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510...Rathgar...Ave.....
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Manitoba,,Canada...

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THE EFFECTS OF COMPETITION AND SOCIAL REINFORCEMENT UPON PERCEPTUAL MOTOR PERFORMANCE

by

© Dennis W. Hrycaiko

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Effects of Competition and Social Reinforcement Upon Perceptual-Motor Performance" submitted by Dennis W. Hrycaiko, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

R B Alderman
Supervisor

Gary Smith

Murray Smith

E. E. Fox

Albert Ramm
External Examiner

Date September 29, 1976

ABSTRACT

The primary purpose of this thesis was to examine a social evaluative definition of competition and determine whether competition, initial ability level and social reinforcement interact to influence the performance of a novel perceptual-motor skill. A review of the literature was used to develop a strong social evaluative and potentially competitive experimental situation.

Based on a five trial pre-test on the ball roll-up game subjects were assigned to one of three initial ability levels, high, medium or low. Ten different junior high school boys (five pairs) were randomly assigned to each of eighteen treatment conditions (six treatment conditions within each initial ability level). Each test subject performed an additional forty trials on the ball roll-up game. To supplement performance data, tonic heart rate and palmar sweat prints were obtained as measures of physiological arousal. A post-experiment questionnaire and taped interviews provided additional information pertaining to the subjects' perception of the experimental situation.

The behavioral data supported the hypothesis that social reinforcement (reproof) facilitated performance; however, competition had no effect. The high ability subjects performed better than the low ability subjects throughout the

experiment and groups learned at the same rate over the forty trials regardless of the treatment condition. Tonic heart rate demonstrated that competition was an incentive, while no significant differences were found with the palmar sweat print. The two measures of arousal were found to have low nonsignificant correlations with each other. Questionnaire and interview data tended to support the behavioral results.

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CHAPTER I

STATEMENT OF THE PROBLEM

INTRODUCTION

Since Triplett (1897) found that competition improved the speed of winding a fishing reel, psychologists have been concerned with obtaining a better understanding of this complex social phenomenon. However, based on a review of the relevant literature it is apparent that little real understanding has been gained despite its importance in our society.

A critical factor limiting progress in competition research has been the lack of a theoretical framework to order the past research and guide future investigations. To date, a reward definition of competition (Church, 1968) has received considerable support; however, this definition requires the experimenter to make numerous critical assumptions. As a result, operationalizing a reward definition is extremely difficult, if not impossible. Furthermore, Martens (1975) has suggested that the probable explanation of the diverse findings in competition research simply reflect the manner in which competition has been operationally defined.

In an attempt to further research on competition, Martens (1975) has drawn a parallel between the critical

element in social facilitation research, evaluation potential, and the fact that almost all definitions of competition have included the potential for evaluation. Martens (1975: 71) feels that the primary feature of a competitive situation distinguishing it from other comparison situations is that the criterion for comparison is known by the person(s) in a position to evaluate performance.

Support for Martens's position has been provided by Evans and Bonder (1973) who have demonstrated the importance of impending social comparison in relation to rivalry. The importance of rivalry in competition is well documented (Evans, 1968, 1972, 1973; Wankel, 1971). The main advantage of a social facilitative definition of competition is that it clearly defines the competitive situation in a manner which may be operationalized for experimental research, while maintaining most of the characteristics commonly associated with a competitive situation.

Social facilitation research has demonstrated that an evaluative audience influences performance; therefore, further examination of a social facilitative definition of competition must focus on clarifying the relationship of competition to additional variables found in the learning situation. In recent years competition research has taken this approach, however, without the benefit of a operational definition.

Two additional variables of interest to the physical

educator are ability levels and social reinforcement. While Wankel (1969) has demonstrated the importance of initial ability levels in determining the effects of competition (rivalry induced) on performance, Martens has suggested that lack of ability is a limiting factor preventing social reinforcement effects in complex motor performance. The research of Wankel (1969), Martens, Burwitz and Newell (1972) supports this viewpoint. However, recently Harney and Parker (1972) have shown that with proper experimental procedure social reinforcement will influence performance.

From the research available it is evident that a social facilitative definition of competition must be examined and particular emphasis must be placed on determining whether competition interacts with ability levels and/or social reinforcement to influence perceptual-motor performance.

THE PROBLEM

The purposes of this study are:

A. To examine a social evaluative definition of competition.
B. To determine whether competition, initial ability level and social reinforcement interact to influence the performance of a novel perceptual-motor task.
C. To determine whether initial ability level is a significant factor for determining the effects social factors have on perceptual-motor performance.

D. To determine whether social reinforcement interacts with competition in perceptual-motor performance.

E. To examine the relationship of physiological arousal to a social evaluative definition of competition.

F. To test the following experimental hypotheses:

1. High initial ability level subjects perform better than low initial ability subjects in the learning of a perceptual-motor skill.
2. Competition retards performance in the early stages of the learning of a perceptual-motor skill.
3. Competition facilitates performance in the late stages of the learning of a perceptual-motor skill.
4. Competition ceases to be detrimental in the early stages of the learning of a perceptual-motor skill, when the initial ability level of the individual is high.
5. Competition ceases to be detrimental in the late stages of the learning of a perceptual-motor skill, when the initial ability level of the individual is low.
6. Competition hinders over-all performance in the learning of a perceptual-motor skill.
7. Social reinforcement facilitates performance in the learning of a perceptual-motor skill.
8. Praise enhances performance to a greater extent than does reproof in the learning of a perceptual-motor

skill.

9. Competition increases the individual's physiological arousal during the learning of a perceptual-motor skill.

IMPORTANCE OF THE STUDY

Does a relationship exist between initial ability level, social reinforcement and competition? Do these variables interact to influence the learning of a perceptual-motor skill?

The Physical Education Curriculum Guide for Secondary Schools of Alberta (1966) has advocated competition as an effective teaching method. However, in recent years the value of competition in the learning situation has received considerable criticism (Senior and Brophy, 1973; Campbell, 1974). As a result, many teachers rely less on competition, particularily in early learning situations. Unfortunately, the physical educator's idea of competition is usually based on rivalry (verbally induced by the teacher) rather than by social comparison or the evaluation potential of the situation as suggested by Martens (1975).

Although teachers and coaches have taken steps to control verbally induced competition, similar steps have not been taken to control the evaluation potential of most

learning situations. This criticism is particularly applicable to the physical education learning situation with its preponderence of easily observable perceptual-motor skills. If evaluation potential is the basis of competition, then almost all physical education skills are taught in a competitive situation. What effect does this have on learning and performance? It is important for the physical educator to know and understand these effects. Only in this manner may the beneficial effects be maximized and the harmful effects minimized.

However, in addition to the fact that the learning situation may be competitive and the task to be mastered in the physical activity class usually is a perceptual-motor skill, there are additional variables which further complicate the situation. For example, although the students may be introduced to a novel complex task, it is evident that the initial ability levels of the students' varies. Wankel (1969) has shown that initial ability level interacts with competition (produced by rivalry inducing instructions) to affect learning. Furthermore, the teacher or coach often provides social reinforcement in the form of praise and reproof. Does social reinforcement have any effect on this type of a learning situation? Does initial ability level, social reinforcement and competition based on social evaluation interact? The answer to this question is more relevant since Catano (1975) demonstrated that verbal praise could not only improve performance, but was particularly effective

with a perceptual-motor task. Certainly it is important for the physical educator to have some insight and understanding of the situational variables interacting to influence the learning of motor skills. Only in this manner can effective teaching result.

DELIMITATIONS

A. The sampling of subjects will be limited to one hundred and eighty male grade seven and eight students from Hardisty Junior High School in Edmonton, Alberta.

B. The study, by definition, will be limited to the effects of individual (pair) competition. It will not include self or group competition.

LIMITATIONS

A. The study is limited by the precision of the two roll-up tasks.

DEFINITION OF TERMS

A. Ability level. A subject's ability level is operationally defined as the top (high), middle (medium), or bottom (low) one-third of all subjects' ranked scores based on a five trial pre-test.

B. Arousal. A subject's arousal is operationally defined by: (1) the deviations in the Palmar Sweat Index from a basal level and (2) the deviations in tonic heart rate from a basal level.

C. Audience effects. The influence on behavior which results from the presence of passive observers.

D. Coaction effects. The influence on behavior that occurs as a result of the presence of other individuals who are engaged in the same activity.

E. Competition. Competition is a social process which occurs when a person decides to compare his performance to some standard that will be evaluated by another person(s). It is one form of social evaluation which includes both the audience and coaction effects of social facilitation. Competition is operationalized by having two coactors perform before an audience of evaluating "experts".

F. Interaction effect. An interaction effect is an effect attributable to the combination of variables above and beyond that which can be predicted from the variables considered singly. It is representative of real life situations where two or more variables are often used in combination.

G. Learning. Learning is inferred from the improvement in performance over a series of trials as a result of practice. It is operationally defined as the gain in raw performance scores between the initial level of

performance and the final level of performance for each individual subject.

H. Perceptual-motor learning. Perceptual-motor learning involves the learning of motor skills. It is operationalized through practice of the ball roll-up game which is a motor task requiring eye-hand coordination.

I. Performance. Performance is the raw score received on any single trial or group of trials by a subject or group of subjects on the roll-up task.

J. Social facilitation. Social facilitation refers to the consequences upon behavior which derive from the presence of other individuals. These consequences may have positive or negative effects on performance.

K. Social reinforcement. Social reinforcement refers only to nontangible reinforcement under the control of others. Social reinforcement is operationalized by verbal communication in the form of praise (positive reinforcement) and reproof (verbal punishment).

CHAPTER II

REVIEW OF THE LITERATURE

INTRODUCTION

This study is primarily concerned with examining the effects of three variables in an experimental learning situation, which has practical applicability in the physical education field. Studies designed to test the validity of theory or the merits of using one definition of competition over another, will be left to future study and/or other researchers. The approach towards practical application utilized in the present study is reflected in the review of literature, which is limited to studies directly related to methods and procedures applied to develop the experimental setting and to examine its effects on learning. The review of literature is divided into four main areas: competition, social facilitation, social reinforcement and physiological arousal.

The review of competition literature provides a brief overview of Martens's (1975) social evaluative definition of competition. The relative merits of Martens's definition are considered in relation to two additional definitions of competition. The remaining portion of the literature in this area is directly concerned with studies which have examined

the effects of numerous variables interacting in competitive situations.

The social facilitation review emphasizes research since the work of Zajonc (1965) and Cottrell (1968, 1972). Primary concern is given to studies testing the mere presence versus evaluation apprehension hypotheses, as herein lies the basis for operationalizing a social evaluative definition of competition.

The third major area of the review consists of social reinforcement studies which have utilized praise and reproof as motivational and informational incentives. The majority of the studies examined deal with perceptual-motor performance in learning situations.

Physiological arousal research concludes the review of the literature. Although an introductory overview of the current state of arousal research is presented, the review of the literature deals primarily with studies using either tonic heart rate or the palmar sweat print as physiological measures of arousal. The advantages and disadvantages of each technique are discussed.

COMPETITION AND MOTOR PERFORMANCE

Research on the complex social process termed competition has been limited by the lack of a clear definition of the term, including a description of the components which

make up its conceptual framework. In an effort to alleviate this problem Martens (1975) has conceptualized competition as a process consisting of four closely related stages of events. They are: the objective competitive situation, the subjective competitive situation, the response made to the situation and the consequences of the response.

The objective competitive situation refers to the objective reality (physical or social environment) that exists, independent from any subjective interpretations by the individual. The subjective competitive situation results from the individual's perception and interpretation of the situation (i.e. whether one interprets the objective competitive situation as competitive). The response made to the situation is usually examined at the behavioral level; however, it may also be a psychological or physiological response. Finally, the consequences of the responses provide the individual with feedback for future use. The feedback may be positive, negative or neutral and may well determine the individual's responses in future objective competitive situations.

The definition of an objective competitive situation has been developed from social evaluation theory (Festinger, 1954) and the research of Cottrell (1968, 1972) and Martens and Landers (1972). In brief, Festinger (1954) hypotheses that two basic drives, a uni-dimensional drive upward to improve one's ability and the need to constantly evaluate one's abilities, emotions, and opinions with those of his

referent group, produce competitive behavior. If one cannot evaluate his performance due to the absence of objective criteria, the social comparison process occurs as evaluation is attained by comparing one's abilities with similar others. The objective competitive situation is operationalized on the basis of social facilitation research (Cottrell, 1969, 1972; Martens and Landers, 1972) which has empirically demonstrated that the evaluation potential of a social situation is a critical factor influencing performance.

The objective competitive situation may be defined as one in which an individual's performance is compared with a standard in the presence of at least one other person, who is aware of the criterion for comparison and can evaluate the comparison process (Martens, 1975: 71). According to Martens (1975: 72) the advantages of defining an objective competitive situation in this manner are:

1. The objective competitive situation can be operationalized for careful study.
2. The definition incorporates the great majority of activities commonly thought to be competitive.
3. The definition has theoretical and empirical support from social evaluation theory and research.
4. The definition makes no inferences about the person's perception of the situation, the response made to it, or the consequences of the response.

Martens (1975: 74) has concluded that the direction of future research should be the study of numerous factors influencing the relationship between the stages of events in

the process of competition. Applying this approach to research in physical education, the teacher or coach may wish to determine the answers to some of the following questions: Do boys presented with an objective competitive situation, perceive it as a competitive situation? Secondly, will the boy accept the situation as competitive and consciously attempt to improve his performance? If the situation is accepted as competitive, how does it affect learning and performance? Can any of the effects be offset or facilitated by other factors (e.g. social reinforcement, initial ability level) in the learning situation?

To better understand the relative merit of Martens's (1975) approach to competition one must consider other definitions of competition. Two definitions which have drawn considerable attention are by Allport (1924) and Church (1968).

Allport (1924) has examined the influence of the co-acting group upon the individual's performance. His conclusions (Allport, 1924: 262) are as follows:

> In all kinds of competitive performance we may recognize two social factors. The first is social facilitation which consists of an increase of response merely from the sight and sound of others making the same movements. The second is rivalry, an emotional reinforcement of movement accompanied by the consciousness of a desire to win.

Allport (1924) went further and concluded that although rivalry and social facilitation were supplementary, social

facilitation could exist independently from rivalry. This conclusion sparked two recent studies (Evans, 1968; Wankel, 1971) to determine whether the motivational components of a competitive situation could, in fact, be isolated from one another.

Evans (1968) used a form board as a task and attempted to differentiate between rivalry and social facilitation in a competitive situation (coaction). The study was also designed to investigate the relationship between performance, level of motivation and cognitive activity (alertness rating). A questionnaire was used to examine individual differences in competitiveness. The findings of the study provided heart rate data support for rivalry as a motivational component, however, ratings of alertness, and the competitiveness questionnaire provided no significant differences.

In an attempt to analyze a competitive situation into separate motivational components and to investigate their influence on performance, Wankel (1971) used both simple and complex motor tasks. Eight treatment conditions were examined, made up of various rivalry, coaction and audience combinations. Junior high school boys were used as subjects and additional data in the form of heart rate, ratings of alertness and a personality (IPAT) test were administered. The behavioral data provided support for rivalry as a motivational component, however there was no support for the social facilitation components (audience and coaction). There

was no relationship between performance, heart rate and ratings of alertness. Furthermore, personality traits did not differentiate between good and poor performers.

The research of Evans (1968) and Wankel (1971) provided very little support for Allport's (1924) analysis of competition. However, in defence of Allport (1924) it seems quite likely that the social facilitation manipulations were inadequate to provide a good test of these components as the evaluation potential of the competitive situations was minimal. The results of the Evans (1968) and Wankel (1971) studies, however, have demonstrated that the "mere presence" of others, or Zajonc's (1965) view of social facilitation, is not sufficient to be considered a motivational component of competition.

Church (1968: 152) has defined a competitive situation as one in which "the available reinforcements are allocated among two or more subjects as a function of some characteristic of their behavior." The assumption is made that one subject will not receive all of the reinforcement and as a result differential reinforcement occurs. In this manner, it is concluded that competition can only be understood in terms of the allocation of the rewards (reinforcements). The reward definition has been criticized because in many situations, defined as competitive, it is difficult "to achieve consensus on the criteria for the distribution of rewards, on the subjective value of the rewards

and on the goal to be achieved" (Martens, 1975: 70).

In summary, the merit of a social evaluative definition of competition is that social evaluation theory and research provides the definition with a strong base of support (theoretical and empirical). In addition, the objective competitive situation can be readily operationalized. In contrast, research has failed to provide much in the way of support for Allport's (1924) analysis of competition, while the reward definition (Church, 1968) presents serious problems in operationalizing the competitive situation.

Due to the difficulties in theory and definition, competition research to date, has been primarily directed towards determining what variables interact in a competitive situation. A brief review of the relevant literature follows.

In an effort to determine how task factors interact with experimental variables Noble, Fuchs, Robel and Chambers (1958) used perceptual-motor tasks involving intermittant selective responding and continuous eye-hand coordination. It was hypothesized that a social group would perform better than an individual group due to social competition; while individual groups would be more proficient and less variable than the social group due to less distraction. The results showed that the individual group's performance was poorer on the discrimination task, but there was no change on the pursuit task. It appeared that the facilitation in discriminative speed was an additive effect due to social competition, however, the effect was independent of initial ability level.

The authors concluded that since the subjects had practiced under analogous conditions, the motivational role of social competition in perceptual-motor learning was contingent on an as yet to be analyzed task factor.

Bruning, Sommer and Jones (1966) hypothesized that a competitive situation was more highly motivating than a cooperative situation and that whether heightened motivation would be reflected in superior performance would be a function of task difficulty. The hypotheses were tested in two experiments, the first utilizing a simple reaction time task and the second experiment, a complex pursuit rotor task. Although faster reaction time occurred in competition than cooperation, there was no differences using the complex task. The authors concluded that despite the discrepancy in the results, greater consideration had to be given to variables which determine the level of motivation induced.

Based on the above assumption (Bruning et al, 1966) competition research has since tended to focus on the effects of various factors upon motivation in a competitive situation. Studies utilizing this approach have included: Bruning and Mettee (1966), Evans (1966, 1968), Martens and Landers (1969), Wankel (1971), Carment (1970), Carment and Hodkin (1973). A noteable exception to the emphasis on motivation was Wankel's (1969) study of the interaction between competition and initial ability levels.

Bruning and Mettee (1966) examined the effects of various social factors on motivation in a competitive

situation. Volunteer male undergraduates participated in one of two experiments designed to determine the effects of opponent proximity on performance and to investigate performance as it was affected by the proportion of wins and losses experienced by the subjects. The results provided partial support for the hypothesis that motivation increased when the opponent was actually present. In addition, performance was shown to be best when the outcome was in doubt.

In order to examine differences between social and nonsocial competition and to investigate possible relationships between performance, the level of motivation and cognitive activity; Evans (1966) had sixty subjects perform a reaction time task under one of three conditions: alone, competition versus an instrument, and competition with another subject. Heart rate was used to measure motivational differences and ratings of alertness and interest were taken to study cognitive activity. Minimal differences between social and nonsocial competition occurred. No information was obtained regarding the possible relationships between performance, the level of motivation, and cognitive activity.

Martens and Landers (1969) attempted to determine if two stressors, competition and failure (bogus feedback), interacted with the effects of anxiety to influence learning and performance with a complex motor task (coincident timing). Anxiety was determined using the Taylor Manifest Anxiety Scale. The results showed low anxiety subjects performed better than high anxiety subjects during initial learning,

but there was no difference in later learning. The competition and failure treatments did not produce any significant differences. No arousal measure was taken.

In order to investigate the interaction of aspects of competition and varying ability levels upon learning and performance of a motor skill; Wankel (1969) dichotomized seventy-two, grade eight boys into high and low ability groups based on a five trial pre-test on a stabilometer. Subjects were further sub-divided into competitive and non-competitive groups. Results showed that the high ability group performed better than the low ability group; however, competition didn't influence over-all performance. The author concluded that the effects of competition cease to be detrimental early in the stages of learning of a motor task when initial ability level is high and in later stages of learning if the initial ability level is low.

Carment (1970) examined the differences in rate of simple motor responding as a function of coaction, competition and sex of a participant. The experiment was designed to assess the performance increments attributable to the presence of a coactor and those attributable to competition. Subjects were eighty undergraduates, half performing a simple motor task alone, while the other half were coacting. Half of each of the groups was given instructions to compete. The findings showed that the presence of a coactor greatly increased the response rate of females but had little effect on

males. For both sexes, competition increased the rate of responding only when a coactor was present.

The performance of Indian and Canadian undergraduates (male), while either alone or coacting, under either competitive or non-competitive instructions, and under instructions which emphasized either quality or quantity was reported by Carment and Hodkin (1973). The results demonstrated that the Canadians were significantly more responsive to the competitive instructions and the presence of a coactor. A unique finding in this study was that whereas competitive instructions influenced the performance of Canadians in the alone treatment, they had no effect in the coacting situation.

Evans and Bonder (1973) have reported a finding similar to that of Carment et al (1973) in a study defined to investigate the effects of rivalry in conjunction with impending social comparison. Previous research had demonstrated that rivalry (a cognitive desire to out perform or win) appeared to be motivational as reflected by both performance (Wankel, 1971) and tonic heart rate (Evans, 1971, 1972). Furthermore Evans (1972)had demonstrated that the promise of an opportunity to engage in social comparison was motivational (significant heart rate and performance data). Evans et al (1973) examined social comparison and rivalry in a two by two factorial design (both factors present and absent), with a task which consisted of five different modified

forms of the Wechsler Adult Intelligent Scale digit symbol task. The results produced identical effects on tonic heart rate and performance. The findings indicated that when an opportunity to engage in social comparison was not impending a rival was a source of motivation, but when an opportunity to engage in social comparison was impending a rival did not have any significant motivational effects. Evans et al (1973) concluded that there were three possible reasons for the results; they were: the results occurred due to a ceiling effect; the only reason rivalry is motivational is that it offers one the opportunity to engage in social comparison and is merely another manifestation of the drive people have to evaluate themselves (Festinger, 1954); or finally, the opportunity to engage in social comparison is motivational because people perceive it as a rivalrous situation and have a cognitive desire to win or out perform the other people with whom they are going to compare themselves.

The review of studies examining variables which interact in a competitive situation suggests the following:

1. The type of task and its degree of complexity are important criteria for interpreting the results of learning and performance.
2. Ample consideration must be given to factors which determine the level of motivation induced in the experimental situation (eg. competition, anxiety, failure and coaction).
3. Opponent proximity and outcome doubt appear to be

important factors in a competitive situation.

4. Initial ability level merits consideration in a competitive situation.
5. The effects of social comparison requires further study in competitive situations involving coaction.

SOCIAL FACILITATION

Introduction:

Social facilitation as defined by Zajonc (1965: 269) refers to "the consequences upon behavior which derive from the sheer presence of other individuals." These consequences may have a positive or negative effect on performance. In an attempt to explain the contradictory findings of social facilitation research, Zajonc has suggested that two distinct experimental paradigms exist. These he refers to as audience effects and coaction effects. Zajonc (1965: 273) has proposed that the two paradigms are similar in that the presence of others as spectators, or as coactors, enhances the emission of dominant responses. Zajonc and Sales (1966) confirmed this conclusion in a study using a pseudo-recognition task. Further support has been provided by Cottrell, Rittle and Wack (1967), Cottrell (1968), Martens (1969), Martens and Landers (1969) and Hunt and Hillery (1973). On the basis of the above generalization Zajonc (1965: 273) has hypothesized "that the mere presence of others increases

the individual's general arousal or drive level." This explanation has prompted renewed interest in social facilitation research.

Cottrell (1968, 1972) has provided a valuable addition to Zajonc's (1965) theory. Zajonc has proposed that the "mere presence" of others is a source of drive, while Cottrell (1968, 1972) maintains that the presence of others is a "learned" source of drive, in that, arousal is a function of anticipating positive or negative outcomes from the presence of others. This has been referred to as drive induced by evaluation apprehension. Recent social facilitation research has been primarily concerned with testing the validity of the mere presence and evaluation apprehension hypotheses.

Coaction:

The coaction paradigm consists of two or more individuals performing the same task in the presence of one another. Three recent coaction studies have examined the mere presence and evaluation apprehension hypotheses.

Klinger (1969) investigated the effects of feedback and coaction on vigilence. Forty-eight male undergraduates performed a visual vigilence task in both isolation and coaction with a peer. Performance was improved by the presence of a coactor only when the coactor had access to information about the quality of the subject's performance.

Martens and Landers (1972) tested one hundred and thirty-two male undergraduates on the ball roll up game in four coactor groups: alone, dyads, triads, and tetrads. Support was found for the hypothesis that increasing numbers of coactors results in increasing impairment of motor performance. Support was also found for Cottrell's hypothesis that evaluation apprehension, rather than mere presence of others, is the source of the social facilitation phenomenon.

In a study (Burwitz and Newell, 1972) to determine the effects of the mere presence of one or three coactors, support was found for Zajonc's (1965) mere presence hypothesis. A motor task similar to the ball roll up game was used to test one hundred and eight male undergraduates between three cells: alone, dyads and tetrads. In no condition could the subjects observe their coactor's performance. The performance of the tetrad group was significantly less than the alone or dyad groups.

Zajonc (1965) and Tolman (1968) have produced excellent reviews of social facilitation studies with animals, which tend to support Zajonc's mere presence hypothesis. A recent study by Zajonc, Heingartner and Herman (1969) is an excellent example of social facilitation animal research. The experiment consisted of the observation of maze and runway performance of cockroaches under solitary and social conditions. The social conditions consisted of both audience and coaction. In both social treatments maze performance

was impaired while runway performance was facilitated compared to the performance of the cockroaches in the solitary condition. Zajonc et al (1969) interpreted this as support for the hypothesis that mere presence of conspecifics is a source of general arousal that enhances the emission of dominant responses.

There are a number of additional coaction studies worthy of mention, although they were not designed to test the mere presence versus evaluation apprehension aspects of coaction research. Studies by Allport (1920), Kiesler (1966), Martens and Landers (1969), Garment and Latchford (1970), Pederson (1970), and Hunt and Hillery (1973) fall in this category.

One of the initial major coaction studies was performed by Allport (1924). The study was designed to compare the mental processes of the individual working alone with the processes demonstrated when a member of a co-working group. In order to reduce the effects of rivalry, subjects were instructed not to compete. The results showed that coaction increased the speed of the free association process while personal associations were increased when the subject worked alone. It was concluded that coaction effects were subject to the nature of the task, individual differences, and other less important factors.

Kiesler (1966) examined the interaction between stress and affiliation (coaction) while subjects worked on

simple and complex tasks, (timed digit symbol and figure drawing tasks) alone or together, with three other subjects under high or low manipulated stress. The results replicated previous drive theory research and extended the applicability of drive theory predictions to speed tasks.

Coaction effects on muscular endurance were examined by Martens et al (1969). Young boys, of three different age groups performed either alone or in groups of dyads or quadrads. The task consisted of extending the dominant leg for as long as possible. The results demonstrated that individuals in quadrads performed significantly better than individuals in dyads or alone.

A study by Pederson (1970) examined the effects of test anxiety and coaction on learning and performance. The paired associate learning task did not produce a coaction effect, regardless of anxiety level. However, differences did occur on a vowel cancellation performance task. The results of the study indicated that a complex interaction existed between the personality characteristics of the subject (anxiety), the conditions of work (alone, coaction) and the type of task involved (learning or performance task).

Carment and Latchford (1970) attempted to assess the effects of the presence of absence of the experimenter on the rate of responding of males and females, either coacting or alone, with a simple motor task. The results showed that the subjects responded more rapidly, and social facilitation effects appeared, only in the presence of the experimenter.

It was concluded that the results provided strong support for Cottrell's (1968) view that anticipated evaluation was necessary for performance facilitation. The coactor was not considered an evaluator because there was no knowledge of results in this study.

Finally, a study reported by Hunt and Hillery (1973) examined social facilitation in a coaction setting. The study was designed to test the hypothesis, that the presence of others facilitates the emission of dominant responses in a coaction situation with a human maze learning task. An attempt was made to minimize evaluation by eliminating all cues which could be used to evaluate performance. The findings supported Zajonc's proposal that the presence of others facilitated the emission of the dominant response.

On the basis of the foregoing coaction studies the following conclusions can be made:

1. The hypothesis that evaluation potential rather than the mere presence of others is the source of social facilitation effects has not received overwhelming support in coaction studies.
2. Animal research appears to support the mere presence hypothesis.
3. Important factors to consider when examining coaction effects include: the nature of the task, individual differences, presence of stressors, number of coactors, age and personality characteristics of the subjects, the evaluation potential of the situation and the stage of

learning (initial versus well learned).

Audience:

The audience paradigm consists of a single subject performing a task in the presence of one or more (usually in addition to the experimenter) passive observers. A considerable number of audience studies have examined the mere presence versus evaluation apprehension hypothesis with the results heavily supporting Cottrell's (1968) interpretation. Only one study (Cohen and Davis, 1973) lends support to Zajonc's (1965) mere presence hypothesis (Zajonc et al, 1969 study was supportive, but used cockroaches as subjects). A study by Roberts (1975) has provided partial support for an evaluation apprehension interpretation, but concluded, that other factors must be considered for a complete understanding of the results. Studies by Cottrell, Wack, Sekerak and Rittle (1968), Henchy and Glass (1968), Paulus and Murdoch (1971), Criddle (1971), Haas and Roberts (1973) and Gore and Taylor (1973) have supported an evaluation apprehension hypothesis in audience research.

The Cohen and Davis (1973) study investigated the effects of audience status, evaluation and time of action on performance with hidden word problems. The results of the experiment showed that an audience labeled as neutral produced a social facilitation effect; however, an evaluative audience increased the intensity of these effects.

In a study to determine the effect of the presence of others and evaluation potential on learning a motor maze, Roberts (1975) found a significant evaluation potential main effect. However, Roberts (1975) cautioned against prematurely supporting Zajonc or Cottrell because the evaluative group, although it differed from the alone group, was not significantly different from the blindfolded audience group. Instead, it was concluded that new directions and procedures are required to fully understand social facilitation.

In an effort to evaluate Zajonc's (1965) proposal that the mere presence of other persons produced audience effects, Cottrell et al (1968) extended the Zajonc et al (1966) study by adding a treatment consisting of a blindfolded audience. Although the presence of an audience enhanced the emission of dominant responses, the mere presence (blindfolded audience) of others did not.

To test the hypothesis that the presence of an audience enhances the emission of dominant responses at the expense of subordinate responses, only under conditions where the audience is perceived to be an evaluative element in the situation, Henchy and Glass (1968) used a pseudo-recognition task and confirmed the hypothesis. The probability of dominant responses was found to be higher for subjects who thought their performance was being evaluated, compared to the subjects in the merely present audience or alone conditions. The opposite effect was observed, as expected, for

subordinate responses. However, physiological data failed to support the autonomic interpretation of social facilitation effects.

A pseudo-recognition task was also used by Paulus and Murdoch (1971) to test the hypothesis that anticipated evaluation was essential to the enhancement of dominant responses. The hypothesis was supported, in that, anticipated evaluation of performance produced greater emission of dominant responses than no anticipation of evaluation. Furthermore, the presence or absence of an audience had no significant effect on the emission of dominant responses.

Criddle (1971) had sixty female nursing undergraduates learn competitive and non-competitive lists of paired associates while alone and while being observed from behind a one-way mirror. Dominant responses were enhanced when subjects were observed through the one-way mirror. No significant effects were found with the non-competitive list. It was concluded that the mere physical presence of others was neither a necessary nor sufficient condition for the occurence of social facilitation.

Utilizing a motory pursuit task and measuring learning over trials, Gore and Taylor (1973) tested two assumptions of Cottrell's learned drive theory. The assumptions were: the presence of an audience inhibits learning and an audience perceived as expert will inhibit learning to a greater extent than a non-expert audience. Both of the

hypotheses were supported. In addition, this study demonstrated the appropriateness of generalizing these effects to all groups, regardless of their composition.

To determine the effect of an evaluative audience on motor skill acquisition and performance, Hass and Roberts (1973) tested ninety female undergraduate volunteers on a mirror tracing task. The results supported Cottrell's (1968) hypothesis that the source of arousal is the evaluative potential of the audience. The audience perceived to have the greater degree of evaluative potential had significantly greater effect upon the performance of subjects. In addition the findings tended to support Cottrell's (1972) hypothesis that an evaluative audience gives rise to an anticipation within the subject of positive or negative responses from the audience.

A number of audience studies which were not designed to test the mere presence versus evaluation apprehension hypotheses are worthy of mention. In this manner the reader may have a better understanding of the directions audience research has taken.

To begin with, Martens (1969a) used a coincident timing motor task to determine the effects of the presence of audience on palmar sweating. Forty-eight male undergraduates were tested in one of two groups (audience present or absent). The results supported Zajonc's social facilitation theory in that the presence of an audience increased

arousal which adversely affected learning.

In a second study using the coincident timing task, Martens (1969 b) examined the effect of an audience on learning and performance. The study also attempted to determine the relationship of the Taylor Manifest Anxiety Scale to the presence of audience. Ninety-six male undergraduates, representing the top and bottom eleven percent of the anxiety scores gathered, performed the task. The results were consistent with social facilitation theory predictions for learning and performance of a complex motor task. The palmar sweat print provided evidence in support of the assumption that the presence of others is a source of arousal. In addition, anxiety and audience presence failed to interact in a manner consistent with drive theory or previous research.

Quarter and Marcus (1971) tested sixty-eight grade eight students (male and female) on a digit span test to determine whether drive level increased and performance impairment occurred in the presence of an audience. Drive level was determined by anxiety test scores. The predicted audience effect occured; however, an interaction with drive level did not.

In an effort to resolve the contradictory social facilitation predictions of drive theory and the inverted U-hypothesis, Dorrance and Landers (1973) applied the principle of summation to manipulate the strength of audience induced drive by varying audience from one (experimenter) to

six. In order to avoid the learning-performance problem the ball roll up task and a reaction time task were used and initial learning was examined. To measure arousal Thayer's Activation-Deactivation Adjective Test List (AD-ACL) and an additional questionnaire were completed by the subjects and the audience. The results showed that increments in audience size were paralleled by increments in arousal. Although ball-rolling scores suggested an inverted U trend, reaction scores were not consistent with either drive theory or the inverted U.

Sorce and Fouts (1973) attempted to determine the effect of level of motivation on the social facilitation of well-learned behavior. The galvanic skin response was used to measure arousal and subjects (forty-five) were divided into motivational groups (high, medium and low). The task consisted of pulling a lever in the presence and absence of an audience (one passive observer). The results showed a significant motivation by social condition interaction. With the audience present the highly motivated group performed slower than the middle and low motivated groups. It was concluded that the social facilitation of well-learned behavior depends on the subjects level of motivational reactivity.

A study (Good, 1973) utilizing sixty-four female undergraduates tested the hypothesis that subjects responses to low-competition words would be facilitated only if the

subject anticipated performing well before an evaluative audience (since this would be the only condition which could lead to positive social reinforcement). The hypothesis was supported and the results were interpreted as supporting the importance of positive outcomes from performance. Good (1973) concluded that the presence of others may often function as a source of social reinforcement. However, the results of the study support Cottrell's (1968, 1972) explanation of audience effects and serve as a rebuttal to Weiss and Miller (1971) who have suggested audience effects are due to an anticipation of negative performance outcomes in the presence of others.

Sasfy and Okun (1974) attempted a more stringent test of Martens and Landers' (1972) conclusion that direct evaluation of performance and outcomes leads to greater impairment than indirect evaluation of outcomes. The motor task used was the ball roll up game. Contrary to Martens and Landers, there was no difference between direct and indirect evaluation. Both were equally detrimental. The results indicated that at least two factors, audience characteristics and the form of evaluation can be considered interactive determinants of evaluation potential. The findings support Cottrell's idea that the potential for evaluation in a social situation is the chief source of audience and coaction effects in humans.

Based on the results of the foregoing audience studies the following conclusions can be made:

1. Audience studies have provided strong support for Cottrell's (1968, 1972) evaluation apprehension hypothesis.
2. The proposed relationship between anxiety and audience presence has not been substantiated.
3. Research has failed to support the assumption that the presence of others leads to increased arousal. However, this may simply reflect the difficulty in measuring arousal.
4. The palmar sweat print appears to have some merit as a measure of arousal in audience studies.
5. Additional factors that warrant consideration in audience studies include: audience size and characteristics, nature of the task, stage of learning (initial versus well-learned), form of evaluation and personality characteristics of the subjects.

SOCIAL REINFORCEMENT AND MOTOR PERFORMANCE

Walker (1967: 25) has observed that reinforcement always seems to be present in learning, but whether or not it is required for learning remains a matter of debate. It has often been suggested that reinforcement is a concept of tremendous importance to all teachers. However, Oxendine (1968: 51) has stated that reinforcement is of particular

importance to teachers of perceptual-motor skills because often they can make more direct and obvious application of reinforcement. This simply reflects the obvious ease with which motor skills may be observed, evaluated and then reinforced. Unfortunately, to date, physical educators have largely failed to take advantage of reinforcement theory (Mackenzie and Rushall, 1973). A possible reason for this oversight could be the lack of research to support the effectiveness of social reinforcement in a learning situation.

Extensive reviews of the social reinforcement literature have been conducted by Kennedy and Willcut (1964), Parton and Ross (1965), Marshall (1965) and Wodtke and Brown (1967). In a study confined to empirical research considering the effects of verbal incentives, praise and blame, on discrimination, learning and motor skills in school children; Kennedy et al (1964) reviewed thirty-three articles which spanned fifty years. The authors concluded that praise generally acted as a facilitator of performance, although it was often indistinguishable from practice effects. However, praised underachievers were an exception to this conclusion. In contrast blame generally had a negative effect on performance; however, exceptions to this conclusion were numerous and included underachievers, very bright adolescents and Negro children working under Negro examiners. Kennedy et al concluded that a major problem in the research reflects the confounding effect of the subjects' social

reinforcement history.

Parton and Ross (1965) reviewed a number of studies which had attempted to evaluate the effectiveness of positive social reinforcement on repetitive motor behavior in children. The effort of the authors was concentrated on examining the methodological weaknesses and problems of measurement found in numerous studies. Problems uncovered included omission of control groups, effects of different schedules, problems related to difference scores (baseline) and the function of mediating response strategies. The authors recommended the need for the development of appropriate tasks for assessing social reinforcement effects and research to examine the possible role of awareness of the reinforcement contingency on the influence of the other mediating responses. It was also concluded that it may be quite unreasonable for researchers to assume that social reinforcement should uniformly facilitate performance with a group of randomly selected children.

Marshall (1965) examined the literature pertaining to the effect of punishment and/or negative reinforcement on children. The author hypothesized that negative reinforcement (blame, reproof) had an informative and, therefore, beneficial effect on specific responses. The literature provided support for this hypothesis demonstrating that negative reinforcement improved performance. However, numerous other factors were found to influence this effect

including task complexity, subjects' personality, the experimenter, the instructions as well as the intellectual and achievement level of the subjects.

Finally, Wodtke and Brown (1967) reviewed the social learning research and suggested the following alternative hypotheses for social reinforcement. First, increased responsiveness to social reinforcement following negative encounters or social isolation have been attributed to increased social drive, heightened emotional arousal, and general stimulus deprivation. Secondly, an attitude intepretation predicts decreased responsiveness to social reinforcement following a negative encounter with a reinforcing agent as a result of the individual's negative attitude towards the reinforcing agent.

The fact that social reinforcement has been shown to influence human behavior motivated Martens (1970, 1971, 1972 (b)) to undertake a series of experiments to determine whether positive or negative reinforcement of motor behavior by other individuals through verbal and visual cues affected perceptual-motor performance. Until this time little had been done in physical education to relate social reinforcement to the learning and performance of complex motor skills (Roberts and Martens, 1970). Although these studies (Martens 1970, 1971, 1972 (b)) failed to demonstrate that social reinforcement affected performance they are worthy of examination as enough was learned from them to eliminate a

number of problems in experimental technique.

Roberts and Martens (1970) used a coincident timing task to determine the effect of positive and negative social reinforcement compared to a non-reinforced group and a control group in complex motor performance. The experimenter and three confederates administered the treatments except for the control group where only the experimenter was present. Although the performance of all groups significantly improved, there was no differences between the groups. The authors concluded that the subtleness of the reinforcement treatments may have rendered them ineffective (lack of contingency).

In a study to determine the effects of positive, negative and combined social reinforcement on the accuracy of motor performance among fifty preschool boys and girls; Martens (1970) administered reinforcement on a contingency basis. The motor task involved rolling a tennis ball up an incline plane. No significant effects were obtained. Martens (1970) concluded that the failure of social reinforcement to influence performance was due to the lack of control that each individual had in varying his performance.

Martens (1971) investigated the effects of praise and reproof as social reinforcers on the performance of a motor task among boys high in internal control as compared to external control. The Bialer Locus of Control Scale was used to determine the subjects' locus of control. The results of the study provided no support for the hypotheses that social

reinforcement had greater influence on the motor performance of internal control subjects compared to external control subjects. Martens (1971) concluded that social reinforcement may be supplementary information, rather than essential information when given along with knowledge of results.

Similarly, in a study (Martens, 1972 (b)), to determine the influence of social reinforcement as a function of social position on motor performance, it was concluded that knowledge or results rather than praise or reproof was the essential information. It was concluded that social reinforcement provided only supplementary information, acting as mild incentives, and thus failed to influence performance. The subjects were sixty, grade four, five and six boys from an upper and lower socio-economic background. The motor task involved rolling a ball up an incline to a target area. There were no significant effects.

In the foregoing studies Martens concluded that the lack of social reinforcement effects reflected either inability of the subjects to control their complex motor performance or the fact that social reinforcement was not essential information to the subjects. To further examine the limiting aspects of motor control, Martens, Burwitz and Newell (1972) used a pursuit rotor task, and hypothesized that social and tangible reinforcements have no effect on early practice trials with a qualitative motor task, but facilitate performance after the skill is learned. Although

difficulties were encountered in analyzing the data due to inequitable initial abilities, there was limited support for the hypothesis. It was found that social reinforcement influenced motor performance only after improvements in performance receded.

A number of studies Harney and Parker (1972), Wankel (1975), Senior and Brophy (1973), and Levy (1974) have examined the motivational rather than the informative aspects of social reinforcement. The Harney et al (1972), Wankel (1973) and Levy (1974) studies examined complex motor performance, while Senior et al (1973) used two simple tasks, one boring and repetitive and the second a more interesting, ego-involving task. A brief review of these studies follows.

The Harney et al (1972) study examined the effects of positive, negative and conversation control social reinforcement on children performing a gross motor task. Reinforcement was administered on every trial. Male subjects in the positive and negative social reinforcement treatments performed significantly better than males in the conversation control condition. Heart rate differences gave partial support to the obtained performance differences as heart rate differed as a function of social reinforcement, experimenter sex and subject sex.

Wankel (1975) applied reinforcement after every trial in a study utilizing a stabilometer task to determine the interacting effects of social reinforcement, initial ability

levels and audience presence. Ninety-six junior high school boys were dichotomized into high and low ability levels based on a five trial pre-test. Subjects then performed twenty-five trials under one of the assigned treatments. Neither the presence or absence of audience, nor the positive or negative reinforcement significantly affected total performance. However, the positive reinforcement group tended to perform better than the negative reinforcement group, which in turn, performed better than the control group in later learning (blocks 4 and 5).

In an effort to determine the effect of social reinforcement and knowledge of results on the performance of an accuracy motor task; Levy (1974) tested eighty EMR children (CA = 8.2 to 14.0 years and MA = 5.0 to 10.3 years) on a rotary pursuit. Results showed improved performance in all social reinforcement conditions to a greater degree when knowledge of results was present. It was concluded that it is very important to consider the motivational disposition of the subjects while performing an accuracy (qualitative) motor task.

Finally, in a study to determine the relative effectiveness of praise and group competition as motivating incentives affecting task persistence, Senior and Brophy (1973) tested ninety-six children (half from kindergarten, half from grade two) on two tasks. The first task was boring and repetitive, while the second task was more interesting

(ego-involvement). The dependent variable was task persistence. The results indicated that competition was more effective than praise only in a boring task. It was concluded that the advantages of praise in a teaching situation included: it was simpler, equally effective, and did not possess the negative side effects of competition.

Studies by Foot and Lee (1970), Dusek and Dietrich (1973) and Gill and Martens (1975) have examined the interactive effects of the motivation and information components of social reinforcement on motor performance. The general findings of these studies; however, has indicated there was considerable difficulty in distinguishing between the two effects.

Foot et al (1973) attempted to determine the motivational effects of the transmission of results between members of a group performing a motor task. The results of this study suggested that two processes were in operation: first, reinforcement through evaluation of one's own performance with social norms, which significantly increased the rate of learning, and secondly, motivation through an audience effect which increased the general level of performance. The findings were discussed in relation to other evidence from social comparison and audience studies.

According to Dusek and Dietrich (1973) research has ignored the possibility that social reinforcement may have two simultaneous effects, information and motivation. These

researchers (Dusek et al, 1973) hypothesized that contingent reinforcement provides both effects. Testing thirty-six, four year old children on a two choice marble task, the authors interpreted their results as indicating that social reinforcement acts as a cue function and also as a motivator.

Gill and Martens (1975) performed two experiments to examine the relative informational and motivational effects of knowledge of results and social reinforcement, separately and in combination upon initial acquisition and later performance. Grade seven and eight females were used as subjects with a task which involved rolling a rubber ball to a target area. Experiment one suggested a combination of informational and motivational effects with both knowledge of results and social reinforcement facilitating initial acquisition. However, in experiment two social reinforcement did not significantly affect performance. The authors concluded that the overall results did not clearly separate informational and motivational social reinforcement effects. Furthermore, demotivational effects were not observed. It was suggested that it was essential for future research to give consideration to the subjects' cognitions.

A number of researchers (Cairns, 1967; Parnes, 1973; Pawlicki, 1974; and Catano, 1975) have approached social reinforcement research emphasizing the effects of the informational component of reinforcement. The results of these studies generally indicates that information does in fact facilitate performance.

Cairns (1967) hypothesized that the reinforcement properties of any event vary as a function of its informational characteristics. Forty fourth grade children were tested on a card sorting task to determine whether reinforcement effectiveness of an established verbal reward could be enhanced by structuring its informational content through instructions. The results demonstrated a strong experimentally induced information effect for both the verbal (the word right) and the non-verbal (buzzer) events, with the latter making the greatest gain in effectiveness. The information treatment was operationalized by telling the information group that the buzzer (or the word right) indicated that the correct answer had been provided. While the no information group were not told what the buzzer or the word right would mean. The study underlines the importance of considering the cue properties of the reinforcing stimulus.

Using a task which involved the copying of five different designs, Parnes (1973) examined the differential effectiveness of direct and indirect praise and reproof on the design copying performance of first graders. Social reinforcement was given after the third work trial. The results demonstrated an immediate performance increase for the information receiving group and a later decline in performance.

Pawlicki (1974) attempted to test the hypothesis that the developmental change in the effectiveness of social reinforcement was related to changes in the locus of control.

Using a card choosing game as a task, the author tested one hundred and forty-five children of grades three, four, six and seven. Results did not indicate a developmental change in the effectiveness of various types of social reinforcers, but rather, showed a consistent superiority in the effectiveness of information connoting social reinforcers at each grade level.

Catano (1975) investigated the outcome of praise administered by experimenter (superior to subordinate) as opposed to praise administered by a member of the subject's peer group (equal to equal). The perceptual motor task used was a mirror tracing, involving difficult and easy tasks. Sixty inexperienced undergraduates were used as subjects and tested individually. The results were consistent with an information-feedback-incentive interpretation (eg. a naive subject with no independent standard with which to compare his work receives verbal praise which is informative even if it only confirms that his over all performance as a subject is satisfying to the experimenter). Only the experimenter's praise lead to improved performance on both tasks. Verbal praise did not affect the rate of improvement. In addition, the experimenter's praise produced significantly less errors than no praise.

Based on the results of the social reinforcement research reviewed the following conclusions can be made with regard to motor performance:

1. Praise has been shown to facilitate performance, while reproof, may either improve or impair performance.
2. Social reinforcement is particularily applicable to physical education due to the preponderence of easily observeable perceptual-motor skills.
3. Social reinforcement consists of both motivational and informational components; however, numerous studies have indicated difficulties in distinguishing between them.
4. It seems essential that future research consider the subjects' cognitions.
5. It appears quite likely that gross motor skills may be facilitated to a greater extent by the motivational component, while fine motor coordination appears to be more dependent on the informational component of social reinforcement.

PHYSIOLOGICAL AROUSAL AND MOTOR PERFORMANCE

Introduction:

The concept of arousal like almost all hypothetical constructs in psychological research is plagued by the problems of definition and measurement. Martens's (1974) recent evaluation of arousal research clearly substantiates this fact.

There are two major research approaches to examining the relationship between arousal and motor performance, drive theory and the inverted-U hypothesis. Both approaches have

failed to receive overwhelming support although each has its proponents. The inverted-U hypothesis, which views arousal as a uni-dimensional continuum ranging from deep sleep to extreme excitement, has derived its strength from the work of Duffy (1962). Recently, Martens (1972 (a), 1974) has strongly supported this position. Drive theory views drive and arousal as being synonamous or at least drive being a source of arousal. Spence and Spence (1966) developed the basic prediction of drive theory and this approach has recently been advocated by Spielberger (1975).

The two approaches differ in that, the inverted-U hypothesis predicts a curvilinear or non-monotonic relationship between arousal and motor performance, while drive theory predicts a linear or monotonic relationship. A major criticism of both approaches is the manner in which they are similar, that is, both approaches are so broad and general that results from an experiment can often be explained post hoc with either approach.

Recently, Dorrance and Landers (1973) attempted to test the validity of the two hypotheses in a social facilitation and motor performance study. Similar to most studies to date, the results were inconclusive. Martens (1974) has suggested that the major problem in arousal research is centered around the difficulty of measuring arousal. Presently, researchers are able only to detect increases or decreases in arousal rather than specific points on the arousal continuum. Furthermore, Lacey (1967) has suggested that arousal as a

single unitary concept is an over-simplification and has proposed that three forms of arousal exist, electrocortical, autonomic and behavioral, each complex in itself.

As a result of the problems relating to the measurement of arousal and the disarray of arousal theory no hypotheses relating to arousal theory were made in the present study. However, the literature of two commonly used autonomic arousal measures was reviewed to determine the value of these measurement techniques as indicators of the effectiveness of the experimental treatments. The two arousal measures examined were palmar sweating and heart rate.

Palmar Sweat Print:

The palmar sweat print technique was developed by Sutarman and Thomson (1952) who found that a permanent record of active sweat glands could be obtained from plastic impressions of the skin. Recently, Johnson and Dabbs (1967) described the technique in detail and concluded that it was a simple, reliable, unobtrusive method.

To date, studies utilizing the palmar sweat print to measure arousal in stressful situations have produced results which show both increases and decreases in palmar sweating. Harrison, MacKinnon and Monk-Jones (1962) demonstrated that the number of active palmar sweat glands of surgery patients significantly decreased prior to surgery. Harrison (1964) also found decreased sweating in twenty-four

of twenty-eight subjects when stress was experimentally induced with a straight leg raise test. In a task involving working on multiplication problems (Johnson and Dabbs, 1967) a decrease in sweating resulted. However, in the same study (Johnson et al 1967) subjects performing a mid-term statistics exam experienced increased sweating. The authors (Johnson et al, 1967) concluded that the high level of sweating on the statistics exam resulted from "situational" arousal, while the decrease in sweating during the multiplication task was the result of concentration. Dabbs, Johnson and Leventhal (1968) examined palmar sweating in three different situations and found that: sweating during an airplane flight increased compared to sweating prior to takeoff, there was no significant difference in pre and post sweating of surgery patients, and in a mental activity task (word spelling), there was a rapid initial increase in sweating followed by a steady decline. Dabbs et al (1968) hypothesized that sweating decreased in stressful situations emphasizing internal feelings, while sweating increased in situations involving external activity or interaction with the environment.

Martens (1969a,b) utilized the presence of an audience as a stressor to examine the value of palmar sweating for audience studies. In both studies (Martens, 1969 a,b) a coincident timing task was utilized which allowed ample time for interaction with the audience, rather than a task (reaction time) which emphasized concentration. The results

of the studies supported Dabbs et al's (1968) hypothesis, as sweating increased in the presence of an audience. Although Martens (1969a,b) concluded that the method was very appropriate for audience research, another audience study (Cohen and Davis, 1973) did not find the measure effective for obtaining measures of arousal for an audience. Recently, however, Johnson and Stockdale (1975) demonstrated that anxiety (as measured by palmar sweating) was significantly decreased by presenting a puppet show on hospital procedures to hospitalized children.

Studies by Johnson et al (1967), Dabbs et al (1968), Martens (1969a) and O'Malley (1972) have paid particular attention to demonstrating the reliability of the palmar sweat print technique. Dabbs et al (1968) concluded that the main advantage of the technique is its simplicity; however, it also requires a minimum of equipment and does not restrict the subject's movement. However, the technique has been criticized. Martens (1974) has suggested that the main drawback of the palmar sweat print is the time taken to score the prints. A more severe criticism has recently been made by Weisenberg, Kreindler, Schachat and Werboff (1976) who argue that the main problem with the palmar sweat print is the interpretation of the results. In a study with dental patients, Weisenberg et al (1976) failed to obtain a significant correlation between the palmar sweat print score and scores on either the State-Trait Anxiety Inventory or the

Dental Anxiety Scale. The lack of correlation adds to the difficulty of interpreting the meaning of palmar sweat prints.

Tonic Heart Rate:

The term "tonic" has been defined as referring to a time base of measurement of about one-half minute or more. The time interval is used as a sample to infer something about a relatively enduring motivational state of the sort associated with experimental manipulations involving incentives, anxiety, relaxation or task difficulty levels (Elliot, 1970: 156).

Elliot (1969) performed five experiments to assess the effects of conflict and uncertainty on tonic heart rate in a variety of situations. The results demonstrated that the collative variables had no effect on tonic heart rate or they had an effect opposite to expectations (decelerative). However, response factors and incentive factors had str accelerating effects. Following a review of the relevan literature Elliot (1969: 226) stated that the incentive for perceptual motor performance was one of the most consistent accelerators of heart rate. Elliot (1969) hypothesized that under the usual experimental conditions the critical features controlling tonic heart rate acceleration are the instigation, acticipation and initiation of responses and the presence of incentives.

Three studies by Evans (1971, 1972, 1974) support

Elliot's (1969) conclusions with regard to incentives. In a study (Evans, 1971) to determine whether the effects of social facilitation could be isolated from the effects of rivalry when individuals were competing in the presence of one another on a form board, increases in tonic heart rate were interpreted as indicating that rivalry was an incentive. There was no indication that social facilitation had incentive properties. No (performance) evidence was found to indicate that the effects of social facilitation could be isolated from the effects of rivalry.

In a second study designed to determine whether an incentive such as competition (rivalry-induced) would cause increments in the performance of subjects with low resting heart rate and decrements in the performance of subjects with high resting heart rate, Evans (1972) failed to find any performance differences. However, the hypothesis that an increase in incentive is accompanied by an increase in heart rate was substantiated. The results also demonstrated that the relationship between incentive and heart rate was not affected by the resting heart rate level. Evans (1972) concluded that the results were further support for Elliot's (1969) hypothesis if one thinks of competition as an incentive. Evans (1972) explained the lack of performance differences by suggesting that the incentive improved the performance of some while hindering the performance of others (off-setting effects).

A third study (Evans, 1974) was designed to investigate the hypothesis that the promise of an opportunity to engage in social comparison would be motivational. The dependent variables were performance on a digit symbol task and tonic heart rate. The results confirmed the hypothesis and subjects being promised the opportunity to engage in social comparison also had a significantly greater improvement in performance. Evans (1974) concluded that the exact nature of the motivation was unknown.

In an effort to demonstrate the merits of heart rate as a psycho-physiological measure Elliot (1970) surveyed a sample of the literature on resting heart rate and concluded that heart rate could be easily compared from laboratory to laboratory and was unaffected by the technical parameters of the recording operation. Additional advantages Elliot (1970) noted for heart rate included: a robust signal, easy to record, its importance within the individual and its relation to theories of motivation. However, Malmstrom (1971) has criticized Elliot's (1970) conclusions and stated that the tonic heart rate measure was unduly restrictive and inappropriate for studying various aspects of cardiac behavior. Similarly, Norman and Melville (1972) responded to Elliot's (1970) comments on heart rate and concluded that a comparison of heart rate data across various laboratories in an attempt to infer motivational states was not necessarily justifiable.

Although Elliot (1972a) appears to have provided an

adequate rebuttal to the criticisms of Malmstrom (1971) and more specifically Norman et al (1972); the work of Lacey (1967, 1974) and the considerable research (Symposium on heart rate variability, 1973) which strongly suggests that simple heart rate is an inadequate measure by itself, certainly raises doubts concerning the use of heart rate as an arousal measure.

The Relationship Between Measures of Physiological Arousal:

Studies performed to determine the relationship between different measures of physiological arousal have been primarily concerned with heart rate and skin conductance (as measured by the galvanic skin response). A common characteristic relating these studies to one another has been the low correlations between indices of arousal. Due to the failure to find a substantial relationship between measures of arousal numerous solutions to the problem have been proposed and tested.

To begin with, Lazarus, Speisman and Mordkoff (1963) suggested that the use of the inappropriate traditional inter-individual (across subjects) procedures for correlating rather than a number of more appropriate intra-individual (across occassions) correlational methods produced a lack of significant correlations. Malmstrom, Opton and Lazarus (1965) used a new heart rate method of measurement (cyclic maxima) to produce closer correspondence between heart rate and skin conductance, while Opton and Lazarus (1967) suggested

on the basis of experiment and a theoretical analysis of the problem, the value of ipasative research analysis designs for controlling the extraneous variance produced by normative designs.

The transformation of data approaches proposed above have been criticized by Taylor and Epstein (1967) and Elliot (1970). Taylor and Epstein (1967) concluded that the solution to the general measurement of arousal problem wasn't transforming single measures, innovations in data reduction or combining of measures. Rather, the solution was in learning more about the unique properties of different physiological systems by determining how they vary as a function of the parameters of stimulus input (eg. intensity, rate of stimulation, time of stimulus onset).

Elliot (1970) also criticized Malmstrom et al (1965) and Lazarus et al (1963) for their various transformations of data. Elliot (1970) has made it very clear that the measurement of heart rate has numerous advantages over skin conductance. Skin conductance measures have encountered difficulty with the quality and kind of electrodes, sufficiency of preparation of skin surfaces, number placement and resistance of reference electrodes and the degree of hydrolization. Furthermore, Elliot (1969) has hypothesized differences in the motivational significance of heart rate and skin conductance. Accordingly, factors controlling

increases in skin conductance are the collative properties of the situation. These factors include novelty, complexity, uncertainty and surprisedness (factors controlling heart rate -see heart rate). A study (Elliot, Bankart and Light, 1970) was performed to test the hypotheses for skin conductance and heart rate. It was concluded that although heart rate and skin conductance offer different information about various aspects of the motivational state of the subjects, one is unable as yet, to specify the exact or entire nature of the difference.

Recent studies (Wilkinson, El-Behari and Giesking, 1972; Borden, Hendrick and Walker, 1976) have failed to clarify the physiological arousal situation. Wilkinson et al (1972) attempted to determine the relationship between various measures of physiological arousal (pulse and respiration rate, pulse volume, skin conductance and muscle tension) as a function of incentive, information load and task novelty. It was concluded that the pattern of variation in the level of physiological functioning may be largely specific not only to the individual, but also to how he is behaving and what he is responding to. Borden et al (1976) examined the affective, physiological and attitudinal consequences of audience presence. Heart rate and skin conductance were unaffected by the observer's presence and tended to be unrelated to the subject's feeling states and attitudinal responses.

The review of the physiological arousal research indicates that the following conclusions may be made:

1. The difficulty in measuring arousal is a major problem in arousal research.
2. Drive theory and the inverted U hypothesis are the two most commonly used approaches to arousal research; however, both approaches have readily apparent weaknesses.
3. The palmar sweat print has the advantages that it is a quick, simple, unobtrusive measure of arousal, that appears to be quite appropriate for audience research.
4. The disadvantages of the palmar sweat print include problems in interpreting the results, as well as, the time required to score the prints.
5. The advantages of heart rate as an arousal measure include: a robust signal, easy to record, its importance within the individual, its relation to theories of motivation and its capabilities for cross-laboratory comparisons.
6. The disadvantages of heart rate as an arousal measure include: criticism of its cross-laboratory comparison capabilities, equipment required, and the presence of considerable research to suggest simple heart rate is not an adequate measure by itself.
7. Heart rate and palmar sweating techniques have been criticized along with numerous other arousal measures for low correlations between measures which are supposedly

tapping the same system.

8. It is apparent that heart rate and palmar sweating have differences in their motivational significance, therefore, which technique is most appropriate for audience research remains unanswered.

CHAPTER III

METHODS AND PROCEDURE

THE SUBJECTS

The one hundred and eighty subjects involved in this study were male grade seven and eight students at Hardisty Junior High School in Edmonton, Alberta. Subjects ranged in age from eleven to fifteen years with the average age being twelve years, eight months. All testing was carried out at Hardisty Junior High School, which was made available by the Edmonton Public School Board.

Junior high school students were particularly appropriate subjects for this study as the physical education program for this age group places particular emphasis on physical activities involving perceptual-motor skills. Only males were utilized in the study to avoid a sex effect. Studies by Strong (1963), Chevrette (1968) and Carment (1970) have shown that males and females react differently to competition.

EXPERIMENTAL DESIGN

The experimental design was a 3 x 2 x 3 x 8 factorial design with repeated measures on the last factor. Factor A

TABLE I

EXPERIMENTAL DESIGN *

		Trials							
		D1 (1-5)	D2 (6-10)	D3 (11-15)	D4 (16-20)	D5 (21-25)	D6 (26-30)	D7 (31-35)	D8 (36-40)
High Ability A_1	B_1 (no competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			
	B_2 (competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			
Medium Ability A_2	B_1 (no competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			
	B_2 (competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			
Low Ability A_3	B_1 (no competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			
	B_2 (competition)					C_1 (no reinforcement) C_2 (praise) C_3 (reproof)			

*Means for Initial Ability Level (A), Competition (B), Social Reinforcement (C), and Stages (D). Each cell entry is the mean of the scores of ten subjects for five trials.

was initial ability level (high, medium and low). Factor B was competition (no competition, competition). Factor C was social reinforcement (no reinforcement, praise, reproof). Factor D was the stage factor with eight successive stages comprised of five trials each. Note that the subjects were nested within the levels of ABC.

The dependent variables were learning, performance, heart rate, (in beats per minute) and palmar sweating, (in number of active sweat glands). Eighteen independent groups of ten subjects each were established. Each group was tested on forty trials under one of the eighteen treatment conditions. The forty test scores were sub-divided into eight five trial performance stages. Table I represents a diagrammatical description of the design.

THE TASK

The motor task used in this study was the ball "roll up" game which was available commercially. The use of this task in motor skill studies is well documented (Martens and Landers, 1972; Burwitz and Newell, 1972; Dorrance and Landers, 1973; Sasfy and Okun, 1974). The task was especially appropriate for this study in that it could be classified as a high evaluation potential task (as compared to a low evlaution potential task such as a reaction time task), and as such, provided an excellent opportunity to test the

effect of evaluation on the learning of a motor skill.

The objective of the task was to move a ball up an incline by manipulating two rods upon which the ball rested. Beneath the path of the ball were six adjacent holes. Skilled performance required the precise manipulation of the rods in the horizontal axis to squeeze the ball along the incline. Opening the rods too quickly caused the ball to travel only a short distance before dropping into one of the holes. Closing the rods too much caused the ball to either regress or not move at all.

The difficulty of the two tasks was standardized by measuring the incline of the metal rods on each game with a carpenter's level. The height could be adjusted at the starting end of the task. The level of difficulty selected was one that had demonstrated that learning occurred for over forty-five trials. This level was determined on the basis of a pilot study (Appendix A).

Performance was scored from zero to eleven points, so that the greater the distance the ball travelled the higher the subject's score. This scoring procedure was adopted as a result of the pilot study which demonstrated that the ball often landed between holes where it either bounced forward, backward, or remained. It was found that with the foam padding applied to the wooden surface of the game the ball had an increased tendency to remain where it landed. (Foam padding was applied to the surface of the board in order to

minimize the noise produced by the ball falling. In this manner information on the coactor's performance from hearing the coactor's ball fall was limited). The holes were scored progressively 1,3,5,7,9,11 with the intervening spaces scored 2,4,6,8,10. If the ball dropped prior to the first hole or regressed to the starting point (wooden block), the trial was scored zero. Scores were clearly indicated on the foam padding.

MEASUREMENT OF AROUSAL

To aid in determining the effectiveness of the experimental manipulations, measures of physiological arousal were obtained. Palmar sweating and tonic heart rate were both examined due to past difficulties in measuring arousal and the lack of a strong indication in the research literature (Martens, 1974) as to which measure was most appropriate.

The palmar sweat print technique used was developed by Sutarman and Thomson (1952) and recently described by Johnson and Dabbs (1967). The procedure is described in Appendix B.

Tonic heart rate refers to heart rate measured over at least thirty seconds (Elliot, 1969). Heart rate was measured with two portable electrocardiograms which were attached to the coactors throughout the experiment. A thirty-second heart rate measure was taken after each block

of five trials.

METHODOLOGY

Two hundred and forty-seven male grade seven and eight students from Hardisty Junior High School performed a five trial pre-test on the ball roll-up motor task. The pre-test was conducted in the test room with a single subject and only the experimenter present. The pre-test scores were ranked and the distribution of scores was divided into the top, middle and bottom one-thirds. Subjects ranked in the top one-third were classified as high in initial ability level, while those in the bottom one-third were classified as low in initial ability level. Subjects in the middle one-third were classified as medium in initial ability level.

Within each ability level subjects were randomly paired with a coactor in their class. Subjects who indicated that they had prior experience with the task and subjects who could not be paired with a coactor were deleted from the study. The one hundred and eighty subjects for the study were obtained by randomly selecting thirty pairs of subjects from each of the three initial ability groups. A further random assignment of these subjects to one of the six treatment groups within each ability level was then performed.

The treatment groups for this study were as given in Table II. The ability groups which performed the perceptual motor task in the non-competitive situation and received no

TABLE II

TREATMENT GROUPS *

Experimental Group	Ability Level	Competitive Situation	Type of Social Reinforcement
1	H	C	NR
2	H	C	P
3	H	C	R
4	H	NC	NR
5	H	NC	P
6	H	NC	R
7	M	C	NR
8	M	C	P
9	M	C	R
10	M	NC	NR
11	M	NC	P
12	M	NC	R
13	L	C	NR
14	L	C	P
15	L	C	R
16	L	NC	NR
17	L	NC	P
18	L	NC	R

*Symbols for each entry in Table II are as follows: High (H), Medium (M), Low (L), Competitive (C), Non-competitive (NC), No reinforcement (NR), Praise (P), and Reproof (R).

social reinforcement (groups 4, 10, and 16 of Table II) were the control groups of the experiment. The remaining fifteen treatment groups consisted of either or both competition and social reinforcement interacting with ability level.

An integral part of this study was the understanding that a competitive situation existed only when an audience was present to evaluate performance. Martens (1975) has defined a competitive situation as one in which the comparison of an individual's performance is made with some standard in the presence of at least one other person who is aware of the criterion for comparison and can evaluate the comparison standard. In this study competition was operationalized by having the coacting subjects perform the task while being observed by a passive audience of four male university graduate students who were introduced as "experts" in the study of motor skill learning for young boys.

PROCEDURE

Upon their arrival, the two coactors were admitted to the test room, seated at the test tables and given a five minute rest period. During the rest period two palmar sweat prints and two tonic heart rate measures were obtained. The first of each measure was taken after two and one-half minutes and the second measure after five minutes. The average of each of the two arousal measures served as the subject's basal level for that particular arousal measure technique.

Following the five minute rest period a brief set of instructions (Appendix D) was read to the subjects. The subjects were told that the basic differences between this test and the previous test (pre-test) was that: (1) they would perform forty trials rather than five trials; (2) they would keep their own score on the score sheets provided; (3) they would perform the task while seated opposite each other at the tables. The experimenter then assured the subjects that paired testing was being done to insure the collection of the necessary data in the shortest possible time.

Tables with partitions (library tables) were used to insure subjects were unable to observe their coactor's performance. The subjects were told that the partition was necessary when testing two subjects together, so that, performance wasn't hindered by one coactor distracting the other from his task. (In fact, tables with partitions were used specifically to limit the feedback available to the subjects. In this manner subjects could not compare their own performance with their coactor's and with less information available, it was hoped that the reinforcement treatments would be effective because of the subject's dependency on them for information).

Following the explanation of the partition the experimenter instructed the subjects not to verbalize or interact in any manner once the experiment started. The experimenter

explained that this could distract their coactor, hindering his performance and thus ruining the experimert. Finally, the subjects were instructed to begin a trial only when told to do so by the experimenter. In this manner, firm control of the test trials was obtained and ample time was allowed for adequate preparation for each trial.

Following each block of five trials a palmar sweat print and a tonic heart rate measure was taken. Therefore, eight arousal measures for each subject was obtained with each arousal technique.

In the audience present condition four observers were introduced to the coactors following the initial instructions. The experimenter briefly explained to the coactors that the gentlemen were research experts whose main area of interest was the study of how young boys learn skills such as the one being learned in this study. The experimenter then stated that the "experts" had requested an opportunity to observe and take a few notes. The experimenter indicated he could see nothing wrong with that and obtained the verbal consent of the coactors (See Appendix E for instructions).

The observers with pencils and notebooks in hand were seated as close to the subjects as possible, but at a distance which allowed all four observers to oversee the performance of both coactors at once. (Therefore, the observers were visible and evaluating).

In the social reinforcement condition the social

Figure 1. No Competition Treatment Setting

Figure 2. Competition Treatment Setting

reinforcement was provided by the experimenter. When the audience was present, the observers remained passive. Social reinforcement, as operationalized in this study, consisted of praise and reproof verbally administered (See Appendix F).

Considerable research (Martens, 1975: 52) has been produced which terms praise as positive reinforcement and reproof as negative reinforcement. Confusion in terminology has risen because operant reinforcement theory defines reproof as punishment and negative reinforcement as simply the removal of a negative stimulus. In order to avoid this confusion the terms positive and negative reinforcement were avoided. Praise and reproof in the verbal form are very apparent in our learning situations and therefore it seemed logical to operationalize social reinforcement in this manner and let the researcher interpret reproof as either negative reinforcement or punishment depending on his theoretical preference.

Praise or reproof were administered after each treatment block of five trials. After the first, third, fifth, and seventh blocks of trials praise was administered in the same order for each pair of coactors as follows: (a) "Good work, boys, you are both doing okay; it's a very tough task, (b) You're both doing very well, (c) You're both certainly doing much better than most boys do, and (d) Excellent, you're both just excellent." Reproof was administered as follows: (a) "Not too good boys, (b) Certainly, you both

could do better, (c) Boys, you're both doing worse than most boys d and finally (d) Very poor boys, very poor." After the second, fourth, and sixth blocks of trials praise or reproof was administered in the form of head nodding or shaking. Reinforcement was given in a calm, matter of fact, manner. No effort was made to arouse or motivate the subjects. All subjects received praise after the stage eight performance, heart rate and sweat print measures were obtained.

Subjects marked their own score for each trial on a small piece of paper provided. After every five trials the score sheet was turned over and a new one started. At no time during the experiment did the experimenter suggest that the two coactors should compete against one another. Following completion of the forty trials all subjects were required to complete a br[illegible] questionnaire which was designed to obtain information on the subjects' efforts and perceptions of the test situation. Following completion of the entire experiment thirty subjects were randomly selected from two classes (fifteen from each of the competitive treatments) and interviewed on tape to obtain further subjective information.

DATA ANALYSIS

Procedure:

Each subject performed a set of five pre-test trials and forty test trials. The forty test trials were subdivided into eight stages (each stage was made up of five consecutive

trials). Therefore, the performance score for any one stage represented the total score of each subject for five trials. A learning score represented the difference between two given performance scores.

Pre-test Data:

The pre-test scores were examined to determine whether the technique of assigning subjects to groups was effective. Successful assignment produced initial ability level groups homogeneous within a particular ability level, but significantly different from the groups of the other two ability levels. A one-way analysis of variance was performed on the pre-test treatment group means to insure proper subject assignment. Determining which treatment group means differed significantly from one another was done by applying Duncan's Multiple Range Test (Edwards, 1972: [illegible]). If unexpected significant differences occurred, the method of subject assignment would have to have been reconsidered.

Arousal Data:

The arousal scores (sweat print and heart rate) were converted to difference scores (score during performance minus the pre-test basal score), in order to minimize individual differences. Eight scores (for each method) were taken from each subject, one for each performance stage (five trials). The mean and standard deviations for each of the

eight trials was calculated for each of the treatment groups. Two ability level x competition x social reinforcement x blocks of trials (3 x 2 x 3 x 8) analyses of variance with repeated measures on the last factor were performed on the arousal deviation scores. The Greenhouse and Geisser (Edwards, 1972: 271) conservative F test was applied to the blocks of trials factor to make this comparison more stringent in the event that within subject correlations between blocks of trials was not constant. Duncan's New Multiple Range Test was applied to determine which means were significantly different. Finally, the palmar and tonic heart rate deviation scores were correlated for each stage to determine the degree of relationship between the two measures.

Learning Data:

The means and standard deviations were calculated for the following scores: early learning (stage 4 minus stage 1), late learning (stage 8 minus stage 4), and total learning (stage 8 minus stage 1). An ability level x competition x social reinforcement (3 x 2 x 3) analysis of variance was performed on each of the early, late, and total learning scores.

Performance Data:

The means and standard deviations for each of the eight test performance scores was calculated. A trend analysis (3 x 2 x 3 x 8 analysis of variance with repeated measures on the last factor) was performed to analyze the overall main effects due to the four factors as well as their interaction effects (the Greenhouse and Geisser conservative F test was applied to the blocks of trials). The trend analysis provided a summary of the analysis of variance of the overall effects (Stages 1 to 8) due to factors A (ability level), B (competition), C (social reinforcement) and D (blocks of trials).

Post-test Data:

To gain information on the subject's perceptions of the test situation the nine question post-test questionnaire was examined. Non-parametric statistics were used to determine whether treatment groups differed in their responses to questions three to seven. A descriptive analysis of the thirty subject post-test taped interviews was also performed to gain further insight to the subjects' perceptions.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

Pre-Test Data:

Two hundred and forty-seven subjects were pretested. Forty-five subjects were dropped from the experiment because they had previous experience with the task, while one subject was omitted due to a motor disability. The ranked distribution of the remaining two hundred and one scores was divided into the top (range 10-27, N = 70), middle (range 7-9, N = 68) and bottom (range 0-6, N = 63) one-third scores. The one hundred and eighty subjects for the experiment were obtained and assigned to the treatment groups in the manner previously described in Chapter III. Table III presents the mean, median, mode and range of scores for each of the three initial ability levels used in this study.

The analysis of variance of the eighteen pre-test treatment groups (Table IV) yielded significant differences between the groups. This result indicated that differences existed between at least two of the eighteen treatment groups.

TABLE III

DESCRIPTIVE DATA FOR INITIAL ABILITY LEVELS

Group	Mean	Median	Mode	Range
Low Ability	3.21	3	3	0-5
Medium Ability	7.38	7	7	6-9
High Ability	12.90	11	10	10-22

TABLE IV

ANALYSIS OF VARIANCE OF ABILITY GROUP PRE-TEST SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between	2852.40	17	167.79	38.25***
Within	710.60	162	4.39	
Total	3563.00	179		

***$p < .001$

TABLE V

DUNCAN'S NEW MULTIPLE RANGE TEST OF PRE-TEST MEAN SCORES

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Shortest Significant Range
	3.0	3.1	3.1	3.2	3.4	3.5	7.1	7.2	7.2	7.4	7.7	7.7	12.2	12.7	12.7	12.7	13.3	13.8	
A 3.0		.1	.1	.2	.4	[illegible]	[illegible]	[illegible]	[illegible]	4.4*	4.7*	4.7*	9.2*	9.7*	9.7*	9.7*	10.3*	10.8*	1.86
B 3.1			0	.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.3*	4.6*	4.6*	9.1*	9.6*	9.6*	9.6*	10.2*	10.7*	1.96
C 3.1				.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.3*	4.6*	4.6*	9.1*	9.6*	9.6*	9.6*	10.2*	10.7*	2.03
D 3.2					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.2*	4.5*	4.5*	9.0*	9.5*	9.5*	9.5*	10.1*	10.6*	2.07
E 3.4						[illegible]	[illegible]	[illegible]	[illegible]	4.0*	4.3*	4.3*	8.8*	9.3*	9.3*	9.3*	9.9*	10.4*	2.11
F 3.5							[illegible]	[illegible]	[illegible]	3.9*	4.2*	4.2*	8.7*	9.2*	9.2*	9.2*	9.8*	10.3*	2.14
G 7.1									.1	.3	.6	.6	5.1*	5.6*	5.6*	5.6*	6.2*	6.7*	2.17
H 7.2										.2	.5	.5	5.0*	5.5*	5.5*	5.5*	6.1*	6.6*	2.19
I 7.2										.2	.5	.5	5.0*	5.5*	5.5*	5.5*	6.1*	6.6*	2.21
J 7.4											.3	.3	4.8*	5.3*	5.3*	5.3*	5.9*	6.4*	2.23
K 7.7												0	4.5*	5.0*	5.0*	5.0*	5.6*	6.1*	2.24
L 7.7													4.5*	5.0*	5.0*	5.0*	5.6*	6.1*	2.26
M 12.2														.5	.5	.5	1.1	1.6	2.27
N 12.7															0	0	.6	1.1	2.28
O 12.7																	.6	1.1	2.29
P 12.7																	.6	1.1	2.30
Q 13.3																		.5	2.31

$\alpha = .05$ $S\bar{x} = .67$

Duncan's New Multiple Range Test was applied to the eighteen initial ability level group means (Table V). The results indicated that each of the six groups within an ability level was homogeneous with the other treatment groups in that ability level, but significantly different from the twelve treatment groups making up the other two ability levels. This result demonstrated that the assignment of subjects had been effective.

Performance Data:

The means and standard deviations were calculated for each treatment group at each stage of performance (Figures 3,4,5 and Appendix G). An analysis of variance of the overall performance scores (Table VI) yielded significant differences for the ability level, social reinforcement and trial main effects. These results and the profiles of the various treatment groups (Figures 3,4 and 5) indicated that: (a) the level of initial ability significantly affected performance, (b) the treatment condition (i.e. level of social reinforcement) significantly affected the performance, (c) the subjects' performance improved over trials.

Duncan's New Multiple Range Test was applied to the three initial ability level group means (Table VII) and also to the three social reinforcement group means (Table VIII). The results indicated that the high ability level subjects performed significantly better than the medium and the low

TABLE VI

ANALYSIS OF VARIANCE OF PERFORMANCE SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	2053.29	2	1026.64	7.68***
B: Competition	260.12	1	260.12	1.95
C: Reinforcement	1073.87	2	536.94	4.02*
A x B	310.90	2	155.45	1.16
A x C	47.27	4	11.82	0.09
B x C	194.38	2	97.19	0.73
A x B x C	642.66	4	160.66	1.20
S(ABC)	21650.69	162	133.65	
D: Trials	3049.23	7(1)	435.60	21.81***
A x D	239.84	14(2)	17.13	0.86
B x D	229.02	7(1)	32.72	1.64
C x D	247.34	14(2)	17.67	0.89
A x B x D	145.82	14(2)	10.42	0.52
A x C x D	431.06	28(4)	15.40	0.77
B x C x D	188.17	14(2)	13.44	0.67
A x B x C x D	576.25	28(4)	20.58	1.03
S(ABC) x D	22647.31	1134	19.97	

*$p < .05$

***$p < .001$

#Numbers in brackets indicate the degrees of freedom for the Greenhouse and Geisser Conservative F-test.

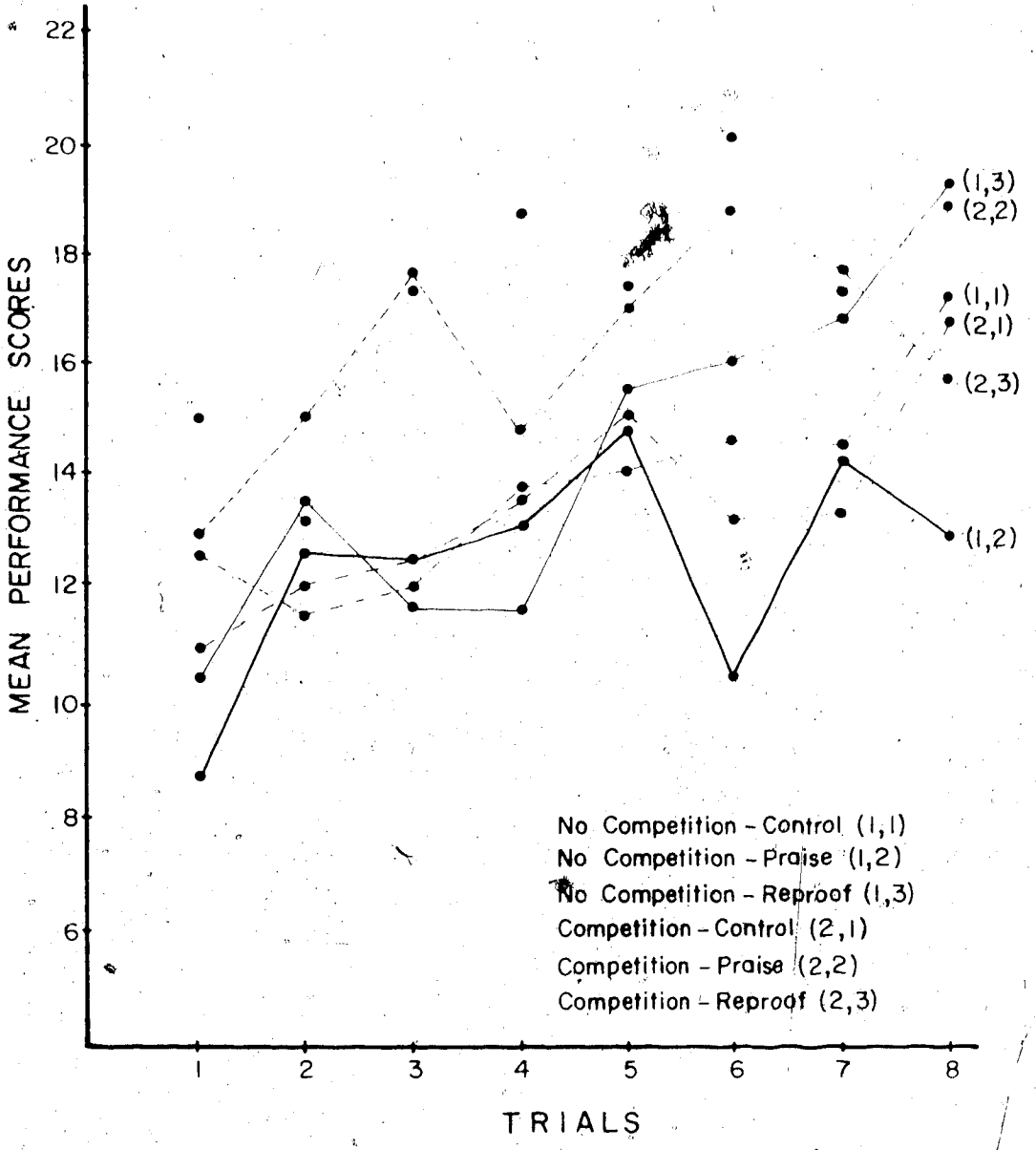

Figure 3. High Ability Treatment Groups' Performance

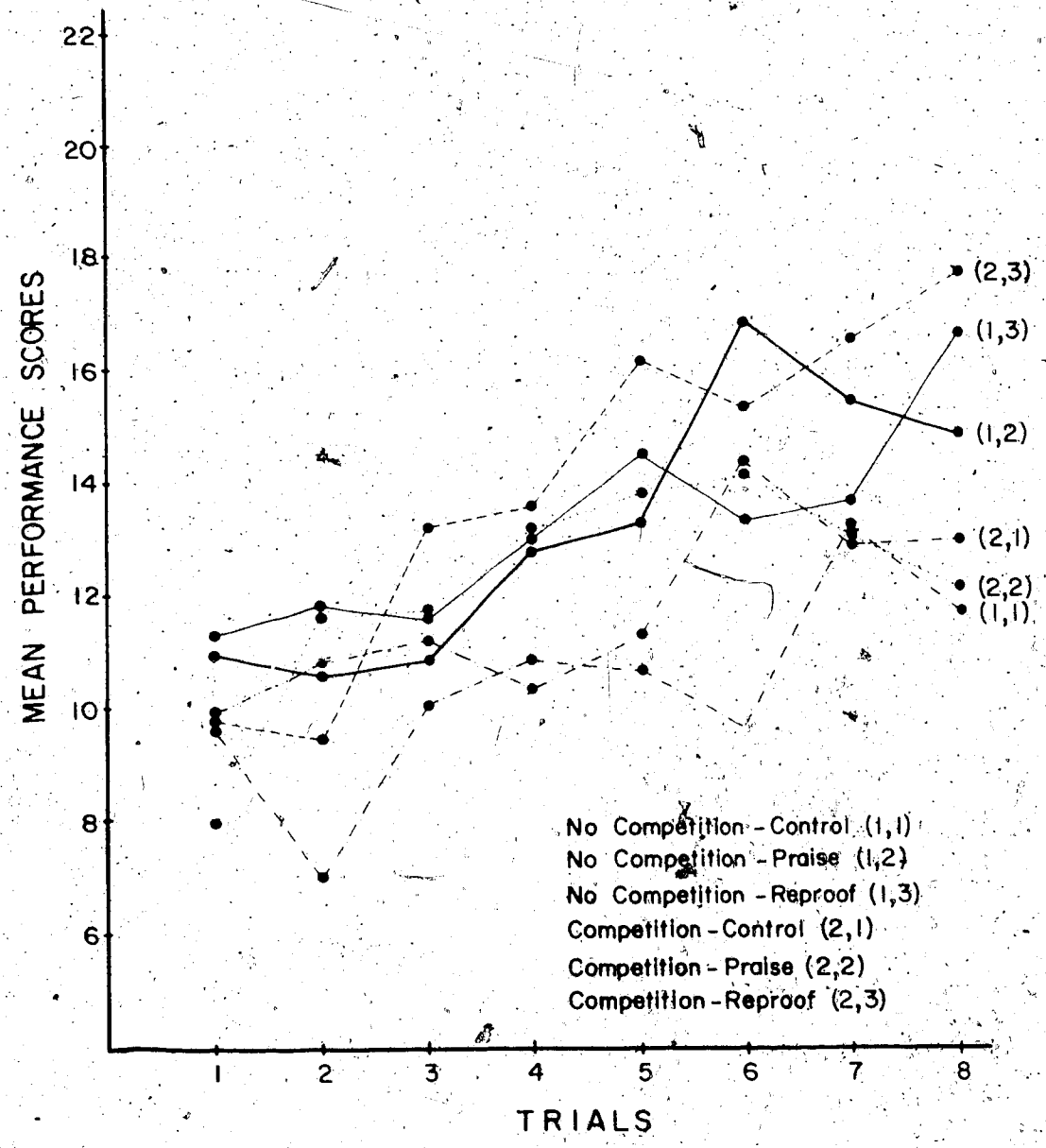

Figure 4. Medium Ability Treatment Groups' Performance

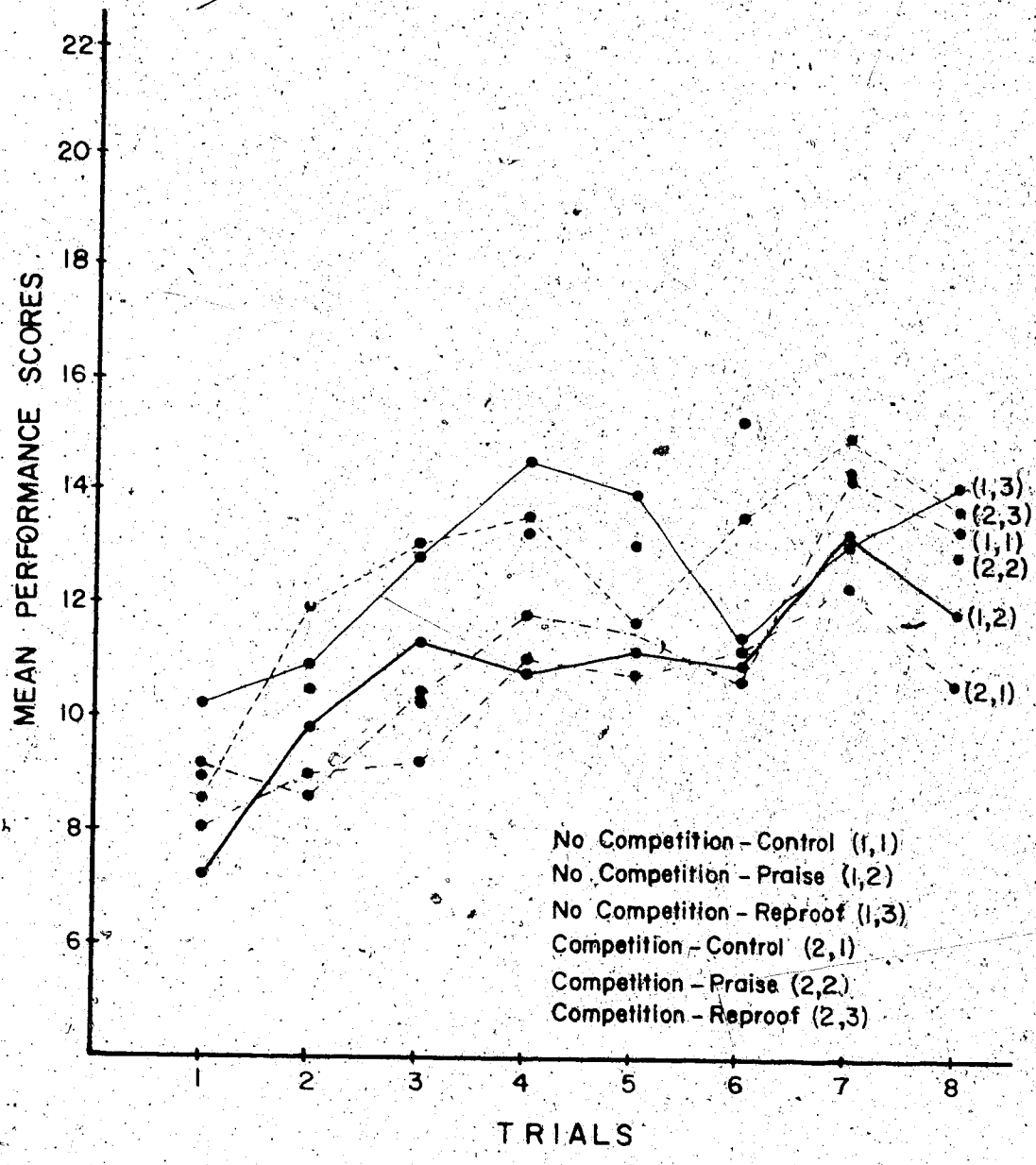

Figure 5. Low Ability 'Treatment Groups' Performance

ability level subjects; while the performance of the medium and low ability level subjects did not differ significantly from one another. The social reinforcement group means indicated that the reproof group had performed significantly better than the control group, while the performance of the praise group approached but did not reach significance.

The subjects, on the whole, improved their performance over the trials. This indicated that learning had occurred. A trend analysis (Table IX) was performed on the trials factor. The results indicated a highly significant linear trend and also a significant quadratic trend. Duncan's New Multiple Range Test was applied to the trial means (Table X). The results (Table X, Figure 6) indicated that the learning curve was initially linear but leveled off between stages seven and eight.

The absence of a competition main effect indicated that competition did not have a significant effect on the overall performance of the subjects. Similarly, the lack of significant interactions indicated that no combination of two or more factors had a unique effect on performance that could not be determined by examining each factor by itself.

TABLE VII

DUNCAN'S NEW MULTIPLE RANGE TEST OF
INITIAL ABILITY LEVEL MEAN SCORES
FOR OVERALL PERFORMANCE

Means	A 11.44	B 12.22	C 14.26	Shortest Significant Range
A 11.44		.77	2.83*	1.47
B 12.22			2.04*	1.55

$\alpha = .05$ $S\bar{x} = .53$

TABLE VIII

DUNCAN'S NEW MULTIPLE RANGE TEST OF
SOCIAL REINFORCEMENT MEAN SCORES
FOR OVERALL PERFORMANCE

Means	A 11.53	B 12.76	C 13.63	Shortest Significant Range
A 11.53		1.24	2.11*	1.47
B 12.76			.86	1.55

$\alpha = .05$ $S\bar{x} = .53$

TABLE IX

TREND ANALYSIS OF PERFORMANCE SCORE TRIALS

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	3049.06	7	435.58	
Linear Term	2833.08	1	2833.08	141.86***
Deviation from Linear	215.98	6	35.99	1.80
Quadratic Term	159.14	1	159.14	7.97**
Deviation from Quadratic	56.83	5	11.37	0.57
Cubic Term	2.73	1	2.73	0.14
Deviation from Cubic	54.11	4	13.53	0.68

**$p < .01$

***$p < .001$

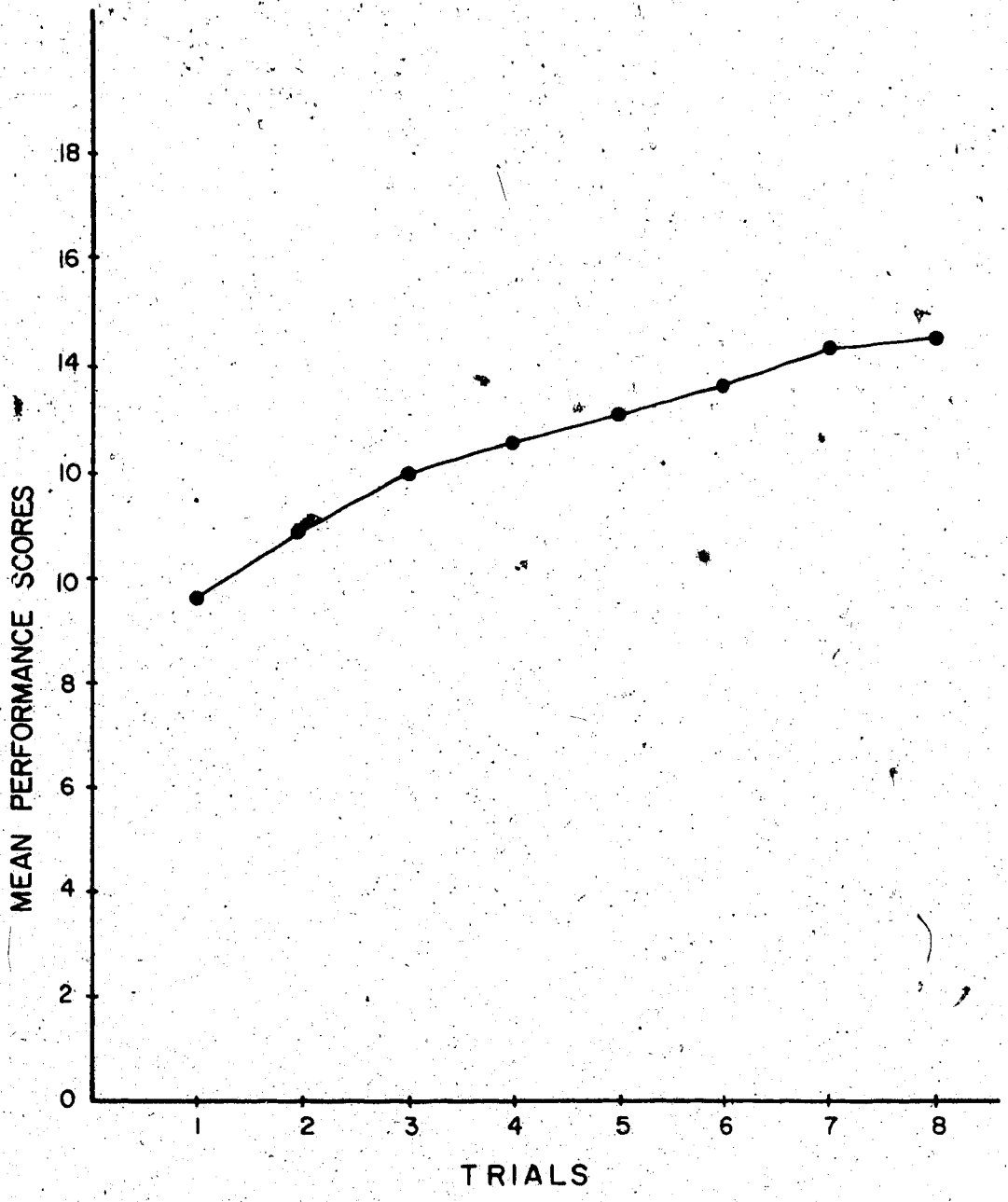

Figure 6. Trend of Performance Scores

TABLE X

DUNCAN'S NEW MULTIPLE RANGE TEST OF THE TREND
MEAN SCORES FOR OVERALL PERFORMANCE

Means	A 9.93	B 11.02	C 12.01	D 12.77	E 13.29	F 13.54	G 14.26	H 14.28	Shortest Significant Ranges
A 9.93		1.09*	2.08*	2.84*	3.36*	3.61*	4.33*	4.35*	0.95
B 11.02			.09	1.75*	2.27*	2.52*	3.24*	3.26*	1.00
C 12.01				.76	1.28*	1.53*	2.25*	2.27*	1.03
D 12.77					.52	.77	1.49*	1.51*	1.05
E 13.29						.25	.97	.99	1.08
F 13.54							.72	.74	
G 14.26									1.10

$\alpha = .05$ $S\bar{x} = .34$

Early Performance:

An analysis of variance of early performance scores (stages one to four) was performed. The results (Table XI) yielded significant differences for the ability level and trial main effects. The social reinforcement main effect approached ($p < .06$) but did not reach significance. These results indicated that: (a) the level of initial ability significantly affected performance and (b) the subjects' performance improved over trials.

Duncan's New Multiple Range Test was applied to the initial ability level group means (Table XII). The results indicated that the high ability group had performed significantly better than the medium and low ability groups. The medium and low ability group means did not differ significantly from each other.

The highly significant trial factor indicated a very strong learning effect for the early trials. From Table X and Figure 6 it is evident that the early stages have produced a linear learning curve.

TABLE XI

ANALYSIS OF VARIANCE OF EARLY PERFORMANCE SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	1037.62	2	518.81	8.07***
B: Competition	134.34	1	134.34	2.09
C: Reinforcement	373.13	2	186.56	2.90
A x B	235.74	2	117.87	1.83
A x C	89.10	4	22.28	0.35
B x C	81.21	2	40.61	0.63
A x B x C	218.28	4	54.57	0.85
S(ABC)	10414.19	162	64.29	
D: Trials	820.04	3(1)	273.35	15.01***
A x D	74.18	6(2)	12.36	0.68
B x D	30.66	3(1)	10.22	0.56
C x D	100.04	6(2)	16.67	0.92
A x B x D	100.59	6(2)	16.76	0.92
A x C x D	116.09	12(4)	9.68	0.53
B x C x D	107.89	6(2)	17.98	0.99
A x B x C x D	148.44	12(4)	12.37	0.68
S(ABC) x D	8849.31	486	18.21	

***$p < .001$

#Numbers in brackets indicate the degrees of freedom for the Greenhouse and Geisser Conservative F-test.

TABLE XII

DUNCAN'S NEW MULTIPLE RANGE TEST OF INITIAL ABILITY LEVEL MEAN SCORES FOR EARLY PERFORMANCE

Means	A 10.44	B 10.74	C 13.12	Shortest Significant Range
A 10.44		.30	2.68*	1.44
B 10.74			2.38*	1.52

$\alpha = .05$ $S\bar{x} = .52$

Later Performance:

An analysis of variance of the later performance scores (Stages five to eight) was performed. The results (Table XIII) yielded significant differences for the ability level and social reinforcement main effects and the competition x trials interaction. The trial main effect was not significant. These results indicated that: (a) the level of initial ability significantly affected performance; (b) the treatment condition (level of social reinforcement) significantly affected performance, (c) competition affected performance differently at different stages (i.e. it affected the rate of learning) and (d) the subjects' performance was not improving over trials.

TABLE XIII

ANALYSIS OF VARIANCE OF LATER PERFORMANCE SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	1077.54	2	538.77	5.48**
B: Competition	125.82	1	125.82	1.28
C: Reinforcement	731.80	2	365.90	3.72*
A x B	91.88	2	45.94	0.47
A x C	80.90	4	20.23	0.21
B x C	114.61	2	57.31	0.58
A x B x C	583.87	4	145.97	1.48
S(ABC)	15941.88	162	98.41	
D: Trials	136.29	3(1)	45.43	2.43
A x D	103.79	6(2)	17.30	0.93
B x D	198.36	3(1)	66.12	3.53*
C x D	116.25	6(2)	19.38	1.04
A x B x D	28.52	6(2)	4.75	0.25
A x C x D	192.27	12(4)	16.02	0.86
B x C x D	78.83	6(2)	13.14	0.70
A x B x C x D	268.28	12(4)	22.36	1.20
S(ABC) x D	9092.69	486	18.71	

*$p < .05$

**$p < .01$

#Numbers in brackets indicate the degrees of freedom for the Greenhouse and Geisser Conservative F-test.

Duncan's Multiple Range Test was applied to both the ability level group means (Table XIV) and the social reinforcement groups means (Table XV). The results indicated that the high ability level group performed significantly better than the low ability group, but was no longer performing significantly better than the medium ability group. There was no significant difference between the medium and low ability groups. The social reinforcement group means indicated that the reproof group had performed significantly better than the control group, while the praise group was not significantly different from either the reproof or control groups.

The competition x trials interaction is depicted in Figure 7. As is evident from the graph, the significant interaction occurs from the performance of the two competition groups at the last stage. The competition group's performance declines at stages seven and eight, while the no-competition group's performance improves, finally surpassing the competition group at the last stage. The different effect competition has on the rate of learning for the two groups in the latter stages produced the significant interaction effect.

Finally, the trial main effect did not reach significance. This indicates that the subjects have not improved their performance in the latter stages (learning has not occurred). The significant quadratic trend (Table IX, Figure 6) is very clearly demonstrated.

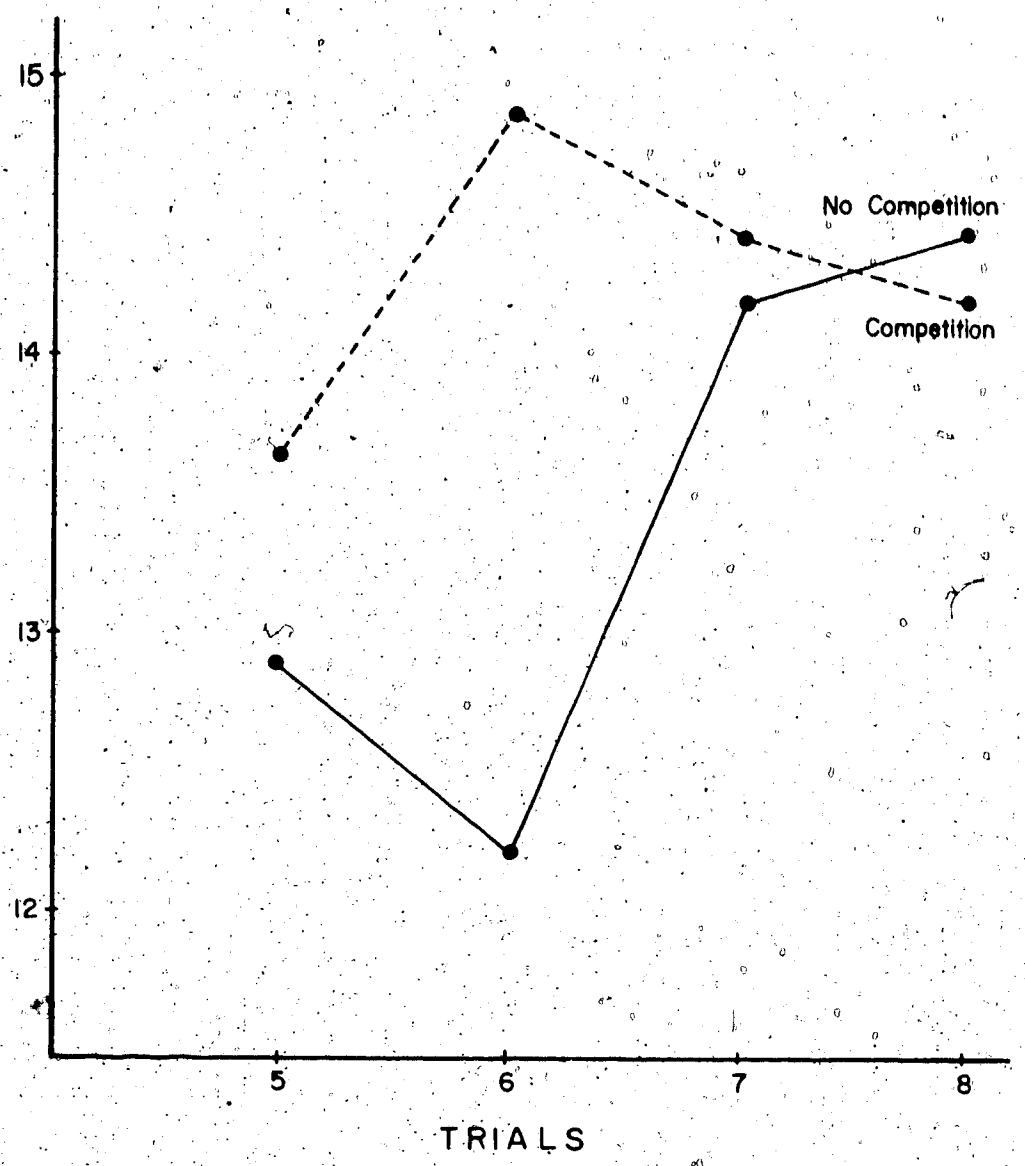

Figure 7. Competetion X Trials (Later Performance) Interaction

TABLE XIV

DUNCAN'S NEW MULTIPLE RANGE TEST OF INITIAL ABILITY LEVEL MEAN SCORES FOR LATER PERFORMANCE

Means	A 12.42	B 13.71	C 15.40	Shortest Significant Range
A 12.42		1.29	2.98*	1.77
B 13.71			1.69	1.87

$\alpha = .05$ $S\bar{x} = .64$

TABLE XV

DUNCAN'S NEW MULTIPLE RANGE TEST OF SOCIAL REINFORCEMENT MEAN SCORES FOR LATER PERFORMANCE

Means	A 12.56	B 13.95	C 15.02	Shortest Significant Range
A 12.56		1.39	2.46*	1.77
B 13.95			1.07	1.87

$\alpha = .05$ $S\bar{x} = .64$

Learning Data:

The means and standard deviations were calculated for: early learning (stage four minus stage one), later learning (stage eight minus stage four) and total learning (stage eight minus stage one). (See appendix H.) Analyses of variance for early learning (Table XVI), later learning (Table XVII), and total learning (Table XVIII) did not yield any significant differences. These results indicated that the treatment groups did not differ from one another in the amount learned during early or later learning. Similarly, the treatment groups did not differ from one another in the amount learned over the eight stages of trials. In addition, interactions of the factors were also not significant and this indicated that any combination of two or more factors did not affect learning in a manner different from any one of the factors considered alone.

Tonic Heart Rate Data:

The means and standard deviations were calculated for heart rate deviation scores (Appendix I). An analysis of variance (Table XIX) yielded significant differences on the competition and trial main effects and the three factor (ability level x competition x social reinforcement) interaction. These results indicated that: (a) the treatment condition (level of competition) significantly affected heart rate, (b) deviations in heart rate changed significantly

TABLE XVI

ANALYSIS OF VARIANCE OF EARLY LEARNING

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	121.81	2	60.91	1.68
B: Competition	66.01	1	66.01	1.82
C: Reinforcement	85.08	2	42.54	1.17
A x B	31.35	2	15.67	0.43
A x C	39.69	4	9.92	0.27
B x C	0.68	2	0.34	0.01
A x B x C	49.22	4	12.31	0.34
S(ABC)	5876.50	162	36.28	

TABLE XVII

ANALYSIS OF VARIANCE OF LATER LEARNING

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	147.63	2	73.82	1.63
B: Competition	147.61	1	147.61	3.27
C: Reinforcement	189.23	2	94.62	2.09
A x B	14.35	2	7.17	0.16
A x C	90.43	4	22.61	0.50
B x C	96.55	2	48.27	1.07
A x B x C	212.26	4	53.06	1.17
S(ABC)	7324.90	162	45.22	

TABLE XVIII

ANALYSIS OF VARIANCE OF TOTAL LEARNING

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	4.90	2	2.45	0.06
B: Competition	5.34	1	5.34	0.14
C: Reinforcement	132.10	2	66.05	1.68
A x B	47.81	2	23.91	0.61
A x C	148.30	4	37.08	0.94
B x C	12.68	2	6.34	0.16
A x B x C	149.52	4	37.38	0.95
S(ABC)	6388.30	162	39.43	

TABLE XIX

ANALYSIS OF VARIANCE OF HEART RATE DEVIATION SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
A: Ability Level	467.15	2	233.58	1.58
B: Competition	711.21	1	711.21	4.80*
C: Reinforcement	92.94	2	46.47	0.31
A x B	239.35	2	119.68	0.81
A x C	483.95	4	120.99	0.82
B x C	642.50	2	321.25	2.17
A x B x C	1690.57	4	422.64	2.85*
S(ABC)	24012.66	162	148.23	
D: Trials	459.02	7(1)	65.57	6.02*
A x D	193.99	14(2)	13.86	1.27
B x D	5.92	7(1)	0.85	0.08
C x D	130.77	14(2)	9.34	0.86
A x B x D	109.62	14(2)	7.83	0.72
A x C x D	317.51	28(4)	11.34	1.04
B x C x D	126.43	14(2)	9.03	0.83
A x B x C x D	209.40	28(4)	7.48	0.69
S(ABC) x D	12360.36	1134	10.9	

*$p < .05$

#Numbers in brackets indicate the degrees of freedom for the Greenhouse and Geisser Conservative F-test.

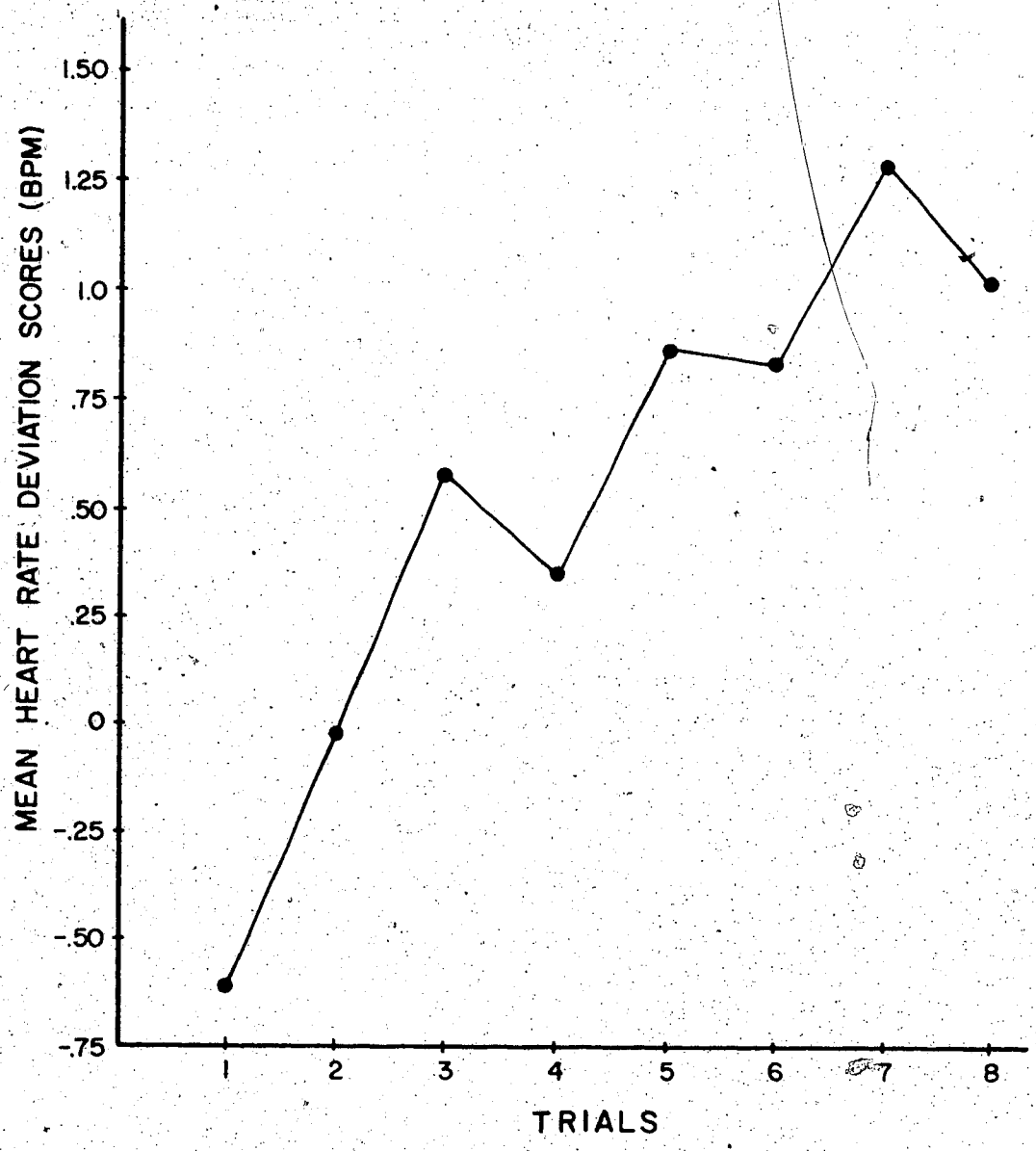

Figure 8. Trend of Heart Rate Deviation Scores

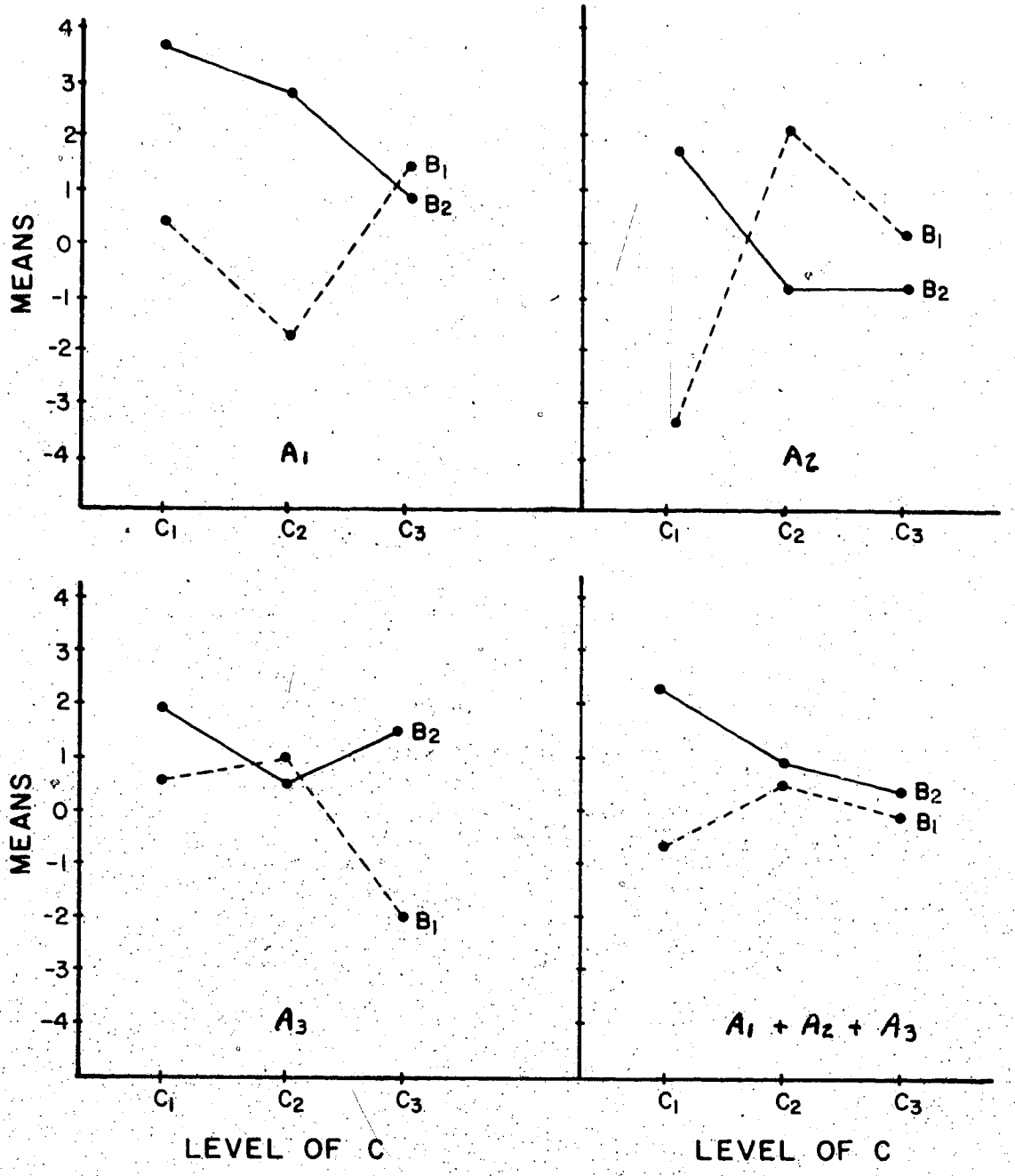

Figure 9. Competition (B) X Social Reinforcement (C) Interactions over the different Ability Levels (A) on Heart Rate Deviation Means

over trials, and (c) competition did not affect social reinforcement in the same manner at each of the different ability levels.

The competition main effect means indicated that the competition group had a significantly higher heart rate increase than the no-competition group. The trial main effect means (Figure 8) indicated that the subjects, on the whole, experienced heart rate increases over trials. The significant three factor (ability level x competition x social reinforcement) interaction (Figure 9) indicated that the competition x social reinforcement interactions were not of the same form for the different levels of initial ability. The two factor (competition x social reinforcement) interaction is also shown in figure 9. It is represented by the competition x social reinforcement interactions summed over the levels of initial ability. It is evident (Table XIX, Figure 9), that the competition x social reinforcement interaction is not significant.

Palmar Sweat Print Data:

The means and standard deviations of the palmar sweat print deviation scores were calculated. (Appendix J). An analysis of variance Table XX yielded significant differences on the trial main effect. This result indicated that deviations in sweating had changed significantly over

TABLE XX

ANALYSIS OF VARIANCE OF SWEAT PRINT DEVIATION SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
A: Ability Level	20673.36	2	10336.68	1.91
B: Competition	12444.93	1	12444.93	2.30
C: Reinforcement	5851.96	2	2925.98	0.54
A x B	7567.29	2	3783.65	0.70
A x C	18989.90	4	4747.47	0.88
B x C	3371.35	2	1685.68	0.31
A x B x C	12869.52	4	3217.38	0.59
S(ABC)	519922.69	96	5415.86	
D: Trials	11633.06	7(1)	1661.87	2.19*
A x D	9039.87	14(2)	645.71	0.85
B x D	5628.61	7(1)	804.09	1.06
C x D	6401.30	14(2)	457.24	0.60
A x B x D	9819.00	14(2)	701.36	0.93
A x C x D	24688.68	28(4)	881.74	1.16
B x C x D	7509.58	14(2)	536.40	0.77
A x B x C x D	22072.72	28(4)	788.31	1.04
S(ABC) x D	509569.25	672	758.29	

*$p < .05$

Note: Unweighted means analysis with missing data: See Appendix for additional analysis.

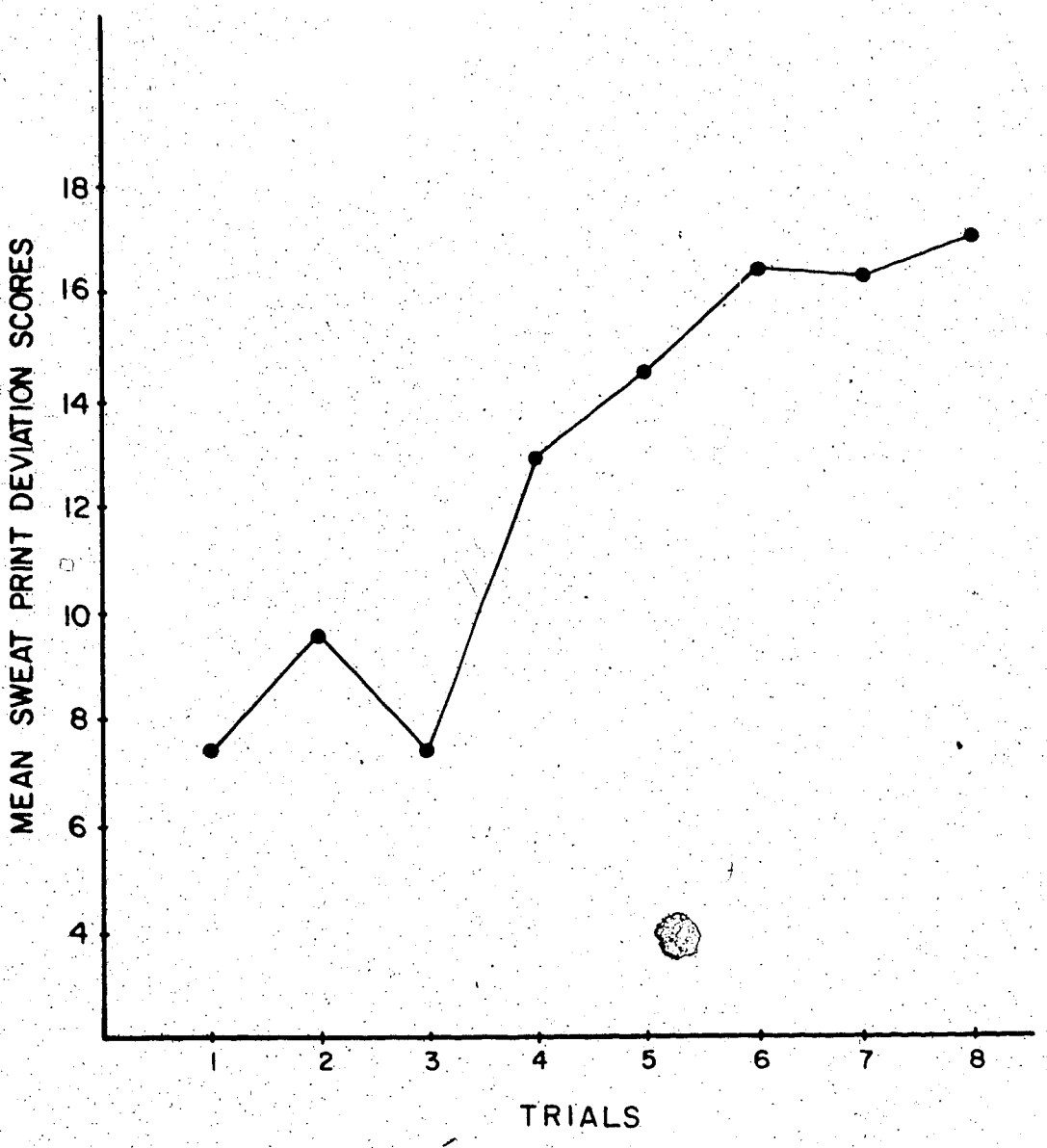

Figure 10. Trend of Sweat Print Deviation Scores

trials. The trial main effect means (Figure 10) indicated that subjects, on the whole, had significant decreases in sweating. The lack of additional main effect or interaction significance indicated that the trial effect was experienced equally by all treatment groups.

The reliability of the palmar sweat print was calculated for one and two scorers. A test-retest measure of two randomly selected subjects (i.e. sixteen prints) produced a one scorer reliability coefficient of .99 (Appendix K). The reliability between two scorers was calculated by randomly selecting five subjects and having both scorers analyze the prints (thirty-seven prints). A reliability coefficient of .97 was found (Appendix K).

Pearson correlation coefficients were calculated to determine the correlations between heart rate and sweat print scores at each stage of performance for the one hundred and eighty subjects (Table XXI). The results indicated that the two measures were related only at stage eight where a low but significant correlation (0.13) was found. The correlations for stages one to seven were low and not significant.

TABLE XXI

PEARSON CORRELATION COEFFICIENTS OF AROUSAL SCORES

Stage	Number of Cases	Coefficient	Significance
1	170	0.04	0.30
2	171	0.08	0.13
3	165	0.10	0.09
4	167	0.05	0.27
5	171	0.06	0.24
6	166	0.08	0.16
7	163	0.09	0.13
8	164	0.13	0.04*

Post-Experiment Questionnaire Data:

The post-experiment questionnaire data was tallied with specific reference to the competition and social reinforcement treatments (Appendix L). Chi square analyses on the responses of the competition treatment groups for questions three, four, five, six and seven yielded significant differences on questions four and five. Chi square analyses on the social reinforcement treatment groups' responses for questions four and five yielded significant differences on question five.

These results indicated that: (a) the competition treatment group perceived themselves to be bothered by

observers to a greater extent than the no-competition treatment group, (b) the competition treatment group perceived their performance to be influenced by observers to a greater extent than the no-competition treatment group, and (c) the effect indicated in (b) was most pronounced in the praise-competition treatment group and least pronounced in the praise-no-competition treatment group.

The non-significant chi squares for questions three, six and seven for the competition treatment group responses, indicated that (a) the competition treatment groups did not differ on their perceived reaction to coaction, (b) the competition groups did not differ on their perceived competitive behavior, (c) the competition groups did not differ in their perceptions of the competitive behavior expected of them in the experimental situation, and (d) there was no differences between the different social reinforcement treatments in terms of the perceived negative (bothersome) effects observers had on them while performing.

Additional information gathered by the post-experiment questionnaire indicated that only one subject didn't enjoy the experiment. Twelve subjects in the reproof treatment indicated that they didn't try their best on every trial, as compared to seven in the control treatment, and only one in the praise treatment. The significance of the results of the post-experiment questionnaire is entirely speculative and the results are considered in further detail in the discussion of results.

TABLE XXII

CHI SQUARE OF POST-EXPERIMENT QUESTION THREE FOR COMPETITION TREATMENT GROUPS

Treatment	Response Yes	No	Totals
Competition	11	78	89
No Competition	5	85	90
Totals	16	163	179

$X^2 = 2.55$, d.f. = 1

$p > .05$

TABLE XXIII

CHI SQUARE OF POST-EXPERIMENT QUESTION FOUR FOR COMPETITION TREATMENT GROUPS

Treatment	Response Yes	No	Totals
Competition	32	57	89
No Competition	15	75	90
Totals	47	132	179

$X^2 = 8.60^*$, d.f. = 1

$^*p < .05$

TABLE XXIV

CHI SQUARE OF POST-EXPERIMENT QUESTION FIVE FOR COMPETITION TREATMENT GROUPS

Treatment	Response Yes	No	Totals
Competition	41	38	79
No Competition	32	58	90
Totals	73	96	169

$X^2 = 4.58^*$, d.f. = 1

$^*p < .05$

TABLE XXV

CHI SQUARE OF POST-EXPERIMENT QUESTION SIX FOR COMPETITION TREATMENT GROUPS

Treatment	Responses Yes	No	Totals
Competition	52	36	88
No Competition	46	44	90
Totals	98	80	178

$X^2 = 1.15$ d.f. = 1

$p > .05$

TABLE XXVI

CHI SQUARE OF POST-EXPERIMENT QUESTION SEVEN FOR COMPETITION TREATMENT GROUPS

Treatment	Response Yes	No	Totals
Competition	24	65	89
No Competition	20	60	80
Totals	44	125	169

$X^2 = 0.09$, d.f. = 1

$p > .05$

TABLE XXVII

CHI SQUARE OF POST-EXPERIMENT QUESTION FIVE FOR PRAISE TREATMENT GROUPS

Treatment	Response Yes	No	Totals
Praise-Competition	11	19	30
Praise-No-Competition	4	26	30
Totals	15	45	60

$X^2 = 4.36^*$, d.f. = 1

$p < .05$

TABLE XXVIII

CHI SQUARE OF POST-EXPERIMENT QUESTION FOUR FOR SOCIAL REINFORCEMENT TREATMENT GROUPS

Treatment	Responses Yes	No	Totals
Control	13	47	60
Praise	13	47	60
Reproof	21	38	59
Totals	47	132	179

$X^2 = 3.98$ d.f. = 2

$p > .05$

Post-Experiment Interview:

The post experiment interview data (Appendix M) indicated that: (a) subjects enjoyed the experiment, (b) subjects would have liked to have tried forty additional trials, (c) subjects rated the motor task as difficult, (d) very little of the experimental procedure was known to the subject prior to entering the experiment room and the greatest portion of information known was learned from the pre-test, (e) subjects were evenly divided in terms of the satisfaction they expressed for their performance, (f) the partition effectively limited feedback and (g) subjects generally indicated a desire for feedback, interpreted feedback as applying to both themselves and their coactor and suggested that information may or may not have influenced performance.

DISCUSSION

Social Evaluative Competition and Performance:

The analysis of variance of performance scores indicated that competition did not have a significant effect on performance. This result has been reported in numerous competition studies to date: Triplett (1898), Evans (1966, 1968), Wankel (1969) and Martens and Landers (1969). In the context of the present study the results indicate social facilitation failed to affect performance. These results provided no support for three hypotheses, they were: competition retards performance in the early stages of the learning of a perceptual-motor skill; competition facilitates performance in the late stages of the learning of a perceptual-motor skill; and competition hinders overall performance on a perceptual-motor skill.

Competition studies usually explain a non-significant effect according to the Yerkes-Dodson Law (1908), by simply stating that some subjects improved their performance, while the performance of others suffered a decrement. The results of these effects are offsetting and no overall performance change results. Although this explanation would also apply to the present study, other possibilities manifest themselves, particularily because numerous social facilitation studies (Martens et al 1972, Burwitz et al 1972, Dorrance et al 1973 and Sasfy et al, 1974) have reported significant effects on performance with the same motor task and with similar

experimental manipulations of the social facilitation treatments.

Although the Evans (1968) and Wankel (1971) studies did not produce a social facilitation effect, there was some question concerning the evaluation potential of the audience treatment. In the present study every effort was made to produce an extremely evaluative experimental situation.

To begin with an expert audience was introduced by evaluation-inducing instructions and took up an evaluative position (visible to both coactors) with notebooks and pencils. In this position the audience was not only visible to both coactors, but was capable of observing the performance of the coactors simultaneously (Henchy and Glass, 1968; Gore and Taylor, 1973; Haas and Roberts, 1973). Furthermore the audience was made up of four university graduate students (ranging in age from twenty-five to thirty-five years) as Wankel (1975) has raised the question as to whether boys of this age perceive their peers as sources of evaluative apprehension. A pilot study (Hrycaiko, 1975) with an expert audience of two graduate students had produced results which approached, but did not reach significance. On the basis of this result, and the work of Wankel (1975) and Dorrance and Landers (1973) the audience size was increased to four expert observers.

The effect of competition was also augmented by having the "opponent" present and providing feedback which indicated

similar performance by both coactors. Bruning and Mettee (1966) have indicated that these factors influence performance in a competitive situation. Additional competition studies have demonstrated that a coactor influences performance in a competitive situation (Carment, 1970; Carment and Hodkin, 1973). Social facilitation studies (Martens and Landers, 1972; Burwitz and Newell, 1972 and Sasfy and Okun, 1974) have also found that coaction affects performance.

The lack of a significant competition effect due to coaction could be explained in terms of the differences in the coaction treatment for the present study compared to the coaction studies mentioned. To begin with, Bruning et al (1966) did not have a partition separating the "opponents"; and they received only partial support for their hypothesis. The Carment (1970) and Carment et al (1973) studies used relatively simple tasks rather than the complex task of the present study. Finally, the social facilitation studies (Martens et al, 1972; Burwitz et al, 1972 and Sasfy et al, 1974) all indicated that performance in dyads was not significantly different from performance alone.

It is difficult, however, to comprehend why the combination of an evaluative audience plus coaction did not significantly affect performance, although a number of possible explanations do exist. With regard to coaction, it is possible that the presence of the coactor acted as a safety signal and reduced the stress of the evaluative potential

of the situation (Davidson and Kelly, 1973). The research of Wankel (1975) and Sasfy et al (1974) indicates that it is much more likely that the explanation for the lack of effects lies in the 'audience and subjects' interaction. While, Wankel (1975) has indicated a need for research to clarify the situational factors producing audience effects on the performance of young boys; Sasfy et al (1974) have suggested that the nature of the task, the quality and quantity of information available to the audience, in addition to the audience and subjects' characteristics interaction must be considered.

The present study indicates that more emphasis must be given to the nature of the task although the numerous factors considered thus far may all have some effect. The basis for this conclusion is the significant competiton x trials interaction in later performance. This result suggests that, particularly for young boys performing a complex motor task, a certain level of skill must be acquired before additional factors (audience, competition, social reinforcement) can influence performance. The assumption being made in reaching this conclusion is that the college undergraduates used in most social facilitation studies (Martens et al, 1972; Burwitz et al, 1972; Dorrance and Landers, 1973; and Sasfy et al, 1974) are capable of reaching the level of skill, where social factors influence performance, much more readily than the young boys in the studies of Wankel (1975) and

Hrycaiko (1975). Further support for this conclusion is provided in the discussion of the social reinforcement effect.

Initial Ability and Performance:

The high initial ability group performed significantly better than the medium or low initial ability groups over the forty trials. This result provided support for the hypothesis which stated: high initial ability level subjects perform better than low initial ability subjects in the learning of a perceptual-motor skill. No hypotheses were made concerning the medium and low ability groups; however, these groups were not significantly different from one another. This result suggests that the effectiveness of the pre-test for distinguishing between subjects of different ability levels must be critically assessed.

The analysis of early performance indicated that although the high ability group differed significantly from both the medium and low ability groups, the latter two groups were virtually equal. However, in the analysis of variance of later performance, the medium ability level group improved considerably and although not significantly different from the low ability group, it was also no longer significantly different from the high ability group. Only the high and low ability groups were significantly different from one another. An examination of the raw means demonstrated that the high ability group mean was greatest at each stage, followed by

the medium ability level mean in all cases except stage four where the low ability mean was greater. The low ability group means also closely approached the medium ability level means on stages two and seven.

Although the five trial pre-test provided strong evidence for the examination of three distinct ability levels, it is apparent from the results of the present study that only two significantly different ability levels exist. The root of the problem may be reflected in the variability of the scores produced by the motor task used. For this reason, five initial trials may have been insufficient to properly assess the subject's ability. It seems quite likely that ten initial trials would have indicated the existence of only two statistically distinct ability levels.

Initial Ability and Competition:

The interaction of ability level and competition on performance was not significant in early, later or overall performance. This finding indicated that competition had the same effect on the high, medium, and low initial ability levels. The result is similar to that found by Noble et al (1958) and Ryan (1961); and contrary to the findings of Wankel (1969).

Noble et al (1958) examined individual and social groups utilizing two perceptual-motor tasks, eye-hand coordination (pursuit task) and intermittant selective responding

(discrimination task). Performance on the pursuit task did not change, while discrimination speed was facilitated, presumably due to social competition. The effect was independent of the initial ability level.

Ryan (1961) had subjects perform a hand grip strength test in one of four incentive conditions. No interaction between ability level and the incentive conditions resulted.

Initial ability level and competition interacted in a study (Wankel, 1969) examining the performance of young boys on a stabilometer. A recent study (Wankel, 1975) using the same motor task did not find a significant interaction between initial ability level and audience presence. The problem with reaching any conclusions from the latter study was that the audience main effect was not significant, (although the ability level x trials interaction was significant) thereby possibly limiting any potential ability level x audience interactions.

It seems quite likely that an ability level x incentive interaction may be quite dependent on the nature of the task. The findings of the present study find no support for the stated hypotheses which were as follows: Competition ceases to be detrimental in the early stages of the learning of a perceptual-motor skill, when the initial ability level of the individual is high; and competition ceases to be detrimental to performance in the late stages of the learning of a perceptual-motor skill, when the initial ability level of the

individual is [illegible]

Social Reinforcement and Motor Performance:

The significant social reinforcement effect indicated that the reproof group had performed significantly better over the forty trials than the control group. The performance of the praise group was not significantly different from either the control or the reproof group. This result provided support for the hypothesis that social reinforcement facilitates performance in the learning of a perceptual-motor skill. The second social reinforcement hypothesis, that praise enhances performance to a greater extent than does reproof in the learning of a perceptual motor skill, was not supported.

A considerable number of studies (Kennedy et al, 1964; Marshall, 1965; Harney and Parker, 1972; Catano, 1975) have indicated that social reinforcement enhances performance. Research examining the value of reproof has produced results indicating both improvements (Marshall, 1965; Harney et al, 1972) and decrements in performance (Kennedy et al, 1964).

With regard to the question of how social reinforcement affects complex motor performance, the results of this study may be interpreted in terms of an information-feedback-incentive mechanism (Catano, 1975). This may be explained as follows: The subject is in a situation with no standard against which to evaluate the quality of his performance,

therefore, verbal reproof is informative and suggests his performance is not up to the standards of other subjects (with the exception of his coactor). The failure of praise to significantly affect performance is contrary to the literature (Harney et al 1972; Catano 1975). It is very likely that the subjects rejected the information as discrepant feedback, because the task was very difficult and performance even for the high ability subjects was not very good in relation to the performance possible on the task.

Ability Level, Competition and Social Reinforcement:

The early and later performance data analyses provide support for Martens's (1970) assumption that social reinforcement affects performance more readily in later trials because of the subjects' inability to significantly influence his performance until after considerable learning has occurred. This interpretation could be criticized because of a lack of a social reinforcement x ability level interaction; the assumption being that high ability subjects should reach the level of learning at which social reinforcement may be effective (subject is able to influence his performance) before the low ability subjects. The results of the present study indicate that the rate of learning is very similar (not significantly different) for the different ability levels and the ability levels are also affected similarly by social reinforcement. This finding suggests that the amount of initial

learning required for subjects to be able to influence their performance is quite similar between ability groups, although their actual level of performance may be quite different (i.e. the performance level at which high initial ability subjects can influence their performance is significantly greater than the performance level at which low initial ability subjects can influence their performance).

It could be argued alternatively that noncontingent social reinforcement did not provide informative cues to the subjects on how they could improve their performance, and as a result, only motivated subjects. The motivational aspect of social reinforcement would then have produced the significant performance changes by creating interest in the task during later performance, when the intrinsic interest of the task had waned. The motivation interpretation is not favored by the author for a number of reasons: to begin with, the manner in which social reinforcement was given, a calm, direct, monotone voice with no attempt to arouse or motivate the subjects (i.e. a simple statement of fact); secondly, the experimental manipulation using a partition to limit feedback proved very effective as was demonstrated by the post-experiment interviews; finally, arousal data did not support a motivation interpretation for the social reinforcement treatments.

The lack of a competition x social reinforcement interaction, or an ability level x competition x social

reinforcement does not necessarily indicate that these interactions are not likely to occur. The fact that the competition main effect was not significant suggests that these effects have not been adequately tested. Future studies must be directed towards examining the interaction of significant main effects.

Learning and Motor Performance:

Early learning, later learning and overall learning did not produce significant effects on the three main factors or their interactions. This result indicated that the treatment groups all improved an equal amount. The nonsignificant ability level and competition main effects were contrary to the findings of Wankel (1969), although numerous competition studies (Triplett, 1898; Strong, 1963 and Evans 1966, 1968) have reported nonsignificant competition effects on learning. In addition, a study by Noble et al (1958) did not find an ability level effect on learning with two perceptual-motor tasks. The nonsignificant interaction effect between competition and ability level supported the findings of Wankel (1969).

The nonsignificant social reinforcement main effect on learning scores supported the results of Catano (1975) who found that subjects receiving praise made fewer errors; however their rate of learning was not affected. Additional support for this finding has been reported by Harney and

Parker (1972). Conflicting results were found by Wankel (1975) who indicated that social reinforcement improved the rate of learning for the positive reinforcement group, compared to the control group over trials. The lack of significant social reinforcement x ability level and social reinforcement x competition (audience) effects were similar to the findings of Wankel (1975).

Tonic Heart Rate and Motor Performance:

The tonic heart rate data indicated a significant competition effect. Examination of the mean deviation scores revealed a significantly higher heart rate for the competition treatment group than the no-competition treatment groups. This finding provided support for the hypothesis which stated: competition increases the individual's physiological arousal during the learning of a perceptual-motor skill. The result is similar to the findings of Evans (1971, 1972, 1973) and Wankel (1971) for the effects of rivalry; Evans (1973, 1974) for the effects of social comparison; and Hrycaiko (1975) for the effects of an audience. The result is contrary to the findings of Evans (1968) and Wankel (1971) for the effects of heart rate on social facilitation. The lack of an accompanying competition effect on performance scores (along with the heart rate effect) parallels the findings of Evans (1968) and Hrycaiko (1975).

Elliot (1969: 226) has suggested that one of the

most consistent accelerators of heart rate is incentive for perceptual motor performance. Based on this conclusion Evans (1971, 1972, 1973, 1974) has concluded that rivalry and social comparison are incentives. Similarly, it can be concluded in the present study that social evaluative competition increased tonic heart rate and therefore, can be considered an incentive. In the present study social reinforcement did not indicate it was an incentive. However, a three factor (ability level x competition x social reinforcement) interaction effect indicated that competition did not interact with social reinforcement in the same manner for all three ability levels (Figure 9).

The Palmar Sweat Print and Motor Performance:

The palmar sweat print failed to produce any significant findings, although missing data may have influenced the results to some degree. The lack of significant findings with an audience present was contrary to the findings of Martens (1969 a,b) but supported the findings of Cohen and Davis (1973).

The palmar sweat print did prove to be a quick, easy, method of measuring arousal; however, the lack of significant findings is confusing. The main problem with the technique was the time involved in scoring the prints. If a large number of prints are taken the time element is compounded by missing data as some prints cannot be scored. The reliability measures for this technique for both test-retest and

inter-rater reliability were extremely high. Scoring the prints as deviations from a baseline tends to reduce possible errors.

Tonic Heart Rate, the Palmar Sweat Print and Motor Performance:

The present study correlated the sweat print scores with tonic heart rate scores for the one hundred and eighty subjects at each stage. With the exception of stage eight all correlations were nonsignificant. The stage eight correlation was significant but very low. These results support the findings of Elliot et al (1970) who have suggested that heart rate and skin conductance differ in their motivational significance. A number of studies (Lazarus et al 1963, Malmstrom et al, 1965, Wilkinson et al 1972, Weisenberg et al 1976) have examined the correlations between these two measures and various other arousal techniques and supported the conclusion of Elliot et al (1970).

Elliot (1970) has indicated that any study with a resting heart rate of eighty-six or better with a reasonable number of subjects must have some unrelaxing properties. In the present study the average resting heart rate was eighty-two and one-half (N = 180). This result suggests that this study is able to provide a relatively accurate assessment of the relative merit of the two autonomic techniques for measuring arousal in motor performance. It was concluded that tonic heart rate is a more appropriate technique for measuring

the motivating effects of incentives in motor performance. This finding supports the conclusions of Elliot (1969).

Post-Experiment Questionnaire and Interview:

The results of the post-experiment questionnaire indicated the subjects enjoyed the experiment and that almost all subjects tried their best on every trial. Subjects did not mind coacting on the task lending some credence to the idea that being in the room with a coactor tended to lessen the stress encountered in the test room (Davidson and Kelley, 1973). Alternatively, subjects may simply have been demonstrating the desire for social comparison. The latter conclusion seems more likely as the two competition groups differed significantly in heart rate and additional subjective responses (indicating that the presence of an audience produced a more stressful situation) but did not differ in their reaction to the presence of a coactor. If a coactor lessened stress it would be expected that the competition group would have expressed a greater desire for coaction.

A significantly higher number of competition subjects were bothered by the audience and felt they could perform better alone. This subjective support for the tonic heart rate increases provides further evidence that the audience manipulation was effective and that young boys perceive an audience of "experts" as a source of evaluation. Lack of performance changes quite likely reflects the nature of the

task.

Although the majority of the subjects in both the competition and no-competition groups indicated that they had competed against their coactor, there was not a significant difference between the responses of the two competition groups. The exact reason for this result is not clear, although the subjective responses indicate that an evaluative audience is not the sole criteria for producing a competitive situation in terms of rivalry (person oriented competitive behavior). It must also be noted that the strength of the competitive manipulation may have been reduced by the use of a partition between coactors. Bruning and Mettee (1966) used a partition but termed the situation "individual" competition rather than "social" competition (coactors with no partition). Furthermore, Jellison and Icles (1974) have demonstrated the importance of being able to see your opponent in competitive situations.

The results of question seven (a non-significant chi square) indicated that the experimental situation had effectively disguised the fact that the study was designed to examine competitive behavior. Subjects overwhelmingly indicated that they did not feel they were expected to try to do better than their coactor.

The interview data confirmed the findings of the questionnaire. In addition almost all subjects indicated that they had found the task difficult and had little

information prior to entering the experiment room. The effectiveness of the partition for limiting feedback was accurately desribed by one subject (when asked if he had any idea of how his coactor was performing). The response was: "No, maybe the bionic man could, but not me." Subjects, in general, expressed a strong desire for feedback on their performance, regardless of whether or not they felt it could influence their performance. The concern for information on task performance combined with the perceived influence of an audience could be interpreted as support for Martens's (1975) definition of competitive behavior (task-oriented competitive behavior). However, there is no evidence in the present study to indicate that the competitive and non-competitive groups differed in their concern for their performance on the task.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

The purpose of this study was to examine a social evaluative definition of competition and determine whether competition, initial ability level and social reinforcement interact to influence the performance of a novel perceptual-motor skill. On the basis of a review of the literature a strong social evaluative and potentially competitive experimental situation was developed.

Two hundred and forty-seven junior high school boys were given a five trial pre-test on the ball roll up game. Based on the pre-test subjects were assigned to one of three ability levels, high, medium and low. Ninety pairs of subjects (thirty pairs from each ability level) were randomly selected to perform an additional forty trials on the ball roll up game in one of eighteen treatment conditions (within each ability level five pairs of coactors were randomly assigned to one of the six competition-social reinforcement combinations).

To supplement performance data, tonic heart rate and palmar sweat prints were obtained as measures of physiological arousal. Prior to the beginning of the experiment two

resting measures for each technique were obtained and the average of the two served as a baseline. The arousal data was analyzed in terms of deviations from the baseline. Additional information pertaining to the subjects' perception of the experimental situation was obtained with a post-experiment questionnaire and taped interviews.

The experimental design was a 3 x 2 x 3 x 8 factorial design with repeated measures on the last factor (ability level x competition x social reinforcement x blocks of trials). Subjects were nested within the first three factors. Data included means and standard deviations for each of the treatment groups at each stage for performance, heart rate and sweating. Correlations between heart rate and sweating were computed for stages one to eight. In addition to overall performance, early and late performance were analyzed, as well as, early, later and total learning (3 x 2 x 3 analysis of variance). Finally, the post-experiment data was analyzed both descriptively and with non-parametric (chi square) statistics.

It was found that social reinforcement (reproof) significantly facilitated performance, while competition had no effect. The high ability group performed better than the low ability group throughout the experiment. Groups learned at the same rate over the forty trials regardless of the treatment condition. In later performance competition had a significant affect on learning, the competition

group performance decreased while the non-competition group continued to improve. Tonic heart rate demonstrated that competition was an incentive, while no significant differences were found with the palmar sweat print. The two measures were found to have low nonsignificant correlations with each other. Questionnaire and interview data tended to support the behavioral results.

CONCLUSIONS

1. Ability level, competition and social reinforcement do not interact to affect learning and performance in a competitive situation.
2. Initial ability level is not a significant factor for determining the effects social factors have upon complex perceptual-motor performance.
3. High initial ability level subjects perform better than low initial ability level subjects in a competitive situation.
4. Social reinforcement facilitates performance, with reproof being significantly more facilitative than a control condition.
5. Social factors (social reinforcement and competition) have greater effect in later performance, after some initial learning occurs.
6. In complex perceptual-motor performance, the informational

value of social reinforcement appears to be of greater significance than the motivational component.

7. Tonic heart rate indicates that competition is an incentive.
8. Tonic heart rate and palmar sweating arousal measures are unrelated in a competitive situation.

Practical Implications of the Study:

1. Competition does not influence the performance of young boys on a novel complex perceptual-motor task. This finding indicates that teachers and coaches need not be concerned with the evaluation potential of the initial learning situation.
2. Tonic heart rate indicates that competition is an incentive. This finding indicates that competition has a psychological effect on young boys but it is not manifested in a change in performance.
3. Young boys must attain an initial amount of learning before social factors (e.g. audience, competition, social reinforcement) can affect performance with a difficult perceptual-motor skill. The problem facing coaches and teachers is determining when that level of learning has been reached and then dealing effectively with any detrimental effects on performance.
4. The subjective responses of young boys indicate that a coaction situation tends to produce rivalry between the

coactors, but this effect is independent of the evaluation potential of the situation. It is important for teachers and coaches to realize that the effects of social evaluation combined with rivalry could produce a very strong competition effect, which could manifest itself in performance change, particularly after an initial amount of skill on the task has been attained.

5. The informational component of social reinforcement is an effective facilitator of complex perceptual-motor performance. This finding suggests that providing the student with emotion free information can effectively improve performance. This conclusion indicates the value of a low key approach to improving performance rather than the "pep talk" motivational approach often advocated in the past.
6. Reproof is a particularly effective facilitator of complex perceptual-motor performance. It appears to be very effective if it is perceived as helpful information rather than as a personal attack on the performer.

Recommendations for Future Research:

1. Further examination of perceptual-motor performance with young boys requires careful consideration of task difficulty.
2. Studies involving young boys, complex perceptual-motor performance and social factors require a preliminary

practice period prior to the introduction of the experimental treatment.

3. Future social reinforcement research should emphasize further efforts to determine the relative merits of the informational and motivational components of social reinforcement.
4. Future studies of competition should attempt to determine whether the subject perceives the situation as competitive in terms of social evaluation (task oriented competition).
5. Additional research is needed to determine conclusively the role of initial ability in perceptual-motor performance.

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APPENDIX A

PILOT STUDY ANALYSIS OF VARIANCE OF PERFORMANCE SCORES

PILOT STUDY ANALYSIS OF VARIANCE
OF PERFORMANCE SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
A: Groups	524.04	3	176.35	1.97
S(A): Error (a)	3224.04	36	89.61	
T: Trials	1189.11	8(1)	148.64	11.68***
A x T	85.33	24(3)	3.56	0.28
S(A) x T: Error (b)	3665.47	288(36)	12.73	
Total	8694.99	359		

***p .005

#Degrees of freedom in brackets indicates the conservative degrees of freedom for Greenhouse and Geisser Conservative F-test.

APPENDIX B

PALMAR SWEAT PRINT PROCEDURE

PALMAR SWEAT PRINT PROCEDURE

The palmar sweat print technique was developed by Sutarman and Thomson (1952) and recently described by Johnson and Dabbs (1967). The palmar sweat index (PSI) was defined as the number of glands secreting sweat in a 4mm square area around the central whorl of a fingertip. The fingerprint was enlarged x10 with a microprojector and the image was projected downwards. A white scoring template (with a grid to aid counting) of proper size to represent a 4mm x 4mm area of skin surface was positioned under the central whorl of the image. Active sweat glands showed up as open pores along the ridges of the fingerprint while inactive glands showed up as darkened points.

Fingerprints were taken by initially wiping the fingertip with a tissue to remove residual perspiration, then applying a thin layer of the solution from the container with a dab or the glass stopper. The solution dried in 10-30 seconds and was then covered with a piece of Scotch "Magic" transparent tape. The tape was removed bringing the print with it, and immediately placed on a glass microscope slide. The tape was removed side to side rather than proximal to distal.

Active sweat glands were visible on a fingerprint made with the following solution:

Polyvinyl formal (Formvar 15/95E)	5 gm
Butyl phthalate	10 ml
Semi-colloidal dispersion of graphite in trichloethylene (dag 155)	20 gm
Ethylene dichloride	100 ml

APPENDIX C

PRE-TEST INSTRUCTIONS

PRE-TEST INSTRUCTIONS

Hi! I am from the university and I have come to this school to test boys your age on eye-hand coordination. This game (points to ball roll up game on table) involves eye-hand coordination and I am going to let you have five tries to see how well you can do it. The idea of the game is to see how far you can get this ball (picking up ball) to roll up the incline (rolling the ball along the incline) before allowing it to drop through (drops ball through incline to padded surface - no scores are indicated on the padded surface). Once the ball begins to roll, you cannot let it roll back to the wood or the try ends. This is how to do it (the experimenter performs one trial). Remember, the idea is to get the ball to roll as far as possible before allowing it to drop through the rods. Would you like to try it five times? (Subjects responds.....then performs five trials).

Good! Now, before you go back to your class could you answer a couple of questions. First, of all the boys I test at Hardisty School, a number of boys will be chosen to try forty additional trials, just as you've done five here today. If you were selected would you like to try forty more trials to see how much better you could get at the game? (subject responds). Secondly, could you tell me if you've ever tried this game before, even if it was only once? (Subject responds). Okay, very good, one last thing, it is very important that you don't discuss anything about the game or how you did on it with any of the other boys in your class. Do you think you could do that for me? (Subject responds). Thank you very much! You can go back to your class now. Maybe I'll be seeing you again before long, bye for now.

APPENDIX D

GENERAL INSTRUCTIONS

GENERAL INSTRUCTIONS

Hello boys, come on in. You have both been selected from among the boys here at Hardisty to try the forty additional trials I mentioned to you when you did the original five trials. However, this time I will test you both at the same time (points to two tables, chairs and games).' This will allow me to acquire the necessary information much more quickly. I would also like to take your heart rate (points to the two portable electrocardiograms on a second table), -so you will have to take off your shirts to allow me to hook you up to the machines.

As the electrodes are being attached the experimenter calms the subjects by telling them they won't feel anything and have nothing to fear. After attaching the electrodes each subject is seated at a game.

Fellas, I am taking your heart rate simply because it has been shown that when people are learning different skills, like the one you are about to do, drastic changes in their heart rate can influence their performance. For this reason I must be aware of what your heart rate is throughout the forty trials. I will also be taking finger prints as you do the game. This is because perspiration on your fingertips may influence your performance. The type of finger print I am taking allows me to tell how much perspiration there is on your fingers by looking at the print under a microscope. Taking the print will not hurt you at all and simply involves wiping your finger, putting a little of this solution on your finger, letting it dry, which takes about ten or fifteen seconds, and removing the print with Scotch tape (experimenter demonstrates on his own finger). I will take a heart rate and sweat print measure after every five trials. Now, I would like you both just to sit and relax for five minutes. In a couple of minutes I will take the first heart rate and sweat print measures (after two minutes the first of the measures were obtained). Now, I'd like you both to sit and relax for another two minutes before we start (two minutes passes). We will take another heart rate and sweat print before getting underway (the second of the two pre-test measures was obtained).

All right boys, in addition to the heart rate and sweat print measures there are two other changes on this test. The first you are aware of, forty trials instead of five. Secondly, I would like you each to keep your own score. Please write your name at the top of one of these score sheets (a four square inch piece of paper with trials one to five and a blank for each score indicated on it), and score as follows: Score the number the ball lands on when it first

drops through the rods. Remember, you want the ball to roll as far along the incline as you can before allowing it to drop through. Once the ball rolls away from the wood the trial begins. The trial ends when you get the ball to the top of the incline or it drops through the rods or it rolls back to touch the wood at the starting point. It is very important that you see where the ball first lands, not where it bounces to. You must be honest in giving yourself the correct score. Remember, you score where it first lands, not where it bounces to!

After each trial I want you to pick up your ball, put it back at the starting point, mark your score and wait quietly for me to tell you when to begin the next trial. Do not begin the next trial until I tell you to.

One final word of caution, it is very important that once the experiment begins, you do not say anything. If you groan or cheer at your own performance you will distract your coactor from his game, hindering his performance and ruining the experiment. The partition is set up so that you do not bother or distract each other. Testing two of you together allows us to get the required information twice as fast, so please give me your cooperation.

For both the competition and no-competition groups the experiment is identical to this point. At this point the experiment begins for the no-competition group and the competition group receives the competition instructions (experiment begins). Following the experiment, subjects are unhooked from the electrocardiograms and asked to complete the post-experiment questionnaire. Before returning to class, subjects are all requested not to discuss the experiment or their performance either with their coactor or other students. They are informed, that in this manner, all boys tested will have an equal chance.

APPENDIX E

COMPETITION INSTRUCTIONS

COMPETITION TREATMENT INSTRUCTIONS

Okay fellas, before we begin the experiment, there are four gentlemen here from the university who have done a large amount of previous research with this game and are experts in learning studies with boys of your age. They are very interested in this experiment and how you boys go about learning the task. They have asked if they could come in to observe your performance over the forty trials and make a few notes. I couldn't see anything wrong with that so I have agreed to allow them to watch. I hope that it is okay with both of you? (Experimenter obtains the verbal consent of the subjects).

The audience is brought in, seated, and the experiment begins.

APPENDIX F

VERBAL SOCIAL REINFORCEMENT

SOCIAL REINFORCEMENT

Praise:

1. Good work boys, you are both doing okay; it's a very tough task.
2. You're both doing very well.
3. You're both certainly doing much better than most boys do.
4. Excellent, you're both just excellent.

Reproof:

1. Not too good boys.
2. Certainly, you both could do much better.
3. Boys, you're both doing worse than most boys do.
4. Very poor boys, very poor.

Note:

Praise, or reproof was given verbally after the first, third, fifth and seventh stages of trials, in the order indicated above. After the second, fourth and sixth stages of trials, praise and reproof were given non-verbally in the form of head nodding or shaking, wherever possible. Reinforcement was given in a calm, matter of fact manner and was not contingent on performance. No effort was made to arouse or motivate the subjects.

APPENDIX G

PERFORMANCE RAW SCORES, MEANS AND STANDARD DEVIATIONS

RAW PERFORMANCE SCORES

NO AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
High Ability Control											
1	12	2,3	12	16	8	8	10	10	6	15	21
2	12	2,3	12	16	17	18	12	24	8	13	17
3	13	2,4	19	13	15	9	11	8	7	10	20
4	13	2,4	12	11	16	20	20	21	30	24	19
5	13	1,5	12	15	16	20	23	24	19	14	18
6	13	1,5	10	12	11	7	6	11	13	11	14
7	15	1,5	18	14	8	10	17	6	13	15	18
8	13	1,5	10	9	10	10	16	20	25	17	15
9	13	2,4	11	9	12	12	14	9	13	15	22
10	13	2,4	11	9	3	5	5	3	6	5	4
High Ability Praise											
1	13	1,2	11	4	11	18	19	16	17	18	12
2	13	1,2	10	12	10	4	26	17	11	16	6
3	13	1,2	11	6	6	3	2	2	6	10	10
4	13	1,2	10	19	19	24	12	25	18	23	21
5	12	1,4	10	7	10	15	7	6	3	6	5
6	12	1,4	11	5	6	13	7	17	9	15	10
7	13	2,5	15	10	8	10	10	13	10	19	13
8	13	2,5	16	12	16	16	21	14	14	12	20
9	12	1,3	17	6	21	6	2	12	4	4	11
10	13	1,3	22	5	17	14	23	19	6	15	15
High Ability Reproof											
1	13	1,2	14	6	11	13	15	19	7	17	16
2	13	1,2	10	6	12	12	8	13	14	8	16
3	13	1,2	14	15	11	10	19	24	23	18	28
4	13	1,2	22	12	5	7	7	12	16	22	23
5	12	1,3	11	16	12	11	13	20	22	24	24
6	12	1,3	10	13	9	20	11	11	15	18	13
7	12	1,3	16	8	15	7	4	6	14	8	7
8	12	1,3	14	8	15	11	11	17	14	13	18
9	12	1,4	10	16	32	14	17	24	27	24	26
10	13	1,4	17	3	13	12	11	4	4	11	15

AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
High Ability Control											
1	12	1,3	12	6	13	5	12	17	15	16	20
2	13	1,3	15	17	6	15	12	10	13	12	15
3	13	1,5	13	8	17	14	15	23	25	27	19
4	14	1,5	12	13	13	7	1	3	5	6	20
5	12	1,4	10	3	17	18	24	21	12	12	12
6	12	1,4	10	15	15	8	10	9	9	10	6
7	12	1,4	12	9	6	10	17	7	14	10	16
8	12	1,4	12	16	14	17	18	12	10	15	18
9	14	2,4	10	11	13	12	10	20	11	15	21
10	13	2,4	21	9	5	16	16	23	14	6	14
High Ability Praise											
1	13	2,4	12	14	9	16	11	10	17	23	13
2	13	2,4	11	7	9	18	10	9	16	13	21
3	13	2,5	16	24	23	14	15	15	16	9	27
4	14	2,5	12	6	8	11	11	7	14	18	15
5	13	2,4	10	14	12	19	21	23	18	13	8
6	13	2,4	11	24	23	29	29	21	31	20	29
7	12	1,4	11	12	8	20	18	24	24	19	10
8	12	1,4	13	10	8	14	11	23	14	18	16
9	13	2,5	12	27	22	20	40	32	35	26	34
10	14	2,5	14	14	11	11	15	7	11	10	10
High Ability Reproof											
1	12	2,3	11	14	19	22	13	29	19	22	23
2	12	2,3	15	10	23	30	16	19	31	24	17
3	12	1,3	21	12	25	25	22	16	15	13	13
4	12	1,3	13	14	17	15	11	12	19	17	13
5	14	2,5	12	11	6	14	12	13	17	15	11
6	13	2,5	13	16	23	21	17	26	16	15	19
7	13	1,2	15	9	5	5	5	17	11	14	13
8	13	1,2	11	14	17	10	20	19	20	24	17
9	12	1,5	10	13	15	18	15	17	18	17	15
10	13	1,5	14	7	13	16	16	0	16	13	11

NO AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control											
1	13	1,3	6	12	7	11	11	21	8	7	11
2	12	1,3	8	10	7	20	18	13	16	23	10
3	12	1,3	8	8	5	5	6	12	9	14	5
4	12	1,3	7	10	9	10	6	13	9	9	13
5	13	1,4	7	3	6	7	9	11	8	8	13
6	12	1,4	8	6	9	13	8	7	7	15	14
7	12	1,4	6	10	2	7	6	2	1	9	7
8	12	1,4	7	7	4	5	6	3	6	5	9
9	13	1,4	8	13	11	12	21	11	16	25	14
10	12	1,4	7	15	8	9	15	11	14	16	18
Medium Ability Praise											
1	14	2,5	9	16	4	10	9	12	6	8	11
2	14	2,5	7	9	8	10	5	10	11	7	7
3	13	1,4	8	13	13	5	12	11	22	17	18
4	13	1,4	7	11	13	21	23	18	24	23	21
5	13	1,5	6	13	15	15	18	9	31	30	19
6	13	1,5	9	8	10	9	17	18	15	14	13
7	13	1,5	8	10	7	10	11	7	9	9	10
8	13	1,5	7	11	12	9	8	20	21	21	25
9	13	2,4	7	4	3	10	5	12	16	13	14
10	14	2,4	6	12	20	8	16	11	13	13	11
Medium Ability Reproof											
1	12	1,2	7	7	9	9	12	13	15	16	22
2	12	1,2	8	17	24	13	21	20	18	9	23
3	12	1,3	7	13	11	11	7	12	9	5	9
4	12	1,3	6	4	10	3	9	11	5	7	18
5	12	1,4	7	8	5	12	15	15	16	21	16
6	11	1,4	7	13	17	19	12	22	24	20	16
7	13	1,5	6	7	8	9	13	12	10	9	20
8	13	1,5	8	10	3	11	8	2	9	14	14
9	13	1,5	8	7	11	10	7	13	9	12	14
10	13	1,5	7	25	19	17	21	24	14	23	16

AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control											
1	13	2,3	7	8	6	15	21	17	17	20	13
2	12	2,3	8	22	18	27	11	13	32	13	20
3	13	1,3	8	10	25	10	7	15	6	13	22
4	12	1,3	9	12	8	9	9	12	13	13	16
5	12	1,3	6	6	5	4	6	5	16	12	19
6	12	1,3	7	5	6	6	5	4	6	8	11
7	13	1,2	9	6	7	12	11	13	16	8	9
8	13	1,2	8	5	5	8	10	10	5	11	5
9	14	1,5	8	2	13	5	2	6	12	12	3
10	13	1,5	7	22	13	14	18	15	20	16	8
Medium Ability Praise											
1	13	1,5	6	9	7	4	9	10	16	10	9
2	13	1,5	6	10	13	11	10	18	12	6	6
3	13	1,5	9	3	9	6	14	15	8	7	11
4	13	1,5	9	14	12	15	15	18	19	19	15
5	12	1,3	6	5	5	9	7	10	9	12	14
6	12	1,3	6	15	19	22	20	12	13	20	13
7	13	2,5	6	0	13	8	6	13	11	10	6
8	13	2,5	8	9	13	17	20	17	24	22	16
9	13	2,5	8	8	14	12	14	9	11	7	6
10	13	2,5	6	3	11	11	11	13	18	14	21
Medium Ability Reproof											
1	13	2,4	7	20	7	13	11	11	15	11	14
2	13	2,4	8	8	11	15	11	10	16	11	14
3	12	1,4	6	7	8	15	19	27	3	23	27
4	13	1,4	8	11	19	25	22	21	23	23	26
5	13	1,2	7	2	5	4	8	7	1	1	7
6	13	1,2	9	16	15	7	8	17	18	33	27
7	12	1,3	6	9	8	5	11	14	14	15	16
8	12	1,3	8	12	7	22	12	22	18	11	12
9	12	1,3	9	6	3	9	12	10	17	12	18
10	12	1,3	9	6	10	14	20	20	26	22	12

NO AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
Low Ability Control											
1	13	1,3	4	12	11	4	16	11	5	19	11
2	12	1,3	3	10	16	12	16	21	15	23	23
3	12	1,4	1	9	7	3	6	2	6	12	12
4	12	1,4	2	9	8	10	13	11	13	10	20
5	13	1,3	4	12	10	23	10	6	13	5	3
6	12	1,3	3	11	4	8	13	7	5	14	9
7	13	2,4	5	3	12	10	10	17	8	16	15
8	14	2,4	5	4	9	11	16	22	15	31	22
9	12	1.3	1	10	10	12	10	10	19	4	6
10	12	1,3	4	8	0	9	7	6	3	8	9
Low Ability Praise											
1	12	1,3	3	7	10	12	14	15	16	11	8
2	12	1,3	3	13	5	18	13	7	13	26	21
3	13	1,2	3	6	7	8	16	12	14	14	13
4	13	1,2	3	6	3	4	5	10	7	10	14
5	12	2,3	4	7	21	19	21	18	12	15	24
6	12	2,3	0	7	13	12	10	6	7	19	8
7	12	2,3	4	8	13	14	6	16	16	10	9
8	12	2,3	4	9	1	4	5	5	8	4	6
9	13	1,5	3	5	15	10	9	12	6	14	2
10	14	1,5	3	0	8	11	6	6	6	10	13
Low Ability Reproof											
1	12	1,4	3	17	8	8	14	8	5	7	9
2	11	1,4	5	6	13	9	14	13	9	10	6
3	13	2,5	5	5	20	12	17	14	19	22	9
4	13	2,5	3	11	9	20	11	20	17	18	21
5	14	1,2	4	5	12	7	24	15	8	14	13
6	13	1,2	5	10	14	11	20	19	11	13	18
7	13	1,5	3	20	13	20	19	12	8	8	14
8	13	1,5	0	8	9	4	7	11	7	13	14
9	13	1,5	2	14	7	26	11	15	20	17	25
10	14	1,5	5	5	4	8	10	13	8	10	12

AUDIENCE

Subject	Age	Class	Base Line	Trials 1	2	3	4	5	6	7	8
Low Ability Control											
1	13	1,2	4	15	15	11	17	19	23	21	17
2	13	1,2	5	5	12	2	13	4	7	8	6
3	13	1,2	5	9	15	9	8	14	15	11	12
4	13	1,2	4	6	3	7	9	3	6	11	2
5	13	2,4	2	9	7	8	7	11	10	19	23
6	13	2,4	5	11	12	16	15	15	14	19	17
7	12	1,4	0	11	11	10	8	14	11	2	2
8	12	1,4	0	4	2	6	6	5	8	8	6
9	12	2,3	5	7	9	12	20	15	7	12	16
10	12	2,3	4	2	3	10	4	2	9	9	0
Low Ability Praise											
1	13	1,2	1	14	13	4	2	[illegible]	[illegible]	16	13
2	13	1,2	4	11	7	5	5	[illegible]	[illegible]	13	19
3	13	1,2	1	[illegible]	8	9	11	11	14	11	9
4	13	1,2	4	[illegible]	8	4	6	7	4	9	8
5	13	2,3	4	[illegible]	6	16	16	9	11	14	8
6	13	2,3	2	[illegible]	10	9	9	5	25	25	17
7	13	1,5	4	4	9	8	11	13	12	9	11
8	13	1,5	5	15	16	10	21	20	22	21	13
9	12	1,4	3	0	9	12	13	15	25	19	17
10	12	1,4	3	8	17	24	14	18	9	5	9
Low Ability Reproof											
1	12	1,4	3	8	10	[illegible]	14	21	26	26	20
2	11	1,4	1	9	9	5	15	11	11	11	9
3	12	2,3	2	10	12	13	18	13	19	21	17
4	13	2,3	1	6	13	17	21	14	12	20	19
5	13	2,5	5	5	7	8	9	3	7	2	2
6	13	2,5	5	14	27	15	16	15	15	17	23
7	12	2,3	3	17	19	10	9	3	8	13	9
8	12	2,3	3	7	15	23	13	21	18	20	19
9	12	1,4	3	0	2	11	4	2	5	3	5
10	12	1,4	5	5	4	5	16	12	6	16	11

PERFORMANCE SCORE MEANS AND STANDARD DEVIATIONS

Groups	Stage 1 $\bar{X}$	Stage 1 S.D.	Stage 2 $\bar{X}$	Stage 2 S.D.	Stage 3 $\bar{X}$	Stage 3 S.D.	Stage 4 $\bar{X}$	Stage 4 S.D.
HA-NC-C	12.40	2.84	11.60	4.50	11.90	5.49	13.40	5.78
HA-NC-P	8.60	4.67	12.40	5.44	12.30	6.62	12.90	8.77
HA-NC-R	10.30	4.69	13.50	7.12	11.70	3.71	11.60	4.60
HA-C-C	10.70	4.55	11.90	4.56	12.20	4.52	13.50	6.12
HA-C-P	15.20	7.36	13.30	6.60	17.20	5.35	18.10	9.68
HA-C-R	12.90	3.96	15.00	6.20	17.60	7.29	14.70	4.81
MA-NC-C	9.40	3.53	6.80	2.66	9.90	4.51	10.60	5.54
MA-NC-P	10.70	3.27	10.50	5.19	10.70	4.37	12.40	5.97
MA-NC-R	11.10	6.21	11.70	6.48	11.40	4.43	12.50	5.21
MA-C-C	9.80	7.01	10.60	6.65	11.00	6.72	10.00	5.79
MA-C-P	7.60	4.86	11.60	3.92	11.50	5.36	12.60	4.90
MA-C-R	9.70	5.27	9.30	4.74	12.90	6.92	13.40	5.04
LA-NC-C	8.80	3.08	8.70	4.40	10.20	5.45	11.70	3.68
LA-NC-P	6.80	3.26	9.60	6.06	11.20	5.07	10.50	5.40
LA-NC-R	10.10	5.38	10.90	4.48	12.50	7.09	14.70	5.25
LA-C-C	7.90	3.87	8.90	4.93	9.10	3.76	10.70	5.25
LA-C-P	8.60	5.38	10.30	3.77	10.10	6.14	13.10	6.28
LA-C-R	8.10	4.82	11.80	7.35	12.70	6.09	13.50	4.97

HA = High Ability
MA = Medium Ability
LA = Low Ability

NC = No Competition
C = Competition

C = Control
P = Praise
R = Reproof

PERFORMANCE SCORE MEANS AND STANDARD DEVIATIONS

Groups	Stage 5		Stage 6		Stage 7		Stage 8	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	13.60	7.85	14.00	8.29	13.90	4.93	16.80	5.14
HA-NC-P	14.10	6.51	9.80	5.25	13.80	5.88	12.30	5.25
HA-NC-R	15.00	6.98	15.60	7.01	16.30	6.09	18.60	6.54
HA-C-C	14.50	7.22	12.80	5.20	12.90	6.06	16.10	4.61
HA-C-P	17.00	8.72	19.60	7.88	16.90	5.55	18.30	9.02
HA-C-R	16.80	7.91	18.20	5.18	17.40	4.35	15.40	3.75
MA-NC-C	10.40	5.44	9.40	4.72	13.10	6.79	11.40	3.81
MA-NC-P	12.80	4.34	16.80	7.66	15.50	7.34	14.90	5.65
MA-NC-R	14.40	6.35	12.90	5.59	13.60	6.26	16.80	4.16
MA-C-C	11.00	4.57	14.30	8.10	12.60	3.53	12.60	6.52
MA-C-P	13.50	3.38	14.10	5.04	12.70	5.83	11.70	5.03
MA-C-R	15.90	6.51	15.10	7.81	16.20	9.07	17.30	7.07
LA-NC-C	11.30	6.70	10.20	5.45	14.20	8.40	13.00	6.83
LA-NC-P	10.70	4.64	10.50	4.12	13.30	5.98	11.80	6.73
LA-NC-R	14.00	3.56	11.20	5.41	13.20	4.73	14.10	5.82
LA-C-C	10.20	6.13	11.00	5.16	12.00	5.98	10.10	7.94
LA-C-P	12.60	4.72	15.50	7.04	14.20	6.14	12.40	4.09
LA-C-R	11.50	6.96	12.70	6.77	14.90	7.78	13.40	7.12

APPENDIX H

LEARNING MEANS AND STANDARD DEVIATIONS

LEARNING SCORE MEANS AND STANDARD DEVIATIONS

Groups	Learning					
	Early		Later		Total	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	1.00	6.02	3.40	5.46	4.20	4.39
HA-NC-P	4.30	8.98	-0.60	9.18	3.70	4.83
HA-NC-R	1.30	4.86	7.00	4.62	8.30	4.83
HA-C-C	2.90	8.61	1.60	6.92	5.40	6.82
HA-C-P	2.90	5.97	0.20	8.19	3.10	6.30
HA-C-R	1.80	4.13	0.70	5.29	2.50	4.20
MA-NC-C	1.20	4.61	0.80	5.03	1.60	4.48
MA-NC-P	1.70	5.91	2.50	6.65	4.20	6.11
MA-NC-R	1.40	4.58	4.30	4.47	5.50	7.74
MA-C-C	2.60	5.76	2.60	8.73	1.80	6.73
MA-C-P	5.00	4.19	-0.90	5.72	4.10	6.76
MA-C-R	3.70	7.85	0.10	8.06	7.60	7.41
LA-NC-C	2.90	4.65	1.30	5.66	4.20	8.78
LA-NC-P	3.70	5.68	0.70	5.83	5.00	6.72
LA-NC-R	4.60	7.47	-0.60	8.49	4.00	6.58
LA-C-C	2.80	4.78	1.80	7.53	4.00	5.50
LA-C-P	5.90	5.24	-3.50	7.14	3.80	5.69
LA-C-R	5.40	6.02	-0.10	5.13	5.30	6.99

APPENDIX I

HEART RATE BASELINE, DEVIATION SCORES, MEANS AND STANDARD DEVIATIONS

HEART RATE DEVIATION SCORES

NO AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	7	8
High Ability Control								
1	73	3	3	7	1	5	11	5	9
2	81	-8	-8	-11	-10	-3	-9	-3	-1
3	87	-9	-7	-9	-5	-1	-9	-3	-7
4	66	-4	0	3	-2	2	-2	0	1
5	88	0	3	2	8	-6	-6	-6	-4
6	71	-2	-1	0	2	-1	-1	-4	-4
7	75	-4	0	0	-2	-4	-5	1	-6
8	98	5	5	2	6	8	6	12	10
9	62	-2	-2	2	6	10	10	8	11
10	59	1	5	1	-3	11	5	15	7
High Ability Praise								
1	67	2	6	6	6	7	6	6	16
2	96	2	0	-6	-3	-6	-2	-3	-5
3	90	-5	-1	-2	-4	-6	-3	-1	2
4	81	-1	1	2	1	5	1	-3	1
5	75	-2	-1	5	5	2	3	11	8
6	110	-10	-8	-4	-7	-10	-12	-7	-10
7	113	-7	-10	-13	-5	-13	-9	-5	-11
8	78	8	-3	-3	4	-4	8	6	4
9	108	-6	-4	-5	-6	-6	-5	-8	-1
10	69	-9	-7	-2	-2	5	-1	4	-4
High Ability Reproof								
1	90	0	0	-5	3	0	6	1	0
2	82	-6	-4	-2	-2	-4	0	-2	-5
3	83	7	10	10	15	10	17	15	17
4	80	-7	-5	-5	0	-11	-6	-4	-2
5	69	2	6	4	-3	1	-1	1	4
6	67	-1	1	6	1	1	1	-4	-1
7	82	-2	2	1	2	3	2	-2	-2
8	71	-5	0	4	1	2	1	-2	2
9	82	-4	4	-2	0	-2	4	0	1
10	71	-4	1	9	-3	2	-3	9	6

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
High Ability Control									
1	76	-3	4	11	10	4	2	4	14
2	73	4	5	1	0	5	3	10	7
3	95	-7	12	-4	2	-5	8	8	1
4	69	2	11	4	0	4	1	4	2
5	70	0	2	0	2	1	0	6	-4
6	104	6	2	2	2	3	0	0	2
7	93	7	7	1	0	5	9	3	5
8	76	4	0	0	2	2	-4	0	-4
9	71	1	1	1	5	11	9	19	15
10	82	2	4	2	8	6	6	8	6
High Ability Praise									
1	62	2	7	4	2	7	8	10	8
2	69	1	2	3	1	1	3	1	3
3	117	5	3	1	1	-2	1	1	3
4	66	4	4	4	10	0	12	8	4
5	83	3	3	4	2	2	5	4	4
6	72	-6	-4	2	0	2	-4	12	2
7	82	-2	0	2	0	1	6	2	4
8	97	1	1	9	-1	5	5	3	-1
9	101	5	3	-3	2	1	7	2	-5
10	79	-3	1	3	3	1	1	1	1
High Ability Reproof									
1	52	4	5	3	0	1	2	4	5
2	75	-5	-5	-5	-4	-4	-4	-2	-5
3	57	-1	3	0	1	1	0	3	-3
4	76	4	6	4	4	5	5	5	6
5	92	-4	-10	-6	-6	-8	-8	-6	-10
6	97	3	-3	-1	-3	-3	-3	-2	-3
7	76	6	15	10	8	10	12	12	18
8	79	3	3	3	-1	7	-1	-1	5
9	65	-1	5	7	7	7	7	9	7
10	89	-9	-5	-3	-5	-5	-7	-5	-5

NO AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control									
1	93	11	[illegible]	11	9	-1	3	5	7
2	99	-8	1	5	1	11	1	3	6
3	96	-6	-7	-6	-6	-3	-8	-10	-8
4	86	-4	-2	-1	0	-1	4	4	0
5	91	-1	2	4	3	-2	-4	-3	-3
6	83	-3	-5	-3	-5	-6	-3	0	-5
7	112	-8	-12	-14	-16	-12	-12	-14	-16
8	93	-1	-9	-6	-7	-9	-8	-8	-10
9	103	-5	-8	-7	-9	-3	-8	-3	-13
10	89	-7	-4	-6	-15	-6	-4	-2	-2
Medium Ability Praise									
1	67	2	3	7	7	6	5	5	6
2	98	-2	2	2	6	0	2	2	-3
3	83	-1	0	6	-3	-3	-1	5	5
4	90	-6	0	0	-4	3	1	0	-5
5	99	5	1	8	1	3	1	6	1
6	83	-1	0	0	-3	-5	-5	-3	-5
7	82	7	6	6	7	5	1	8	8
8	91	7	7	5	5	5	5	2	3
9	104	-4	-2	-2	-4	-2	-1	-4	5
10	66	9	7	5	5	10	3	4	3
Medium Ability Reproof									
1	88	0	0	1	1	-2	3	-8	-3
2	77	-7	-8	-6	-6	-4	11	1	1
3	75	-7	-5	-4	-5	-3	-5	-11	-5
4	88	1	1	-1	3	2	2	3	5
5	71	-2	1	2	5	7	7	9	0
6	86	1	-2	-3	-6	-6	-6	-6	-6
7	100	-4	2	0	-6	0	-2	-9	-9
8	88	1	-2	6	3	3	4	9	0
9	86	10	-2	-1	7	-1	7	-4	2
10	88	8	12	2	15	12	8	8	10

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control									
1	79	3	4	13	13	9	8	8	4
2	54	-1	-1	0	2	1	2	6	6
3	101	-7	-1	7	6	-1	-1	7	5
4	88	0	1	1	2	6	2	2	1
5	85	-5	-5	-7	-5	-5	-5	-3	-3
6	79	1	3	1	5	3	3	7	1
7	78	4	-1	-1	2	-1	4	10	2
8	85	-2	-5	-2	-2	-2	3	8	3
9	74	-2	2	0	0	4	0	-4	0
10	97	5	5	3	1	3	3	3	3
Medium Ability Praise									
1	85	-1	-3	-5	-4	-4	-5	-5	-4
2	99	-9	-7	-1	-1	-5	-7	-7	-5
3	84	5	5	7	7	6	7	9	10
4	83	0	-3	-8	-9	-6	-3	-6	-5
5	80	0	0	10	10	3	0	5	15
6	71	1	5	9	3	5	9	9	7
7	84	-11	-12	-6	-10	-8	-8	-12	-8
8	86	-2	-2	-4	-2	-4	0	-2	0
9	60	0	2	8	2	3	11	6	4
10	113	-1	-3	-5	-9	-5	-7	-9	-13
Medium Ability Reproof									
1	111	-9	-1	1	-4	-7	-4	-4	1
2	88	0	-2	-2	-4	-4	-8	-6	-6
3	82	11	2	2	2	14	4	8	8
4	79	8	3	7	7	9	11	7	9
5	65	-2	3	-5	-1	-2	-5	-5	-2
6	93	-3	-2	2	1	-4	4	-3	2
7	95	-7	-1	-7	-7	1	-9	-11	-11
8	99	-9	-3	-7	-3	-1	-9	-13	-11
9	90	2	4	0	4	2	6	4	2
10	74	-1	-2	-2	-4	0	-4	-2	0

NO AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Low Ability Control									
1	86	1	-4	4	2	-4	-2	0	-2
2	88	6	2	4	2	3	4	4	3
3	96	0	8	4	2	7	4	-1	1
4	84	-2	-4	-4	-4	-4	-1	-1	-4
5	88	-2	-1	-10	-8	-6	-8	-8	-4
6	71	-5	-2	-2	-2	-2	1	-1	-1
7	79	-10	-7	-9	-3	-1	-1	4	6
8	68	5	0	7	-1	2	7	5	2
9	78	8	2	0	5	2	8	2	9
10	71	3	4	7	6	5	4	9	7
Low Ability Praise									
1	89	-3	1	-9	-7	-2	-1	1	-5
2	77	8	-3	3	3	3	5	6	5
3	72	-4	-1	-3	3	16	-4	1	2
4	70	0	7	8	0	-1	0	0	-5
5	88	-2	0	0	0	5	4	-1	2
6	83	3	-1	-5	3	5	1	4	-3
7	81	3	5	3	7	3	7	11	11
8	85	-1	1	2	9	1	3	5	5
9	66	-8	-8	-6	-10	-6	-10	-6	-8
10	79	1	1	3	3	8	4	1	5
Low Ability Reproof									
1	95	-8	-9	-4	-1	-8	1	1	8
2	89	0	5	4	4	9	4	4	6
3	88	3	-5	0	0	2	-1	0	4
4	83	-9	-5	-3	-1	1	-1	-1	1
5	70	-6	0	6	3	6	3	3	7
6	86	-6	-6	-8	-13	-13	-11	-6	-13
7	72	4	4	6	4	4	6	6	8
8	98	-11	-8	-7	-10	-8	-8	-7	-7
9	121	-3	-3	-1	-7	-9	-9	-7	-8
10	86	-10	-8	-12	-8	-10	-14	-14	-11

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Low Ability Control									
1	72	6	-1	2	0	4	4	2	4
2	56	2	4	6	4	4	2	6	4
3	73	3	1	2	2	3	2	1	2
4	84	3	7	4	7	4	2	4	4
5	78	0	4	2	4	4	2	-2	4
6	60	4	0	0	6	0	4	8	6
7	99	-3	-5	2	-5	1	-3	-5	-3
8	60	-4	-4	0	0	4	6	2	2
9	78	2	-2	-4	-5	2	0	0	-5
10	74	3	5	3	6	3	4	5	6
Low Ability Praise									
1	107	3	3	1	1	-3	-5	1	-7
2	81	-1	-7	-3	-3	-5	-5	-5	-3
3	85	2	3	2	1	2	3	3	5
4	70	5	4	2	3	4	5	3	-7
5	96	2	4	0	-2	2	8	-2	2
6	92	-6	-2	2	0	-2	-2	2	10
7	87	-3	-5	-1	-5	-5	-3	3	-5
8	78	-4	-6	0	0	2	-1	0	2
9	80	8	2	4	10	6	8	4	6
10	75	-3	1	3	-1	1	1	5	5
Low Ability Reproof									
1	80	-2	-2	0	2	0	-2	-2	-6
2	79	3	3	3	7	7	3	1	3
3	76	-4	-9	-3	-3	-2	-3	4	4
4	67	5	3	1	1	3	3	3	5
5	103	-7	-5	3	3	1	1	3	1
6	85	-3	-7	-3	-5	-3	-1	-1	4
7	77	-1	-5	1	3	-1	1	-3	-1
8	63	1	9	7	7	7	13	13	15
9	65	1	2	5	1	2	2	3	-5
10	69	8	4	11	7	7	3	1	-1

HEART RATE DEVIATION SCORE MEANS
AND STANDARD DEVIATIONS

Groups	Stage 1		Stage 2		Stage 3		Stage 4	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	-2.00	4.47	-0.20	4.54	-0.30	5.50	-0.40	6.02
HA-NC-P	-2.80	5.67	-2.70	4.76	-2.20	5.57	-1.10	4.77
HA-NC-R	-2.00	4.22	1.50	4.43	2.00	5.46	1.40	5.19
HA-C-C	1.60	4.20	4.80	4.08	1.80	3.82	3.10	3.48
HA-C-P	1.00	3.65	2.00	2.87	2.90	3.00	2.00	3.06
HA-C-R	0.00	4.83	1.40	7.21	1.20	5.16	0.10	4.91
MA-NC-C	-3.20	5.61	-4.10	5.04	-2.30	7.24	-4.50	7.90
MA-NC-P	1.60	5.19	2.40	3.24	3.70	3.43	1.70	4.79
MA-NC-R	0.10	5.63	-0.30	5.27	-0.40	3.44	1.10	6.98
MA-C-C	-0.40	3.84	0.20	3.46	1.50	5.38	2.40	4.88
MA-C-P	-1.80	4.73	-1.80	5.22	0.50	7.14	-1.30	6.90
MA-C-R	-1.00	6.70	0.10	2.60	-1.10	4.43	-0.90	4.33
LA-NC-C	0.40	5.44	-0.20	4.39	0.10	6.21	-0.10	4.31
LA-NC-P	-0.30	4.42	0.20	4.10	-0.40	5.21	1.10	5.80
LA-NC-R	-3.90	5.04	-3.00	4.71	-0.80	4.96	-2.80	6.07
LA-C-C	1.60	3.10	0.90	4.01	1.70	2.67	1.90	4.36
LA-C-P	0.30	4.42	-0.30	4.32	1.00	2.06	0.40	4.06
LA-C-R	0.10	4.46	-0.70	5.76	2.50	4.35	2.30	4.11

HA = High Ability NC = No Competition C = Control
MA = Medium Ability C = Competition P = Praise
LA = Low Ability R = Reproof

HEART RATE DEVIATION SCORE MEANS
AND STANDARD DEVIATIONS

Groups	Stage 5		Stage 6		Stage 7		Stage 8	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	2.10	6.08	0.00	7.53	2.50	7.20	1.60	7.03
HA-NC-P	-2.60	6.90	-1.40	6.28	0.00	6.38	0.00	8.19
HA-NC-R	2.40	4.74	2.10	6.23	1.20	6.13	2.00	6.15
HA-C-C	3.60	4.06	3.40	4.43	6.20	5.59	4.40	6.48
HA-C-P	1.80	2.53	4.40	4.43	4.40	4.09	2.30	3.47
HA-C-R	1.10	6.03	0.30	6.33	1.70	5.93	1.50	8.20
MA-NC-C	-3.20	6.14	-3.90	5.28	-2.80	6.27	-4.40	7.59
MA-NC-P	2.20	4.64	1.10	3.00	2.50	3.89	1.80	4.66
MA-NC-R	0.80	5.43	2.90	5.71	-0.80	7.80	-0.50	5.56
MA-C-C	1.70	4.14	1.90	3.41	4.40	4.79	2.20	2.62
MA-C-P	-1.50	5.15	-0.30	7.04	-1.20	7.80	0.10	8.75
MA-C-R	0.80	6.34	-1.40	7.09	-2.50	7.04	-0.80	6.91
LA-NC-C	0.20	4.26	1.60	4.79	1.30	4.62	1.70	4.57
LA-NC-P	3.20	6.03	0.90	5.00	2.20	4.59	0.90	5.95
LA-NC-R	-2.50	7.71	-2.30	6.31	-1.40	5.02	-0.20	8.00
LA-C-C	2.90	1.45	2.30	2.50	2.10	3.87	2.40	3.66
LA-C-P	0.20	3.77	0.90	4.93	1.40	3.03	0.8-	5.96
LA-C-R	2.10	3.81	2.00	4.42	2.20	4.47	1.90	5.95

APPENDIX J

PALMAR SWEAT PRINT BASELINE, DEVIATION SCORES, MEANS AND STANDARD DEVIATIONS

SWEAT PRINT DEVIATION SCORES

NO AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
High Ability Control									
1	52	[illegible]	[illegible]	-3	-30	16	-48	5	-14
2	54	[illegible]	[illegible]	[illegible]	0	13	-16	-27	-22
3	87	[illegible]	[illegible]	-77	-79	-82	-73	-81	-38
4	19	-7	-10	---	-12	-11	-7	-12	-13
5	21	-17	-15	-4	-8	-14	-21	-15	-13
6	68	-40	-61	-17	-17	2	-37	-15	-18
7	77	28	-37	-8	---	31	27	-1	14
8	96	0	-41	-20	-83	-18	-29	-68	7
9	37	20	5	-19	8	16	-29	-28	---
10	44	---	35	0	41	78	48	91	89
High Ability Praise									
1	62	17	-44	-40	-40	-52	-54	-47	25
2	106	-13	-24	13	-23	23	0	-3	-16
3	76	8	6	-17	---	21	-22	-37	-25
4	53	-17	-24	-9	27	-11	-11	-32	-16
5	87	-81	-71	---	-72	-79	---	-48	-71
6	100	12	24	14	22	21	14	26	17
7	120	6	3	-10	-22	-26	-62	-71	-53
8	90	12	-17	-15	-6	-17	-16	-60	-63
9	81	-7	15	-7	-21	-9	0	-10	-50
10	86	-21	-27	0	-4	-23	1	-26	-14
High Ability Reproof									
1	76	30	-32	-45	-43	6	-16	---	-43
2	79	-78	-77	-50	-66	-79	-50	-75	-75
3	42	17	45	41	22	29	48	59	-16
4	64	40	-63	-43	-55	-6	---	-52	---
5	58	9	-22	-16	-6	41	-8	-26	-1
6	65	-48	20	33	-50	5	-44	12	44
7	52	-3	53	10	---	-17	-40	-42	-39
8	73	-51	-10	-47	100	---	81	79	-9
9	57	-53	-37	7	-42	-10	-46	-29	-17
10	45	56	58	-40	79	61	15	2	-1

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
High Ability Control									
1	75	-8	-17	0	-2	-35	-26	-4	-28
2	35	18	-19	-5	-21	-11	-17	-15	-22
3	14	-2	-4	-6	-4	-7	-3	-4	-8
4	82	22	-13	11	-7	6	-40	17	-29
5	40	---	-14	---	---	-9	-39	-31	31
6	57	---	5	-26	---	13	-12	---	---
7	51	57	78	63	31	17	---	63	75
8	15	7	-8	5	40	7	12	49	0
9	62	-22	2	-53	13	4	---	---	-9
10	10	-6	37	-7	-1	-6	2	-3	-7
High Ability Praise									
1	15	11	-5	-8	-4	2	---	-10	--
2	15	57	37	49	53	32	9	47	20
3	68	-6	-58	-51	---	-19	-44	-27	-57
4	28	4	6	10	-10	-4	-21	-10	-27
5	57	-23	-28	-32	-33	56	-11	-7	25
6	81	-44	22	-77	-10	4	-70	-47	-13
7	28	-26	19	50	-3	-24	-12	-21	-27
8	14	-9	38	8	-9	-7	-7	0	-10
9	59	-16	-5	-16	-29	-43	-22	-23	-16
10	54	49	-4	-4	-51	-15	54	51	11
High Ability Reproof									
1	93	-50	---	17	-31	-34	-58	-51	-50
2	108	2	22	-70	-46	-48	-35	-25	-10
3	52	5	-23	47	64	-40	31	-24	38
4	46	-34	9	---	-42	-38	---	---	-45
5	27	16	17	27	30	-9	25	-1	13
6	22	-21	-18	-4	-15	-12	-16	-16	-18
7	52	-1	5	0	-12	5	-17	35	24
8	66	-27	-5	-23	-33	-57	-32	-3	---
9	80	9	33	54	22	-14	-3	-40	-10
10	47	-29	15	-44	-44	84	-47	-46	-47

NO AUDIENCE

Subject	Base Line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control									
1	102	-37	-27	-63	-75	-94	-94	-99	-89
2	38	2	-34	5	-32	-35	-32	-32	-24
3	75	-36	-63	-57	-57	---	-73	-65	---
4	120	-80	36	18	-15	-62	42	12	21
5	69	-71	31	-2	-3	15	-4	-32	-29
6	11	41	16	37	15	44	30	67	9
7	45	-36	-19	-9	-35	-39	-20	-21	-40
8	129	-19	-41	-21	-41	-20	-12	-33	-5
9	91	-40	-7	-65	-2	9	-3	-12	1
10	76	61	35	71	-15	60	---	-72	-60
Medium Ability Praise									
1	99	39	-59	-19	-46	-89	-77	-47	-48
2	36	-4	-28	-2	12	-17	-18	-15	-22
3	118	11	-57	-68	-91	-52	-99	-99	-43
4	19	27	15	25	-19	-15	-15	24	-1
5	28	4	-24	-5	17	23	-19	21	-6
6	66	81	33	-10	29	-22	15	80	-38
7	24	-4	---	-2	58	4	-24	---	7
8	28	18	-16	-16	-24	-19	-28	---	-25
9	81	-62	33	11	50	-11	8	24	-47
10	96	---	24	26	41	14	43	42	-14
Medium Ability Reproof									
1	56	---	37	-34	-53	8	-44	-50	17
2	61	-13	-32	-9	-8	0	-30	-52	-8
3	119	-98	-32	-81	-99	-64	-75	-56	-99
4	56	---	---	---	39	8	-45	17	22
5	25	40	92	6	-10	-19	-25	11	0
6	52	-28	30	-40	5	-49	0	-33	---
7	83	-4	14	-27	---	-65	-5	2	-33
8	7	---	0	36	51	69	87	15	68
9	62	-56	-58	---	-16	47	-49	22	-55
10	29	7	-18	---	3	16	-25	-28	-25

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Medium Ability Control									
1	41	-26	-26	9	-31	27	38	-9	44
2	57	27	-12	-49	-54	-47	-42	-50	-49
3	76	-2	-29	-1	-14	-11	-33	-33	-57
4	109	-7	-23	-49	-37	-75	-44	-82	-42
5	16	0	---	1	27	-11	-8	---	31
6	104	2	-26	-71	33	-38	-94	-99	-34
7	64	47	39	54	20	-47	-12	-57	17
8	93	-23	-41	-43	-13	-55	-37	---	-77
9	100	-43	-51	-98	5	-16	-17	-29	2
10	98	-27	-55	-42	20	-46	15	-82	-80
Medium Ability Praise									
1	64	33	8	4	-28	1	4	21	16
2	54	10	15	35	26	34	23	---	31
3	76	16	-64	2	-11	-5	---	-43	---
4	63	-52	24	-47	---	-13	11	---	-40
5	88	-43	20	-12	11	-43	27	---	---
6	62	39	38	2	20	-20	5	8	13
7	117	-13	-52	0	-65	-99	-51	-57	-61
8	73	-4	-20	-3	4	-5	0	-17	-42
9	42	-6	-20	-6	---	-28	-38	-24	-29
10	40	10	-7	-26	-10	---	-22	-27	---
Medium Ability Reproof									
1	66	8	4	-15	31	-42	-35	-9	44
2	85	-7	-11	-43	15	-17	---	1	-4
3	93	-70	-91	9	-2	56	7	-82	4
4	38	-16	-6	-13	-18	---	-35	-30	-30
5	55	-20	10	-16	-49	-21	15	0	-42
6	106	-36	-87	-3	-89	-72	-88	-41	31
7	40	---	-40	-37	-35	19	---	-3	-33
8	11	-9	105	---	59	79	---	1	---
9	66	-29	-21	-63	-64	-49	-10	-37	-63
10	89	-9	-52	15	-36	0	-24	-39	-8

NO AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Low Ability Control									
1	58	32	-47	---	-1	---	-36	-21	---
2	60	-60	-3	11	-60	-38	---	-58	-51
3	34	-14	-17	-17	-9	26	-15	3	-12
4	57	-16	-49	-28	-14	-15	14	-41	-48
5	39	-33	-7	---	-17	7	---	-7	11
6	44	-41	-32	-17	-42	-40	-20	38	-40
7	109	-64	-93	-58	-30	-99	-81	-86	-67
8	90	-20	-24	4	24	-5	-61	4	-11
9	41	2	27	18	-20	24	-2	---	14
10	83	-54	-33	69	3	65	-79	-44	-8
Low Ability Praise									
1	35	-15	51	9	42	14	-3	-18	-14
2	76	-62	2	-34	-57	-70	-1	-1	-12
3	139	-99	-26	-9	-66	-99	-36	-65	-88
4	79	9	-52	-56	39	---	41	43	30
5	35	54	51	50	47	41	88	33	12
6	98	-13	-62	-63	-82	-65	-85	---	-28
7	99	28	29	32	52	-20	36	41	33
8	153	-91	19	19	-54	-16	-27	4	21
9	70	-26	-3	-12	-25	-32	-40	-56	-16
10	44	-22	-38	-28	-37	-42	-24	-31	-37
Low Ability Reproof									
1	75	-5	-5	-22	-36	-22	-70	-46	---
2	58	0	-42	-33	14	-25	-44	23	30
3	7	51	85	113	62	3	66	13	26
4	106	24	6	-10	-39	2	6	-30	-23
5	72	-60	-55	---	---	-50	-58	-33	---
6	85	3	-4	27	-2	-24	-60	-43	-66
7	7	7	52	19	4	29	6	104	20
8	153	-29	-99	-16	-98	-12	-99	-66	-99
9	100	17	-56	-71	-31	-71	-72	-87	-30
10	75	47	-21	-53	-59	-17	-52	-54	-68

AUDIENCE

Subject	Base line	Trials 1	2	3	4	5	6	7	8
Low Ability Control									
1	38	-5	-20	-16	-12	-31	-16	-26	-21
2	128	---	-43	-9	-70	-2	2	-83	-28
3	34	-18	11	20	44	36	24	23	2
4	125	8	-22	-40	-94	-98	8	-28	-12
5	55	8	23	---	---	-53	-26	-29	-34
6	55	-48	---	43	15	56	---	15	47
7	44	-19	1	-15	-7	-42	-26	-9	---
8	61	-58	-21	---	-39	-23	-21	-44	-45
9	3	0	3	10	29	33	45	28	13
10	40	40	---	-23	-6	33	35	-20	-35
Low Ability Praise									
1	80	-8	-34	-30	3	-18	-11	-16	-37
2	31	5	-7	68	29	---	41	---	66
3	45	---	43	---	-40	-36	4	-5	58
4	83	-6	-2	9	-49	8	12	---	2
5	21	23	-7	-15	-14	-17	-17	-20	-11
6	116	-43	-83	17	-50	4	0	-14	-20
7	40	62	---	29	57	-1	42	-7	-10
8	16	0	14	-4	-1	17	-5	26	-9
9	65	-42	6	-7	16	-42	-53	0	-34
10	79	-69	-34	-68	3	-37	55	-26	-56
Low Ability Reproof									
1	27	67	56	24	51	41	-3	40	-9
2	72	17	7	72	4	-29	-50	33	-68
3	44	-34	-12	25	15	---	76	---	62
4	79	-18	18	27	26	4	-10	41	---
5	50	34	---	-24	-11	31	23	-32	-48
6	37	4	25	8	23	13	48	43	41
7	46	10	---	---	---	---	-16	---	---
8	63	1	-37	-7	-12	17	28	3	20
9	48	28	-43	-18	9	11	-9	-46	-8
10	36	-23	-26	-27	---	-27	-24	-22	-27

PALMAR SWEAT PRINT DEVIATION SCORE MEANS AND STANDARD DEVIATIONS

Groups	Stage 1		Stage 2		Stage 3		Stage 4	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	-9.17	30.05	-21.17	21.52	-21.33	28.15	-36.17	36.15
HA-NC-P	-1.38	14.86	-11.75	23.34	-6.75	17.14	-8.38	23.17
HA-NC-R	-16.17	51.25	-2.17	52.04	-4.17	37.61	-10.50	54.26
HA-C-C	5.17	12.66	-4.00	20.84	-0.33	7.15	0.83	20.53
HA-C-P	-1.00	36.13	5.13	24.81	-1.50	41.87	-11.50	30.64
HA-C-R	-2.71	16.32	7.29	20.79	1.43	45.99	-0.14	40.62
MA-NC-C	-30.00	38.83	-5.63	29.85	-12.50	36.23	-23.50	28.28
MA-NC-P	13.71	43.76	-12.43	39.61	-9.71	29.44	-6.86	48.65
MA-NC-R	-23.67	69.62	9.33	71.59	-28.00	46.51	-39.00	51.97
MA-C-C	-3.63	29.63	-22.88	28.85	-30.88	48.67	-7.25	31.48
MA-C-P	13.75	26.07	-6.50	38.48	0.75	2.99	-17.25	37.57
MA-C-R	-26.00	26.56	-39.50	44.16	-12.17	27.85	-45.18	29.80
LA-NC-C	-34.83	21.28	-41.33	27.49	-3.83	42.84	-11.33	23.48
LA-NC-P	-29.13	53.75	10.63	33.02	3.38	29.37	-13.50	49.27
LA-NC-R	15.00	26.12	-9.88	58.97	-3.00	57.42	-18.63	49.07
LA-C-C	-3.75	10.91	-7.00	16.50	-6.50	27.00	-8.25	61.87
LA-C-P	-23.17	33.90	-23.00	35.52	-17.80	28.97	-7.17	23.08
LA-C-R	23.40	26.65	1.60	41.88	15.80	35.17	15.00	23.70

HA = High Ability
MA = Medium Ability
LA = Low Ability

NC = No Competition
C = Competition

C = Control
P = Praise
R = Reproof

PALMAR SWEAT PRINT DEVIATION SCORE MEANS
AND STANDARD DEVIATIONS

Groups	Stage 5		Stage 6		Stage 7		Stage 8	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
HA-NC-C	-13.80	36.12	-37.33	20.87	-33.50	33.63	-16.33	14.60
HA-NC-P	-11.75	24.69	-16.00	27.48	-22.38	29.24	-21.25	32.27
HA-NC-R	7.83	49.48	-14.50	39.57	-9.50	45.23	-11.00	38.42
HA-C-C	-9.67	16.67	-13.67	20.21	5.00	25.32	-15.67	12.24
HA-C-P	-0.13	31.38	-10.00	34.51	-1.25	34.07	-4.63	20.56
HA-C-R	-4.86	43.28	-8.86	28.94	-16.71	27.21	-1.43	28.60
MA-NC-C	-22.75	44.61	-11.63	41.42	-18.75	46.82	-19.50	34.73
MA-NC-P	-25.57	36.28	-29.29	42.67	-1.71	58.03	-29.29	19.68
MA-NC-R	-27.67	32.87	-43.33	27.54	-32.33	37.58	-35.67	54.99
MA-C-C	-31.63	30.96	-19.88	45.30	-55.13	30.94	-24.88	41.83
MA-C-P	-30.75	46.35	-10.50	27.09	-11.25	34.34	-18.50	38.91
MA-C-R	-21.33	45.16	-22.50	37.10	-34.67	28.86	-5.67	41.27
LA-NC-C	-11.33	56.18	-40.33	38.94	-21.00	44.35	-31.00	24.32
LA-NC-P	-28.00	44.32	-0.86	43.50	-11.63	38.46	-12.63	38.00
LA-NC-R	-14.38	28.97	-31.13	53.32	-17.50	61.71	-26.25	48.81
LA-C-C	-15.00	63.38	10.25	34.36	-0.75	30.39	-4.50	15.02
LA-C-P	-15.50	22.85	-5.17	34.95	-8.33	18.91	-27.80	17.97
LA-C-R	10.60	25.20	9.80	27.03	14.60	37.41	-4.80	41.03

ANALYSIS OF VARIANCE OF SWEAT PRINT DEVIATION SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
A: Ability Level	11987.80	2	5993.90	1.27
B: Competition	9838.70	1	9838.70	2.08
C: Reinforcement	4694.73	2	2147.37	0.50
A x B	20432.00	2	10216.00	2.16
A x C	19390.16	4	4847.54	1.02
B x C	1.72	2	0.86	0.00
A x B x C	10449.75	4	2612.44	0.55
S(ABC)	767042.00	162	4734.82	
D: Trials	11913.70	7	1701.96	2.27
A x D	9111.07	14	650.79	0.87
B x D	4099.42	7	585.63	0.78
C x D	9833.73	14	702.41	0.94
A x B x D	14183.35	14	1013.10	1.35
A x C x D	29643.70	28	1058.70	1.41
B x C x D	8348.50	14	596.32	0.80
A x B x C x D	20716.26	28	739.87	1.00
S(ABC) x D	850186.00	1134	749.72	

$p > .05$

Note: Treatment group stage mean has been included for missing data.

APPENDIX K

PALMAR SWEAT PRINT TEST-RETEST RELIABILITY COEFFICIENT AND TWO JUDGE CORRELATION COEFFICIENT

TEST RETEST RELIABILITY MEASURE OF
PALMAR SWEAT PRINT SCORES

Score	X	Y	X^2	Y^2	XY
1.	7	9	49	81	63
2.	-24	-22	576	484	528
3.	-15	-16	225	256	240
4.	0	-6	0	36	0
5.	51	41	2601	1681	2091
6.	-11	-8	121	64	88
7.	-20	-26	400	676	520
8.	-5	-1	25	1	5
9.	-52	-48	2704	2304	2496
10.	18	20	324	400	360
11.	30	33	900	1089	990
12.	-50	-50	2500	2500	2500
13.	6	5	36	25	30
14.	-41	-44	1681	1936	1804
15.	11	12	121	144	132
16.	42	44	1764	1936	1848
	-53	-57	14027	13613	13695

$r = .99$

CORRELATION BETWEEN TWO JUDGES ON
PALMAR SWEAT PRINT SCORES

Score	X	Y	X^2	Y^2	XY
1.	-4	0	16	0	0
2.	1	3	1	9	3
3.	2	10	4	100	20
4.	26	29	676	841	754
5.	14	33	196	1089	462
6.	35	45	1225	2025	1575
7.	11	28	121	784	308
8.	2	13	4	169	26
9.	-6	-6	36	36	36
10.	-11	-2	121	4	22
11.	3	9	9	81	27
12.	-53	-49	2809	2401	2597
13.	3	8	9	64	24
14.	4	12	16	144	48
15.	-8	2	64	4	-16
16.	-49	-43	2401	1849	2107
17.	-24	-9	576	81	216
18.	-71	-70	5041	4900	4970
19.	20	-2	400	4	-40
20.	8	2	64	4	16
21.	-90	-83	8100	6889	7470
22.	-21	-28	441	784	588
23.	31	28	961	784	865
24.	25	29	625	841	725
25.	37	32	1369	1024	1184
26.	51	52	2601	2704	2652
27.	-41	-20	1681	400	820
28.	9	36	81	1296	324
29.	46	41	2116	1681	1886
30.	39	33	1521	1089	1287
31.	-6	-3	36	9	18
32.	49	53	2401	1809	2597
33.	9	10	81	100	90
34.	-26	-17	676	289	442
35.	-46	-40	2116	1600	1840
36.	-50	-42	2500	1764	2100
37.	-43	-39	1849	1521	1677
	-124	55	42944	40173	39723

$r = .97$

APPENDIX L

POST-EXPERIMENT QUESTIONNAIRE AND RESPONSE DATA

QUESTIONNAIRE

1. Did you enjoy participating in this experiment? . . . . . ___Yes___No

2. Did you try your best on every trial? . . . . . ___Yes___No

3. Did it bother you to have another student playing the game at the same time as yourself? . . . . . ___Yes___No

4. Did it bother you to have someone watching you play the game? . . . . . ___Yes___No

5. Do you think you could have done better if you were alone while playing the game? . . . ___Yes___No

6. Did you try to do better at the game than the person seated opposite you? . . . . . ___Yes___No

7. Did you feel you were expected to try to do better than the person seated opposite you? ___Yes___No

8. Did you try to beat your best score on every trial? . . . . . ___Yes___No

9. Did you know anything about the experiment before coming to the experiment room? . . . ___Yes___No

Comment:

RESULTS OF POST-EXPERIMENT QUESTIONNAIRE

	Group	Yes	No	Group	Yes	No
1.	Competition Control	30	0	No Competition Control	30	0
	Competition Praise	30	0	No Competition Praise	30	0
	Competition Reproof	28	1	No Competition Reproof	30	0
2.	Competition Control	25	5	No Competition Control	28	2
	Competition Praise	30	0	No Competition Praise	29	1
	Competition Reproof	24	5	No Competition Reproof	23	7
3.	Competition Control	2	28	No Competition Control	2	28
	Competition Praise	4	26	No Competition Praise	0	30
	Competition Reproof	5	24	No Competition Reproof	3	27
4.	Competition Control	10	20	No Competition Control	3	27
	Competition Praise	8	22	No Competition Praise	5	25
	Competition Reproof	14	15	No Competition Reproof	7	23
5.	Competition Control	11	19	No Competition Control	14	16
	Competition Praise	11	19	No Competition Praise	4	26
	Competition Reproof	19	10	No Competition Reproof	14	16

6.	Competition Control	17	12	No Competition Control	16	14
	Competition Praise	19	11	No Competition Praise	13	17
	Competition Reproof	16	13	No Competition Reproof	17	13
7.	Competition Control	6	24	No Competition Control	5	25
	Competition Praise	7	23	No Competition Praise	4	26
	Competition Reproof	11	18	No Competition Reproof	11	19
8.	Competition Control	27	3	No Competition Control	29	1
	Competition Praise	29	1	No Competition Praise	29	1
	Competition Reproof	26	3	No Competition Reproof	26	4
9.	Competition Control	6	24	No Competition Control	11	18
	Competition Praise	10	20	No Competition Praise	10	20
	Competition Reproof	12	17	No Competition Reproof	14	15

APPENDIX M

INTERVIEW QUESTIONS AND RESPONSES

INTERVIEW

1. Did you enjoy participating in the experiment?

2. If given a chance, would you like to try forty more trials?

3. Did you think the game was difficult? How difficult? Rate it between: difficult, very difficult, extremely difficult. Would you consider it easy? How easy? Rate it between easy, quite easy, very easy.

4. Were you satisfied with your performance? Why?

5. What exactly did you know about the experiment before coming to the room to do the forty trials? What did you know in addition to what you learned from the pre-test? Did you know anything about measuring heart rate, the finger prints, the audience or testing in paris?

6. Did you have any idea how the boy opposite you was doing? If so, how? Could you hear the ball roll? Did the noise give you any idea how the other boy was doing? If you had some idea how he was doing, would you consider it an accurate estimate or just so-so?

7. What was your reaction to the information I gave you on your performance? Did you think I was talking to just you or just your coactor or both of you? Did the information I gave you help your performance? Would you rather have had no information?

INTERVIEW DATA SUMMARY

Subject	Treatment	Question 1	2	3	4	5	6	7
1.	LA-C-R	Yes	Yes	Difficult	No	Pre-test	No- Noise but no information	Both of us, tried harder
2.	LA-NC-P	Yes	Sure	Difficult	Don't know	Pre-test	No-Could sort of hear sound	Both not disappointed, wasn't doing okay.
3.	LA-C-P	Yes	Sure	Not really difficult	So so	Pre-test	No, maybe the bionic man, but not me"	Both, felt good.
4.	LA-C-R	Yes	Yes	Little difficult	No	Nothing	No, nothing	Both, no reaction wanted information
5.	HA-C-R	Yes	Yes	Sort of difficult	No	Game and coaction	Yes, heard his ball roll, fast and a long time	Both, rather not have information
6.	LA-C-C	Yes	Yes!	Difficult	Yes	Pre-test	No, nothing	Would have liked information
7.	LA-C-R	Yes	Yes	Difficult	No	No	No	Both, didn't bother me

8.	LA-C-P	Yes	Yes	Difficult	Yes	Heart rate	No	Both, made me happy
9.	LA-NC-P	Yes	Yes	Difficult	No	Nothing	No	Both of us
10.	LA-C-R	Yes	Yes	Difficult	No	Nothing	Little idea	Both, wasn't doing well, didn't bother me
11.	LA-NC-P	Yes	Yes	Difficult	No	Nothing	Nope, I concentrated	Both, information, didn't help or matter
12.	MA-C-C	Yes	Yes	Difficult to easy	Yes	Pre-test	No	Information wouldn't matter
13.	MA-NC-R	Yes	Yes	Difficult	No	Heart rate, prints	Nope	Both, no reaction
14.	LA-C-C	Yes	Yes	Easy to difficult	Yes	Pre-test Heart rate	No, heard ball roll, no distraction	Information wouldn't have mattered
15.	HA-C-P	Yes	Yes	Difficult to easy	Yes	Nothing	No, but could hear ball roll	Both, praise helped
16.	HA-C-P	Yes	Yes	Difficult	No	Nothing	No, but could hear ball roll	Both, wanted information, but made no difference
17.	LA-NC-C	Yes	Yes	Difficult	No	Nothing	No, could hear ball roll	Wanted information

18.	MA-NC-C	Yes	Yes	Difficult	Yes	Pre-test, prints, co- acter, heart rate	Could hear ball roll, good idea of performance	Information would have helped
19.	HA-C-P	Yes	Yes	Not difficult	Yes	Nothing	No, concentrated on my own game	Both, information helped, tried harder
20.	HA-C-R	Yes	Yes	Difficult	Yes	Pre-test	No, could hear ball, concentrat-ed on my own	Both, information didn't affect performance
21.	HA-NC-C	Yes	Yes	Very Difficult	No	No	Always finished after me-so must have done better	Information wouldn't have mattered
22.	LA-C-C	Yes	Yes	Easy	Yes	No	No, could hear ball roll	Information would help, try harder
23.	HA-NC-C	Yes	Yes	Easy to difficult	No	Pre-test	No could hear ball roll	Would like information
24.	HA-NC-P	Yes	Yes	Easy	Yes	Nothing	Yes, by sound so, so estimate	Both, wanted information
25.	HA-NC-P	Yes	Yes	Difficult	Yes	No	No, could hear ball, wasn't distracted	Both, information helped increased confidence
26.	MA-NC-P	Yes	Yes	Difficult	Yes	Pre-test	No	Both, information helped

27.	LA-NC-C	Yes	Yes	Difficult	Yes	Nothing	No, could hear ball roll	Information, would make try harder
28.	LA-NC-C	Yes	Yes	Easy to difficult	No	Pre-test Heart rate	No, could hear ball	Information would help-try harder
29.	LA-NC-C	Yes	Yes	Easy	No	Nothing	No, could hear ball, not distracted	Didn't want information, but might have helped
30.	MA-NC-P	Yes	Yes	Easy to difficult	Sort of	Pre-test prints and heart rate	No, could hear ball, not distracted	Both, information helped reproof, try harder.