbaum, D. H. Cognitive-behavior modification: An integrative approach. New York: Plenum, 1977.

Meichenbaum, D. H., & Goodman, J. The developmental control of operant motor responding by verbal operants. Journal of Experimental Child Psychology, 1969, 7, 553-565.

Meichenbaum, D. H., & Turk, D. The cognitive-behavioral management of anxiety, anger and pain. In P. Davidson (Ed.), The behavioral management of anxiety, depression and pain. New York: Brunner/Mazel, 1976.

Mischel, W. Introduction to personality. New York: Holt, Rinehart & Winston, 1971.

Nideffer, R. M. The ethics and practice of applied sport psychology, Ann Arbor: McNaughton Gunn, 1981.

Nideffer, R. M. The inner athlete: Mind plus muscle for winning. New York: Thomas Y. Crowell Company, 1976.

Oglvie, B. C., & Tutko, T. A. Problem athletes and how to handle them. London: Pelham Press, 1966.

O'Leary, S. G., & Dubey, D. R. Applications of self-control procedures for children: A review. Journal of Applied Behavior Analysis, 1979, 12, 449-465.

Orlick, T., & Botterill, C. Every kid can win. Chicago, Illinois: Nelson-Hall, Inc., 1975.

Powers, R. A practical approach to muscle relaxation and mental preparation for swimmers. Swimming Technique, 1979, 15, 101-102.

Presbie, R. J., & Brown, P. L. Physical education: The behavior modification approach. Washington, D. C.: National Education Association, 1977.

Rosenthal, T. L., & Bandura, A. Psychological modeling: Theory and practice. In S. L. Garfield & A. E. Bergin (Eds.), Handbook of psychotherapy and behavior change: An empirical analysis (2nd ed.). New York: Wiley, 1978.

Rushall, B. S. Coaching styles: A preliminary investigation. Behavior Analysis of Motor Activity, 1981, 1, 3-19.

Rushall, B. S. A direction for contemporary sport psychology. Canadian Journal of Applied Sport Sciences, 1976, 1, 13-21.

Rushall, B. S. Environment specific behavior invertories: Developmental procedures. International Journal of Sport Psychology, 1978, 9, 97-110. (a)

Rushall, B. S. Motivating the athlete. Coaching Review, 1978, 1, 26-29. (b)

Rushall, B. S. A motivational device for swimming. Swimming Technique, 1975, 11, 103-106.

Rushall, B. S. Psyching in sport: The psychological preparation for serious competition in sport. London: Pelham Books, 1979.

Rushall, B. S. The scope of psychological support services for Canadian Olympic athletes. Canadian Journal of Applied Sport Sciences, 1977, 2, 43-47. (a)

Rushall, B. S. Some applications of psychology to swimming. Swimming Technique, 1970, 7, 71-82.

Rushall, B. S. Two observation schedules for sporting and physical education environments. Canadian Journal of Applied Sport Sciences, 1977, 2, 15-21. (b)

Rushall, B. S. Using applied behavior analysis for altering motivation. In R. M. Suinn (Ed.), Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Rushall, B. S., & Pettinger, J. An evaluation of the effect of various reinforcers used as motivators in swimming. Research Quarterly, 1969, 40, 540-545.

Rushall, B. S., & Siedentop, D. The development and control of behavior in sports and physical education. Philadelphia: Lea & Febiger, 1972.

Rushall, B. S., & Smith, K. C. The modification of the quality and quantity of behavior categories in a swimming coach. Journal of Sports Psychology, 1979, 1, 138-150.

Sage, G. H. Introduction to motor behavior: A neuropsychological approach. Don Mills, Ontario: Addison-Wesley Publishing Company, 1971.

Shapiro, D. Knowledge of results and motor learning in preschool children. Research Quarterly, 1977, 48, 154-158.

Siedentop, D. Developing teaching skills in physical education. Boston: Houghton Mifflin Company, 1976.

Singer, R. N. Motivation in sport. In R. M. Suinn (Ed.), Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Skinner, B. F. Are theories of learning necessary? In B. F. Skinner, Cumulative record. New York: Appleton-Century-Crofts, 1972.

Skinner, B. F. The behavior of organisms. New York: Appleton-Century-Crofts, 1938.

Skinner, B. F. Beyond freedom and dignity. New York: Alfred A. Knopf, 1971.

Skinner, B. F. Contingencies of reinforcement: A theoretical analysis. New York: Appleton-Century-Crofts, 1969.

Skinner, B. F. Science and human behavior. London: Collier-MacMillan, 1953.

Skinner, B. F. The technology of teaching. New York: Appleton-Century-Crofts, 1968.

Skinner, B. F. Walden two. New York: MacMillan, 1948.

Smith, R. E., Smoll, F. L., & Hunt, E. A system for the behavioral assessment of athletic coaches. Research Quarterly, 1977, 48, 401-407.

Smoll, F. L., Smith, R. E., Curtis, B., & Hunt, E. B. Toward a mediational model of coach-player relationships. Research Quarterly, 1978, 49, 528-541.

Stokes, T. F., & Baer, D. M. An implicit technology of generalization. Journal of Applied Behavior Analysis, 1977, 10, 349-367.

Stuart, R. B. Assessment and change of the communication patterns of juvenile delinquents and their parents. In R. D. Rubin, H. Fensterheim, A. A. Lazarus, & C. M. Franks (Eds.), Advances in behavior therapy. New York: Academic Press, 1971.

Suinn, R. M. Psychology for Olympic champs. Psychology Today, 1976, 2, 38-43.

Suinn, R. M. Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Tutko, T. The coach's secret weapon--positive reinforcement. Track Technique, 1976, 63-65.

Tutko, T., & Richards, J. Psychology of coaching. Boston: Allyn and Bacon, Inc., 1971.

Tutko, T., & Tosi, U. Sports psyching: Playing your best game all of the time. Los Angeles: J. P. Tarcher, Inc., 1976.

Valeriote, T. (Ed.). Level 3 coaching theory: National coaching certification program. Ottawa, Ontario: Coaching Association of Canada, 1981.

Van Houten, R. How to motivate others through feedback. Lawrence, Kansas: H & H Enterprises, Inc., 1980. (a)

Van Houten, R. How to use reprimands. Lawrence, Kansas: H & H Enterprises, Inc., 1980. (b)

Van Houten, R. Learning through feedback. New York: Human Sciences Press, 1980. (c)

Wolf, M. M. Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. Journal of Applied Behavior Analysis, 1978, 11, 203-214.

Woods, S. M. The violent world of the athlete. Quest, 1971, 16, 55-60.

Yen, S., & McIntyre, R. W. (Eds.). Teaching behavior modification. Kalamazoo, Michigan: Behaviordelia, 1976.

Youngblood, D., & Suinn, R. M. A behavioral assessment of motivation. In R. M. Suinn (Ed.), Psychology in sports: Methods and applications. Minneapolis: Burgess Publishing Company, 1980.

Reference Notes

1. Naylor, J. C. Parameters affecting the relative efficiency of part and whole practise methods: A review of the literature. (Report No. Navtradecen 950-1). Port Washington, New York: U. S. Naval Training Device Center, July 1961.

2. O'Brien, R. M., & Simek, T. C. A comparison of behavioral and traditional methods of teaching golf. Poster session presented at the meeting of American Psychological Association, Toronto, Ontario, August 1978.

3. Paese, P. C. The effect of feedback and individual-group contingencies on the team behaviors of an intercollegiate baseball team. Unpublished doctoral dissertation, Ohio State University, 1980.

4. Kolonay, B. J. The effects of visuo-motor behavior rehearsal on athletic performance. Unpublished manuscript, Hunter College, 1977.

5. Jones, R. A. A modified basketball game: The effects of contingency management on competitive game behavior of girls attending a basketball camp. Paper presented at the meeting of the Midwestern Association of Behavior Analysis, Chicago, 1978.

6. Burke, E. J., & Straub, W. F. Psychological considerations in successful age-group swimmers. Paper presented at the meeting of the International Congress of Physical Activity Sciences, Quebec City, 1976.

7. Counsilman, J. (Producer). Swimming Stroke Analysis, Film No. 1, 1965.

Appendix A

Sample Data Sheets

Illustrating all Identified Potential Errors

For the Freestyle, Backstroke and Breast Stroke Swimming Strokes

Date:____________________ Observer:____________________

FREESTYLE SWIMMING STROKE

Subject:____________________

Description of Error	Trials									
	1	2	3	4	5	6	7	8	9	10
A. Side										
1. Head position: (a) too high, causing legs & hips to drop; or (b) too low, so buttocks are raised too high. (Water level should be at top of goggles.)										
2. Pulling with a dropped elbow, rather than with a high, forward elbow.										
3. Swimming with a "short stroke;" i.e., not reaching arm full extent before entering water and/or not pushing back far enough past hips.										
B. Front										
1. Head turned too far to the side (rather than rotated) during breathing, causing hips to wiggle.										
2. Arm recovery with low elbow and hand swinging wide, or higher than elbow, or with straight arm, causing hips to wiggle.										
3. Hands enter water flat or cupped (rather than pitched at a 45° & with thumb entering the water first).										
4. Hands cross over midline on entry (rather than entering in front of the shoulder).										
5. Pulling with a straight arm under water (rather than entering with a bent elbow pull).										
6. Pulling hand straight back under water (rather than in an elliptical pattern).										

Date:________________ Observer:________________

BACKSTROKE SWIMMING STROKE

Subject:________________

Description of Error	Trials									
	1	2	3	4	5	6	7	8	9	10
A. Side										
1. Head position: (a) too high, forcing hips too low; or (b) too low, raising hips (& too much of kick occurs out of water).										
2. Swimming with body too flat (rather than rolling 45^{o} to each side with arm recovery), which may result in hand breaking surface in midpull.										
3. Hand flopping backwards on water (rather than turned so that little finger enters first).										
4. Pulling with a dropped (rather than a high, medially rotated) elbow.										
5. Kicking with too much bend in the knees. (May cause knees to come out of water if hips are too high.)										
B. Front										
1. Pulling with a straight armed pull.										
2. Showing lateral arm recovery (rather than straight over top and then straight in front of head).										

Date:__________ Observer:__________

BREAST STROKE SWIMMING STROKE

Subject:__________

Description of Error	Trials									
	1	2	3	4	5	6	7	8	9	10
A. Side										
1. Swimming with hips too low in water.										
2. Raising head to breathe too early during pull (rather than during last half of pull).										
3. Pulling with a dropped (rather than high) elbow.										
4. Pulling too far back (well past shoulders).										
5. Bringing knees too far forward during coil (should approximate 120°).										
6. Starting pull or kick too soon, so that they are not properly sequenced.										
7. Failing to (a) stretch out completely during glide, and/or (b) finish kick with feet together.										
B. Front - Approach										
1. Pulling with hands too narrow during first part of pull.										
C. Front - Departure										
1. Pointing feet straight back at top of coil (rather than turning them sideways).										
2. Leading kick with knees from the coil (rather than with feet).										
3. Pushing straight with feet from the coil (rather than having feet go through an oval rotation).										

Appendix B

Checklist of Coaching Behaviors

During a Training Session

TRAINING CHECKLIST

Subject: ____________________ Date: ____________

Trainer: ____________________ Session: ____________

Observer: ____________________ Time 1: ____________

Time 2: ____________

Out-of-pool (with reference to Correct Stroke Checklist).

1. Describe 2 or 3 correct features of S's stroke and give social approval for these.
2. Identify target behavior and describe correct performance.
3. Model incorrect and correct behavior, using appropriate self-prompt.
4. Ask S to imitate incorrect and correct behavior, while repeating the self-prompt.
5. Ask S if he/she can feel the difference between incorrect and correct behavior.
6. Have S practice correct behavior several times while repeating self-prompt.
7. Instruct S to swim 2 trial laps. Give further feedback if necessary.
8. Instruct S to swim 6 laps while attempting to perform target behavior correctly and repeating self-prompt.
9. Explain consequences of correct and incorrect performance.

While S is swimming six laps.

1. Give social approval immediately following each correctly swum lap.

   Lap: (1)____ (2)____ (3)____ (4)____ (5)____ (6)____
2. Tap S on shoulder immediately following each instance of an error on the target behavior.
3. If 3 consecutive errors occur, stop S at end of lap and give corrective feedback.

After S has completed six laps (or after 15 minutes)

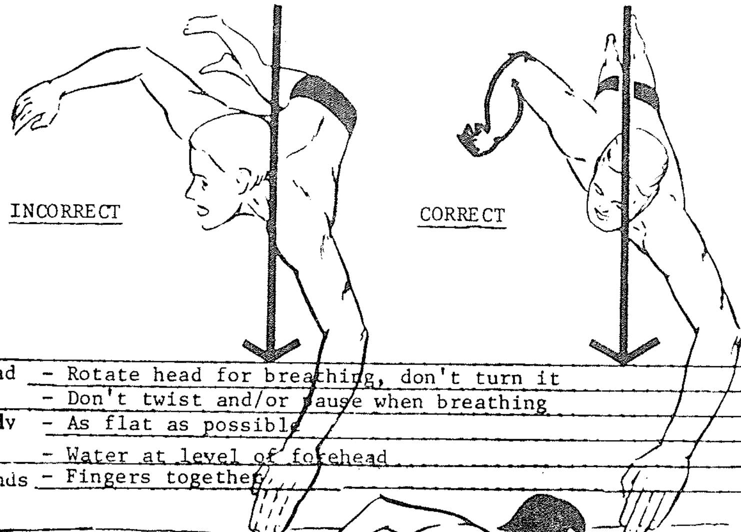
1. Provide social approval and feedback regarding his/her performance.
2. Provide a final verbal prompt to S to practice the correct behavior and use the self-prompt during regular practice.

Appendix C

Correct Behavior Checklists

For the Freestyle, Backstroke and Breast Stroke Swimming Strokes

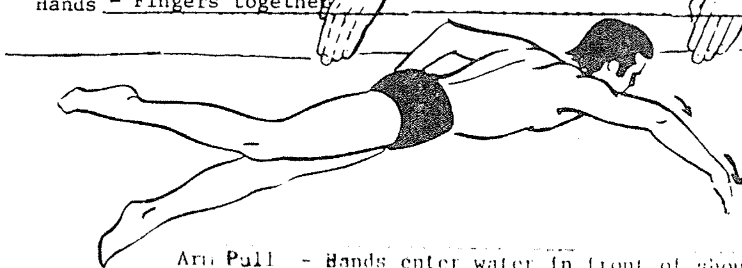
Freestyle Checklist



Head - Rotate head for breathing, don't turn it
- Don't twist and/or pause when breathing

Body - As flat as possible
- Water at level of forehead

Hands - Fingers together

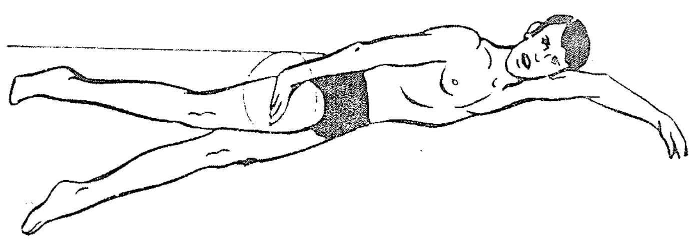


Arm Pull - Hands enter water in front of shoulder
- Hands bent down on entry
- Enter water in order of thumb, fingers, wrist, elbows
- Lower arm bends inward as it comes under the head
- Keep elbows high during pull
- Hand never goes past body midline underwater

- Bend wrist backwards (90°) at waist
- Pull all the way to the thigh

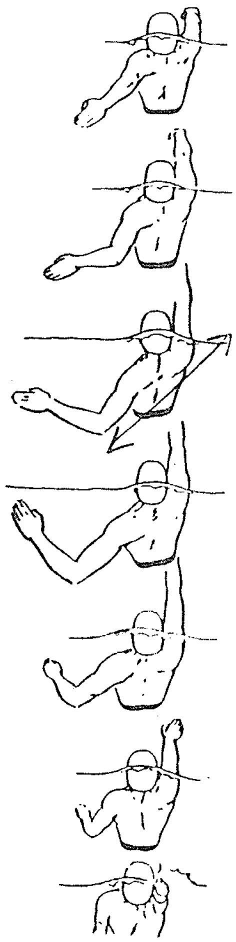
Breathing - Breathe as hand finishes pull

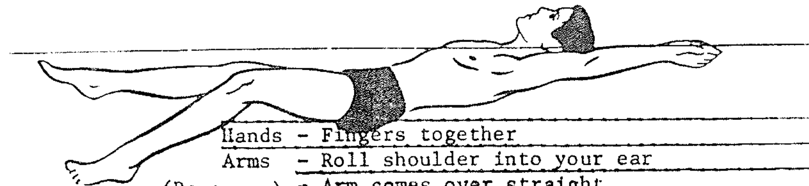
ARM RECOVERY - elbow leads
- elbow high
- hand near water



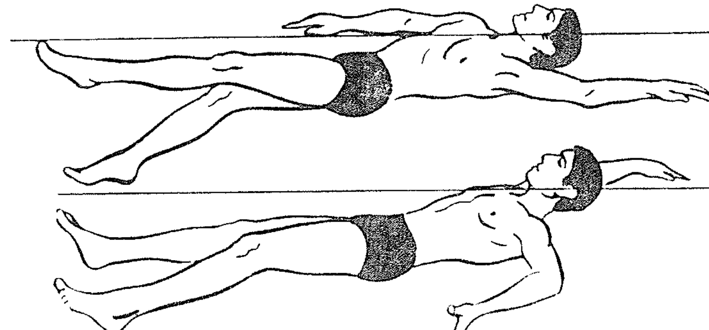
Legs - Kick from the hips, bending knees only slightly
- Toes point back at top of kick
- Heels and toes just break surface at top of kick
- Kick should keep hips flat

Backstroke Checklist

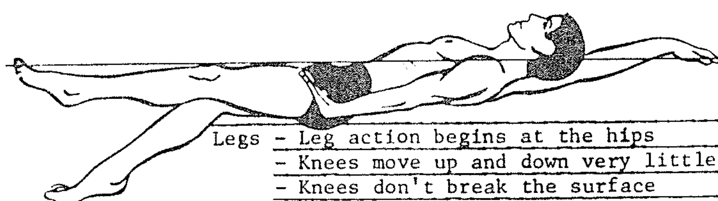




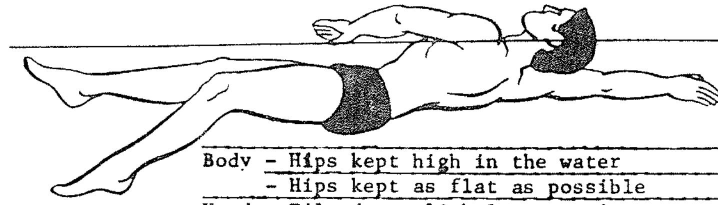
Hands	- Fingers together
Arms	- Roll shoulder into your ear
(Recovery)	- Arm comes over straight
	- Arm comes over close to ear
	- Little finger enters water first



Arms	- Lower arm bends to almost 90° under shoulder
(pull)	- As arm straightens underwater, snap wrist at thigh & down



Legs	- Leg action begins at the hips
	- Knees move up and down very little
	- Knees don't break the surface
	- Toes point down at bottom of kick
	- Toes just break surface at top of kick



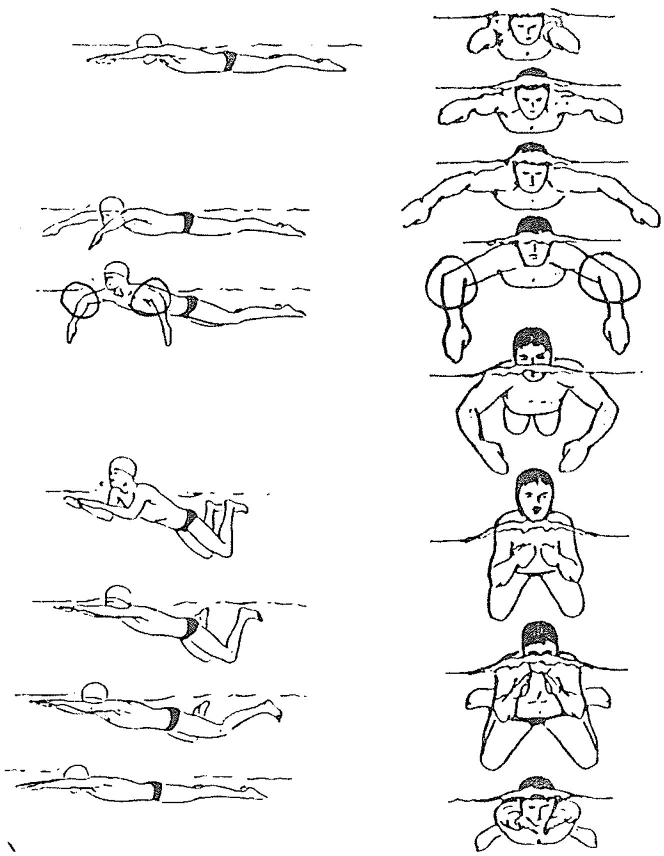
Body	- Hips kept high in the water
	- Hips kept as flat as possible
Head	- Tilted up slightly, ears in water
	- Head kept stationary, don't rock

Breastroke Checklist

Head
- Does not go underwater at any time
- During glide, head down so ears at top of arms

Body
- As flat as possible at all times
- Keep shoulders low in water when breathing

Breathing
- raise head just enough to breathe with chin on water
- raise head to breathe during last half of arm pull



Arms
- Outstretched and facing downward during glide
- Hands start pulling outward and downward
- Keep elbows high and forward during first half of pull
- Pull hands to shoulders (no further than chest)
- Hands brought together, elbows drop down
- Hands touch, arms shoot forward, palms down and glide

Legs
- Bring knees and legs forward as hands touch after pull
- While coiling, knees shoulder width, heels 6 inches apart
- At top of coil, feet turn out
- At top of coil, knees not too far forward (120°)
- At top of coil, knees not too far apart
- From top of coil, lead to kick with the feet, not the knees
- From coil snap feet out and down, thighs up and heels together
- Backward thrust of feet begins just before arms are fully extended in front of body
- Arms reach straight forward just before completion of kick
- Always achieve a fully extended glide position

Appendix D

Social Validation Questions

Administered to the Coach and the Subjects

Social Validation Questionnaire: Coach

A. Please rate the training procedure on the following components by circling the appropriate number (1 = no or not at all; 4 = neutral or no strong opinion; 7 = yes or very much so).

1. Assuming another person was available to supervise your other swimmers, would this procedure be very disruptive to practice?	1 2 3 4 5 6 7
2. Do you enjoy using this procedure (as one component of your coaching strategy) to work with swimmers who have problem strokes?	1 2 3 4 5 6 7
3. Is the actual training procedure difficult to apply?	1 2 3 4 5 6 7
4. Do you think this procedure is effective for reducing errors in swimming strokes?	1 2 3 4 5 6 7
5. Do you think the swimmers enjoy being taught in this manner?	1 2 3 4 5 6 7
6. Do you think this type of training procedure is more effective for reducing errors than the methods you were using prior to this program?	1 2 3 4 5 6 7
7. Rate the overall usefulness of this procedure to your coaching strategy.	1 2 3 4 5 6 7

B. Rank order the following components of the training package from the one that you think was the most effective (#1) to the least effective. The same number may be assigned to two or more components if you believe them to be of equal effectiveness.

Component	Number
- instructions (regarding correct and incorrect behavior)	________
- modeling of correct behavior	________
- modeling of incorrect behavior	________
- self-prompts	________
- feedback while swimming (the "stick")	________
- verbal approval and/or feedback at end of each lap	________
- Correct Behavior Chart	________

C. Will you continue to use this training procedure after the research has ended?

Yes ______

No ______ Why not? ______________________

In a modified form? (Explain) ______________________

D. Please add any additional comments, criticisms and/or suggestions that you may have regarding this training procedure:

Social Validation Interview Questions: Subjects

A. Remember when (trainer's name) took you to the small pool to work on your (stroke)? (describe error and procedure briefly)

1. Did you like the way (he or she) was teaching you? ____________

____

2. Did it help to practice beside the pool first? Did that help you to see what you were doing wrong, and what you should be doing right?

____

____

3. Was it hard for to swim the way (trainer's name) wanted you to swim?

____

4. Remember how (trainer's name) was going to tap you on the shoulder while you were swimming if you made a mistake? What did you think about that?

____

____

5. Would you like to be taught like that again (let's say, to help you with another stroke)? Why or why not?

____

____

6. Do you think it's helped you swim the (stroke) better?

____

B. For the next two questions, 10 = very much; 5 = neutral; 1 = not at all.

1. Overall (on a scale of 1 to 10), how much did you like being taught that way?

   1 2 3 4 5 6 7 8 9 10

2. Overall (on a scale of 1 to 10), how much do you think it's helped you?

   1 2 3 4 5 6 7 8 9 10