CALIFORNIA STATE UNIVERSITY, NORTH RIDGE

THE EFFECTS OF SPECIFICITY OF REINFORCEMENT
ON THE PERFORMANCE OF A NOVEL
FINE MOTOR TASK

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Arts in
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by

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I.C.B.
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ABSTRACT

THE EFFECTS OF SPECIFICITY OF REINFORCEMENT ON THE PERFORMANCE OF A NOVEL FINE MOTOR TASK

by

Ian Charles Bennett

Master of Arts in Physical Education

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One hundred male junior high school subjects participated in this study to determine the effects of four grading techniques, varying in specificity of reinforcement, upon the performance of a novel fine motor task and upon the performance of high and low achievers. The subjects used a probe to follow a target on an illuminated target pursuit rotor. The time that the subject was on-target was recorded from a millisecond timer. Four groups: no reinforcement, Pass-Fail, ABCD/F and percentile rank were tested over ten trials of thirty seconds each. After each trial, subjects were allowed a one-minute rest, and after the fifth trial subjects were allowed a five-minute rest. The differences in group mean scores and inter-trial differences were considered over the ten trials. All
groups improved over the ten trials with groups receiving ABCD/F or percentile rank scores determined to be significantly better than both other groups at the tenth trial. There were four of six hypotheses that were accepted. This study appears to support the theory that certain specific reinforcements are most effective in facilitating the rate and amount of motor skill improvement during the initial stages of novel skill acquisition. The degree of specificity varied for both high and low achievers; the percentile system was the best for high achievers and the ABCD/F was best for the low achievers, although all of the systems employed were less effective for the low achievers than high achievers.
CHAPTER 1

INTRODUCTION

According to the theories of Thorndike (22), Hull (10), and Skinner (20), the most effective method of learning motor skills is physical practice involving a maximum number of repetitions with some form of response feedback or reinforcement. Little has been said about how specific the reinforcement should be and how different specificities of reinforcement affect groups and individual high and low achievers within those groups.

Many physical educators use grading as a means of reinforcement for students without really considering how the system selected will affect the performance of the group as a whole nor the different individuals within that group.

Several investigations (66, 57, 51) into the specificity of reinforcement indicated that the more specific the information, the better was the subsequent performance. This study investigated an area where there was more research needed as to the degree to which specific
reinforcement influenced performance of junior high school boys while learning a novel fine motor task.

**Importance of the Study**

If grading systems are going to be used then physical educators should be concerned with finding the most effective methods of evaluating (reinforcing) the performance of motor tasks. Research studies (66, 51) in psychology have tended to suggest that the more specific the reinforcement the better is the subsequent performance.

Until the last two decades, however, much of this research has been concerned with classroom skills and usually over a period of days, weeks or months.

If a particular reinforcement significantly improves the performance of a group, and high or low achievers within that group, then physical educators should pursue the implications, and apply where appropriate, to the teaching of motor skills. By providing the most effective type of reinforcement to an individual after a performance, a greater improvement may result from that feedback.

This study was designed to provide additional
information as to the effects of specificity of reinforcement upon learning a fine motor task. Questions that were considered were:

1. How does each particular grading technique affect the performance of the group?

2. How does each particular grading technique affect the performance of high and low achievers?

The Problem

Statement of the Problem

The problem which stimulated this study was that little is known regarding the effects of variations in specificity of reinforcement on the learning of motor skills. Recent discussions in educational institutions have pointed to the possibility of changing from the traditional ABCD/F grading system to a more general Pass-Fail system. The author is unaware of any research which has investigated the implications of such a change.

Statement of the Purpose

The purpose of this study was to determine the effects of four grading techniques, varying in degree of specificity of reinforcement, upon the performance of a novel fine motor task, and upon the performance of high
and low achievers, within each group, of junior high school boys ranging in age from eleven to fifteen years.

Scope and Limitations

This investigation was concerned with the effects of four grading techniques, varying in degree of specificity of reinforcement, upon the performance of a novel fine motor task with the illuminated-target pursuit rotor.

Included in the study were one hundred male students enrolled at Sepulveda Junior High School during the spring semester of 1973. They ranged in age from eleven to fifteen years. The findings and resultant conclusions were based solely upon the subjects attending Sepulveda Junior High School during the spring semester of 1973. Therefore, no attempt was made, nor should be made, to generalize from these findings to a group dissimilar to the population represented.

Hypotheses

It was predicted that significant differences would exist among four groups receiving reinforcement according to one of the following forms of evaluation: no reinforcement, Pass-Fail, ABCD/F, or percentile ranking.
It was further predicted that the more specific
the reinforcement the greater will be the change in be-
havior over ten trials. In particular, it was predicted
that at the tenth trial there would be a significant
difference in the level of performance of the novel fine
motor task between groups receiving:

1. percentile ranking and ABCD/F reinforcement
2. percentile ranking and Pass-Fail reinforcement
3. percentile and no reinforcement
4. ABCD/F and Pass-Fail reinforcement
5. ABCD/F and no reinforcement
6. Pass-Fail and no reinforcement

It was assumed that statistical differences ob-
tained at or exceeding the .05 level of confidence would
be considered significant.

Assumptions

In order to conduct this study the following
assumptions were made:

1. The four groups were of equal ability at the
beginning of the study.

2. Each subject was performing to the best of his
ability during each trial.
3. The pursuit rotor used in this study provided a valid measurement of fine motor skill.

4. Intrinsic feedback, which comes from sensory stimulation during and after a performance, was the same for all subjects.

5. All other pertinent variables such as the hour of the day, fatigue and others, were randomly distributed amongst groups.

Definition of Terms

In order to facilitate common understanding and interpretation of the terminology in this investigation, the following terms were defined:

1. Fine Motor Task

   Fine motor task refers to a task which involves movement of an isolated part of the body in such a way that the center of gravity of the body is stable in relation to the base of support.

2. Reinforcement

   Reinforcement refers to a stimulus which follows the performance of the task, and increases the probability that the same response will reoccur, given the same behavioral conditions. It is a feedback condition
concerning the degree of success or failure of the performance.

3. **Learning**

Learning refers to a relatively permanent change in behavior as a result of practice, distinguishable from temporary fluctuations, and from maturationally induced alterations in performance.

4. **Performance**

Performance refers to the execution of the motor task.

5. **Grading**

Grading refers to an evaluation of the performance.

**Preview of the Remainder of the Study**

Chapter II contains a review of the literature and investigations related to motor learning, reinforcement, the effects of reinforcers on learning, knowledge of results, specificity of knowledge of results, grading, tension and performance. The design of the research, the techniques and the procedures of the investigation are described in Chapter III. The analysis and discussion of the data, and the findings, may be found in Chapter IV.
Chapter V includes a summary of the investigation, major findings, conclusions, implications for teaching, and recommendations for further research.
CHAPTER II

REVIEW OF RELATED LITERATURE

The purpose of this study was to determine the effects of four grading techniques, varying in degree of specificity of reinforcement, upon the performance of a novel fine motor task, and upon the performance of high and low achievers within each group.

The study, therefore, was concerned with the following areas of motor learning: one, the nature and value of reinforcement; two, the effects of reinforcers on learning; three, knowledge of results; four, specificity of knowledge of results; five, grading; and six, tension and performance.

Motor Learning Research

Since the beginning of this century, motor learning and movement behavior have been studied almost exclusively by experimental psychologists.

Johnson forwarded the idea that:

Both psychologists and physical educators are vitally interested in motor learning.
The major emphasis of the psychologist is on the observation of a phenomenon, describing it, setting up conditions for its replication, then devising a system which summarizes, integrates and explains the facts (11:601).

Much of the study of movement behavior and learning has used animal subjects (3, 11, 13, 53, 56). This research has been directed towards developing general theories of learning rather than explaining motor learning specifically (3, 8, 11). During the last twenty years there has been increased interest in the performance of human learning and motor skills (3:4). However, experimental psychologists have not clearly or satisfactorily separated the possible theories explaining motor learning from those which they believe explain verbal learning (3, 11). Physical educators have taken an increased interest in motor learning research too, particularly in the areas of how and under what conditions do human beings best learn varied motor tasks.

Defining Motor Learning

Both physical educators and psychologists have difficulty in defining motor learning in exact terms. Cratty defined motor learning as "a rather permanent change in motor performance brought about through practice and excludes changes due to maturation, drugs, and
nutrients" (3:10). Oxendine suggested that motor learning is "the process by which movement behavior is developed or altered through practice or experience" (17:7).

Lawther's definition is more specific:

Perceptual-motor learning is a change in response in which muscular contractions, static and dynamic, play a major part; and in which bodily movements make up much of the adopted response (50:68).

Some researchers, such as Cratty, have assumed that skill acquisition rests upon the individual's ability to perceive and act upon increasingly subtle cues. This becomes a technique of minimizing errors and maximizing methods of attention to the positive task components.

Cratty (3:255) contended that the motor learning process can be fragmented into several components indicating separate stages of acquiring skills. First, the learner attempts to discover the task components which are similar to, or different from, those he has known in the past, and secondly, factors such as ability to handle the various inputs of information become important. He organizes parts of the task into progressively larger components. Finally, he is able to perceive larger quantities of information and to respond more qualitatively.

Motor learning has also been described subjectively according to how learners behave when learning the
prescribed task. Kingsley (13) suggested that, movements are revised and edited of unnecessary components, during motor learning.

Theoretical Concepts of Reinforcement

The Nature and Value of Reinforcement

Reinforcement has been said to be the key to understanding the learning process (7, 17, 1, 14). It increases the probability that the same response will re-occur on subsequent occasions when similar educive stimuli are presented.

Teachers use reinforcement techniques to change the response probability of a particular act. The repetition of the desired responses with related reinforcement tends to form strong habits and reduces the probability of undesired responses. Reinforcement was closely associated with the idea of contiguity, i.e., two ideas that were seen together in time or space would be connected. More recently psychologists have concluded that contiguity alone does not ensure a mental connection. Rather, the stimulus and the appropriate response must be related in some way to ensure learning (4, 17, 3).
Reinforcement Theories

Keller (12) believed that the reinforcement theories of Pavlov, Thorndike, Hull, Skinner, and Guthrie, see the role of reinforcement differently.

**Pavlov's Respondent Conditioning**

Pavlov wrote that:

The occurrence of an unconditioned reflex in temporal contiguity with a conditioned reflex increases the strength of the latter ...

...If a conditioned reflex is elicited without reinforcement by an unconditioned reflex, the conditioned reflex is weakened or inactivated (18:543).

According to Pavlov's theory of reinforcement, conditioning is aided by reward which tends to connect two stimuli. He inferred, that without reinforcement, conditioning would not have taken place to the same degree.

**Thorndike's Law of Effect**

Thorndike believed that the effect of the response was strategic for reinforcement:

When a modifiable connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, that connection's strength is increased; when made and accompanied or followed by an annoying state of affairs, its strength is decreased. The strengthening effect of satisfyingness (or the weakening effect of annoyingness) depends upon a bond varying with the closeness of the connection between it and the bond. This closeness or intimacy of association of the satisfying (or annoying)
state of affairs with the bond in question may be the result of nearness in time or of attentiveness to the situation, response and satisfying event in question (21:4).

**Hull's Drive Reduction**

Hull (10) stated that any stimulus-response sequence which is followed by a lessening of the strength of a drive, will be reinforced. A particular need would be reduced, which in turn is connected to either a biological, psychological or social drive, or combination thereof.

**Skinner's Operant Reinforcement**

Skinner (65, 20) identified two types of behavior, respondent and operant. Operant behaviors are those which are prompted by the individual himself and are not the responses to any identifiable stimuli. Skinner was interested in shaping operant behavior by rewarding (reinforcing) desired operants and punishing undesired behavior. Skinner suggested that the learner makes a connection between the response and the reinforcement to develop most skills, knowledges and attitudes.

**Guthrie's Contiguity Theory**

Guthrie developed the contiguity theory and believed that the connection between the stimulus and the response is fully established in one trial. According to this theory, a specific response to a specific stimulus
cannot be improved with practice. Guthrie did not emphasize praise or reward because he believed that motivation was not an important factor.

The Effects of Reinforcers on Learning

A reinforcement is generally considered a necessary element for learning to take place. According to Oxendine:

Motivation, which is assumed to be an internal state of mind, arises from an organism's desire for certain incentives. Such incentives may take the form of food, a grade in school, or success in the performance of a specific task. The intensity of drives, wants and needs determines the level of motivation. A comfortable or satisfied individual is not as receptive to learning as one who has a greater need for attaining a particular goal (17:15).

Zimny (70) studied four incentive conditions: an excused assignment, threat of electric shock, a statement that the task was related to intelligence and a statement that the task afforded additional practice. He used two tests, one which did not produce any detectable effect on performance and a second one which did. It would appear that the type of task used in motivational effects can be an important variable.
Incentive Magnitude and Performance

Pubols (56) reviewed the literature on this subject and concluded that there was a relatively high degree of consistency of results. Some of the generalizations which emerged from his review were that with an absolute method, quantitative variation in incentives has no apparent effect on the rate of learning but learning is more rapid with any positive incentive amount other than with zero amount. Magnitude of reward affects resistance to extinction indirectly through differences in terminal level of rewarded performance. There exists conflicting evidence on the interaction of incentive magnitude with drive level. With a differential method, incentive magnitude affects learning, but only after subjects have learned to discriminate amounts. Pubols said:

In the section on learning vs. performance effects by the absolute method, it was concluded incentive magnitude affects performances but not learning (56:112).

Research studies involving incentives generally support the fact that certain motive-incentive conditions have a marked influence on learning and performance of verbal material (9, 16). While attempts to manipulate the level of motivation in performers of physical skills through special incentives have been common, research as
to the effects of those incentives has been limited. Those studies that do exist are contradictory to the extent that some show improvement under motive-incentive conditions (39, 45), and others show no effect (54).

Johnson (46), had fifty-nine junior high school boys, with instructions to do as well as possible, pedal a bicycle ergometer against a fixed resistance of five pounds. The subjects were given eight sixty-second trials, with a thirty-second rest between each trial. Each subject had two tests, one with continuous verbal encouragement, the other with no encouragement. There was no significant difference between performance under the two conditions.

Ryan (61), used eighty male subjects with four types of motive-incentive conditions on grip strength. One group was told to do as well as possible, the second was verbally exhorted to improve, the third was given the results of the previous test, and the fourth was threatened with electric shock for failure to improve.

Several studies (38, 39, 45, 52) indicated that positive incentives such as praise and encouragement have a positive effect upon learning.
McManis (52) studied pursuit rotor performance of normal and retarded children in four verbal incentive conditions: namely, neutral, reproof, praise and competition. There were significant differences found between intelligence levels (normal over retardates) and between praise or competition over neutral or reproof conditions.

Sims (64) found that with rate of reading and rate of substituting, individual motivation was vastly superior to group motivation which in turn was slightly superior to no motivation. Patrick (71) found that the methods of motivation employed should be dependent upon the task to be performed, and the ability and age level of the performer.

Knowledge of Results

Knowledge of results may come verbally, or as visual confirmation of accuracy, or through a feel of a successfully completed movement. Seashore and Brevales (62) pointed out that the extent to which knowledge of results is effective may also depend upon the alertness of the learner in supplying his own information concerning success. Thus, a factor influencing the knowledge of results involves the little-studied "self-estimation" factor.
Arps (27) found that the amount of work and the rate of work were positively influenced when the individual was constantly informed of how hard he pulled upon an ergograph. It was hypothesized that muscular efficiency was increased because knowledge of results helped the learner maintain attention upon the task (29).

Spencer and Judd (67), using a motor skill involving drawing dots which were the extension of lines, found that improvement seemed to take place even when knowledge of results was lacking.

Crafts and Gilbert (35) found that specific knowledge of accuracy in a stylus maze did not produce greater learning. They suggested that for college students who received exact knowledge of results, this proved to be of no help as they generally are aware of how well they are doing in most tasks.

Greenspoon and Foreman (40) used a line drawing task and found that students' learning efficiency was directly affected as knowledge of results was increasingly delayed. The most effective learners were those who obtained immediate knowledge of results. Similar results were found in other studies (51, 25). However, Archer and Namikas (26) discovered that delays of information feedback did not significantly effect performance. Five
groups of fifteen men each learned a rotary pursuit task for forty-five trials. During the first thirty trials subjects heard a 1,000-cps tone after being on-target continuously for one of five durations. The delays of information feedback intervals were 0, .2, .4, .8 and 1.6 seconds. During the last fifteen trials no tone was heard. The negative results were explained in terms of the different motivational effects used in the study.

Variable frequency and knowledge of results were studied by Bilodeau (30). In his experiment he tested the effects of relative and absolute frequency of knowledge of results. Learning was found to be independent of relative frequency and positively related to absolute frequency.

Oxendine stated that:

To be most effective, knowledge of results must be meaningful to the learner, specific in nature, and closely follow the performance. If the information provided the learner is not clearly understood, or if it is too general to be applied to a specific act, then it is of little value. This principle is important for both verbal and motor learning. In the classroom, it is not unusual for students to receive test papers or project reports from the teacher with no more than a letter or numerical grade. Unfortunately, "correcting" papers today often means that the teacher applies a mark to the paper. With this limited knowledge of results the student can only guess at the strengths and weaknesses
of his work. Even on objective examinations, the student may not find out which answers or solutions were correct or incorrect. If the teacher is to use tests as an educational as well as an evaluative device, he should provide specific performance information to the student....the effective teacher will find some way to provide students with as much feedback as possible regarding their performances (17:58).

Feedback

According to Sage: "Feedback is the information which the individual receives as a result of some response" (19:336). Bilodeau (29) suggested that feedback is probably the most important variable controlling learning and performance.

Research consistently shows that feedback increases the rate of improvement early in practice on a new task. In reviewing the literature, two types of feedback were identified, intrinsic and extrinsic. Sage (19) suggested that intrinsic feedback comes from sensory stimulation during and after a performance. Extrinsic feedback, which was the type used in this study, is the provision of special information which is ordinarily not present in a learning task, although it may be present. This may be either verbal information by an instructor or an external stimulus, such as a feedback circuit from a machine, which
supplements the feedback obtained from the senses.

Reynolds and Adams (57) found that on a target pursuit task, where subjects could see whether or not they were on target, additional information in the form of a clicker, which sounded when the subjects were on target, clearly enhanced learning and performance of the task.

Robb (59) investigated the course of learning an arm movement pattern under varied conditions of feedback. She found that the group which received the greatest variety of feedback produced the most effective learning pattern. Robb indicated that the literature tends to support the idea that augmented feedback influences performance but not learning. Sage felt that "there are three major functions which feedback may serve: information, motivation and reinforcement" (19:343).

Oxendine commented that:

When students can readily observe the results of their efforts, the teacher may still increase the usefulness of this information as reinforcement in learning. Whereas the student may know the distance of his broad jump, his time in the 100-yard dash, or the number of push-ups performed, he often does not relate these details to previous performances in the same activity. Students do not often take a scientific or analytical approach toward their abilities and their progress. The teacher can be effective in getting students to keep records of their daily and weekly
performances. In this way, knowledge regarding progress can be emphasized. Greater emphasis on self-evaluation will result in greater concern for learning and greater effort to improve. Too often, students go to practice or perform without considering whether or not they are operating at maximum efficiency. Record keeping and competition against personal standards will probably result in greater motivation, more serious practice, and continued efforts to gain this type of detailed knowledge of results (17:59).

Specificity of Reinforcement

Knowledge of results (feedback) is a common term for a type of reinforcement based upon information which the individual is able to use to check or confirm his performance. Awareness of one's performance is very important in learning because of the inherent reinforcement values and it tends to motivate one to continue to work on the task.

Researchers generally recognize that the learner improves more if he receives specific information about the relationship of his performance to his objective. The student, although not necessarily aware of the learning advantages, may not be satisfied with a Pass or Fail rating or a simple letter grade. He will often ask "How was it better?" What did I do right?" or "What did I do wrong?"
Thorndike (22) had students make 3,000 attempts each to draw a specified four-inch line, while blindfolded. During their practices, they were not told how closely they approximated the specified four inches. On a retest the students did not improve. Kingsley (13) conducted a similar experiment in which students attempted to draw a four-inch line 400 times, and were not shown any of the results. When the same students drew four more lines and were informed of their margin of error after each trial, a great deal of improvement was shown in each attempt.

Smode (66), Reynolds and Adams (57), and McGuigan (51) also found that precision (specificity) of knowledge of results did significantly improve performance. Smode's study (66) was designed to provide an independent assessment of performance effects, in a compensatory tracking task, as a function of the method used in providing cumulative information as to achievement level. High and low information feedback conditions differed in terms of the aggregate effect of the following three parameters: a) the amount of information presented, b) the sensory mode of presentation, and c) the temporal characteristics of presentation. All groups improved over training trials; however the high-information feedback groups were superior
at the end of the first ninety-second trial, and main-
tained this superiority throughout the training period. 
Profiles of subjective reactions to the tracking tasks 
indicated that interest level accrued as a function of 
increased information feedback. It was suggested that 
manipulation of extrinsic information feedback may prove 
to be a useful technique for controlling human motivation-
al levels in learning tasks.

Hunt (44) found while testing a tracking test that 
performance improved monotonically, but by decreasing 
amounts, as the number of categories of information was 
increased, and that this improvement was relatively un-
affected by the simplicity of this first tracking task, 
and that inhibitory effects were greater for the less 
specific information conditions. In a second, more 
complex controlling task, he found that the effects of 
specificity of feedback did depend upon the difficulty of 
the task.

The present study used a grading or evaluation 
scheme to vary the specificity of reinforcement.

**Grading**

Grading and evaluation of performance usually in-
volve the concept of failure. Glasser suggested that
today "the major problem of the schools is the problem of failure" (6:7). He contended that "it is the school and school alone which pins the label of failure on children" (6:26).

Evaluation of individuals also includes the concept of ability levels, that is, high and low achievers. Fleishman (37) studied the effects of certain supplementary verbal motive-incentives upon performance of individuals of different ability levels. The 400 subjects practiced on a motor task for twenty sixty-second trials. There were four groups representing the possible combinations of levels of ability and motivation. Each group improved at about the same rate and in an approximately linear fashion. The major finding was that although supplementary motivation instructions made no difference in overall performance of the low ability subjects; these instructions did not make a difference in the performance of the high ability subjects either.

An early study by Bayton and Conley (28) suggested that whereas initial failure inhibits performance to some extent, failure following success has a more intensive and disruptive effect upon performance (at least temporarily).

Child and Waterhouse (32) have pointed to the seemingly inconsistent results obtained in experiments on
the relation of failure to performance. In some instances there was a decrease in quality of performance; in others an increase occurred. Child and Waterhouse concluded that these conflicting results could have been attributed to a systematic set of factors that operate in failure-performance situations. Factors such as success or failure background prior to encountering failure can operate in failure-performance situations. Failure can sometimes be a motivator and in other cases inhibit performance.

Bayton and Conley (28) discovered that certain aspects of the individual's background prior to encountering failure influenced the relationship between failure and performance. It appeared that as success accumulates through time, a point is reached where subsequent failure increases motivation, but without a sufficient background of success, failure tends to inhibit performance.

In the present investigation there was no attempt by the researcher to deliberately create a success-failure situation. The success or failure of a performance depended solely upon the interpretation of the grade by the subject. In considering evaluation of performance the area of tension and performance needed investigation.
Tension and Performance

The effects of tension and emotion on physical performance have not been studied to any great extent. Reviews have been published by Davis (36) and Courts (33), dealing with tension and mental performance. Other studies that have investigated physical response have been concerned only with whether tension facilitates or inhibits performance. Responses which have shown facilitation under stress or tension are pursuit learning (34), reaction time (41), and tapping (31). Some performances, such as throwing tennis balls at a target (60) and postural steadiness (63), have been reported as being inhibited under tension. There appear to be two main types of tension; one is due to emotional upset and is inhibitive of performance, and the other is due to effort and is facilitative.

In Howell's study (43) the tense group improved 33.3 per cent, which was significantly more than the non-tense group, with 26.2 per cent improvement. However, the use of electric shock or threat thereof may account for the conflict in the literature on tension.

Ulrich and Burke (68) tested a group of eighteen subjects on a bicycle ergometer under two varieties of
motivational stress. All subjects received three trials. On the first trial, subjects were told to pedal for one minute, doing as well as possible. Scores were reported at thirty and forty-five seconds. On the second and third trials, subjects were again asked to do as well as possible, equalling or improving upon the first trial. They were instructed that a bell would ring periodically if their performance improved, but if their performance was below the previous standard, a buzzer would ring. Unknown to subjects, it was determined prior to testing whether the buzzer or bell would ring during the trials regardless of performance. All groups heard the bell on one trial and the buzzer on the other. Results indicated no difference in total work output between the two motivating conditions, although both of these conditions were significantly better than the initial trial. It was found that the reaction of men and women to motivation is similar in kind and quality, that motivational techniques elicit greater work output, and that when motivational stressors indicating success are employed, the gross mechanical efficiency of the body is greater than when neutral stressors or stressors indicating failure are employed. In Ulrich and Burke's study (68), subjects received reinforcement during the trials whereas in this
study subjects received reinforcement after the trials.

Some research on the behavioral effects of stress is open to the criticism that the relevant background of the subjects prior to their encountering stress is not taken into consideration. Failure being experienced in a current time period can be considered stress-of-the-moment. It seems important to question whether the behavior that occurs during this time period is solely a function of the stress of the moment (28).

Another question is whether or not the effect of failure upon performance in a given situation is similar for people who differ in prior success or failure backgrounds. Hill (42) found that the general level of anxiety of the child is an important determinant of the child's rate of response at simple motor tasks and that this should be taken into account.

Rim (58) studied the influence of praise and blame on twelve year old children. The study used measures of both extroversion/introversion and neuroticism or emotional stability/instability. He concluded that extroverted and emotionally stable children, whether blamed or praised, improved their performance more than did the introverted group.
This review of literature has covered areas of motor learning, reinforcement, the effects of reinforcers on learning, knowledge of results, specificity of knowledge of results, grading, and tension and performance. The next stage must be to consider its importance to teaching.

Importance to Teaching

Bugelski discussed the question:

Can learning theory be applied to education? It is true, that there is no single, general, complete, ready-made system that can be taken over as a whole by educators. The field of learning is and has been riddled with controversy for decades. But, in spite of many basic theoretical disagreements, there is much common agreement on specific empirical findings and on some isolated principles (2:15).

Vincent (69), having reviewed the literature, suggested that reinforcement theory is extremely important when applied to teaching gymnastics. This application of reinforcement theory should be considered in terms of its importance to physical educators.

In motor skills such as archery, shooting a basketball and typewriting, knowledge of results is easily observed. In other skills, however, faults may not be as easily observed; and even when results can be observed the performer often does not know exactly why the
An experienced physical educator can guide the learner to understand the particular movement which contributed to the results, and one knowledgeable in reinforcement can provide an appropriate form of feedback to a particular individual.

Physical educators can feed back casual information regarding success or failure in activities where the performer can readily see the results of his performance, and provide valuable knowledge in activities in which the participant gets almost no feedback.

**Summary**

Although explanations of motor learning have been both practical and theoretical, almost all of the investigators agree that positive reinforcement facilitates the learning of motor tasks. Studies from the field of physical education have in general reported that specific knowledge of results were more conducive to learning than no feedback at all. However, there is a lack of research as to how specific this feedback should be, and the degree of similarity to which various types of groups of individuals of differing achievement levels, perceive identical forms of feedback.
CHAPTER III

DESIGN AND PROCEDURES

This chapter describes the design of the experiment and the procedures employed in an attempt to fulfill the purpose. The chapter includes: one, a description of the subjects who were used in the study and an explanation of how they were selected and grouped; two, a discussion of the neuromuscular task and experimental apparatus; three, a description of the types of reinforcements employed; and four, a description of the experimental design.

The purpose of this study was to determine the effects of four grading techniques, varying in degree of specificity of reinforcement, upon the performance of a novel fine motor task.

Subjects

One hundred male subjects were selected at random from the physical education classes at Sepulveda Junior High School during the spring semester of 1973. Subjects were not told that the study involved four groups nor that it was a research project.
Lindquist suggested that "while certain group differences may be unavoidable, their effects may nevertheless be randomized" (15:11). A research assistant, using a table of random numbers, randomly assigned subjects to one of four groups: Group 1, the control group which received no reinforcement; Group 2, Pass-Fail reinforcement; Group 3, ABCD/F reinforcement; and Group 4, percentile reinforcement. There were twenty-five boys assigned to each group, making a total of one hundred subjects.

The Neuromuscular Task

The neuromuscular task employed in the investigation is discussed under the following categories: one, a description of the task; two, the equipment involved in performing the task and the general procedure; and three, the scoring procedures employed to measure performance of the task. The task involved the use of the illuminated-target pursuit rotor designed by the Marietta Apparatus Company of Ohio. Prior to its use in this study, the illuminated-target pursuit rotor was employed in several motor learning studies (23, 24, 26, 47, 48, 49, 52). The equipment was found to be appropriate as a novel fine
motor task as it met the requirements of the study based upon the definition of terms in Chapter I. Performance of the task required coordination, timing and accuracy.

Description of the Task

The fine motor task used in this study involved the subject standing squarely before the illuminated-target pursuit rotor, holding the handle of the probe firmly, but not tightly, and in the preferred hand. Following the signal "Ready" the investigator said "Go". Upon the command "Go" the subject lifted the probe off a central penny and he then placed the probe lightly on the translucent fibreglass top and attempted to follow the target and to remain in contact with it as much as possible. The time that the subject was on-target was recorded by a millisecond timer as his on-target score in milliseconds. The target rotated for thirty seconds for each trial during the study. Starting positions were held constant by a fixed penny in the center of the circular path.

Equipment Involved in the Task

The Illuminated-target Pursuit Rotor. The illuminated-target pursuit rotor incorporates the basic functional attributes of contact-target meters and the
quality of variability in target position and size. The instrument consists of an illuminated target of adjustable diameter (3/8" x 1"), which moves in a circular path of variable radius (4" - 6"). A metal case with a translucent fibreglass top houses the assembly, a 60 RPM motor, and a photocell amplifier. Binding posts are provided for connection with a recorder, and Velcro fastener strips secure the fibreglass top; removal for target adjustment is readily accomplished. An on-target buzzer is controlled by a separate "on-off" switch. The duration of the test periods can be automatically controlled by a separate test-period timer which may be set from near zero to approximately one hundred seconds. The probe is a lucite light-pipe and photocell assembly of adjustable sensitivity.

The unique design of this instrument renders it an exceptional predictive device as well as a laboratory device especially suitable for the study of motor learning. The unit operates on 115 volts, 60 Hz., AC., unless otherwise specified. It has an accuracy of ±.5 per cent for the time controller.

The General Procedure. In this study the millisecond timer/event counter was connected but the buzzer was not used. The target may be moved up or down, increasing target size or decreasing it, respectively. The
size was held constant at three-quarters of an inch for this study. The radius of the circle inscribed by the target light can be adjusted but in this investigation was held constant at four inches. The sensitivity control was held constant at a reading of seventy. The test-period timing control can be arbitrarily calibrated; thirty seconds was the selected trial period. The probe and fibreglass top were kept clean because dirt can interfere with the sensitivity of the unit.

**The Millisecond Timer/Event Counter.** The millisecond timer/event counter is an instrument which features silence, sensitive operation, easy to read numerals, compact size, the latest integrated circuits, and it is constructed for long reliable service. It measures time in milliseconds with a total accumulation of 99,999 seconds or counts up to 50,000 events per second with a minimum ten microseconds circuit closure per event. This instrument has an accuracy of ±.005 per cent, or ±10 microseconds over the full operating range.

**Indicator Boards.** Three indicator boards were used to visually reinforce Groups 2, 3, and 4, respectively. Group 1, the control group, had no indicator board.
A pin was placed in the first indicator board (Figure 1.A) to show a subject from Group 2 how his performance was rated on a Pass-Fail scale. These ratings of performance were based upon norms collected and established in a pilot study prior to the testing. A pin was placed in the second board (Figure 1.B) to show a subject from Group 3 how his performance was rated on an ABCD/F scale. A pin was placed in the third board (Figure 1.C) to show a subject from Group 4 how his performance was rated on a percentile scale from zero to one hundred.
**Scoring Procedures**

All subjects received the same orientation before their first trial. Following the signal "Ready" the investigator said "Go" and pressed the red starter button. The millisecond timer/event counter scored (automatically) from the time the illuminated-target pursuit rotor was triggered off. The subject used the probe and attempted to follow the target and remain in contact with it as much as possible. The time in milliseconds that the subject was on-target was recorded on the daily score sheet (Appendix B). The trial lasted for thirty seconds after which the subject was allowed a sixty-second rest. After the fifth trial, the subject was allowed a five-minute rest. The investigator watched for any breaches of the simple rules, such as using both hands, in which case the trial would not be counted. The score for each trial was recorded and the only feedback given to the subjects was according to their position in their specific grouping.

**Experimental Design**

This investigation was designed to test one dependent variable alone (time on-target), using a control group design.
**Group 1 (N=25)**

Subjects in Group 1 performed the task without any extrinsic reinforcement from the researcher after a performance. This group was the control group for the experiment.

The subjects in this group performed simple mathematical problems after each performance. This activity was considered to be a control and not a reinforcement.

**Group 2 (N=25)**

Subjects in Group 2 performed the task and were told if they were in the Pass or Fail category according to established norms. This was equivalent to the 50th percentile.

**Group 3 (N=25)**

Subjects in Group 3 performed the task and were told how they rated on a scale of ABCD/F according to established norms. These were equivalent to the 90th, 75th, 60th and 50th percentiles respectively and were based upon the school's grading procedures.

**Group 4 (N=25)**

Subjects in Group 4 performed the task and were told how their performances were ranked on a percentile
scale from zero to one hundred.

Practice Environment

The testing sessions were administered in the correctives room at Sepulveda Junior High School. The subjects entered the room from the hall; the door was closed and all attempts were made to overcome as many outside influences as possible. Room lighting was furnished by a series of ceiling lights and remained constantly on during the trial periods. The room temperature varied between seventy-one and eighty-one degrees Fahrenheit. Testing was only administered between 8:00 A.M. and 11:00 A.M.

Orientation

All subjects received the same verbal explanation and demonstration before the first trial. The investigator questioned to ensure that no subject had ever seen or performed the task before his first trial. Each subject was allowed to ask any questions that he had about the task before proceeding to his first trial. Subjects were allowed a one-minute rest between trials, except after the fifth trial when they received a five-minute rest. All ten trials for each subject were completed during one session.
Pilot Study

Prior to testing, an intensive pilot study was given to establish: the reliability of the apparatus, suitability of time for each trial, optimal distribution of trials, number of trials required to establish a learning curve, norms to be used to establish accurate reinforcements for Groups 2, 3, and 4, and a suitable score to determine high and low achievers based upon the first trial. The one hundred first-trial scores were ranked in order and the top thirty-three were considered high achievers, and the bottom thirty-three were considered low achievers. The remainder were considered average achievers. The cut-off score for high achievers was very close to 2.000 seconds and the cut-off score for low achievers was very close to 1.000 seconds. First-trial scores greater than 2.000 seconds were considered high, less than 1.000 seconds were considered low and in between 1.000 and 2.000 seconds were considered average.

The distribution of trials and rest periods for this study were based upon both the pilot study and a review of the literature, including Kimble's study (48) on the role of motivation in determining the amount of reminiscence in pursuit rotor learning.
Statistical Procedures

An F test, analysis of variance, was used to determine if there was a significant difference between the trial means for the four groups varying in specificity of reinforcement. It was assumed that any statistical differences exceeding the .05 level of confidence would be considered significant. Tukey's test for main effects was used to determine between which groups there was a significant difference.

This was repeated for all ten trials. The same statistical procedures were followed for the high and low achievers. Because of the nature of Tukey's test, a .01 level of confidence was selected.
CHAPTER IV

ANALYSIS OF DATA

This chapter considers the analysis of the data and the results under four sections: one, the criterion test reliability; two, the four complete reinforcement groups; three, a comparison of high and low achievers; and four, the findings.

The purpose of the study was to determine the effects of four grading techniques, varying in degree of specificity of reinforcement upon the performance of a novel fine motor task, and upon the performance of high and low achievers within each group.

The following reinforcements were given after each of the ten trials: Group 1, no reinforcement; Group 2, Pass-Fail reinforcement; Group 3, ABCD/F reinforcement; and Group 4, percentile rank. The total time, in milliseconds, that the subject was on the target of the illuminated-target pursuit rotor, was recorded as his score for each trial.

The scores were analyzed using analysis of variance to determine if there were significant differences between
group mean scores and if there were significant differences within trials. Tukey's test for main effects was used to determine between which groups there was a significant difference. This was repeated for all ten trials and the same procedures were followed for high and low achievers. The test for main effects was also applied to each group to ascertain between which trials there was a significant difference.

**Criterion Test Reliability**

Fox (5) said that the general criteria for acceptable research instruments are reliability, or the accuracy, stability, and repeatability of the data produced by the instrument, and validity, or the extent to which the instrument does what it purports to do. "The test-retest procedure is most effectively used to estimate reliability in instances when the procedure being evaluated is seeking to elicit information or measure some skill which is slow to change or develop" (5:354).

A standardized test was given before and after trials on each testing day. At no time did the daily test score vary more than ±0.002 seconds from the standard score established prior to the pilot study.
All groups significantly improved their scores between trial one and trial ten. An F ratio of 123.373 was highly significant at the .001 level within trials and it was found that learning took place. Although each group's improvement in ability to perform the task was significant, the learning exhibited by Groups 3 and 4 was significantly greater than Groups 1 and 2. In the opinion of the researcher, this significant difference supports the theory that reinforcement (feedback) is an integral part of the learning process. The subjects who received the more specific feedback (ABCD/F and percentile rank) had information upon which they could gauge their improvement in performance against themselves or other subjects, and so it also provided a form of motivation. This feedback reinforced the subject's decision-making processes and consequently his movement behavior. An F ratio of 11.452 was highly significant of the .001 level between groups over all trials (Table 1).
### TABLE 1

**ANALYSIS OF VARIANCE: FOUR COMPLETE REINFORCEMENT GROUPS**

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean Square</th>
<th>D F</th>
<th>F Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9.2011</td>
<td>999.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between</td>
<td>48.5692</td>
<td>99.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups</td>
<td>422.4257</td>
<td>3.</td>
<td>11.452</td>
<td>0.000*</td>
</tr>
<tr>
<td>Error (G)</td>
<td>36.8862</td>
<td>96.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>4.8706</td>
<td>900.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials</td>
<td>246.6695</td>
<td>9.</td>
<td>123.373</td>
<td></td>
</tr>
<tr>
<td>G x T</td>
<td>16.1488</td>
<td>27.</td>
<td>8.077</td>
<td></td>
</tr>
<tr>
<td>Error (T)</td>
<td>1.9994</td>
<td>864.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

G = Groups  
T = Trials

Group 1. No Reinforcement (control)  25 subjects  
Group 2. Pass-Fail  25 subjects  
Group 3. ABCD/F  25 subjects  
Group 4. Percentile  25 subjects  

*Level of significance
Results for the Four Complete Reinforcement Groups

At the tenth trial (Table 2) there was a significant difference between Groups 1 and 4, with an F ratio of 4.62; Groups 1 and 3, with an F ratio of 4.92; Groups 2 and 4, with an F ratio of 3.73; and Groups 2 and 3, with an F ratio of 4.03. The critical F value at the .01 level was 2.0614. No significant difference was found between Groups 1 and 2 nor Groups 3 and 4.

Groups 3 and 4 had almost parallel results, possibly because of the simple nature of the task. The researcher contends that Group 3 saw themselves improving through categories D, C, B and A at about the same learning rate as those in Group 4 who saw themselves improving over the 50th, 60th, 75th and 90th percentiles. It would be interesting to see if there was a significant difference using ABCD/F and percentile reinforcements, with a more difficult motor task where improvement rates were not as fast.

There was not a significant difference found between Groups 1 and 2. The researcher believes that this may have been due to the fact that subjects in Group 2 had only one general gauge of their performance (Pass-Fail),
**TABLE 2**

COMPARISON OF COMPLETE GROUP MEANS 
ON TENTH TRIAL BY TUKEY'S TEST

Critical $F$ value 2.0614 ($P<.01$)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.25</td>
<td>.89</td>
<td>4.62*</td>
<td>4.92*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.14</td>
<td>.89</td>
<td>3.73*</td>
<td>4.03*</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7.87</td>
<td>4.62*</td>
<td>3.73*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.17</td>
<td>4.92*</td>
<td>4.03*</td>
<td>.30</td>
<td></td>
</tr>
</tbody>
</table>

*There was a significant difference at the .01 level between: Groups 1 and 4, 1 and 3, 2 and 4, and 2 and 3.

No significant differences at the .01 level were found between: Groups 1 and 2 and 3 and 4.

which did not give them any indication of how their performance rated in that category. Perhaps, Pass-Fail was not perceived as being very different from no reinforcement at all. During early trials, all subjects in Group 2 received a "Fail" grade and so another possible explanation of the lack of significant difference between Groups 1 and
may have been due to a negative perception of the Pass-Fail reinforcement.

A significant difference between groups first occurred at the fourth trial when Group 1 differed from Group 3, with an F value of 2.590. In trials 5 and 6, Group 1 differed from Groups 3 and 4. In trials 8 and 9, the results were the same as for trial 10.

The graph (Figure 2) of the four complete reinforcement groups shows some interesting points. Group 1, the no reinforcement group, at no stage reached the "Pass" level of competence. Group 2, the Pass-Fail group, only once reached a low "C" level of competence. Both Groups 1 and 2 after trials 7 and 8 deteriorated in performance. Groups 3 and 4 reached the "A" level of confidence for trials 8, 9 and 10. Both Groups 3 and 4 were continuing to improve on the tenth trial.

A Comparison of High and Low Achievers

The researcher was interested in the findings of the effects of specificity of reinforcement upon high and low achievers within each group. It was found in the pilot study that first-trial scores were accurate predictors of ultimate achievement level. The one hundred
FIGURE 2

COMPLETE GROUP MEAN SCORES PER TRIAL

Seconds/Trial

9.000

8.000

7.000

6.000

5.000

4.000

3.000

2.000

1.000

0.000

1 2 3 4 5 6 7 8 9 10

Trials

Group 1  (Control)
Group 2  (Pass-Fail)
Group 3  (ABCD/F)
Group 4  (percentile)

*Level of Significance

Pass (50)
Fail

Not* F

Not* E

0.05*

C (60)

B (75)

A (90)

0.000 -- 9.000

*Level of Significance
first-trial scores were ranked in order and the top thirty-three were considered high achievers and the bottom thirty-three were considered low achievers. First-trial scores greater than 2.000 seconds were considered high, and less than 1.000 seconds were considered low achievers.

High Achievers' Improvement

All groups significantly improved their scores between trial one and trial ten. An F ratio of 53.304 was highly significant at the .001 level within trials and it was found that learning took place. Although each group's improvement in ability to perform the task was significant, the learning exhibited by Groups 3 and 4 appeared to be significantly greater than Groups 1 and 2. It is the researcher's belief that this difference can be explained as for the four complete reinforcement groups (p. 45), which was related to the degree of reinforcement. Although not significant, a trend seemed to indicate that at the tenth trial Group 4 was improving performance scores per trial at a greater rate than was Group 3. Further research over more trials using ABCD/F and percentile reinforcements may indicate a significant difference.
An F ratio of 6.764 was significant at the .001 level between groups.

Low Achievers' Improvement

All groups improved their scores between trial one and trial ten. An F ratio of 30.057 was significant at the .001 level within trials and it was found that learning took place. Although each group's improvement in ability to perform the task was significant, the learning exhibited by Group 3 appeared to be greater than that of Groups 1 and 2. Group 4 was found to have learned significantly more than Group 1. An F ratio of 3.368 was significant at the .04 level between groups.

Results for the High Achievers

At the tenth trial there was a significant difference between: Groups 1 and 3, with an F ratio of 4.77; Groups 1 and 4, with an F ratio of 6.65; Groups 2 and 3, with an F ratio of 3.48; and Groups 2 and 4, with an F ratio of 5.36. There was not a significant difference found between Groups 1 and 2 nor Groups 3 and 4. The critical F value at the .01 level was 3.362.

A significant difference between groups first occurred at the sixth trial when Group 1 differed from
Group 3, with an F ratio of 3.66. In trial 7, Group 1 again differed from Group 3. In trial 8, Group 1 differed from Group 4. In trial 9, the results were the same as for trial 10.

The graph (Figure 3) of the high achievers illustrates some interesting points. Group 1, the no reinforcement group, at no stage reached the "C" level of competence. Group 2, the Pass-Fail group, only just reached the "A" level on one occasion.

Both Groups 1 and 2, after trials 7 and 8, deteriorated in performance but maintained a "Pass" level of competence. Groups 3 and 4 reached the "A" level of competence by trial 6. Both Groups 3 and 4 were continuing to improve on the tenth trial but Group 4 was doing so, in terms of improvement in scores per trial, at a greater rate than was Group 3.

Results for the Low Achievers

At the tenth trial there was a significant difference between Groups 1 and 4, with an F ratio of 3.01; Groups 1 and 3, with an F ratio of 4.84; and Groups 2 and 3, with an F ratio of 4.49. The critical F value at the .01 level was 2.9621. No significant differences were found between Groups 1 and 2, 2 and 4, nor 3 and 4.
FIGURE 3
HIGH ACHIEVERS: MEAN SCORES PER TRIAL

Seconds/Trial
11.000
10.000
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000

Trials
1 2 3 4 5 6 7 8 9 10

*Level of Significance

Group 1 ......... (Control)
Group 2 .... (Pass-Fail)
Group 3 ....... (ABCD/F)
Group 4 ........ (percentile)

0.05*
A
(90)
B
(75)
C
(60)
D
Not*
Pass (50)
Fail
The researcher believes that the non-significant differences between Groups 1 and 2 and Groups 3 and 4 can be explained as for the four complete reinforcement groups (p. 47), which was related to the degree of reinforcement. However, for the low achievers there was no significant difference between Groups 2 and 4 as there was for the four complete groups and for the high achievers. In the opinion of the researcher this was because low achievers receiving percentile reinforcement during the early trials perceived their grades as negative reinforcement due to the fact that their scores were so low. After trial 7, when some of the low achievers in Group 4 did markedly improve, this seemed to account for the increase of mean scores for the percentile group.

A significant difference between groups first occurred at the eighth trial when Group 1 differed from Group 3, with an F value of 4.02, and Group 2 differed from Group 3, with an F value of 3.11. In trial 9, again Group 1 differed from Groups 4 and 3, and Group 2 differed from Group 3.

The graph (Figure 4) of the low achievers indicates some interesting points. Both Groups 1 and 2 did not reach the "Pass" level of competence. Both Groups 1 and 2 declined in performance after the seventh trial. Group 3,
FIGURE 4

LOW ACHIEVERS: MEAN SCORES PER TRIAL

Seconds/Trial

9.000

8.000

7.000

6.000

5.000

4.000

3.000

2.000

1.000

0.000

Trials

Group 1 .......... (Control)
Group 2 ........ (Pass-Fail)
Group 3 ........ (ABCD/F)
Group 4 ------- (percentile)

*Level of Significance

A (90)
B (75)
C (60)
D
Pass (50)
Fail

05*

05*

Not*

Not* F

Not*
the ABCD/F group, reached a "B" level of competence on trials 8, 9 and 10. Group 4, the percentile group, just reached a "C" level of competence on the last two trials. It was interesting to note that until trial 7, the mean for Group 4 was below the "Pass" level, and was in fact below Group 2's level of competence on trial 7.

Findings

The analysis of the data indicated the following findings:

1. All groups learned the motor task.

2. Groups 3 and 4, representing the more specific reinforcements, learned more and at a greater rate than Groups 1 and 2, representing the less specific reinforcements. There was no significant difference found between Groups 1 and 2 nor Groups 3 and 4.

3. High achievers performed well from all groups, with the more specific reinforcements producing the greater learning. There was no significant difference found between Groups 1 and 2 nor Groups 3 and 4.

4. Low achievers performed more poorly than high achievers in all groups. For the low achievers, the most specific reinforcer (percentile rank) did not significantly
produce greater learning than either ABCD/F or Pass-Fail. There was no significant difference found between Groups 1 and 2, 3 and 4, nor Groups 2 and 4.
CHAPTER V

SUMMARY, MAJOR FINDINGS, CONCLUSIONS, IMPLICATIONS FOR TEACHING AND RECOMMENDATIONS FOR FURTHER RESEARCH

Reinforcement theory is widely used in modern teaching in an attempt to assist an individual's learning of motor skills. However, too many physical educators use minimal feedback in situations when the learner needs more detailed specific knowledge of results. Other physical educators give feedback that is too specific for a particular individual's needs.

Unfortunately, a very limited amount of research has considered the type of reinforcement, or the specificity of feedback to best assist the individual learner in the performance of a motor task.

Summary

The purpose of this study was to determine the effects of four grading techniques, varying in degree of specificity of reinforcement, upon the performance of a novel fine motor task and upon the performance of high and low achievers within each group of junior high school boys.
whose ages ranged from eleven to fifteen years.

The motor task employed in this study involved using a probe to follow a target on an illuminated-target pursuit rotor. The time that the subject was on-target was recorded from a millisecond timer.

In an attempt to solve the problem, one hundred male subjects were selected at random from the physical education classes at Sepulveda Junior High School during the spring semester of 1973.

Four groups were randomly assigned: the first, Group 1 became the control group and received no rein­forcement. Mathematical problems, designed to distract the subject's thoughts away from the performance of the motor task, were conducted during the reinforcement period. The second, Group 2 received a Pass-Fail reinforcement; the third, Group 3 received ABCD/F reinforcement; and the fourth, Group 4 received percentile reinforcement. All subjects were tested over ten trials of the motor task, each trial lasting thirty seconds. After each trial the subject was allowed a one-minute rest, and after the fifth trial the subject was allowed a five-minute rest.

In discussing the data, both the differences in group scores and in inter-trial differences were con­sidered over ten trials.
Major Findings

From an analysis of the data presented in Chapter IV, it was found that significant differences do exist among the four specificities of reinforcement.

Analysis of variance of the mean scores indicated that significant inter-group differences began after the fourth trial. Groups 3 and 4 were determined to be significantly better than both Groups 1 and 2 at the tenth trial.

All groups significantly improved between their first and tenth trials including Group 1. This could perhaps be explained in the novel nature of the task and that even by trial and error learning significant improvement can be made (55).

Four of the six specific hypotheses were accepted. There was a significant difference in the level of performance of the novel fine motor task between groups receiving:

2. percentile and Pass-Fail reinforcement
3. percentile and no reinforcement
4. ABCD/F and Pass-Fail reinforcement
5. ABCD/F and no reinforcement
Two of the six specific hypotheses were rejected. There was not a significant difference in the level of performance of the novel fine motor task between groups receiving:

1. percentile and ABCD/F reinforcement
6. Pass-Fail and no reinforcement

Possibly Hypothesis 1 was rejected because subjects were more familiar with the ABCD/F system. Hypothesis 6 may have been rejected because Pass-Fail was not perceived as being very different from no reinforcement at all.

Conclusions

Based upon the assumptions and within the limitations of this study, and if the findings may be justifiably generalized, it may be concluded that the more specific the reinforcement, the greater will be the change in behavior over trials.

Four of the six specific hypotheses were accepted. There was a significant difference in the level of performance of the novel fine motor task between groups receiving:

2. percentile and Pass-Fail reinforcement
3. percentile and no reinforcement
4. ABCD/F and Pass-Fail reinforcement
5. ABCD/F and no reinforcement

Two of the six specific hypotheses were rejected. There was not a significant difference in the level of performance of the novel fine motor task between groups receiving:

1. percentile and ABCD/F reinforcement
6. Pass-Fail and no reinforcement

Because four of the six specific hypotheses were accepted and in view of a trial by trial analysis of the learning curves, this investigation appears to support the suggestion that specific grading techniques such as percentile rank and ABCD/F grading are more effective in facilitating the rate and amount of fine motor skill improvement during the initial stages of novel task acquisition than Pass-Fail or no reinforcement at all. High achievers particularly prefer specific reinforcement. Low achievers prefer ABCD/F grading to facilitate their learning.

**Implications for Teaching**

Students do need knowledge of results and "generally" the more specific the feedback the better.
Subjects who received specific feedback tended to be still improving at their last trial whereas those who received little or no feedback were becoming disinterested or fatigued towards the end of the trials.

The conclusions of this study include the most obvious implication for teaching: learning appears to be facilitated by specific reinforcement. Based upon the subjective evaluation of verbal comments, facial expressions, etc., the investigator formed an opinion that students were concerned about "Failing" and receiving a "C" or "D". From this observation, it would seem that teachers need to be more aware of the concern about failure and employ techniques which endeavor to promote success.

The author is aware that findings in the "unreal atmosphere" of the laboratory cannot simply be generalized to the field situation. However, if the conclusions of this study could be justifiably extended to specificity of reinforcement in general (not simply to grading), the following implication could be drawn.

A student who performs a skill and receives specific feedback such as video-tape replay of his performance, with verbal explanation of the good and poor
points about his performance and recommendations for his next performance, will probably improve to a higher standard and at a faster rate than his counterpart whose teacher gives him little or general feedback about his performance, such as a statement like "that was good."

Recommendations for Further Research

This investigation has a number of findings which appear to have implications that bear further investigation. The following are some suggested areas of possible research:

1. There is some question as to whether similar results would be obtained if individuals of a different age level were selected as subjects. A suggested area of research would be with university students and/or senior high school students.

2. Because of the novel nature of the task, in the "unreal" atmosphere of the laboratory, additional research needs to consider the application of varying specificities of feedback to movement skills which are taught in physical education classes.

3. Of the existing grading systems studied, it would appear that the ABCD/F system is the most effective
for the greatest majority. However, Glasser (6) suggested "abolish ABCD/F grades." In its place, he suggests setting a high standard (equivalent to a "B" in the ABCD/F system) and when a student reaches this standard he is satisfied.

Glasser's thesis is that:

If he is given a chance to pass and to avoid the CDF label of failure, the poor student, who now usually does not work at all, may become interested in learning more (6:99).

He would recognize superior work with an (S) grade.

The choice for trying for an S is solely the student's responsibility ... Teachers set standards and "pass" only those who achieve these standards. A student who does not achieve the standards set by the teacher is eligible to take the course again (6:103).

Schemes like this one should be empirically tested in motor learning areas to determine their effects upon performance and learning in an attempt to find a system which would cater for all levels of achievement. This study would suggest that within Glasser's scheme there should be provision for specific reinforcement of performance.
BIBLIOGRAPHY

Books


Periodicals


Unpublished Material

APPENDIX A

GROUP MEAN SCORES PER TRIAL FOR:

The Four Complete Reinforcement Groups

The High Achievers

The Low Achievers
### Group Mean Scores Per Trial
**The Four Complete Reinforcement Groups**

<table>
<thead>
<tr>
<th>Trials by Groups</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>1.8147</td>
<td>1.7605</td>
<td>2.0033</td>
<td>1.9038</td>
<td>2.2296</td>
<td>3.2733</td>
<td>3.8171</td>
<td>3.9540</td>
<td>3.5991</td>
<td>3.2543</td>
</tr>
<tr>
<td>Group 2</td>
<td>1.7112</td>
<td>2.5894</td>
<td>2.8678</td>
<td>2.8294</td>
<td>3.0570</td>
<td>4.2128</td>
<td>5.1366</td>
<td>4.9320</td>
<td>4.1826</td>
<td>4.1436</td>
</tr>
</tbody>
</table>

- **Group 1**: No reinforcement (control): 25 subjects
- **Group 2**: Pass-Fail: 25 subjects
- **Group 3**: ABCD/F: 25 subjects
- **Group 4**: Percentile: 25 subjects

(Scores recorded as time on-target in thirty seconds)
## HIGH ACHIEVER'S MEAN SCORES PER TRIAL

<table>
<thead>
<tr>
<th>Trials by Groups</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2</td>
<td>2.6939</td>
<td>3.4664</td>
<td>4.0370</td>
<td>3.7844</td>
<td>4.0632</td>
<td>5.3562</td>
<td>7.0478</td>
<td>6.2950</td>
<td>4.9843</td>
<td>5.4402</td>
</tr>
</tbody>
</table>

- Group 1: No reinforcement (control)
- Group 2: Pass-Fail
- Group 3: ABCD/F
- Group 4: Percentile

(Scores recorded as time on-target in thirty seconds)
LOW ACHIEVERS' MEAN SCORES PER TRIAL

<table>
<thead>
<tr>
<th>Trials by Groups</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0.7530</td>
<td>1.2490</td>
<td>1.1682</td>
<td>1.3448</td>
<td>1.4458</td>
<td>2.4606</td>
<td>2.7806</td>
<td>2.6486</td>
<td>1.9474</td>
<td>2.0728</td>
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<tr>
<td>Group 2</td>
<td>0.6240</td>
<td>1.4949</td>
<td>1.7760</td>
<td>1.6259</td>
<td>1.6093</td>
<td>3.2610</td>
<td>3.6204</td>
<td>3.5504</td>
<td>2.9333</td>
<td>2.4224</td>
</tr>
<tr>
<td>Group 3</td>
<td>0.8488</td>
<td>2.1855</td>
<td>2.5557</td>
<td>2.6583</td>
<td>3.4142</td>
<td>4.5275</td>
<td>5.3040</td>
<td>6.6558</td>
<td>6.2908</td>
<td>6.9108</td>
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<tr>
<td>Group 4</td>
<td>0.5303</td>
<td>1.3270</td>
<td>1.6227</td>
<td>1.9558</td>
<td>2.5193</td>
<td>2.9615</td>
<td>3.5537</td>
<td>4.6453</td>
<td>5.0257</td>
<td>5.0812</td>
</tr>
</tbody>
</table>

Group 1  No reinforcement (control)
Group 2  Pass-Fail
Group 3  ABCD/F
Group 4  Percentile

(Scores recorded as time on-target in thirty seconds)
APPENDIX B

DAILY SCORE SHEET
APPENDIX B

DAILY SCORE SHEET

<table>
<thead>
<tr>
<th>Name</th>
<th>Class</th>
<th>Group</th>
<th>No.</th>
</tr>
</thead>
</table>

**Trial Number**

1  
2  
3  
4  
5  
6  
7  
8  
9  
10 

**Best Score**  
**Percentile**

**Poorest Trial**

**Best Trial**

**High Achiever**

**Average Achiever**

**Low Achiever**