

A FACTORIAL STUDY OF INCENTIVES IN
CERTAIN LEARNING AND PERFORMANCE SITUATIONS

By

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Thesis submitted to the Faculty of the Graduate School
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fulfillment of the requirements for the
degree of Doctor of Philosophy

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CHAPTER I

INTRODUCTION¹

It is a "common" assumption that, if two individuals of equal ability are performing the same task, one of the individuals may perform at a higher level if praised and the other is likely to be unaffected by praise. It is also a "common" assumption that the reason for this is that individuals differ in some respect. The search for and measurement of the sources of differences in the performances of individuals has long been a fascinating occupation and avocation.

Many dimensions have been proposed; some have been measured. This study attempts to determine the nature of the interaction between one of these dimensions, "interest in the task," and two commonly used incentive conditions, praise and reproof, and competition. In doing this, the study substitutes for the artificiality of the laboratory situation a real life situation in which the individual's performance can be compared with a common, socially known norm. An experimental design was used in this study which permitted the evaluation of the interaction of the conditions operating in such a situation. For many years, psychologists have recognized and done lip service to the interdependence and interaction of the many dimensions operating in any situation, but have proceeded to examine them by using the classical method of the single variable. In this study the multi-variable design through which the effects of

¹This study was conducted under the sponsorship of the School of Aviation Medicine as part of contract number AF-33-038-508 between the Psychology Department of the University of Maryland and the U.S.A.F.

several variables may be assessed has been used.

This chapter presents a brief review of the literature which has dealt with incentives and outlines the conflicting results presented by these studies. It presents an outline of the research undertaken in the present study, the variables which were systematically varied, and the definition of those variables.

The term "incentive" is used frequently to avoid the entanglement in suppositions about the underlying systems or mechanisms connoted by the term motivation. Bird (4) has pointed out that psychologists generally agree that internal states of great complexity, involving both physiological and neural processes, and representing both native and acquired mechanisms of integrations of behavior, serve to direct men and other animals in their dealings with their environments. Motivation is a general term used to designate the dynamic relationships of an organism with its environment and does not denote specific manipulatable mechanisms. It does not denote a specific activity or a pattern of behavior. Motivation, as Bird (4) has pointed out, is a construct. It is an influence, or a state of disequilibrium imputed because living organisms do not always respond to similar situations in the same manner. The term "incentive" as here used denotes a specific stimulus or pattern of stimuli to which the subject is systematically exposed during the performance of the task.

The three types of incentives given most consideration in the literature of psychology are knowledge of results, praise and reproof, and competition. Schmidt (24) has suggested that, regardless of the announced objective of an experiment, be it

the effects of praise vs. blame, or bell-right vs. bell-wrong, the matter of knowledge of results plays a role (24 , pp. 2-3).

The incentive of praise and/or reproof has been the center of much interest for the teacher and the psychologist. Schmidt (24) has quite correctly suggested that it is unfortunate that the terminology of incentives is no more clear cut than it is. He suggests that studies of praise vs. blame, reward vs. punishment, knowledge of results vs. no knowledge of results have in many instances been examining the same thing, or that these problems have been interwoven in the same research design. The terms have not always been clearly defined. Despite the popular notion that the use of praise is more effective than the use of reproof, the evidence is not clear cut. This is emphasized by several writers. David and Ballard (7) have concluded that praise is better than reproof; that both may be effective but praise is better; that too much praise will defeat its purpose; that positive incentives are better for all ages, grades, and intelligence than negative incentives; but that the effects of these incentives vary with age, intelligence, sex, and are affected by individual differences. Young (26) has suggested the need to study praise and blame in relation to self-evaluation, i.e., to the level of self esteem.

Murphy, Murphy and Newcomb (23 , ch. 7), after their comprehensive review of the studies concerned with incentives, conclude that the results of experiments on incentives are by no means clear, and that it is impossible to generalize to any group of individuals in any situation. They suggest that

personality factors be considered in relation to the problem, since these may be tied up not only with the situation inherent in the receiving of praise and reproof as such, but also with the individuals' characteristic modes of response. They suggest that the statement of the problem should be rephrased to read: "With what kind of personality is praise or reproof most likely to be stimulating, and in what form and amount will it be most effective?"

Davis and Ballard (7) in their review of various incentives used in the school situation conclude that individual differences in pupils and teachers will govern the extent to which praise or reproof will be effective. The importance of the variable of "motivation" or incentive upon individual performance has been suggested by Kathryn (20) and by Baker (3). Both authors suggest that the factor of motivation operates to attenuate the correlation between certain predictors and criteria of performance in student pilots.

With regard to the variable of competition, Murphy, Murphy and Newcomb (23) hold the same view as they do towards praise and reproof. Here again they point out the conflicting evidence of the studies summarized and suggest that this confusion arises from a failure to consider the individual in relation to his cultural background and his own peculiar personality make-up.

The voluminous writings on incentives and the paucity of agreement in results have suggested to many psychologists the need to consider the numerous variables in any experimental situation and to evaluate their interactions. For example, in

the reviews of the literature on motivation, conclusions are drawn regarding the relative effects of praise or reproof. Each of the writers presents qualifications or conditions modifying their conclusions. The effect of praise or reproof seems to require the phrase "dependent upon. . . ." One of the "dependent upons" has already been mentioned, namely, Murphy, Murphy and Newcomb's personality factors. Allport (2) has suggested "ego-involvement" in the task. Edwards (9) speaks of the "ego-involved frame of reference." Mowrer (21) has equated Allport's "ego-involvement" to "emotional arousal." For the purposes of this study these terms are equated to the general term "interest in the task."

The isolation of such a dimension has been suggested by still other writers. Fryer (11), for example, has stated it thus:

Motivation is the energy aspect of experience and reaction; a basic motivational principle is that varying degrees of stimulation liberate quantities of energy. Interest, on the other hand, refers to qualitative changes in behavior; it is the acceptance-rejection aspect of reaction. Measurement of motivation and measurement of interest are thus separate and it is important to keep them apart to avoid experimental confusion.

Katz and Likert (12) would like to differentiate between external and internal motives. By external motivation they refer to that which comes into play from praise and punishment given outside the person. Internal motivation is that which starts from the ego needs of the person. The prestige that an employee attaches to his job, a sense of accomplishment in doing a job well, the need to be employed at work in which one is interested, the illusion of self-determination and freedom,

are examples given of internal motivation. These authors further state that these complicate the determination of the relative value of external motivation since each employee interprets the external stimuli uniquely. These interpretations are based on the "frame of reference" of the employee and on his personality. Young, as mentioned previously, has suggested that a need exists to study the effects of praise and blame in relation to self-evaluation, i.e., in relation to the level of self esteem. Diserens and Vaughn (8), on the basis of a comprehensive review of the literature in the field of motivation, posit several "laws." The fourth of these "laws" is as follows:

The effectiveness of a given motive in any situation varies directly with the number of cooperating motives or facilitating factors, and inversely with the number of competing motives or inhibiting factors.

Previous experimentation has shown the importance of the interaction of "interest in the task" and other variables in learning and performance situations. Gordon Allport (2) has summarized experiments dealing with what we have assumed to be a similar dimension in his article "The Ego in Contemporary Psychology" (2). Gardner Murphy, as Allport indicates in his article, was one of the first to point out the importance of interest in connection with the controversy over specificity and generality. Murphy (22 , p. 385) suggested that, "Honesty is either a general characteristic or a set of specific habits, depending on your interest and your emphasis."

Klein and Schoenfeld (17) have demonstrated a marked relationship between "ego-involvement" and the consistency of

confidence ratings. The confidence ratings of the subjects became much more consistent with a shift in the atmosphere or emphasis on the importance of the task. The authors conclude that confidence is a personality trait when the ego is involved, but that it is specific to each situation when the subject has no deep interest at stake. The Office of Public Opinion Research has found that intensity of feeling is associated with consistency of opinion (5 , ch. 3).

One experiment is particularly pertinent to the problem and the method of this study. Edwards (9) applied the analysis of variance technique to the problem of the relationship between ego-involved frames of reference and memory for material. He demonstrated that memory for material is positively associated with the individual's frame of reference. Levine and Murphy (18) have demonstrated that pro-communist sympathizers memorize pro-communist material more readily than they do anti-communist material.

The conclusions to be drawn from the survey of the literature suggest definitely that knowledge of results plays a role in determining the level at which an individual will perform a task. However, the results of studies on the influence of praise and reproof and of competition are inconsistent and lead to equivocal conclusions. Several writers have suggested that the results of experiments concerned with these incentives must be examined in the light of their relation to other variables operating in the experimental situation. Such "other" variables have been variously named; "ego-involvement," "self-esteem," "egocentric frame of

reference," and "interest in the task," are examples. Certain experiments have indicated that the hypothesis of such a variable or variables is reasonable and that their consideration and evaluation in experimental research would lead to the resolution of many of the conflicting results produced by past research.

The problem of the present study is to evaluate the effect of the incentives of (1) praise and reproof, and (2) competition and their interactions on task performance. It was designed also to study the relationships between these variables and the dimension of "interest in the task."

In this study these incentives are defined as follows:

1. Praise and reproof

- a. Praise. Verbal encouragement by the experimenter; performance cited as exemplary in comparison to past performance and/or expected performance and in comparison to other subjects.
- b. Reproof. Performers subjected to re-priming, negative criticism, and verbal attacks on their ability and performance by the experimenter.

2. Competition

This variable was made up of three aspects or conditions.

- a. No competition. The subject performed the task alone except for the presence of the experimenter.
- b. Paired competition. Two subjects were paired against another two within a group of four competing for the highest combined score of the two.
- c. Individual competition. One individual subject competing within a group of four for the highest individual score.

The effect of a third aspect of the praise and reproof

9

variable, i.e., indifference or ignoring the individual, would be desirable in assessing the relative merits of praise or reproof. Under the conditions of the experimental design, the addition of this variable would require the addition of one-third more subjects and time. Only the two extremes of this "continuum" were used to test the main thesis, namely, the relationship of certain incentive conditions to the dimension of "interest in the task."

The present study sets up two null hypotheses. First, that scores obtained on a task under different incentive conditions will fluctuate from condition to condition no more than would be expected by chance. Second, the relative position of individuals will not vary from condition to condition beyond the limits of sampling variability. That is, the correlation of scores obtained under conditions of "no competition" and praise with those obtained under conditions of "no competition" and reproof, would not be expected to be different from the correlation obtained if the scores under conditions of paired competition and praise were correlated with those obtained under conditions of paired competition and reproof. Within the experimental design a number of such correlations may be obtained and compared to test our hypothesis. If the performance of individuals under different incentive conditions varies so as to produce significant differences in correlation coefficients, we must reject the hypothesis and conclude that incentives act differentially on individuals.

The experiment was conducted using two psycho-motor tasks holding differential interest for the subjects. The first of

these was a laboratory psycho-motor task and the other was the task of playing golf. The psycho-motor task was chosen because of the following considerations:

First, in a highly industrialized economy, millions of man hours are spent each day in production of goods and services by men engaged in simple or complex psycho-motor tasks such as running lathes, presses, laying bricks, barbering, etc. Even small increments in performance brought about by proper knowledge and application of incentives would be vastly important to such an industrialized economy.

Second, the task of training new employees to operate old machines and old employees to operate new machines must go on constantly. Proper administration of incentives can cut down the time and cost of such training and the savings in each instance would be substantial.

Third, and most important, the safety of millions of people depends upon the psycho-motor skills of airplane pilots, truck drivers, automobile drivers, etc. If the proper application of incentives can increase the efficiency of these persons to even a slight degree the saving to society would be of extreme importance.

CHAPTER II

THE EXPERIMENTAL PROCEDURE

Experimental Design

The design for this experiment can be said to represent a 2 x 3 factorial arrangement with six possible treatment conditions. Two main conditions were systematically varied within the design. These conditions were (1) praise and reproof, and (2) competition. The basic block of the design is shown in Table 1.

TABLE 1. The basic block of the 2 x 3 factorial design.

	* N C	C 2 x 2	C 1 x 3
Praise	4 subjects	4 subjects	4 subjects
Reproof	"	"	"

* N C = No competition

C 2 x 2 = Competition by pairs in a group of four

C 1 x 3 = Individual competition in a group of four

Praise = Verbal encouragement and performance cited as exemplary

Reproof = Verbal discouragement and negative criticism; performance cited as unusually poor in comparison to other performances and/or performance expected by experimenter.

Each subject underwent six combinations of conditions:

- (a) "no competition" with reproof (NCR); (b) "no competition" with praise (NCP); (c) paired competition with reproof (C2x2R); (d) paired competition with praise (C2x2P); (e) individual

competition within a group of four with reproof (Clx3R); and (f) individual competition within a group of four with praise (Clx3P). The basic design required 24 individuals undergoing each of the combinations of conditions represented. Two other variables associated with the individuals performing the task were controlled and evaluated: (3) initial level of ability of the individual, and (4) the trial, whether 1, 2, 3, etc., i.e., the amount of practice of the individual.

In any learning experiment, the performance of the individual is a function of his previous practice on the task. In this type of factorial design the variable of trial, or practice, presents a somewhat unique problem. In the usual experiment employing the multi-variable design one may set the task so that any deviations in performance may be ascribed to the influence of the experimental conditions. In the learning experiment, however, the influence of practice and experimental conditions may be confounded unless care is taken in setting up the design. In order to evaluate the effect of learning in this study, individuals were placed into the basic design so that each combination of conditions was represented under each level of practice. In order to evaluate the effect of level in this design, each group of four individuals in each cell was made up of one individual from each of four initial ability levels. These four initial ability levels were drawn from a population of individuals on whom preliminary trial scores had been obtained. The levels were set up so as to represent four distinct levels of initial ability on the task. Table 2 represents the order of trials for the 24 subjects. The arrangement shown in Table 2 represents the order in which the

TABLE 2. Latin square order of groups and trials for the initial phase of the psycho-motor experiment.

	1	2	3	4	5	6
NCP	A*	F	E	D	C	B
2x2P	B	A	F	E	D	C
1x3P	C	B	A	F	E	D
NCR	D	C	B	A	F	E
2x2R	E	D	C	B	A	F
1x3R	F	E	D	C	B	A

* Groups of four individuals composed of one individual from each of four initial ability levels.

initial seventy-two subjects participated in the psycho-motor laboratory task. This arrangement was used to approximate the ordinary testing situation in which individuals of differing abilities are brought together into a group for testing. At the same time, however, we were able with this design to estimate the effect of practice and its relation to the other variables being assessed.

In the golf situation, the arrangement shown in Table 3 was used in order to assess the effects of practice. This design was used to approximate the situations in training and learning in which individuals of approximately equivalent abilities or levels of learning perform in a group, e.g., the primary or secondary level of flying training, or grade or apprentice level in training in motor tasks. In this situation the individual was subjected to either praise or reproof under conditions in which the differential treatment of individuals

TABLE 3. Latin square order of groups and rounds for golf experiments

Round	Group or Level																				
	A			B			C			AA			BB			CC					
	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual			
1	2x2 Condition*	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P
2	2x2 Condition**	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P
3	1x3 Condition	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P
4	2x2 Condition	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P
5	2x2 Condition	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P
6	1x3 Condition	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P	1 R	2 P	3 R	4 P

* Condition
 NO = No Competition
 2 x 2 = Competition by pairs in groups of 4
 1 x 3 = Individual competition in groups of 4
 **R = Reproof or verbal discouragement and negative criticism
 P = Praise or verbal encouragement and performance cited as exemplary.

by the experimenter was immediately apparent. More specifically, this design sets up a situation in which the individuals were aware of the injustice and discrimination shown by the administration of either praise or reproof.

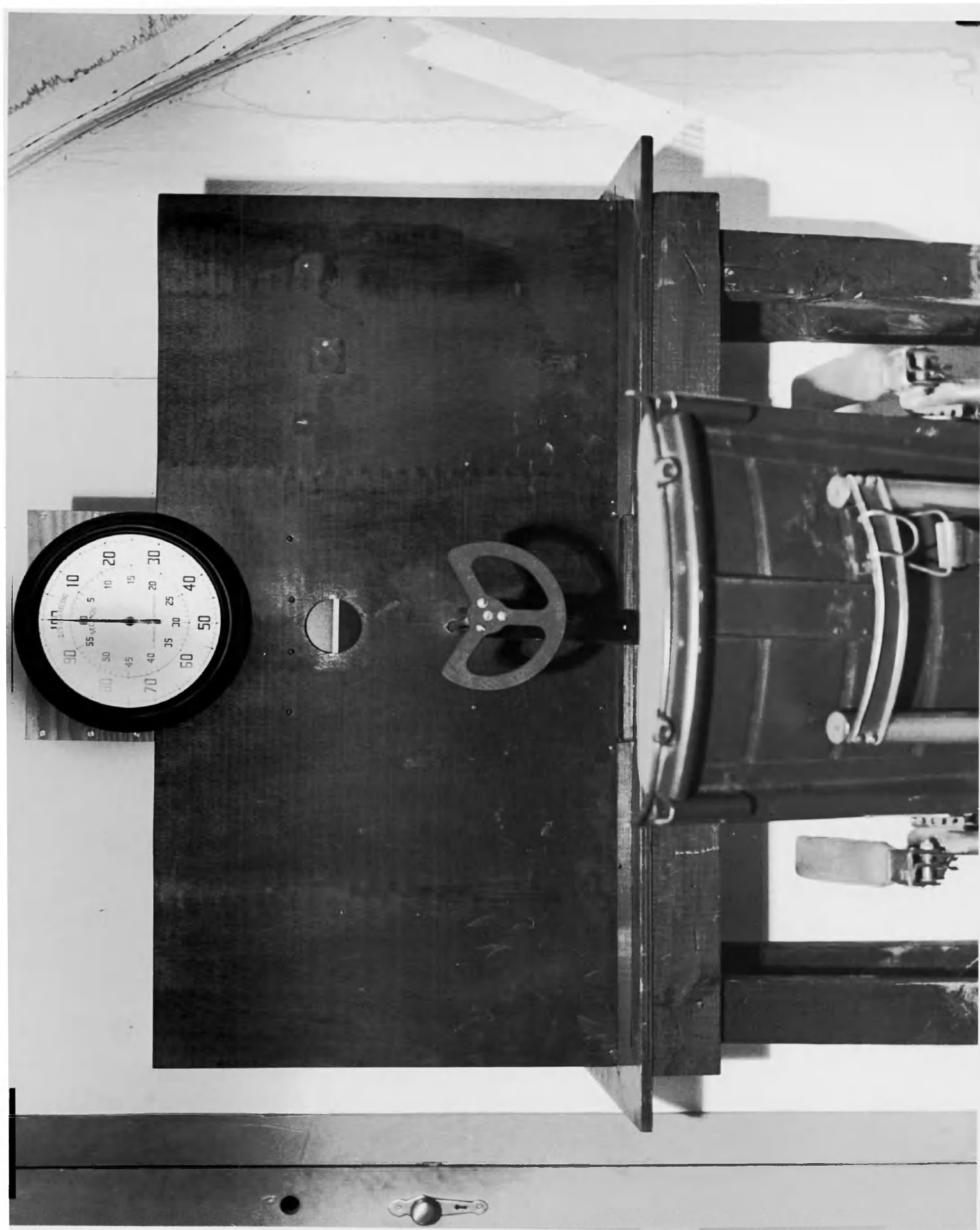
Subjects

The individuals who participated in the experiment were selected from a group of male university students who volunteered their services. Their ages ranged from 18 to 36. The group was selected so as to represent gradations in golfing ability from experienced golfers to those having no knowledge of the game. None of the individuals in the group had had previous experience on the psycho-motor task. All subjects were paid fifty cents per hour for the time spent participating in the experiment. Seventy-two subjects participated in the psycho-motor experiment and twenty-four in the golf experiment.

Apparatus and Procedure

The psycho-motor apparatus. The experiment was carried out in two different task situations. The first of these was a single dimension pursuit task furnished by the School of Aviation Medicine, Randolph Field, Texas. This apparatus was slightly modified in that additional scoring clocks were added and the face of the task apparatus was enlarged from a 11 by 13 inch area to one of 24 1/2 by 46 inches. A photograph of the task apparatus appears in Plate I.

In the face of the apparatus there is a circular aperture



three inches in diameter. Visible through this aperture is a horizontal bar, one-quarter inch in width which is displaced through the vertical plane in an irregular manner by means of a motor driven cam. The task required of the subject is to compensate for the irregular movement of the bar and to keep the bar in line with two reference marks, one-quarter inch in width, located on either side of the circular aperture. The subject accomplishes this by proper manipulation of a control wheel mounted on a one-half inch steel rod extending from the face-panel 4 1/2 inches below the circular aperture. The control wheel rod extends 18 1/2 inches from the face of the apparatus in maximum forward position with two inches of movement fore and aft for control of the horizontal bar. Movement of the control wheel toward and away from the apparatus makes it possible for the subject to compensate for the movement of the horizontal bar and to keep it in line with the reference marks. Two contact points are mounted on the bar so that an electrical circuit is completed when the bar is kept within one-half its width above or below the reference marks. When this circuit is completed it activates a Standard Electric timer so that total time "on target" may be obtained. The subjects performance is measured in terms of the amount of time that he is successful in keeping the bar within one-half its width above or below the reference marks, the score being recorded upon the timer in 1/1000 minutes.

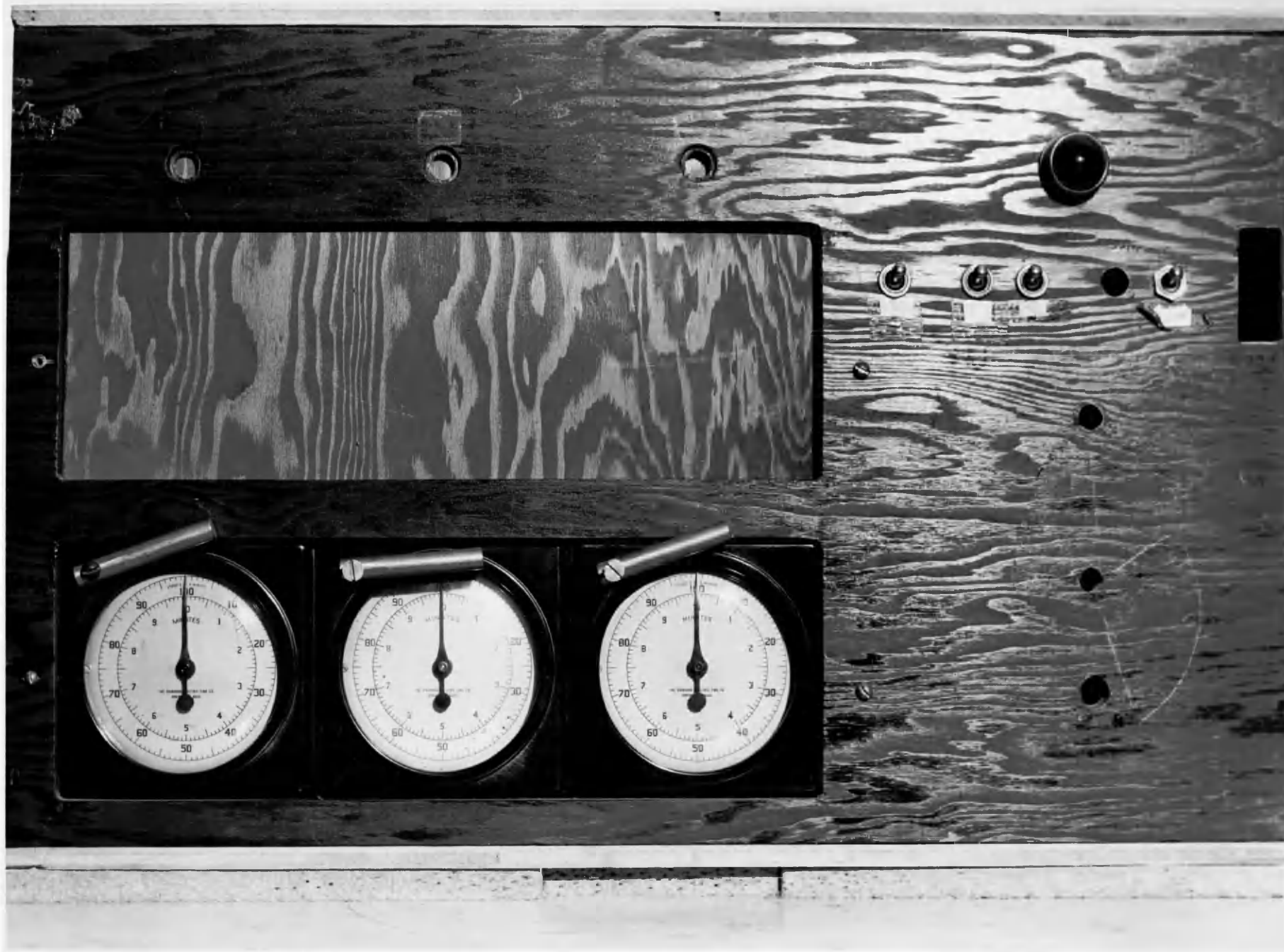
A Standard Electric timer with a face nine inches in diameter was mounted on the apparatus six inches above the center of the circular aperture. This timer was mounted in

full view of the subject so that immediate knowledge of results was available. When the subject was "on target" the hands of the clock moved and when he was "off target" the hands stopped. The timer recorded time "on" in 1/100 seconds so that a quite rapid sweep of the hand accompanied successful manipulation of the task control wheel. Also total time "on" was immediately known to the subject at the end of each trial. While the face of the clock was visible to the subjects, observation of their behavior showed that the subjects also gauged their performance by the auditory cues offered by the scoring mechanism.

The subject was seated before the apparatus in an adjustable multiple-engine aircraft type seat so that he could comfortably reach and manipulate the control wheel. The height of the seat was adjusted so that the subject's eyes or line of sight was on the same level as the circular opening and horizontal bar. The scoring console was located behind the subject so as not to create a visual distraction for him.

The control console as shown in Plate II consisted of three Standard Electric timers scoring in 1/1000 minutes and mounted in a horizontal row. The center timer of the three recorded total time and ran continuously. It was synchronized with the scoring timers so that at the end of each one-half minute period the switching mechanism transferred the scoring process from one timer to the other. Thus, the experimenter was provided with information as to when to tell the subjects to begin and to stop. Further, this timer served to time the rest intervals between trials. The only other controls necessary on the console face were the master switch; task switch, which provided electrical current for the pursuit task

PLATE II. Scoring console for the psycho-motor task.



can motor and scoring contacts; total time switch serving to start and stop the total time timer; and a reset switch which served to re-set the large timer on the apparatus face after each trial. The control console contained two timers and a switching mechanism which shifted the scoring from one clock to another in one-half minute intervals and scores could then be taken for each one-half minute interval. The experimenter recorded the score on one clock and re-set it to zero while the other clock was operating.

The apparatus was housed in a well lighted and well ventilated room of a "pacific" hut. All conditions other than those experimentally varied were controlled as carefully as possible.

Equipment for golf task. Eight sets of equipment were purchased for the golf phase of the experiment. Each set of clubs consisted of four irons (numbers 3, 5, 7, and 9); two matched woods (number 1, or driver, and number 3, or spoon); and one putter. All irons were of the same make. Three different makes of wood were represented in the sets. Seven of the sets of woods were of the same length while one set was shorter in length. All sets were in the medium price range for golf equipment. Those subjects who owned their own equipment were allowed to use them with the number of clubs restricted to those mentioned above. A standard make of golf ball was used throughout the experiment.

All rounds of golf were played on one golf course located six miles from the University and operated by the Maryland National Capital Park and Planning Commission. Par for the course was 36 strokes for the nine holes

round. Hole number five had a temporary green during the major portion of the golf runs and was changed back to the permanent green during the latter phase of the experiment. The course is considered as a good "beginners" course by experienced golfers since there is no rough between the fairways. A diagram of the course with the major hazards is shown in Appendix A. Greens fees were paid for the subjects and transportation to and from the course was furnished.

Scoring

Psycho-motor task. Total time on target was taken for each one-half minute interval and recorded on the form shown in Appendix B. Scores were recorded in 1/1000 minutes. These scores were then summed for each trial (one two minute period) and entered on the form shown in Appendix C. From this form total scores were obtained.

Golf task. The task of golf was scored by marking the position of the ball after each stroke on a diagram of the course. An example of this scoring sheet is shown in Appendix D. The experimenter noted upon this sheet the number of the wood or iron used and drew a line from the point of origin of the stroke to the position of the ball after the stroke. Penalty strokes were noted when, for example, the ball was taken from a natural hazard and put back into play. The number of putts used on each hole was noted beside the green of the hole in question along with the total number of strokes required to complete the hole. Thus, errors in recording the number of strokes for each hole were minimized. An example of

a completed score sheet is shown in Appendix E.

Procedure for Psycho-motor Experimentation

The experimental design utilized in phase one and two of the psycho-motor experiment is shown in Table 2.

Phase I. In selecting individuals to undergo this phase of experimentation preliminary trials of two minutes duration were administered to 116 subjects. A large group was tested initially to insure a population from which to draw random samples. The distribution of preliminary scores for this population is shown in Appendix F. From this group, four levels of initial ability were set up. Six individuals were selected at random from each ability level. From these individuals, six groups of four individuals were set up for each replication of the basic design in order to fulfill the requirement of 24 individuals. The distribution of scores within each group is shown in Appendix G. Each of these six groups of four was made up of one individual from each of the four initial ability levels. Thus, for each replication of the basic design there were six groups of four individuals each with each group containing one individual from each of the ability levels. Each individual was picked from the ability level and assigned to a group by a random procedure. Tests were then made to determine the comparability of the means and standard deviations of each of the groups. The population of individuals participating in the psycho-motor experiment was made large so as to insure the drawing of a random population

therefrom for participation in the golf experiment.

The twelve groups constituting the first phase of the psycho-motor experiment were compared since all of these groups were subjected to the same experimental conditions. Groups A, B, C, D, E, and F constituted the first six to undergo the experiment and groups G, H, J, K, L, and M constituted the groups undergoing the replication.

The comparability of means was tested by setting up the fiducial limits about the total mean of all individuals within these groups. The total mean for groups A through M was 1621.1 with a standard error of 19.24. The one percent confidence limits were from 1571.5 to 1670.6. One of the group means fell outside of these limits (group A). Analysis of the variance of the means, however, showed the mean variation not to be greater than the error variance in the total group.

The comparability of variance was tested by utilizing the Welsh-Mayer (16) test for homogeneity. The variances were found to be equal. ($L_1 = .6963$) Table 4 gives the means for groups A through M.

TABLE 4. Means of groups A through M utilized in phase I of the psycho-motor experiment.

Group		
A	1565.7	
B	1656.0	
C	1611.0	
D	1599.0	
E	1630.3	
F	1643.5	
G	1576.8	
H	1631.3	
J	1665.0	
K	1612.5	
L	1598.3	
M	1664.0	
Total	1621.1	

N = 4 per group
 SD (Total) = 131.99
 SE = 19.24
 Fiducial limits:
 1% = 1670.6 - 1571.5
 5% = 1568.8 - 1583.4

These groups were then ordered to the conditions of the experiment as outlined in the section on experimental design and as shown in Table 2. Six of these groups underwent all six conditions while the other six underwent only three conditions. We were able to evaluate the effect of the main variables of praise and reproof, and competition after three conditions since all groups are comparable. Between group variation has been taken out of the situation and does not confound our estimates of the effects of the other variables. Had significant mean differences between the groups existed it would have been impossible to determine whether the variation was due to conditions or to initial status.

Each individual was given four two-minute trials under each of the conditions. Trials were alternated so that all four individuals completed trial one, then trial two, etc., individuals following one another in order. During trials in which competition was present, all four of the individuals in the group were present in the testing room and could observe the performance of the other individuals. Under "no competition" conditions the subjects were taken into the testing room one at a time while the other three subjects waited in an adjoining room.

Under conditions of praise the subjects were encouraged by the experimenter, complimented on their improvement, and told that they were performing well. Under conditions of reproof the subjects were criticised for their lack of improvement, and told that they should have shown much more improvement over previous performance than they were ex-

hibiting. These conditions were administered in a uniform but not highly standardized manner since in the usual non-laboratory situation they have no standard pattern of administration. Two experimenters were used to conduct the study. Difficulty in scheduling prohibited counter balancing the conditions by experimenter so this source of variance remains uncontrolled within the system.

Phase II. In setting up the groups for Phase II of the psycho-motor experiment individuals were again chosen from four initial ability levels. These individuals were picked at random and assigned by random process to conditions as in Phase I. As in Phase I each group was comprised of one individual from each ability level.

The comparability of the groups was tested as in Phase I by setting up fiducial limits about the total mean and by the Welch-Wayer test for homogeneity of variance. Variances did not differ significantly one from the other. However, one group mean, group Q, fell outside the fiducial limits. An analysis of the variance between means showed, however, that the total variance between means did not differ significantly from error variation. Means for groups N through S used in Phase II are shown in Table 5.

TABLE 5. Means of groups N through S used in phase II of the psycho-motor experiment.

Group		
N	1742.0	N = 4 per group SD = 139.11 SE = 28.98 Fiducial limits: 1% level = 1798.2 - 1648.9 5% level = 1780.4 - 1666.6
O	1627.8	
P	1737.8	
Q	1752.5	
R	1737.3	
S	1744.3	
Total	1723.6	

In this phase of psycho-motor experimentation a change was made in the competitive situations. Under condition of 2 x 2 competition (two pairs of individuals competing for highest combined score) a reward of five dollars was given to the pair obtaining the highest total score. Under 1 x 3 competition (individual competition in a group of four) a reward of two dollars and one half was given to the individual with the highest total score. The conditions of praise and reproof were varied as in Phase I.

Procedure for Golf Experimentation

The golf phase of the experiment was designed to test the effects of the same combination of conditions as was tested in the psycho-motor experiment. The experimental design utilized in this phase is shown in Table 3. In Table 3 it will be seen that each condition is represented for each round and that each individual is subjected to each of the conditions.

Thirty of the subjects who had participated in the psycho-motor phase of the experiment were given three preliminary rounds of golf to determine their initial ability. The distribution of the preliminary scores is given in Appendix II. From these subjects three levels of initial ability were set up and eight individuals selected at random from each level. These individuals were then assigned at random so that each level of ability was represented by two groups of four individuals each. Group A and AA represent the highest ability level; groups B and BB the middle level; and C and CC the lowest level. The distribution of scores within each group is also

shown in Appendix H. These groups were then ordered in Latin square fashion to conditions and trials as shown in Table 3. In selecting the particular individuals who were to receive praise and reproof in the initial round a random process was used. After this initial assignment the conditions were ordered as shown. Subjects were then subjected to different conditions for each round of play with each subject participating in a total of six rounds during the experiment. The scores obtained under each of the conditions are given in Appendix J. Scores obtained under the components of total score, i.e., first three holes, middle three holes, and last three holes, are given in Appendices K, L, and M.

During competitive rounds the group played as a foursome with the experimenter accompanying the group. The experimenter recorded strokes as shown in Appendix E and administered praise and reproof according to the ordering of the conditions. Two of the individuals within the foursome received praise and encouragement while the other two were negatively criticised and reproofed. During non-competitive rounds the individual subject played alone accompanied only by the experimenter with praise and reproof being administered as demanded by the experimental design. Two experimenters were again used to conduct the study with only one experimenter accompanying any group or individual. Difficulties in scheduling prohibited the counter balancing of conditions by experimenter so this source of variance remains uncontrolled in the system.

The experimenter recorded the comments and behavior of the subject during the round which served to indicate the subjects'

feelings toward his performance. Examples of such notes include, "Throws club"; "Don't give a ____ about this round"; "Oh well, tomorrow is another day"; "It wasn't that the course was bad, I just didn't care," and "I don't like to play by myself." At the completion of the six rounds of golf the subjects were asked to answer the questions and make the ratings shown on the Final Questionnaire form shown in Appendix N.

During the course of experimentation, one individual dropped from the experiment after the first round of play. The group of which he was a member began the experiment under conditions of "no competition." Therefore, substitution of another player could be made without disturbing the conditions of the experiment for his group or confounding them with practice. Fortunately, for the conditions of the experiment, no other losses of subjects occurred. Preliminary rounds to establish level of performance were begun on March 15 and play under the experimental conditions was begun on April 5. Experimentation was completed on May 17 with a total of 144 rounds of golf played. Weather conditions remained fairly uniform throughout the experiment with only three holes of play for one man rained out. These holes were played before the group continued on to the next condition. Illness or injury of the subjects forced postponement of play in three instances. These were not incurred during golf play.

CHAPTER III

ANALYSIS AND RESULTS

The data collected were summarized by analysis of variance. The computational steps in the analysis of variance deserve a brief discussion at this point. They will be taken up in more detail by concrete example after the first results of such an analysis have been presented. The steps are outlined in detail by Fisher (10) and Snedecor (25). Briefly, the analysis is designed to (a) determine the total variance about the general mean by obtaining the total sum of squares of deviations from this general mean. This is the total amount of variance associated with all variables in the situation. (b) The total variance is then broken down into specific parts each of which is traceable to one of the main experimental factors called main effects or to the interaction of these main effects. In this experiment the major interest centers around the main effects of (1) praise or reproof and (2) competition. The interaction effects may be thought of as the effect of a combination of conditions such as "no competition with reproof." (c) The residual (or error) variance is that part of the variability which cannot be accounted for by the experimental factors or their interactions. It follows that if the total amount of variability could be accounted for by the various main effects and interactions there would be no residual or error variance. (d) An efficient test of significance is provided by the F ratio. F

is the ratio of the variance of the factor under consideration, e.g., praise and reproof, to the error variance or variance due to uncontrolled random variation. The variance contributed by praise and reproof is compared with the error variance to determine whether or not it is greater than that of error at a set level of confidence. The probability of the occurrence of a given F value is given in tables of F values which show the numerical value of the ratio (variance of variable under consideration/variance of error) which must be equalled or exceeded in order to be greater than fluctuations which would occur merely by chance. One should bear in mind that the F values obtained are ratios based on summary statistics and show only the chance expectation of such values being reached or exceeded. If an experimentally controlled factor is introduced into the system, e.g., praise and reproof, all that the statistic can show is whether or not the variability in performance under these conditions is greater than would be expected under conditions of random sampling variability. For each analysis of variance the homogeneity of the variances of the sub-groups was tested using the Welch-Mayer test of homogeneity (L_1) as outlined in reference (16, p. 86). This test is fundamental to the use of the F test of significance utilized in the analysis of variance. It is designed to test the hypothesis that the variances of the samples used are not significantly different.

The problem may be clarified by brief discussion of the F test and the distribution of F. The discovery of the F distribution provides an answer to the following type of problems:

Assume a normally distributed variate in an infinite population. From this population, randomly select two samples each of a specified number of cases. In that these samples are randomly selected, the variances (σ^2) of these two samples (σ_1^2 and σ_2^2) will each be an estimate of the true variance of the population. But due to sampling errors, they will differ from the true variance and from each other by varying amount depending on the size of the samples. The problem is to determine the probability of obtaining a difference of any specified size ($\sigma_1^2 - \sigma_2^2$), granting the above assumptions. The F test or F distribution is a solution to this problem. The problem is stated in slightly different though equivalent terms. Instead of dealing with the differences between two variances it deals with the ratio of the larger variance to the smaller variance (σ_1^2 / σ_2^2). It gives the probability of obtaining a ratio of a given size or larger.

Note that the following assumptions are made:

1. The variate is normally distributed in an infinite population.
2. The samples are randomly selected from the population. This implies that the variances are independent, i.e., variations in the size of one variance do not operate to influence variations in the size of the other, i.e., there is no bias operating to cause such a relationship in the size of the variance.

The first assumption has been shown empirically not to seriously invalidate the test (6, p. 24). The second assumption is tested through use of the Welch-Hayer technique.

In this study assignment of the variance attributable to each of the main effects and their interactions was made by

usual analysis of variance procedure. In each analysis, two estimates of residual or error variance was made. In the first of these, the residual variance appropriate for testing the significance of the variance attributable to systematically varied conditions, i.e., praise and reproof, and of competition was estimated.

The analysis and tests of significance based on this estimate are presented as the first of each of the subsequent tables and it is this analysis upon which conclusions regarding these variables are based. The estimate of error variance in this case is the total variance less the variance attributable to the main effects of praise and reproof and of competition, their interaction, and the between individual variance.

$$n_T \sigma_T^2 = n_T \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1x2}} \sigma_{I_{1x2}}^2 + n_{\text{Det. Ind.}} \sigma_{\text{Det. Ind.}}^2)$$

In the second analysis the variance attributable to all conditions whether characteristic of conditions or of individuals was assessed. This analysis and presentation is needed if one is to obtain a complete picture of all sources of variance and their relative effect in the system. This analysis is presented as the second analysis relative to any set of data and is the basis for conclusions regarding the variables of trial and of level. The estimate of error variance in this case is total variance less the variance due to the main effects plus any significant interaction variances.

Analysis of Psycho-Motor Task Data

The ordering of the experimental variables in this design is shown in Table 2. Under these conditions each of the six

groups was comprised of one individual from each of four initial ability levels. When the order of experimental conditions called for a group to undergo conditions of praise, all individuals within that group were subjected to the same conditions of praise. In like manner all were subjected to reproof.

Analysis was carried out with respect to the following sets of data:

1. Total task scores for six trials on the task with all groups undergoing all conditions.
2. Total task scores with any one group undergoing only three of the conditions of the experiment.
3. Total task scores with any one group undergoing only three conditions of the experiment and with added monetary reward during competitive trials.

Analysis of total task score for six trials on the task with all groups undergoing all conditions (N = 24). The test of the homogeneity of the variances of the sub-groups showed the variances not to differ significantly ($F_1 = .9447$; $k = 5$; $N = 4$). The analysis of the variances of this data is given in tabular form in Table 6. In Table 6 it will be noted that the variable of praise and reproof is not a significant source of variation in performance. The variable of competition is associated with variability of performance at between the 20 percent and 5 percent level of confidence. The interaction of the two variables is significant at between the 5 percent and 1 percent level of confidence. Table 7 shows the mean performance under each of the conditions. Figure I is a graphic presentation of the mean performances under the conditions of competition while Figure II shows mean performance under conditions of praise and reproof.

TABLE 6. Analysis of the variance and tests of significance of the experimentally varied conditions; psycho-motor task; all groups undergoing all conditions.

<u>Variable</u>	<u>Sum of Squares</u>	<u>df</u>	<u>Variance</u>	<u>F</u>	<u>P</u>
E_1 Praise & Reproof	29155.6	1	29155.6		
E_2 Competition	236513.8	2	118256.9	2.27	< .20 > .05
1×2	376428.2	2	188214.1	3.61	< .05 > .01
Between Individuals	6607762.5	23	287294.0		
Residual *	5991304.6	115	52098.3		
Total	13241164.7	143			

$$* s_p^2 = s_t^2 - (s_{E_1}^2 + s_{E_2}^2 + s_{1 \times 2}^2 + s_{\text{Bet. Ind.}}^2)$$

From Table 7 it will be seen that competition of pairs in a group of four has the highest total score and "no competition" has the lowest total score. In considering the scores obtained under the combination of conditions, the highest total score is found under conditions of competition by pairs when the group was praised. Lowest total score is found under conditions of "no competition" when the subjects were reproved. Assignment of the variances to each of the several sources was made and is shown in Table 6.

TABLE 7. Mean scores of psycho-motor performance under experimentally varied conditions; all groups undergoing all conditions.

	<u>"No Competition"</u>	<u>2 x 2 Competition</u>	<u>1 x 3 Competition</u>	<u>Total</u>
Praise	7651.6	7687.1	7545.5	7628.1
Reproof	7500.8	7653.1	7644.9	7599.6
Total	7576.2	7670.1	7595.2	7613.8

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

FIGURE I

MEAN PERFORMANCE ON
PSYCHO-MOTOR TASK BY THE
SEVERAL COMPETITIVE CONDITIONS

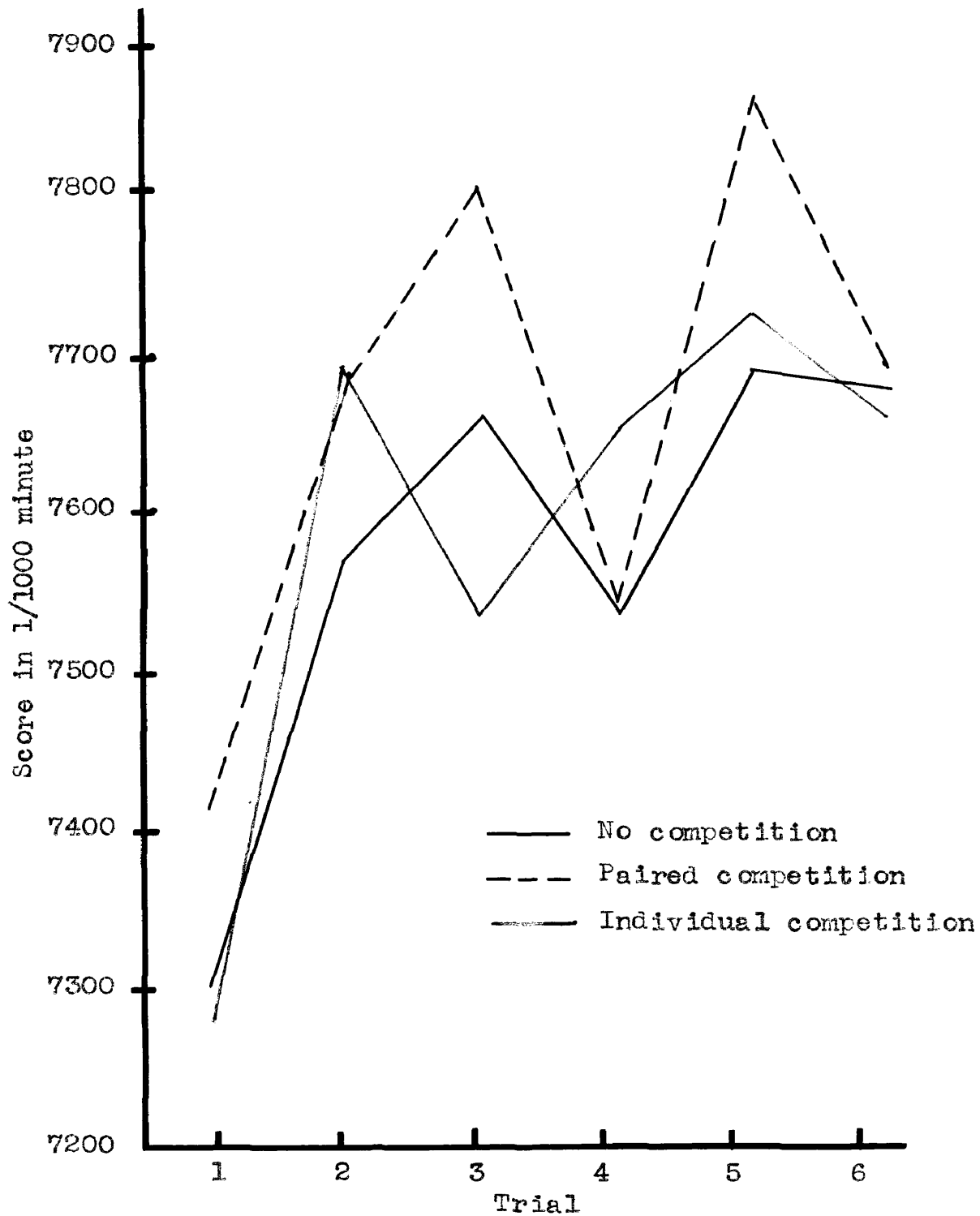


FIGURE II

MEAN PERFORMANCE ON PSYCHO-MOTOR TASK
UNDER CONDITIONS OF PRAISE AND REPROOF

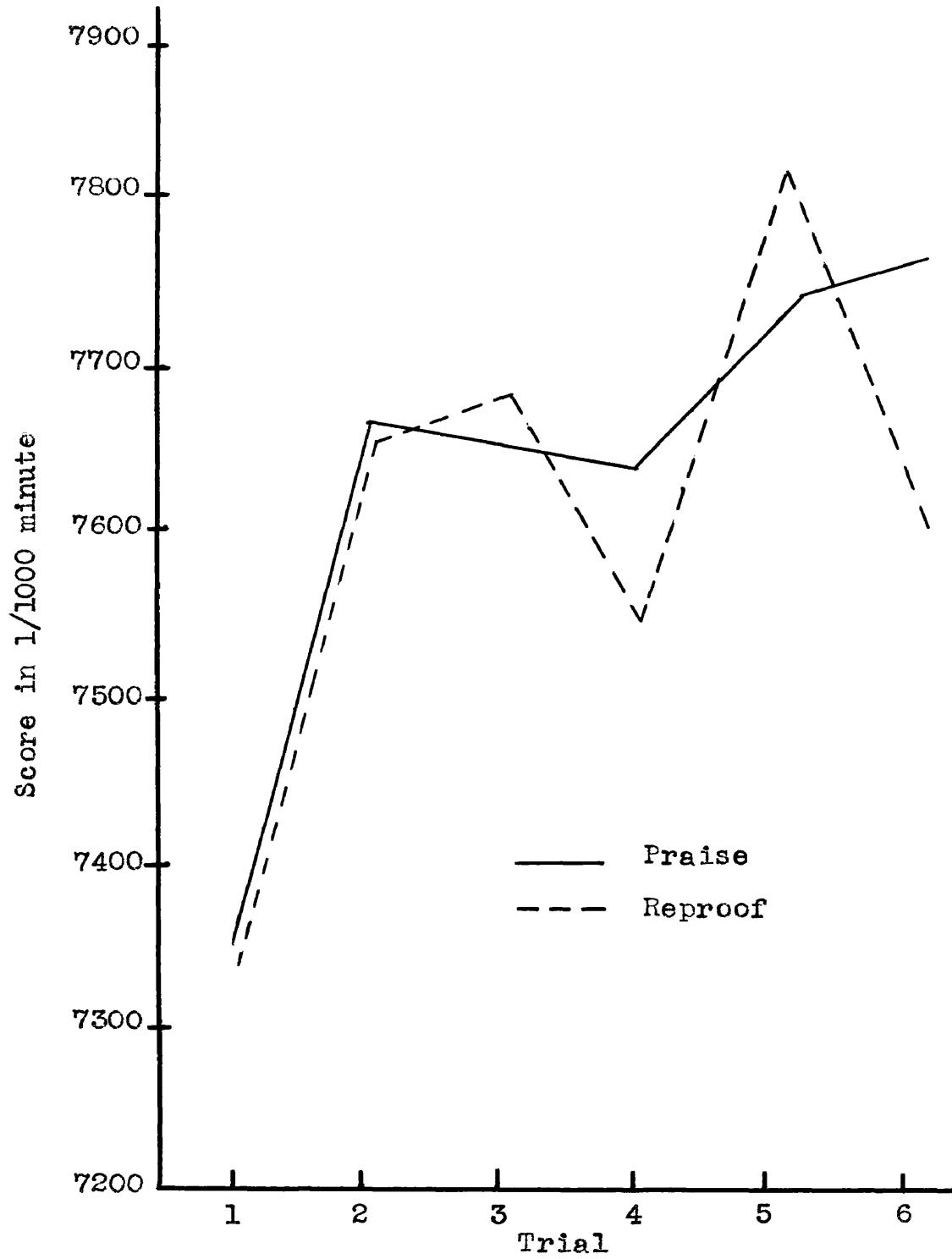


TABLE 8. Contributions to the variability by each of the main variables and their interactions; psycho-motor task; all groups undergoing all conditions.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	29155.6	1	29155.6		
E ₂ Competition	236513.8	2	118256.9	2.36	>.20
E ₃ Between trials	2643213.5	5	528642.7	10.55	<.01
E ₄ Between levels	3717361.3	3	1239120.4	30.80	<.01
I _{1x2}	376428.2	2	188214.1		
I _{1x3}	175380.6	5	35076.1		
I _{1x4}	36446.7	3	12148.9		
I _{2x3}	470080.0	10	47008.0		
I _{2x4}	163037.0	6	27172.8		
I _{3x4}	403054.4	15	26870.3		
I _{1x2x3}	1147676.7	10	114767.7		
I _{1x2x4}	70639.9	6	11773.3		
I _{1x3x4}	536181.9	15	39078.8		
I _{2x3x4}	1057819.2	30	35260.6		
I _{1x2x3x4}	2128175.9	30	70939.2		
Residual *	6614920.5	132	50113.0		
Total	13241164.7	143			

* Residual variance = all interaction variances

The analysis shown in Table 8 provides a concrete example by which the analysis of variance procedure may be illustrated. Reference to Tables 1 and 2 will show that scores were obtained for each of the 24 individuals under each of the conditions and each of the trials. A total of 144 scores was available for

analysis upon completion of the experimental testing. The total sum of squares (Table 8) was obtained by computing the sum of the squared deviations of the 144 scores from the mean of these scores. This total sum of squares divided by the total degrees of freedom provides the estimate of total variance of all scores (σ_t^2). A simple rule for obtaining the degrees of freedom is to subtract one from the number of squared deviates under consideration. For a more complete discussion of degrees of freedom see reference (19), page 33.

The various components contributing to the total variability in the experimental situation are represented by the main effects and interactions. The main effects are E_1 , E_2 , E_3 , and E_4 . The interactions are I_{1x2} , I_{1x3} , $I_{1x2x3x4}$. The sum of squares of each of these sources of variance is determined by computing the sum of the squared deviations of the mean score for each of the breakdowns of the variable from the mean of all scores. For example, the sum of squares for the variable of E_3 (between trials) is determined by summing all scores obtained under each of the breakdowns of the variable, i.e., trial 1, trial 2, trial 3, trial 4, etc.; obtaining the mean for each breakdown ($\Sigma X/N$); and summing the squared deviations of each of these means from the grand or total mean for all scores.

$$\text{Sum of Squares} = \left[(\Sigma X_{t_1}/N_{t_1})^2 + (\Sigma X_{t_2}/N_{t_2})^2 \dots + (\Sigma X_{t_6}/N_{t_6})^2 \right] - (\Sigma X_{\text{tot.}})^2/N_{\text{tot.}}$$

The ratio of the sum of squares to the degrees of freedom SS/df gives the estimate of variance (σ^2). It will be recalled from the discussion of the F test that we may estimate the population variance by drawing samples from that population.

The variance between trials is an estimate of the population variance, with the sample drawn in such a way as to show the extent of variance associated with differences between trial means. Similarly, the variances of all other main effects and interactions are estimated.

Reference to Table 2 shows that the variance between trials is an unconfounded estimate of this variance, i.e., within any one trial each individual, each level, and each combination of conditions is represented in exactly the same way as it is in any other trial. Confounding occurs when this condition does not exist. In Table 3 the main effect of competition is confounded with trial and with level. Each level of initial ability did not receive each condition of competition during each trial. For example, the condition of paired competition (2×2) in round one was undergone by level A and AA alone. Any estimate of the variance of competition by trial would be unduly influenced by the level of initial skill of the individuals. Two replications of this basic design would enable one to obtain the variance estimate if, under replication one, levels B and BB underwent 2×2 on trial one and, in replication two, levels C and CC underwent the 2×2 competitive conditions on trial one. In both replications the appropriate ordering of conditions for the other five rounds must, of course, be made.

The estimate of residual variance in Table 8 was made by subtracting the sum of squares of all the main effects from the total variance and dividing this residual sum of squares by the appropriate degrees of freedom. Before this could be

done, however, a test must be made to determine whether the interaction variances are sufficiently different from the highest order interaction variance ($I_{1 \times 2 \times 3 \times 4}$) so as not to occur by random sampling variability. (F test.) If none differs significantly from this interaction variance, they are combined to give an estimate of residual variance.

The question is sometimes asked as to why the highest order interaction variance is used as the first estimate of residual variance. It will be remembered that residual variance is that variance contributed by the numerous random uncontrolled variables acting in the situation, e.g., apparatus changes, varying lighting conditions, etc.

In the analysis in Table E the total variance in the situation has been accounted for by the main effects and interactions in the situations. The highest order interaction variance ($I_{1 \times 2 \times 3 \times 4}$) embodies the combination of all the various breakdowns of all the variables in the situation. That is, the estimate of variance in this case has been based on variation in means for all the possible combinations beginning with the mean for those individuals who were praised, who performed under "no competition," who performed trial one, and who were of level one, and so on through all possible combinations. This then is the variability contributed by the action and interaction of all variables operating in the situation. Therefore, it is used as our first estimate of error or residual variance against which to test the other interaction sources. After finding that it does not differ significantly from the other interaction variance, all sums of squares for

the interaction are combined to give the new estimate of residual variance. The variability contributed by the main effects are then tested against this residual variance, i.e., variance of source under consideration/residual variance = F . In those instances in which the variance of the main effect was smaller than the residual variance no F test was made since obviously the main effect was associated with less variation in performance than was associated with residual error sources.

Table 9 shows the mean performance under each of the experimentally varied conditions in the situation, i.e., (1) praise and reproof, (2) competition, (3) trial, (4) level, and (5) the interactions. Figure III presents graphically the mean performance by trial of the psycho-motor task.

Analysis of psycho-motor total task score with any one group undergoing only three of the experimental conditions ($N = 48$). The test of the homogeneity of the variances of the sub-groups showed these variances not to differ significantly ($L_1 = .9998$; $k = 5$; $N = 48$). The analysis of the variance of this data is given in Table 10.

In the analysis of the data as shown in Table 10, none of the variability associated with the main effects of praise and reproof or their interactions was significantly greater than the residual or unassessed variance of conditions in the situation. Since the mean variations of the conditions does not differ significantly from residual variance, no further discussion of these is necessary.

The contributions to the total variability by all the

TABLE 9. Mean psycho-motor performance scores under the main conditions of the experiments;
All groups undergoing all conditions.

	"No Competition"		2 x 2 Competition		1 x 3 Competition	
	Trial	Level	Trial	Level	Trial	Level
Praise	1	7379.0	1	7365.3	1	7266.3
	2	7659.3	2	7701.0	2	7614.8
	3	7731.3	3	7896.0	3	7326.8
	4	7650.0	4	7631.0	4	7632.5
	5	7825.3	5	7837.5	5	7520.8
	6	7665.0	6	7691.8	6	7911.8
Reproof	1	7223.5	1	7463.3	1	7292.8
	2	7486.0	2	7674.3	2	7777.8
	3	7579.0	3	7720.0	3	7755.5
	4	7428.5	4	7455.5	4	7775.0
	5	7570.5	5	7897.0	5	7886.5
	6	7715.3	6	7708.5	6	7422.0
Total	1	7331.7	1	7733.7	1	7765.5
	2	7652.5	2	7683.0	2	7815.8
	3	7668.1	3	7329.0	3	7550.7
	4	7588.8	4	7257.5	4	7480.3
	5	7756.3				
	6	7685.7				

FIGURE III

MEAN PERFORMANCE ON
PSYCHO-MOTOR TASK UNDER ALL CONDITIONS

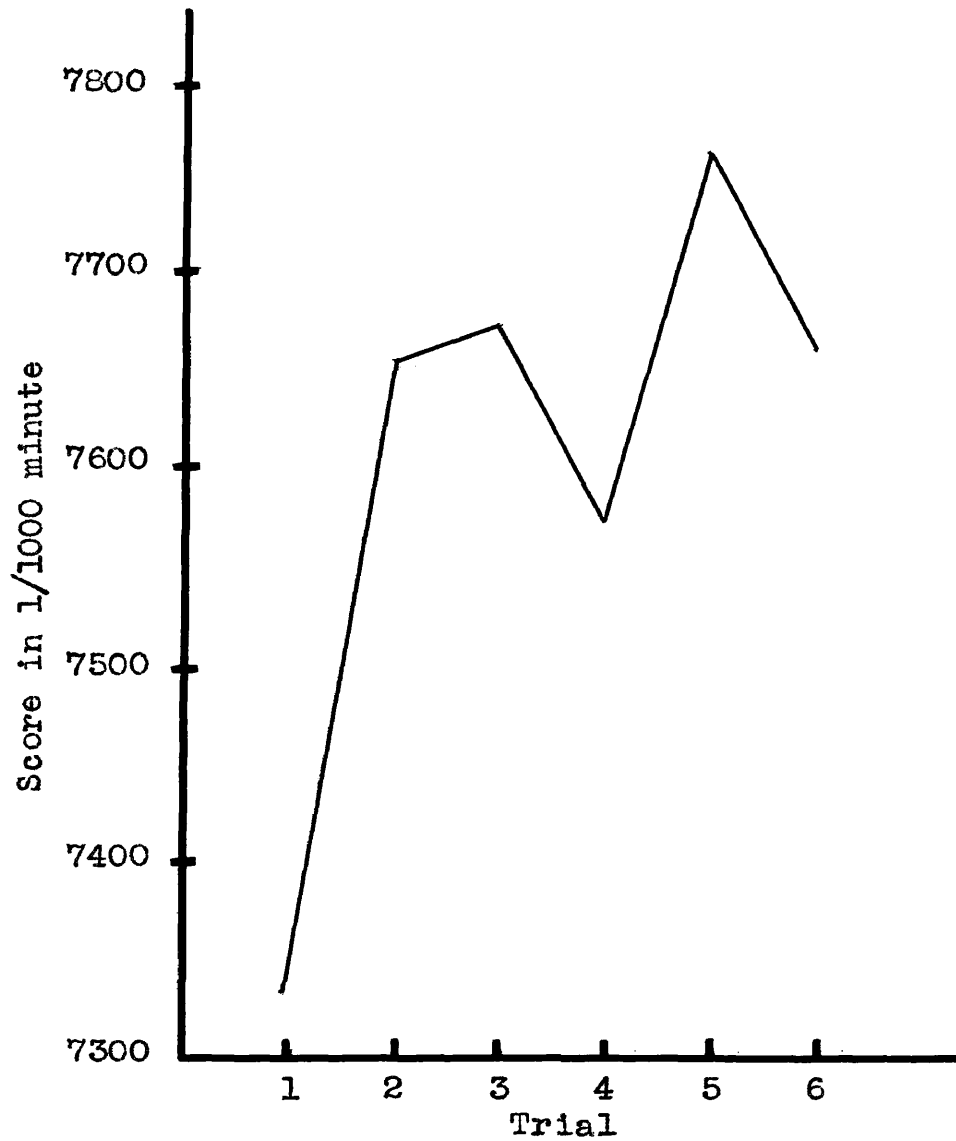


TABLE 10. Analysis of the variance and tests of significance of the experimentally varied conditions; psychomotor task; any one group undergoing only three of the experimental conditions.

Variable	Sum of Squares	df	Variance	F
E_1 Praise & Reproof	36928.0	1	36928.0	-
E_2 Competition	59312.0	2	29656.0	-
$I_{1 \times 2}$	15541.0	2	7770.5	-
Between Individuals	1155589.3	47	245863.6	
Residual *	7756147.7	91	85232.3	
Total	19423518.0	143		

$$* n_r \sigma_r^2 = n_t \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1 \times 2}} \sigma_{I_{1 \times 2}}^2 + n_{\text{Bet. Ind.}} \sigma_{\text{Bet. Ind.}}^2)$$

assessable variables in the experimental situation is given in Table 11. In this table is shown the variability associated with those factors peculiar to experimentally varied conditions, i.e., praise and reproof and competition; those peculiar to the individual, i.e., level of initial ability and amount of practice or trial; and those due to replication.

Table 11 shows the sources of all variability in the experimental system. It was found that none of the interaction variances differed significantly from the highest order interaction variance ($I_{1 \times 2 \times 3 \times 4 \times 5}$). Therefore, all interaction variances were combined to give an estimate of the residual or error variance in the system. The ratio of the variances of the main effects to this residual variation is given in Table 11 (see column F). Of the main effects, the mean variation between trials and between levels differs significantly

TABLE 11. Contributions to the variability by each of the assessable variables; psycho-motor task; any one group undergoing only three conditions.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	36928.0	1	36928.0		
E ₂ Competition	59312.0	2	29656.0		
E ₃ Between trials	3250169.0	2	1625084.5	19.47	<.01
E ₄ Between levels	4286173.0	3	1428724.3	16.24	<.01
E ₅ Replication	2652.5	1	2652.5		
I _{1x2}	15541.0	2	7770.5		
I _{1x3}	75693.0	2	37846.5		
I _{1x4}	526591.0	3	175530.3		
I _{1x5}	3700.7	1	3700.7		
I _{2x3}	256267.0	4	64066.8		
I _{2x4}	536709.0	6	89451.5		
I _{2x5}	153094.8	2	76547.4		
I _{3x4}	407529.0	6	67921.5		
I _{3x5}	94798.9	2	47399.5		
I _{4x5}	959422.3	3	319807.4		
I _{1x2x3}	212475.0	4	53118.8		
I _{1x2x4}	812716.0	6	135452.6		
I _{1x2x5}	604303.3	2	302151.7		
I _{1x3x4}	628043.0	6	104340.5		
I _{1x3x5}	87401.7	2	43700.9		
I _{1x4x5}	50462.2	3	16820.7		
I _{2x3x4}	320735.0	12	26727.9		
I _{2x3x5}	670241.3	4	167560.3		
I _{2x4x5}	626909.7	6	104484.9		

TABLE 11. (Continued) Contributions to the variability by each of the assessable variables; psycho-motor task; any one group undergoing only three conditions.

Variable	Sum of Squares	df	Variance	F	F
I _{3x4x5}	116809.9	6	19468.3		
I _{1x2x3x4}	1213867.0	12	101155.6		
I _{1x2x3x5}	70678.8	4	17669.7		
I _{1x2x4x5}	125319.8	6	20886.6		
I _{1x3x4x5}	376101.1	6	62683.5		
I _{2x3x4x5}	1007089.6	12	83924.1		
I _{1x2x3x4x5}	1837783.4	12	153148.6		
Residual *	11788283.5	134	87972.3		
Total	19423518.0	143			

* Residual variance = all interaction variances

from the residual variance. Thus, performance upon the task shows improvement with practice for three trials and the differences between levels as set up initially are maintained.

Mean performance scores for the main variable of (1) praise and reproof, (2) competition, (3) trial, and (4) level, are given in Table 12. Since only the variables of trial and of level show significant mean variation, they alone deserve special attention when considering this table. With regard to mean performance per trial, Table 12 shows greatest improvement in score between trial 1 and trial 2.

Analysis of psycho-motor task scores with any one group undergoing only three of the experimental conditions and with monetary reward added under competitive conditions. N = 24.
Throughout this phase of experimentation under conditions of

competition, a five dollar reward was given to the pair in any group of four obtaining the highest combined total score under conditions of 2 x 2 competition. Two and one-half dollars was given to the individual obtaining the highest total score under conditions of individual competition in a group of four. The test of the homogeneity of variance for the sub-groups showed the variances not to differ significantly ($L_1 = .8987$; $k = 5$; $N = 12$). The analysis of the variance and tests of significance of those variables peculiar to experimentally varied conditions, i.e., praise and reproof, and competition, are given in Table 13.

TABLE 13. Analysis of the variance and tests of significance of the experimentally varied conditions; psychomotor task; any one group undergoing only three conditions; monetary reward under conditions of competition.

Variable	Sum of Squares	df	Variance	F	P
E_1 Praise & Reproof	170431.0	1	170431.0	3.31	<.20 >.05
E_2 Competition	65317.0	2	32658.5		
I_{1x2}	31446.0	2	15723.0		
Between Individuals	3648868.3	23	158646.4		
Residual *	2216622.7	43	51549.4		
Total	6142685.0	71			

$$* \sigma_r^2 = \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1x2}} \sigma_{I_{1x2}}^2 + n_{\text{Bet. Ind.}} \sigma_{\text{Bet. Ind.}}^2)$$

From Table 13 it can be seen that the variance of praise and reproof is greater than the residual variance with an F ratio significant at between the 20 percent and 5 percent level of confidence. The variability associated with praise and

reproof is seen to be larger than that between individuals although not significantly so ($F = 1.07$). The mean performance scores under the condition of Table 13 are shown in Table 14.

TABLE 14. Mean score of psycho-motor performance under the experimentally varied conditions; any one group undergoing only three of the experimental conditions; monetary reward under conditions of competition.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	7569.7	7663.6	7668.0	7633.8
Reproof	7520.5	7571.9	7516.9	7536.4
Total	7545.1	7617.8	7592.5	7585.1

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

Table 14 suggests that the addition of a monetary reward to the competitive trials was accompanied by a greater difference between praise and reproof than between the different conditions of competition. In the more interesting situations of monetary reward added there are indications of a positive relationship between the dimension of "interest in the task" and conditions of competition which are supported in later analyses.

The variance associated with each of the experimentally varied conditions was analyzed and is shown in Table 15. All sources of variation in the system have been accounted for and the relative amounts of each can be seen. A comparison of the variances shown in Table 15 to the highest order inter-

TABLE 15. Contributions to the variability by each of the assessable variables; psycho-motor task; any one group undergoing only three conditions; monetary reward under conditions of competition.

Variable	Sum of Squares	df	Variance	F*	P
E ₁ Praise & Reproof	170430.7	1	170430.7	2.71	<.20 >.05
E ₂ Competition	65316.1	2	32658.1		
E ₃ Between trial	469749.5	2	234874.8	3.74	<.05 >.01
E ₄ Between level	869988.4	3	289996.1	4.62	<.01
I _{1x2}	31447.1	2	15723.5		
I _{1x3}	735682.2	2	367841.1	5.86	<.01
I _{1x4}	28114.1	3	9371.3		
I _{2x3}	619083.0	4	154770.8		
I _{2x4}	236505.7	6	39417.6		
I _{3x4}	256392.4	6	42732.1		
I _{1x2x3}	299761.6	4	74940.4		
I _{1x2x4}	456784.9	6	76130.8		
I _{1x3x4}	281755.2	6	46959.2		
I _{2x3x4}	741992.9	12	61832.7		
I _{1x2x3x4}	879680.7	12	73306.7		
Residual **	3831517.5	61	62811.8		
Total	6142684.4	71			

* F = the ratio σ^2/σ^2 residual

** Residual variance = all interaction variances combined excepting that of I_{1x3}

action variance in the system (I_{1x2x3x4}) shows that all interaction variances except that of the combination of praise and reproof and trial (I_{1x3}) do not differ significantly from the

highest order interaction variance. Thus, all interaction variances except $I_{1 \times 3}$ were combined to give an estimate of residual variance based upon the higher number of degree of freedom; 61. This variance appears as the residual variance in Table 15. Comparisons of the variance of the main effects (E_1 , E_2 , E_3 , and E_4) and variance of the interaction $I_{1 \times 3}$ to this residual variance shows the variance of level (E_4) and the variance of the interaction between praise and reproof and trial ($I_{1 \times 3}$) to be significantly different from the residual variance. The F ratio $(\sigma_{E_4}^2 / \sigma^2 \text{ residual}) = 4.62$ and the F ratio $(\sigma_{I_{1 \times 3}}^2 / \sigma^2 \text{ residual}) = 5.86$. Both of these F values are significant beyond the 1 percent level of confidence.

The way in which these variables are associated with performance may best be seen by reference to Table 16 in which the mean performance under all conditions is given. From Table 16 it can be seen that the mean performance of each of the levels as set up from an initial two minute trial are still maintained.

The interaction of praise and reproof with trial shows similar performance for all trials under conditions of praise but under conditions of reproof trials one and two have low mean performance scores with trial three showing a mean performance comparable and slightly above those obtained under praise.

Summary of Analysis of the Psycho-Motor Data

The statistics obtained from the three analyses of the psycho-motor task data show:

TABLE 16. Mean psycho-motor performance scores under the main conditions of the experiment; anyone group undergoing only three conditions; monetary reward under conditions of competition.

	"No Competition"				2 x 2 Competition				1 x 3 Competition				Total Trial	
	Trial	Level	Trial	Level	Trial	Level	Trial	Level	Trial	Level	Trial	Level		
Praise	1	7553.3	1	7800.0	1	7643.3	1	7591.7	1	7571.5	1	7864.3	1	7589.4
	2	7614.0	2	7563.7	2	7820.0	2	7816.0	2	7787.8	2	7675.3	2	7740.6
	3	7541.8	3	7639.0	3	7527.5	3	7712.3	3	7644.8	3	7415.3	3	7571.4
	4		4	7276.0	4		4	7544.3	4		4	7717.0	4	
Reproof	1	7481.8	1	7669.0	1	7232.8	1	7740.3	1	7365.3	1	7667.0	1	7359.9
	2	7224.0	2	7527.7	2	7801.5	2	7749.0	2	7443.8	2	7609.3	2	7489.8
	3	7855.8	3	7432.3	3	7681.5	3	7409.7	3	7741.8	3	7494.3	3	7759.7
	4		4	7453.0	4		4	7388.7	4		4	7297.0	4	
Total	1	7474.6	1	7722.1										
	2	7615.2	2	7656.8										
	3	7665.5	3	7517.2										
	4		4	7444.3										

1. The main experimental conditions of a) praise and reproof, and b) competition and their interaction, show no significant variations in mean performance when subjects were given three trials on the task (Table 10).
2. The variable of praise and reproof has a mean variability significant at between the 20 and the 5 percent level of confidence when a monetary reward was added to competitive conditions with praise showing the best performance (Tables 13 and 14).
3. The variable of competition shows a mean variation in performance significant at between the 20 and the 5 percent level of confidence when the subjects were given six trials on the task with best performance obtained under conditions of paired competition. The interaction of the main variables of a) praise and reproof, and b) competition, is associated with variability in performance at between the 5 and the 1 percent level of confidence. In this respect the conditions of paired competition combined with praise shows the best performance with "no competition" combined with praise showing the poorest (Tables 6 and 7).

Analysis of the Golf Task Data

The ordering of the experimental variables in this design is shown in Table 3. Under these conditions groups A and AA were comprised of individuals of equal initial performance and constituted the highest level of initial performance; groups B and BB were made up of individuals of equal initial performance at a lower level of initial performance; and groups C and CC were made of individuals of equal initial performance at the lowest level of performance.

Under the conditions of this design the variable of praise and reproof was ordered so that during group performance two individuals within the group were praised while the remaining two were reproofed.

Analysis was then carried out with respect to the follow-

ing sets of data:

1. Total number of strokes for the nine holes in the round.
2. Total number of strokes to complete holes 1, 2, and 3 (designated as "first three holes").
3. Total number of strokes to complete holes 4, 5, and 6 (designated as "middle three holes").
4. Total number of strokes to complete holes 7, 8, and 9 (designated as "last three holes").

Analysis of total number of strokes. The variance of the sub-groups within the design was tested and found not to differ significantly ($L_1 = .9944$; $k = 5$; $N = 24$). Analysis of the variance and tests of significance for the experimentally varied conditions is given in Table 17.

TABLE 17. Analysis of the variance and tests of significance of the experimentally varied conditions; golf task; number of strokes for a nine hole round.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	79.5	1	79.5	3.66	<.20 >.05
E ₂ Competition	393.4	2	196.7	9.06	<.01
I _{1x2}	261.0	2	130.5	6.01	<.01
Between Individuals	17734.8	23	771.1		
Residual *	2492.6	115	21.7		
Total	20961.3	143	146.6		

$$* s_{r^2} = s_t^2 - (n_{E_1} s_{E_1}^2 + n_{E_2} s_{E_2}^2 + n_{I_{1x2}} s_{I_{1x2}}^2 + n_{\text{Bet. Ind.}} s_{\text{Bet. Ind.}}^2)$$

Table 17 shows that the main effect of competition (E₂) and the interaction between the two main variables (I_{1x2}) varies

from the residual variance beyond the 1 percent level of confidence. The mean variation of the main effect of praise and reproof (E_1) differs from residual variance at between the 20 percent and the 5 percent level of confidence. Table 18 lists the mean number of strokes under each of the experimentally varied conditions. It should be noted in interpreting Table 18 that a low number of strokes is associated with high level performance. In Figure IV is shown graphically the mean strokes per hole. Figure V is a graphic presentation of the means per hole under the separate conditions of praise and reproof.

TABLE 18. Mean score of golf performance under the experimentally varied conditions; number of strokes for a nine hole round.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	66.0	62.2	60.7	63.0
Reproof	65.8	61.6	66.0	64.5
Total	65.9	61.9	63.4	63.7

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

From Table 18 it may be seen that best mean score was obtained under the condition of 2 x 2 competition and poorest mean score was obtained under the conditions of "no competition." Slightly better scores were obtained under conditions of praise than under the conditions of reproof. In regard to the interactions of these variables the lower, or better, scores were

FIGURE IV

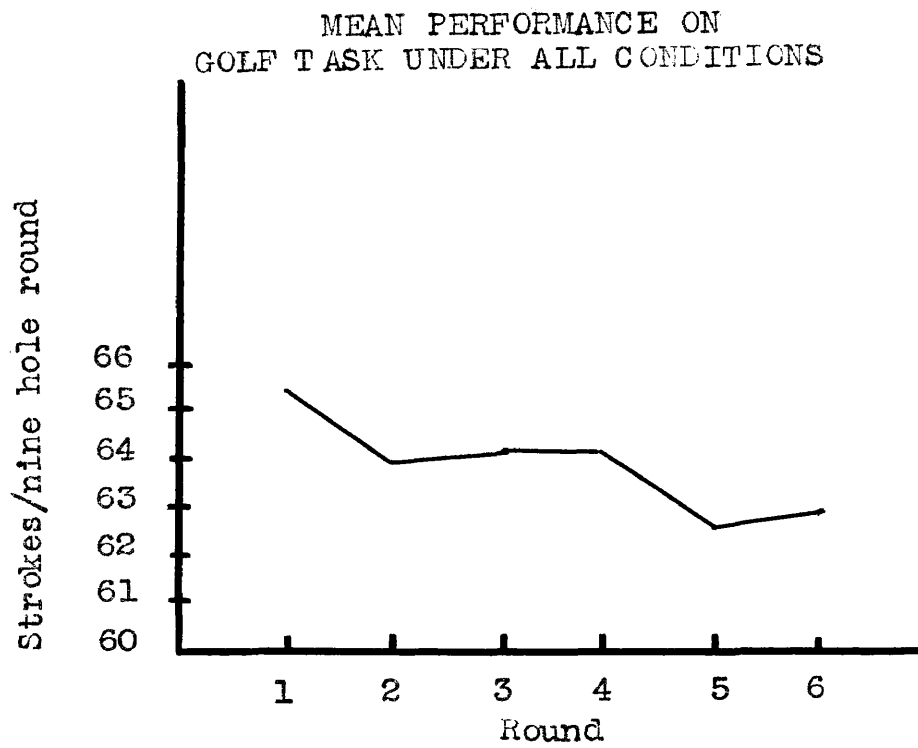
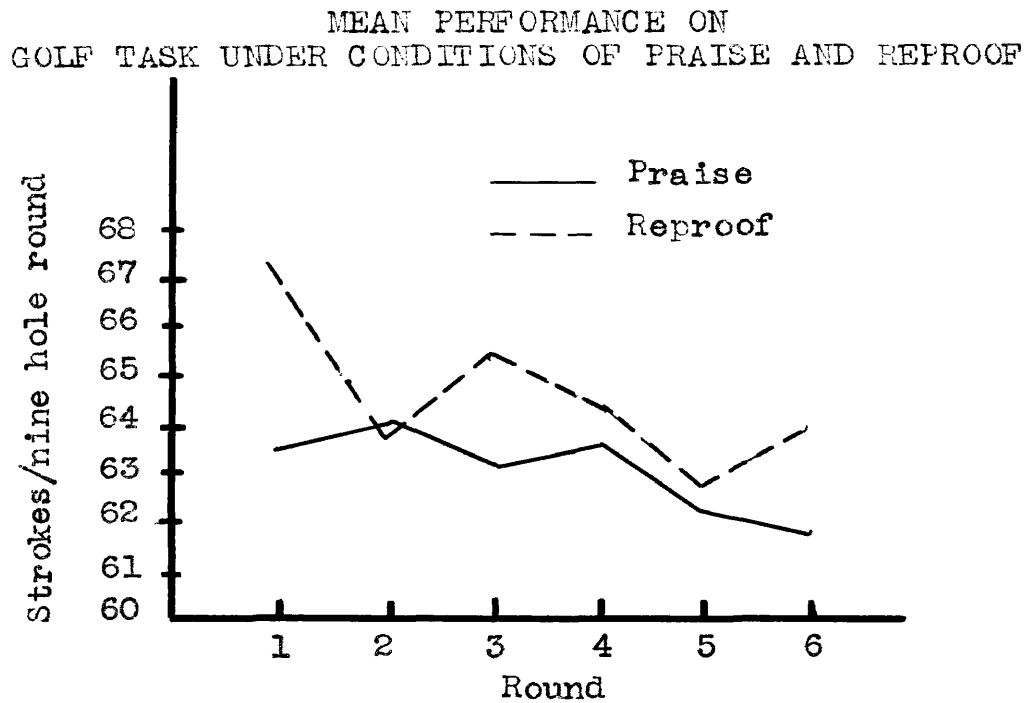


FIGURE V



obtained under conditions of 1 x 3 competition with praise; 2 x 2 competition with reproof; and 2 x 2 competition with praise. The higher or poorer scores were obtained under conditions of "no competition" under both praise and reproof and 1 x 3 competition with reproof.

The assignment of variance to all of the experimentally varied conditions in the experimental situation is shown in Table 19. In this table the relative effect of each of the main variables and their interactions upon performance may be seen.

In assigning the variance to the various sources certain of the interactions are seen to be confounded. In computing the residual variance of Table 19, the interaction variances were first compared to the residual variance in the system after all known variances were subtracted from the total.

$$n_p \sigma_p^2 = n_t \sigma_t^2 - (n_{k_1} \sigma_{k_1}^2 \dots n_{k_b} \sigma_{k_b}^2 + n_{1k_2} \sigma_{1k_2}^2 \dots n_{1k_3 m} \sigma_{1k_3 m}^2)$$

None of the interaction variances were found to differ significantly from this residual variance so all interaction variances were combined with this residual variance to give the estimate of residual or error variance shown in Table 19. Residual or error variance equals total variance less all variances due to main effects.

$$n_p \sigma_p^2 = n_t \sigma_t^2 - (n_{k_1} \sigma_{k_1}^2 + n_{k_2} \sigma_{k_2}^2 \dots + n_{k_b} \sigma_{k_b}^2)$$

It can be seen from Table 19 that the significant mean variation between levels is maintained. There was no significant amount of improvement on the task for the group as a

TABLE 19. Contributions to the variability by each of the assessable variables; golf task; number of strokes for a nine hole round.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	79.5	1	79.5	1.07	
E ₂ Competition	393.4	2	196.7	2.65	<.20 >.05
E ₃ Between trials	120.4	5	24.1		
E ₄ Between level	10508.5	2	5254.3	70.9	<.01
I _{1x2}	261.0	2	130.5		
I _{1x3}	43.3	5	8.7		
I _{1x4}	1.8	2	.9		
I _{2x3} *					
I _{2x4}	64.7	4	16.2		
I _{3x4}	475.0	10	47.5		
I _{1x2x3} *					
I _{1x2x4}	124.8	4	31.2		
I _{1x3x4}	1415.9	10	141.6		
I _{2x3x4} *					
I _{1x2x3x4} *					
Residual **	9859.5	133	74.1		
Total	20961.3	143			

* Interaction variance confounded with level

** Residual variance = all interaction variances

whole as seen from the variance between trials (E₃). Since the variance of the interaction between trials and levels (I_{3x4}) is also not significant we may conclude that no one level of skill showed any significant amount of improvement

during the six rounds played.

The variable of competition (E_2) is contributing more mean variation in performance than is praise and reproof (E_1) although not a significantly greater amount. ($F = 2.77$; $n_1 = 2$; $n_2 = 1$).

The performance means for the main variables listed in Table 19 are given in Table 20. The mean curve of performance by trial is shown in Figure IV and under the two conditions of praise and reproof in Figure V.

Analysis of total number of strokes for first three holes.

Test of the homogeneity of the variance of the sub-groups within this analysis showed these variances not to differ significantly ($L_1 = .9645$; $k = 5$; $N = 24$). The results of the analysis of the variance and the test of significance for the experimentally varied conditions are shown in Table 21.

The analysis in Table 21 shows the variable of praise and reproof as having a significantly large mean variation for the first three holes of play. The variable of competition shows little mean variation as does the interaction of the two variables. Table 22 shows the mean number of strokes under each of the conditions.

Table 22 shows best performance under conditions of praise rather than reproof. The condition of 2 x 2 competition is associated with a better performance than is either 1 x 3 competition or "no competition" with "no competition" being associated with the poorest performance. The mean performances under the interacting conditions did not differ sufficiently to warrant discussion.

TABLE 20. Mean score of golf performance under the main experimental conditions; number of strokes for a nine hole round.

	LEVEL			TRIAL *						TOTAL	
	1	2	3	1	2	3	4	5	6		
No competition	54.1	67.5	76.1								65.9
2x2 competition	52.3	62.3	71.1								61.9
1x3 competition	52.1	64.3	73.7								63.4
Praise	51.9	64.0	73.0	63.3	64.0	63.0	63.3	62.3	61.9		63.0
Reproof	55.7	65.5	74.3	67.0	63.6	65.2	64.3	62.8	63.9		64.5
Total	52.8	64.7	73.4	65.2	63.8	64.1	63.8	62.5	62.9		63.7

* Trial confounded with level under conditions of competition

TABLE 21. Analysis of the variance and tests of significance of the experimentally varied conditions; golf task; number of strokes for the first three holes.

Variable	Sum of Squares	df	Variance	F	P
E_1 Praise & Reproof	76.5	1	76.5	8.14	< .01
E_2 Competition	44.5	2	22.3	2.37	< .20
$I_{1 \times 2}$	28.3	2	14.1	1.50	> .20
Between Individuals	3111.1	25	135.2		
Residual *	1079.6	115	9.4		
Total	4539.9	143			

* $n_T \sigma_T^2 = n_T \sigma_T^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1 \times 2}} \sigma_{I_{1 \times 2}}^2 + n_{\text{Bet. Ind.}} \sigma_{\text{Bet. Ind.}}^2)$

TABLE 22. Mean score of golf performance under the experimentally varied conditions; number of strokes for the first three holes.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	24.6	23.3	23.4	23.8
Reproof	25.5	24.2	26.1	25.3
Total	25.0	23.8	24.8	24.5

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

The relative amounts of variability contributed by all the assessable variables acting in situation are shown in Table 23.

TABLE 23. Contributions to the variability by each of the assessable variables; golf task; number of strokes for the first three holes.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	76.5	1	76.5	4.42	< .05
E ₂ Competition	44.5	2	22.3	1.29	
E ₃ Between trials	103.8	5	20.8	1.20	
E ₄ Between levels	1513.9	2	906.9	52.49	< .01
I _{1x2}	28.8	2	14.1		
I _{1x5}	35.9	5	7.2		
I _{1x4}	16.7	2	8.4		
I _{2x5} *					
I _{2x4}	28.5	4	7.1		
I _{3x4}	83.4	10	8.3		
I _{1x2x3} *					
I _{1x2x4}	40.5	4	10.1		
I _{1x3x4}	200.6	10	20.1		
I _{2x3x4} *					
I _{1x2x3x4} *					
Residual**	2501.5	135	17.3		
Total	4339.9	145			

* Interaction variance confounded with level 1

** Residual variance = all interaction variances

The residual variance in Table 23 was estimated by first comparing all interaction variances to the total variance less all assessable variances.

$$n_r \sigma_r^2 = n_t \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 \dots n_{E_4} \sigma_{E_4}^2 + n_{1 \times 2} \sigma_{1 \times 2}^2 \dots + n_{1 \times 3 \times 4} \sigma_{1 \times 3 \times 4}^2)$$

The interaction variances were found not to differ significantly from this error variance so all interaction variance were combined with error variance to give the new estimate.

$$n_r \sigma_r^2 = n_t \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 \dots + n_{E_4} \sigma_{E_4}^2)$$

The variable of praise and reproof (E_1) is seen to be associated with the greater amount of variability of the two experimentally varied conditions in the situation. The low variance associated with trials (E_3) indicates little improvement in scores on the first three holes for the six rounds played. The interaction between trial and level (1×4) shows this condition to obtain for each level of performance.

Table 24 shows the mean performance in the golf task in the first three holes of play under the main conditions of the experiment. From this table the significant mean square for level (E_4) becomes apparent. Also the lack of improvement with six rounds of practice can be seen.

TABLE 24. Mean score of golf performance under the main experimental conditions; number of strokes for the first three holes.

	LEVEL			TRIAL *						TOTAL	
	1	2	3	1	2	3	4	5	6		
No competition	20.2	25.8	29.2								25.0
2x2 competition	20.1	25.4	27.8								23.8
1x3 competition	19.9	25.0	29.4								24.8
Praise	19.5	24.3	27.6	24.0	24.4	24.0	23.9	23.6	22.8		23.8
Reproof	20.7	25.1	30.0	26.9	25.3	26.6	25.5	24.0	23.3		25.3
Total	20.1	24.7	28.8	25.5	24.8	25.3	24.7	23.8	23.0		24.5

* Trial confounded with level under conditions of competition

Analysis of total number of strokes for the middle three holes. The test of the homogeneity of the variances of the sub-groups within this analysis showed these variances not to differ more than by chance fluctuation ($L_1 = .9835$; $k = 5$; $N = 24$).

The results of the analysis of variance and the tests of significance of the experimentally varied conditions of praise and reproof (E_1) and competition (E_2) are shown in Table 25.

TABLE 25. Analysis of the variance and tests of significance of the experimentally varied conditions; golf task; number of strokes for the middle three holes.

Variable	Sum of Squares	df	Variance	F	P
E_1 Praise & Reproof	.1	1	.1		
E_2 Competition	26.8	2	13.4	2.44	<.20 >.05
$I_{1 \times 2}$	13.5	2	6.8	1.24	>.20
Between Individuals	1423.5	23	61.9		
Residual *	633.0	115	5.5		
Total	2096.9	143			

* $n_T \sigma_T^2 = n_T \sigma_t^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1 \times 2}} \sigma_{I_{1 \times 2}}^2 + n_{\text{Det. Ind.}} \sigma_{\text{Det. Ind.}}^2)$

Comparison of Table 25 with Table 21 (first three holes) shows that the variable of praise and reproof which has significant mean variation during the first three holes does not show this significance during the middle three holes. However, the variability of the condition of competition has remained unchanged. The mean performances under these conditions is given in Table 26.

TABLE 26. Mean score of golf performance under the experimentally varied conditions; number of strokes for the middle three holes.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	19.6	18.5	18.0	18.7
Reproof	19.0	18.3	18.9	18.7
Total	19.3	18.4	18.4	18.7

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

Table 27 lists the variances of all assessable sources in the system. The residual variance was obtained in the same fashion as in the previous tables by first testing all interaction variances against the error estimate.

$$n_r \sigma_r^2 = n_t \sigma_t^2 - (n_{R_1} \sigma_{R_1}^2 \dots n_{R_k} \sigma_{R_k}^2 + n_{I_{1 \times 2}} \sigma_{I_{1 \times 2}}^2 \dots + n_{I_{1 \times 3}} \sigma_{I_{1 \times 3}}^2)$$

When the interaction variances were shown not to differ from this estimate error, all interaction variances were combined to give the new estimate of error or residual variance.

$$n_r \sigma_r^2 = n_t \sigma_t^2 - (n_{R_1} \sigma_{R_1}^2 + n_{R_2} \sigma_{R_2}^2 \dots + n_{R_k} \sigma_{R_k}^2)$$

When the variances of the main sources are compared with this estimate of error variance, only the variance between levels (R_1) shows a significant mean square. The other sources are contributing no more than the uncontrolled variables in the situation.

TABLE 27. Contributions to the variability by each of the assessable variables; golf task; number of strokes for the middle three holes.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	.1	1	.1		
E ₂ Competition	26.8	2	13.4	1.29	> .20
E ₃ Between trials	12.3	5	2.5		
E ₄ Between levels	655.1	2	327.5	31.19	< .01
I _{1x2}	13.5	2	6.7		
I _{1x3}	24.9	5	5.0		
I _{1x4}	2.0	2	1.0		
I _{2x3} *					
I _{2x4}	13.8	4	3.4		
I _{3x4}	59.5	10	5.9		
I _{1x2x3} *					
I _{1x2x4}	15.6	4	3.9		
I _{1x3x4}	161.0	10	16.1		
I _{2x3x4} *					
I _{1x2x3x4} *					
Residual **	1402.6	133	10.5		
Total	2096.9	143			

* Interaction variance confounded with level

** Residual variance = all interaction variances

Table 28 lists the mean performances on the middle three holes under these main conditions. From this table the level difference is still apparent and the lack of any improvement with practice is still evident.

TABLE 28. Mean score of golf performance under the main experimental conditions; number of strokes for the middle three holes.

	LEVEL			TRIAL *						TOTAL
	1	2	3	1	2	3	4	5	6	
No competition	16.6	19.3	22.1							19.3
2x2 competition	16.1	18.6	20.4							18.4
1x3 competition	15.3	18.9	21.1							18.4
Praise	15.8	19.1	21.2	19.3	18.6	17.9	19.1	19.5	18.8	18.7
Reproof	16.2	18.8	21.2	18.9	18.8	18.6	18.1	18.0	19.3	18.7
Total	16.0	19.0	21.2	19.1	18.7	18.3	18.6	18.7	19.0	18.7

* Trial confounded with level under conditions of competition

Analysis of total number of strokes for the last three holes. Test of the homogeneity of the variances of the subgroups within this analysis showed them not to differ significantly ($L_1 = .9498$; $k = 5$; $N = 24$).

The data for these three holes was analysed in the same manner as the previous golf analysis. The primary emphasis in interpretation was placed upon the comparison of the variances of the two main conditions being varied experimentally, i.e., praise and reproof (E_1) and competition (E_2) to the residual variance in the situation not ascribable to individuals. The variances and tests of significance shown in Table 29 are those which receive most attention. Residual variance in this instance is equal to total variance less the variance between individuals and the variances due to the main effects of E_1 and E_2 and their interaction ($I_{1 \times 2}$).

TABLE 29. Analysis of the variance and tests of significance of the experimentally varied conditions; golf task; number of strokes for the last three holes.

Variable	Sum of Squares	df	Variance	F	F
E_1 Praise & Reproof	3.1	1	3.1		
E_2 Competition	76.7	2	38.4	4.47	<.05 >.01
$I_{1 \times 2}$	27.5	2	13.8	1.60	>.20
Between Individuals	1706.7	23	74.2		
Residual *	991.5	115	8.6		
Total	2805.5	143			

$$* \frac{n_s \sigma^2}{Y_T} = n_t \sigma^2 - (n_{E_1} \sigma_{E_1}^2 + n_{E_2} \sigma_{E_2}^2 + n_{I_{1 \times 2}} \sigma_{I_{1 \times 2}}^2 + n_{\text{Bet. Ind.}} \sigma_{\text{Bet. Ind.}}^2)$$

The mean performances under the conditions in Table 29 are shown in Table 30.

TABLE 30. Mean score of golf performance under the experimentally varied conditions; number of strokes for the last three holes.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	21.9	20.0	19.5	20.5
Reproof	21.4	19.9	21.0	20.6
Total	21.6	20.0	20.3	20.6

"No Competition" = each individual performing alone
 2 x 2 Competition = competition between pairs in a group of four for highest total score of pair
 1 x 3 Competition = individual competition in groups of four

In Tables 29 and 30 it can be seen that the variable of competition (E_2) has a significantly greater variance than the unassessed residual sources. The condition of 2 x 2 competition is associated with the best or lowest score and the condition of "no competition" is associated with the poorest or highest score. The variable of praise and reproof (E_1) is not a significant source of variation in performance at this stage of play in contrast to the first three holes of play.

The relative variances being contributed by all assessable sources in the system are shown in Table 31. This table supports the evidence of Table 29 with regard to the effect of the variable of competition (E_2) and of praise and reproof (E_1). The mean performance scores under each of the main conditions

TABLE 31. Contributions to the variability by each of the assessable variables; golf task; number of strokes for the last three holes.

Variable	Sum of Squares	df	Variance	F	P
E ₁ Praise & Reproof	3.1	1	3.1		
E ₂ Competition	76.7	1	38.4	3.49	<.05 >.01
E ₃ Between trials	30.7	5	6.1		
E ₄ Between levels	1061.1	2	530.6	48.20	<.01
I _{1x2}	27.5	2	13.8		
I _{1x3}	74.4	5	14.9		
I _{1x4}	28.8	2	14.4		
I _{2x3} *					
I _{2x4}	24.4	4	6.1		
I _{3x4}	123.6	10	12.4		
I _{1x2x3} *					
I _{1x2x4}	21.5	4	5.4		
I _{1x3x4}	284.1	10	28.4	2.58	<.01
I _{2x3x4} *					
I _{1x2x3x4} *					
Residual **	1349.8	123	11.0		
Total	2805.5	143			

* Interaction variance confounded with level

** Residual variance = all interaction variances

is shown in Table 32. This table shows the condition of 2 x 2 competition to be associated with the better performance and the levels as set up from initial performance to be maintained. The mean scores obtained under conditions of praise and of reproof are very similar.

TABLE 32. Mean score of golf performance under the main experimental conditions; number of strokes for the last three holes.

	LEVEL			TRIAL *						TOTAL	
	1	2	3	1	2	3	4	5	6		
No competition	17.3	22.4	25.2								21.6
2x2 competition	16.7	20.7	22.4								20.0
1x3 competition	17.1	20.6	23.2								20.3
Praise	16.7	20.7	24.1	20.3	19.1	21.3	20.3	21.6	20.4		20.5
Reproof	17.4	21.8	23.1	22.0	20.6	20.5	20.6	19.3	21.8		20.9
Total	17.0	21.5	23.6	21.2	19.8	20.9	20.4	20.4	21.1		20.6

* Trial confounded with Level under conditions of competition

In Table 33 is shown the mean performance scores under the conditions of praise and reproof, trial, and level. This table is given to show the source of the significant interaction variance $1_{1 \times 3 \times 4}$ in Table 51.

The significant variation associated with the interaction of praise and reproof with trial and with level can be seen in Table 33 to be brought about by reversals in performance from trial to trial and from praise to reproof in certain levels. For example, in level 3, trials 2 and 3 under praise we find a change in mean performance from 19.0 to 27.5. This difference is equalized insofar as trial is concerned by the reverse effect in level 1 under the same conditions. A similar situation obtains between trials 4 and 5 of these same conditions, i.e., in level 3 under praise we find the difference equalized insofar as trial is concerned by the reverse effect in trial 4 and 5 in level 3 under reproof. These mean fluctuations, although greater than would be expected from the estimate of error variance are largely inexplicable without reference to the data for each individual. In the nature of the design the poorer performers within any one level may, by chance, be ordered to any one of combination of conditions within an interaction of this high an order. Reference to Table 3 shows that the two poorer performers from each of the groups C and CC may fall within the conditions of praise on trial 5 with the two best performers from each group falling within the conditions of reproof. Interpretation of this interaction, then, holds little of value in terms of our main experimentally varied conditions.

TABLE 33. Mean score of golf performance under conditions of praise and reproof by trial and by level; number of strokes for the last three holes.

		TRIAL						
		1	2	3	4	5	6	TOTAL
PRAISE	1	16.3	19.0	16.6	16.7	15.8	15.8	16.7
	2	23.7	19.3	19.7	20.3	21.0	20.3	20.7
	3	21.0	19.0	27.5	23.4	26.0	25.3	24.1
	TOTAL	20.3	19.1	21.3	20.3	21.6	20.4	20.5
REPROOF	1	17.8	17.5	18.0	16.3	17.0	18.0	17.4
	2	21.7	20.8	21.0	24.0	21.5	21.8	21.8
	3	21.5	23.5	22.5	21.5	19.3	25.5	23.1
	TOTAL	22.0	20.6	20.5	20.6	19.3	21.8	20.8

Summary of Analysis of the Golf Task

The statistics obtained from the four analyses of the

Golf task data show:

1. For the first three holes of play the variable of praise and reproof shows a mean variation in performance significant at beyond the 1 percent level of confidence. This is in contrast to the results of the psycho-motor task when the first three trials were analysed. Best scores are obtained under praise. The variable of competition shows a mean variation in performance significant at between the 20 and the 5 percent level of confidence. Here, as in the psycho-motor task, best performance is obtained under the condition of paired competition. The interaction of the two variables is not a significant source of variation (Tables 21 and 22).
2. Analysis of the middle three holes of play shows the variable of competition to have a mean variability significant at between the 20 and the 5 percent level of confidence. The main variable of praise and reproof and the interaction no longer shows any significant mean variation (Tables 25 and 28).
3. Analysis of the last three holes of play shows the main variable of praise and reproof to have no significant mean variability but the variable of competition to have increased in its variability. The interaction of the two variables is not a significant source of variance in this analysis (Tables 29 and 30).
4. Analysis of the total number of strokes for the round shows the variable of praise and reproof to have a mean variability significant at between the 20 and the 5 percent level of confidence. This variability is not found upon analysis of the six trials on the psycho-motor task. The variable of competition shows highly significant mean variability. In the psycho-motor task this result was found but not at such a high level of confidence. The interaction of the two main variables shows mean variability at a high level of significance. This result was not found in analysis of the psycho-motor task (Tables 21 and 22).

Correlation Analysis and Results

Spearman rank difference correlation coefficients (ρ) were computed between the psycho-motor scores and the golf scores for the various conditions of experimentation. For example, scores obtained under the condition of "no competition" under reproof on the psycho-motor task were correlated with scores obtained under each of the combinations of conditions on the golf task. These correlations were computed to determine the extent to which coefficients of correlation might shift as a result of the changes in the incentive conditions under which the task was performed. Thirty-six coefficients were obtained representing the relationship between scores on the psycho-motor task under each of the six combinations of conditions and scores on the golf task under each of the six combinations of conditions. Tests of significance of the correlation and of differences between them were made utilizing Fisher's z' transformation. The correlations between total scores on the golf and the psycho-motor task under the several conditions are shown in Table 34.

The number of cases upon which the correlations in Table 34 were based ranged from 16 to 18. The standard error of z' for $N = 17$ is .27. To be significantly different from zero at the one percent level of confidence z' must be .69 ($r = .60$) and at the 5 percent level of confidence it must be .53 ($r = .49$). The coefficients given in Table 34 show the correlation between the various conditions not to differ significantly from zero. However, the consistent trend shown

under the condition of 1 x 3 competition under reproof indicates the need for further examination of the effect of differential incentive conditions upon correlation or validity coefficients.

TABLE 34. Correlations between psycho-motor task and golf task under the several experimental conditions; total scores.

Task	Psycho-motor task*					
	NCP	2X2P	1X3P	NCH	2X2R	1X3R
NCP	.04	.00	-.13	.06	.25	.40
2X2P	.07	.17	-.14	.06	.04	.53
1X3P	-.04	-.04	-.22	-.06	.17	.25
NCH	-.05	.21	-.17	.10	.13	.32
2X2R	-.29	.09	-.22	-.11	.02	.51
1X3R	.21	.21	.05	.11	-.13	.38

* High score indicates high performance on the psycho-motor task, but poor performance on the golf task. However, in rating performance the golf scores were reflected so that a positive correlation indicates positive relationship.

To obtain further information concerning the effect upon correlation of varying the incentive conditions the psycho-motor task scores were analysed. In this analysis the scores obtained under each of the six sets of experimental conditions were intercorrelated. Data for this analysis was obtained from Phase I of the psycho-motor experiment. The experimental design employed in this study allows such correlations since each level of initial ability and each trial or level of practice is represented under each condition (see Table 2). These correlations are given in Table 35.

TABLE 35. Coefficients of correlation between scores obtained under differing incentive conditions; psycho-motor task. $N = 24$

	NCP	2x2P	1x3P	NCR	2x2R	1x3R
NCP						
2x2P	.42					
1x3P	.46	.25				
NCR	.35	.71	.50			
2x2R	.50	.44	.17	.57		
1x3R	.22	.67	.21	.60	.64	

From Table 35 it can be seen that the correlations vary widely depending upon the incentive conditions under which the scores were obtained. This variation in correlations is not to be expected in view of the reliability of performance in the task from trial to trial ($r_{11} = .88$). Tests of significance between the higher variations in correlations showed them to be significantly different between the 5 and the 1 percent level of confidence. These results point to the importance of incentive conditions under which tests are given or criterion data is collected.

Reliability Analysis and Results

The reliability performance on the two tasks of psycho-motor and golf was estimated utilizing Hoyt's analysis of variance technique (13). The reliability estimate of the two tasks was computed using the variance among the six trials or rounds and the among individuals variance to compute an

estimate of error variance.

$$\sigma_{\text{Error}}^2 = \sigma_{\text{Total}}^2 - (\sigma_{\text{Among Ind.}}^2 + \sigma_{\text{Among Trials}}^2)$$

$$r_{ii} = \sigma_{\text{True}}^2 / \sigma_{\text{Obtained}}^2 = \sigma_{\text{Among Ind.}}^2 - \sigma_{\text{Error}}^2 / \sigma_{\text{Among Ind.}}^2$$

$$\text{or, } r_{ii} = \sigma_{\text{Obtained}}^2 - \sigma_{\text{Error}}^2 / \sigma_{\text{Obtained}}^2$$

The reliability of the psycho-motor task was found to be .88 and of the golf task to be .96.

Results of Analysis of the Final Questionnaire

The questionnaire administered to the subjects was described in the preceding chapter and is shown in Appendix N. The rating scales were analysed to determine the mean rating of each of the scales. The scales were scored as a twelve unit scale from +6 to -6.

Analysis of rating scale number one ("Indicate your interest in the game of golf at the beginning of the experiment.") showed the mean rating to be 3.3 (standard deviation = 2.52) with a rating of six indicating very high interest.

The mean rating on scale number 2 ("Has your interest in the game increased or decreased since the beginning of the experiment?") was 3.8 (standard deviation of 2.27) with a rating of six indicating increased interest and -6 indicating decreased interest.

Analysis of the third rating scale (number 5) which compared the psycho-motor task with the golf task as to

interest ("Is the game of golf more or less interesting than the psycho-motor laboratory task?") showed the mean rating to be 5.0 (standard deviation = .84) with six indicating very much more interesting and -6 indicating very much less interesting.

The mean rating on number 6, the final scale ("Is the psycho-motor laboratory task more interesting or less interesting when you compete for money?") was 3.03 (standard deviation = 3.37) with six indicating very much more interesting and -6 indicating very much less interesting.

Analysis of question 3 ("Was there any time during the experiment when your interest was especially low?") showed that 12 of the subjects answered this question "no." Of the 12 subjects answering "yes" the answers were distributed as shown in Table 36.

TABLE 36. Distribution of "yes" answers to question three of the final questionnaire ("Was there any time during the experiment when your interest was especially low?") by conditions under which the round was played.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	5	0	0	5
Reproof	5	1	1	7
Total	10	1	1	12

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

Table 36 shows the rounds in which interest was expressed as being low to be largely those of "no competition." There is a slightly larger number of answers indicating interest to be lower under reproof.

Analysis of question 4 ("Was there any time when your interest was especially high?") showed only one person to answer "no." Of the 23 persons answering "yes," one person answered that interest was high during all rounds, two could not recall which round it was, and one answered that it was either "round 4 or 5" which analysis indicated to be either "no competition" with praise or individual competition with praise.

The "yes" answers were tabulated according to conditions under which the round was played and is shown in Table 37.

TABLE 37. Distribution of "yes" answers to question four of the final questionnaire ("Was there any time when your interest was especially high?") by conditions under which the round was played.

	"No Competition"	2 x 2 Competition	1 x 3 Competition	Total
Praise	0	5	6	11
Reproof	1	6	1	8
Total	1	11	7	19

"No Competition" = each individual performing alone

2 x 2 Competition = competition between pairs in a group of four for highest total score of pair

1 x 3 Competition = individual competition in groups of four

Table 37 shows a reversal of the trend shown in Table 36. The subjects expressed their interest as being "especially

high" most frequently under conditions of 2 x 2 competition and 1 x 3 competition and under conditions of praise.

This analysis showed the differential amounts of interest which the tasks held for the subjects as it was defined earlier. The responses to the questionnaire lend support to the quantitative results presented by the analysis. The conditions which affected performance in a quantitative measurable way were also recalled by the subjects as being either more interesting or less interesting in a way which correlates positively with actual performance.

Qualitative Findings

The analysis of the quantitative data has shown in a summary way the relationship between certain experimentally varied conditions and measured performance. However, as must always be the case, the presentation of bare numbers and statistics seems not to present the overall picture of the results to the complete satisfaction of the experimenter. This seems particularly true in this case when attempting to express the relationship between the task and the person performing the task. Overt expressions of attitude or interest in the task by behavior and comment have not here been quantified so as fully to express this relationship.

The qualitative differences in the behavior of persons performing the two tasks should be emphasized. In only one instance during the experimentation on the psycho-motor task did a subject aggress against the task. In this instance the subject started to strike the apparatus and accompanied the

gesture with appropriate comment. It was not uncommon for the subjects, in this phase of experimentation, to bring along a book to read between "runs." At one time a "cram" session for an examination took place. Getting subjects to report promptly was difficult. Performance in this task just did not seem to make any difference to the subjects.

With the golf task, it is a different story. The experimenters were threatened and told they "talked too _____ much." Clubs were thrown and in one instance the ball was pounded into the mud with the club. Former friends of the experimenters vowed never to speak to them again (and actually did not for over a day), and above all, never to play golf with them. This sort of behavior did not happen in the psycho-motor task. In contrast to the psycho-motor task it was not difficult to get the subjects to keep appointments or to meet them promptly even though in many instances appointments were made for 7:15 A.M.

The task of golf seemed also to create a sustained interest in the project. A number of the subjects who participated both in the psycho-motor task and the golf task have called at the project office to see "how things are going," or "what you found out." None of the subjects who participated in only the psycho-motor experiment have shown this interest.

CHAPTER IV

DISCUSSION

In Chapter I it was pointed out that the results of experiments dealing with incentives show extensive disagreement. Several authors have posited conditions of task-subject interaction which may account for these differences. The writer has described one such condition as "interest in the task." This condition has been defined in this study by a graphic rating scale on which the subjects rated their interest in (a) the psycho-motor task with no monetary reward, (b) the psycho-motor task with monetary reward, and (c) the golf task. These ratings suggested that the task of playing golf was most interesting to the subjects; the psycho-motor task with monetary reward was next to golf in interest; and the psycho-motor task with no monetary reward occupied the lowest relative position on the scale. This crude instrument stated merely the relative position of each of these tasks; the degree or amount of interest in any task cannot be stated in any quantitative way at the present time. Intensive research should be undertaken in the assessment of the degree of interest in the task. Such research should lead to an objective and comprehensive method for evaluating interest in performing a certain task or job and should relate this interest to the incentives to which performers are constantly exposed.

The data collected in this study indicate that there are interactions between "interest in the task" and incentives in

the performance of psycho-motor tasks. These interactions should be studied in more detail in the area of psycho-motor tasks and should be extended to other types of tasks.

Table 3B is a summary of the F ratios obtained through analysis of the variance of the various scores obtained on the two tasks. Analysis of the scores obtained from the psycho-motor task, when any one group underwent only three conditions, showed insignificant mean differences under the conditions of praise and reproof. It was this phase of experimentation which was rated by the subjects as relatively the least interesting. When a monetary reward was added during the competitive trials the task was rated as more interesting, and under these conditions praise and reproof showed mean variation significant at between the 20 and the 5 percent level of confidence. This suggests a relationship which should be more intensively investigated. It is significant to note that the addition of a monetary reward under competitive conditions interacted with the factor of praise and reproof but not with the various aspects of competition. Praise and reproof appear to influence performance differentially depending upon the subjects "interest in the task." The exact nature of the relationship must be determined by future research.

The golf task was rated by the subjects as the most interesting. Analyses of the scores on this task suggest that the variable of praise and reproof contributes to the total variability to about the same extent as it did in the psycho-motor task with monetary reward. The analysis of component scores on the task, i.e., first three holes, middle three holes,

TABLE 38. Summary of the tests of significance of the experimentally varied conditions.

Psycho-motor task

	Total Score (3 trials)		Total Score (3 trials - monetary reward)		Total Score (6 trials)	
	F	P	F	P	F	P
B ₁ Praise and Reproof	—	—	3.31	< .20	—	—
B ₂ Competition	—	—	—	—	2.27	< .20
I ₁ I ₂	—	—	—	—	3.61	< .05

Golf Task

Variable	Total Score		First 3 Holes		Middle 3 Holes		Last 3 Holes	
	F	P	F	P	F	P	F	P
B ₁ Praise and Reproof	3.66	< .20	8.14	< .05	—	—	—	—
B ₂ Competition	9.06	< .01	2.37	< .20	2.44	< .20	4.47	< .05
I ₁ I ₂	6.01	< .01	1.50	< .20	1.24	> .20	1.60	> .20

*Variance smaller than residual variance.

and last three holes, showed that praise and reproof was a highly significant source of variation during the first three holes of play. This factor was not a significant source of variability during the middle or the last three holes of play. These results suggest that the variable of praise and reproof is an important factor during the initial phases of adjustment to a situation but that its influence does not remain effective after this initial phase. In each instance in which the variable of praise and reproof was found to be associated with changes in mean performance, better scores were obtained under the conditions of praise.

The variable of competition was represented by three situations: (a) "no competition" in which the individual performs the task alone; (b) competition in which two subjects are paired against another two with competition for the best combined score of the two; and (c) competition in which the individual subject competed within a group of four for the highest individual score. Analysis of the scores on the psycho-motor task with any one group undergoing only three conditions yielded no significant mean differences under these competitive situations. No significant differences in performance were obtained even with monetary reward added to the competitive trials. Analysis of total scores obtained when all groups underwent all conditions yielded variability in scores under competition significant between the 20 and the 5 percent level of confidence.

Competition appears to be more effective in the more interesting task of golf than in the less interesting psycho-

motor task. Competition was a highly significant source of variability for total scores for a round of golf. This result is in marked contrast to that shown in the analysis of the psycho-motor task. Analysis of the component parts of the golf task score showed that competition is an important source of variability primarily during the last three holes of play. The analysis showed that competition tended to be effective during the first six holes of play but its main contribution occurred in the last three holes. This suggests that competition does not exert its greatest effect immediately but that its influence becomes more marked after some time spent in the performance of the task. This time relationship should be taken into consideration when using competition as an incentive to performance, and may well furnish a partial explanation of the conflicting results of experiments dealing with this incentive. Even in situations in which competition is effective there is no assurance that it will be associated with change in performance immediately. These data suggest that the effect on performance of this factor may be a function of both "interest in the task" and the length of time spent in "competitive" performance on the task. In all instances in which competition exerted an influence upon performance, better performance was obtained under conditions of paired competition and poorer performance was obtained under conditions of "no competition." These results are not compatible with the results of many other experiments. Previous research has indicated that, for the most part, individual competition produces better performance.

It should be remembered, however, that these experiments have been mainly concerned with individual competition within a group or competition between groups composed of more than two individuals.

The following hypothesis is suggested as one which should be investigated: The variable of competition has a positive relationship with "interest" in many types of tasks. This relationship is a function of the individual's perception of his position within the group relative to his responsibility for the performance of the group. In individual competition he is responsible to no one except himself. In paired competition he is at least partially responsible for the success of the partnership and the effect of his performance on the standing of the partnership is immediately apparent. As the group is enlarged the individual's uniqueness and the fixing of individual responsibility becomes less and less clearly definable. The individual carries a smaller and smaller share of responsibility for the success of the group and his performance, as he perceives it, becomes less and less important. This is accompanied by a lessening of "interest in the task" or, in other words, he becomes less personally involved. We suggest that the curve of performance under the conditions of varying group size would be higher for paired competition and would drop as more individuals are added to the group. This hypothesis is readily amenable to experimental test and has important implications for education and industry.

In this study the following combinations of conditions or interactions were evaluated:

- a. "No competition" under condition of praise
- b. "No competition" under condition of reproof
- c. Paired competition under condition of praise
- d. Paired competition under condition of reproof
- e. Individual competition with a group of four under condition of praise
- f. Individual competition within a group of four under condition of reproof

Analysis showed that these interactions produced no significant mean variability in performance on the psychomotor task when any one group underwent only three of the possible experimental conditions. This result obtained both with and without a monetary reward. The variance contributed by the interaction of praise and reproof with competition differed from residual variance between the 5 and the 1 percent level of confidence when all individuals underwent all six conditions of the experiment. Highest scores were obtained under conditions of paired competition with praise while lowest scores were obtained under "no competition" with reproof. (See Table 7, page 34.)

Analysis of the golf task total scores showed that the interaction of the two main variables, i.e., (1) praise and reproof, and (2) competition, was significant at beyond the 1 percent level of confidence. High performance was obtained under paired competition and individual competition with praise. Paired competition with reproof yielded equally high performance scores. Poor performance was obtained for both "no competition" and individual competition with reproof while "no competition" under praise yielded an equally poor performance. These results again raise the question of the extent to which "interest in the task" or personal involvement varies with the competitive situation. We have hypothesized

earlier that the variable of competition has a positive relationship with "interest in" many types of tasks in that low personal involvement is associated with "no competition"; individual competition is associated with higher personal involvement; and paired competition is associated with high involvement. Analysis of this data suggests that we may extend this hypothesis in terms of the relationship between the variable of praise and reproof and the variable of competition and/or personal involvement ("interest in the task"). We suggest that under conditions of high personal involvement, i.e., paired competition, the influence of the variable of praise and reproof will not be sufficient to bring about significant differences in performance. Similarly, although at the other extreme of the continuum, under conditions of low personal involvement, i.e., "no Competition", the variable of praise and reproof will again not be sufficient to bring about significant differences in performance. At an intermediate point on the continuum, however, praise and reproof will influence performance so that significant differences in mean performance will obtain.

Analysis of the component scores of the golf task, i.e., first three holes, middle three holes, and last three holes did not show that the interaction of the conditions of praise and reproof and of competition contributed significantly to the total variability. However, the examination of these component scores provides an interesting test of our hypothesis. Analysis has shown that during the first three holes of play the variable of competition contributed to mean variability

at between the 20 and 5 percent level of confidence. Let us assume that the individuals tended to react to the competitive elements in the situation and were personally involved to some extent. Under these conditions praise and reproof was a highly significant source of mean variability. During the last three holes of play the variable of competition became a more significant source of variation. Under these circumstances the variable of praise and reproof no longer had a significant mean variability. In terms of our hypothesis, when interest was only moderate during the first three holes of play, praise and reproof functioned as an effective incentive. Under a higher degree of personal involvement, however, it was no longer effective. The complex interactions between these factors are clearly evident and emphasize the need for intensive further research.

The main variables of trial and of initial level of performance were not varied systematically throughout the experiment. They were controlled within the experimental design. The variable of trial represents the effect of practice upon performance. The analysis of the psycho-motor task scores showed that trial was a significant contributor to overall variability. Table 9, page 42 and Figure III, page 43 show the mean changes in performance from trial to trial and indicate that the greatest change in performance occurred between trials one and two. In the analysis of the golf task the variable of trial was not a significant contributor to overall variability. That is, the mean score for the trials did not differ significantly from one another. Table 20,

page 60, and Figure IV, page 56, shows the mean performances for each trial and indicate no significant improvement with practice on this task.

Initial level of ability constituted a controlled condition within the experiment. Analysis of the psycho-motor scores obtained during experimentation indicated that the mean performance of the levels remained significantly different throughout experimentation. Likewise, analysis of the golf task showed the mean performance of each of the levels of initial ability to remain significantly different throughout experimentation. This lack of improvement with practice is interesting in view of the fact that knowledge of results was always present. It is suggested that since no instruction was given the subjects knowledge of method was not present and associated with knowledge of results. Further research is necessary to determine the interactions of the various incentives studied when the experimenter is perceived in different roles by the subject, for example, as instructor, as supervisor, etc.

When we examine the interactions of the variables of (1) praise and reproof, (2) competition, (3) trial, and (4) initial level of ability we find that only one interaction is a significant source of variability in the psycho-motor task data. This significant interaction occurred under conditions of monetary reward and was the interaction of praise and reproof with trial. Table 16, page 52, shows that similar performance was obtained under all trials under praise but that mean performances on the first two trials under reproof

were lower than under praise. Peculiarly enough the highest mean performance was obtained under conditions of reproof on the third trial. A high level of performance was reached during the first trial under praise with little change in performance after this trial. Under conditions of reproof, however, the scores on the first two trials were depressed, but were followed by a rise in performance on the third trial. This is the differential in performance which produced a significant mean square for this interaction. The fact that the remaining interactions were not significant indicates (1) no differential effect of praise and reproof upon length of practice or on level of initial ability; (2) no differential effect of competition upon length of practice or level of initial ability; and (3) no influence of practice on changes in mean performance of the levels as set up from initial ability.

The analysis of the golf task showed that only one interaction is a significant contributor to the variability in performance. The analysis of the last three holes of play shows a significant F value for the interaction between praise and reproof (E_1), trial (E_3), and level (E_4). This interaction has been explained in connection with Table 33, page 74. It was pointed out there that in this experimental design differences in individual performance within a group may combine to produce such an effect.

The experimental design used in this study allowed the testing of an hypothesis regarding the relative effect of the incentives upon individual performance. This hypothesis states: An individual's score on a task will maintain its position

relative to the scores of other individuals performing the task regardless of the incentive conditions under which the task is performed. That is, individual performance should not vary with the incentive under which performance occurs. In the experimental design used in the psycho-motor task each individual performed the task under each of the six combinations of incentive conditions. Each level of practice and each level of initial ability was represented under each of the incentive conditions. The scores obtained under each of the conditions were intercorrelated. The hypothesis is that correlations should differ one from the other no more than would be expected under conditions of random sampling. The several coefficients of correlation were computed and appear in Table 35, page 78. These correlations range from .17 to .71 with four of them being different one from the other at above the 5 percent level of confidence. The relative positions of individuals did change within a distribution as a function of the incentive conditions under which the individuals performed. This finding serves to re-emphasize the suggestion of Matheny (20) and Baker (3) that differing incentive conditions may attenuate validity coefficients and points to the need for extensive research in this area.

As stated earlier, several writers in this field have postulated a condition or conditions which may influence performance and which have been equated here to "interest in the task." The results obtained in this study lend support to the reality of such a condition and point to the importance of the study of its interaction with other variables in the

learning or performance situation. Some of the specific implications of this study have been discussed. The general implications of the study are so broad that we can do little more than touch upon them here. If one accepts the thesis that such a dimension as "interest in the task" exists and that its interactions with other factors in the learning or performance situation are real, one must adopt a new frame of reference with respect to the anticipated results from the application of incentives to produce, to learn, to buy, or to save. Although a psycho-motor task was used in this study, the implications of the results obtained here are by no means limited to such a task. Participation in decisions and policy making on the part of employees has frequently been used by management to get cooperative effort. This may well be an example of a device used by management to increase interest or personal involvement in the job and is effective because it does serve that function. There are undoubtedly others which are equally or more effective. Future research should establish the efficacy of this device and serve to isolate others. The extent to which an individual employee is "interested in the task" or his job will determine the way in which other incentives are to be used. This can hold not only for the employee on the production line but for the executive and the administrator as well.

"Interest in the task" may be assumed to be a product of an individual's past experiences. Out of this reservoir of experience develop his attitudes and his likes and dislikes for certain types of tasks, people, or conditions. These are

formed as a result of his experiences within a certain culture and socio-economic group. Research attention should be centered on the description of how and under what conditions these interests develop so as to facilitate prediction and control. The isolation and description of the principles underlying the development of the constructs suggested here should be the task of psychologists "interested in the task" of the applied psychology of motivation.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study was designed to evaluate the interaction of the incentives of praise and reproof and of competition on two psycho-motor tasks holding differential amounts of interest for the subjects. An experimental design representing a 2 x 3 factorial arrangement was used to evaluate the mean variability of the experimentally varied conditions and their interactions. The six combinations of conditions were: (a) "no competition" with praise; (b) "no competition" with reproof; (c) paired competition with praise; (d) paired competition with reproof; (e) individual competition with praise; (f) individual competition with reproof. The two additional variables of trial or practice and initial level of ability of the subjects were controlled and evaluated. The data were analysed by analysis of variance.

The experiment was conducted using two tasks. The first of these was a psycho-motor single dimension pursuit task and the second was the task of playing golf. Two phases of experimentation was undertaken on the psycho-motor task; (a) performance of the task with no monetary reward; and (b) performance of the task with monetary reward added during competitive trials.

The task of golf was rated by the subjects as the most interesting; psycho-motor task with monetary reward as next

in interest; and the psycho-motor task with no monetary reward as least interesting.

In interpreting the conclusions which follow, it should be remembered that the commonly used incentive of knowledge of results was present throughout all phases of the experiment. It is conceivable that there may be an interaction between the systematically varied conditions and knowledge of results. Within the limitations of this study the following conclusions can be drawn:

1. The hypothesis that differential "interest in the task" may be one of the significant sources contributing to the variability in the effect of the incentives of praise and reproof and of competition is supported. In the task rated lowest in interest, none of the incentive conditions significantly influenced performance; in the task rated relatively higher in interest, praise and reproof tended to significantly influence performance; and in the task rated highest in interest, competition and praise and reproof, and their interaction influenced performance.

2. Praise and reproof appears to be most effective during the early periods of adjustment to the task, since its influence was highly significant during the first three holes of play in the golf task but was not significant during the middle and last three holes.

3. Under the conditions of this study, individuals performed better under praise than under reproof.

4. The influence of competition on performance, when effective at all, becomes effective only in the later phases of

performance on the task. In this study competition exerted its greatest effect during the last three holes of play in the golf task.

5. Contrary to the results of most previous experimentation, best performance was obtained under conditions of paired competition rather than individual competition. These results may be explained by hypothesizing a positive relationship between competitive conditions and "interest in the task" or personal involvement. Under this hypothesis, an individual's performance is a function of his position within the group relative to the fixation of responsibility for the performance of the group. Fixation of responsibility for group performance is most clearly definable in paired performance. Poorest scores were obtained under conditions of "no competition."

6. The hypothesis that the contribution to variability by praise and reproof is negligible under conditions of high "interest in the task" or under conditions of low "interest in the task" is suggested by this study. The evidence for this conclusion is found in the results of analysis of the golf task total scores. In this analysis a significant interaction occurred between the variable of praise and reproof and that of competition. Equally poor scores were obtained under both praise and reproof under the condition of "no competition," while equally good scores were obtained under praise and reproof under the condition of paired competition. Under the condition of individual competition, however, praise and reproof exerted differential effect. Further evidence is contained in the results of analysis of the psycho-motor task

in which praise and reproof tended to exert a differential effect under the conditions rated as more interesting (monetary reward added) but, they did not exert an effect under the conditions rated as least interesting (no monetary reward).

7. A slight improvement in performance was observed on the psycho-motor task with greatest improvement between the first and the second trial. No significant improvement in performance was observed on the golf task. This is an interesting finding in view of the fact that knowledge of results was always present. A possible explanation of this result may lie in the fact that no instruction was given the subjects and the association between method and result was not made.

8. Interactions between trial or level and the experimentally varied conditions of praise and reproof or competition were not significant sources of variability in either task with two exceptions. In the psycho-motor task when monetary reward was added, performance was high during trials under praise, low during the first two trials under reproof, and high during the third or last trial under reproof. One other significant interaction occurred. In the last three holes of play in the golf task significant difference in mean performance occurred in the interaction of praise and reproof, trial, and initial level of ability. Examination of the data suggests that these interactions may well represent an individual-incentive interaction since there is a small number of individuals in each cell. Such interactions have been recognized for some time by workers using this technique. The individual-incentive interaction could not be examined within

the limits of this experimental design.

9. The hypothesis that incentive conditions may influence performance differentially so as to change the relative position of the individual's scores within a distribution is supported.

10. The implications of the findings of this study for education and industry are numerous. They point to the importance of the consideration of other condition or conditions of "interest in the task" and the interaction with other incentives.

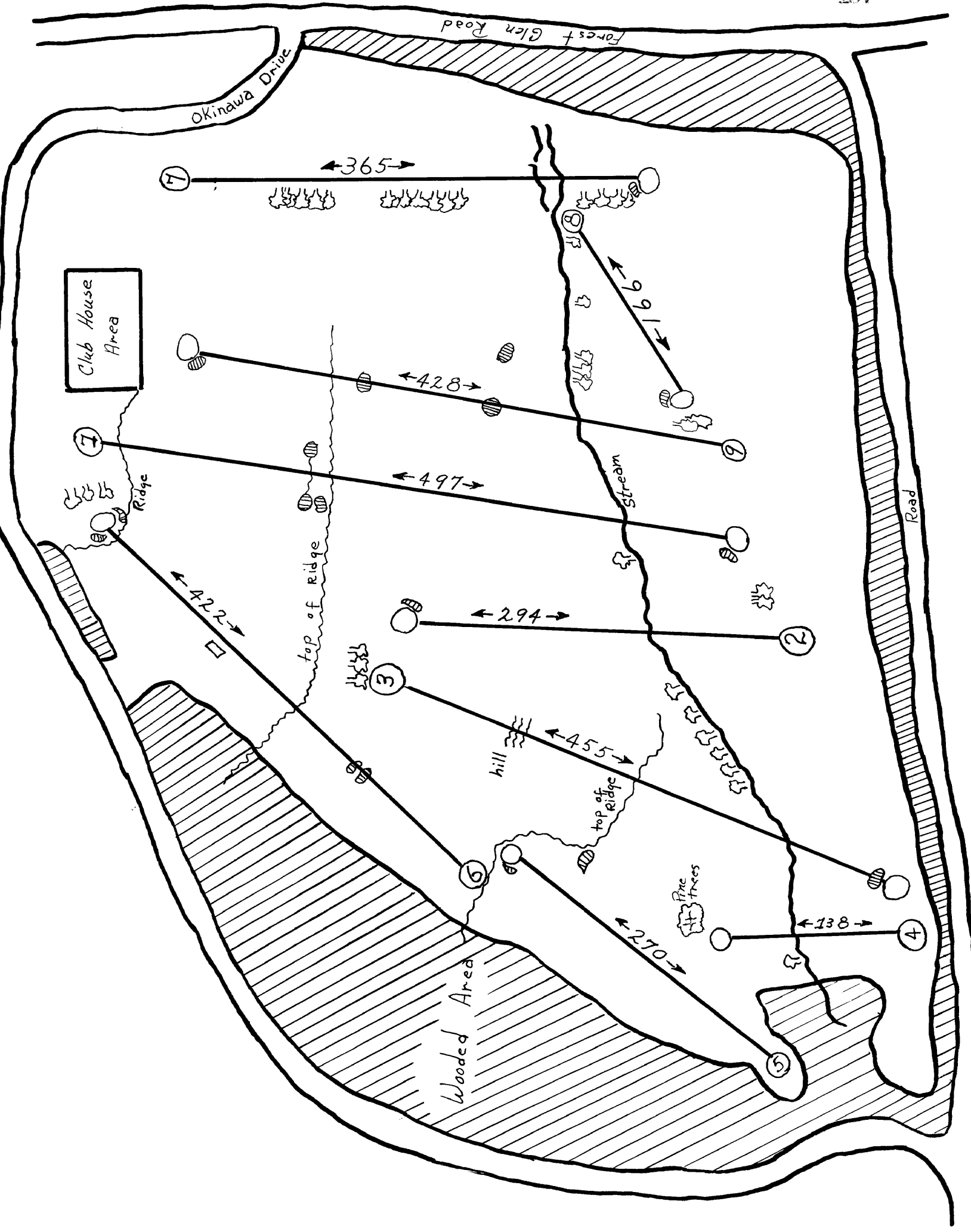
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APPENDICES



APPENDIX B

PSYCHO-MOTOR TASK SCORING FORM

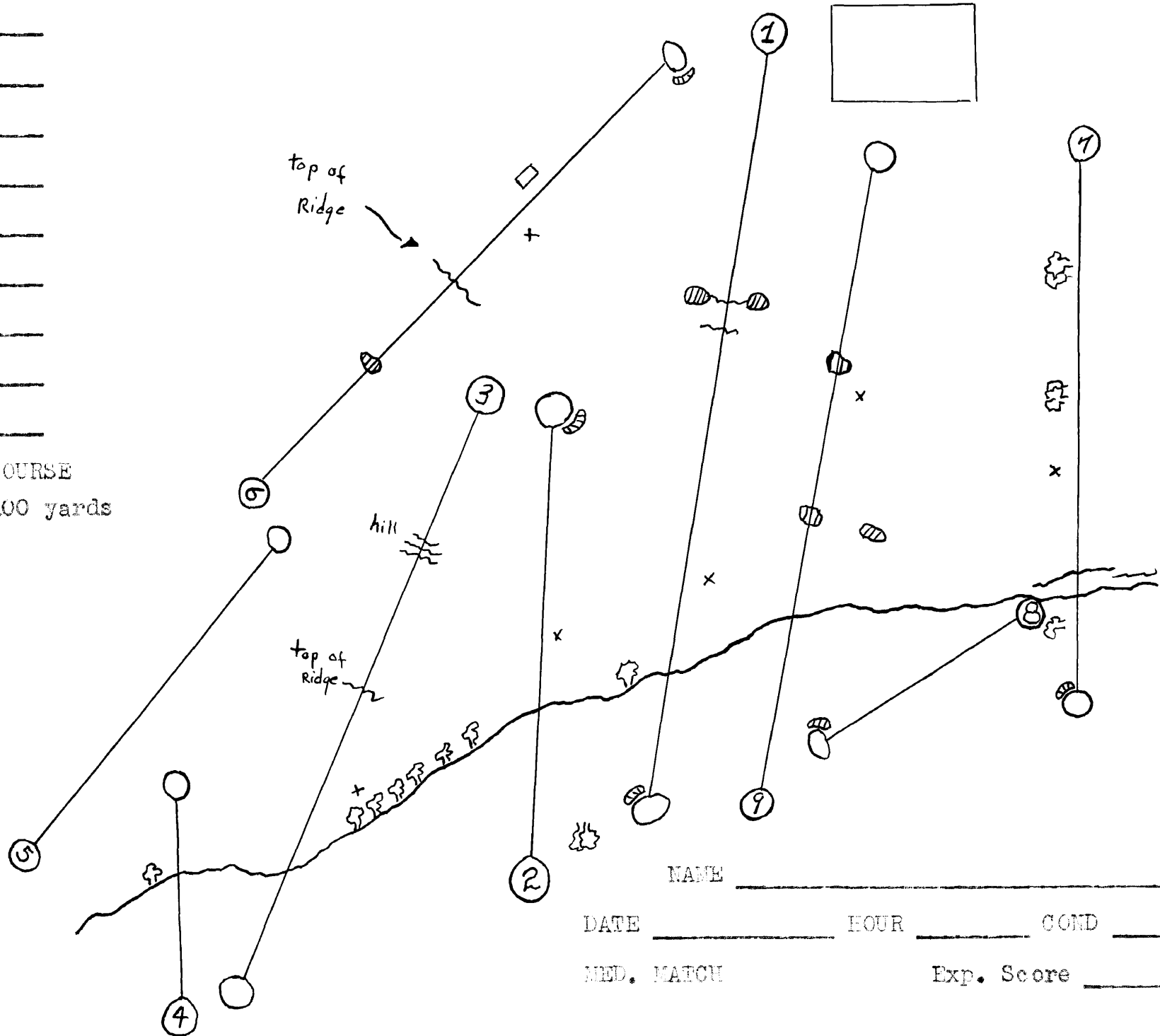
NAME _____ DATE _____ PSYCHO-MOTOR TASK _____

TRIAL	P 2X2	P 1X3	P NC	R 2X2	R 1X3	R NC	
1							TOTAL
2							TOTAL
3							TOTAL
4							TOTAL
						GRAND TOTAL	
DATE							

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____

GOLF COURSE

1" = 100 yards



NAME _____

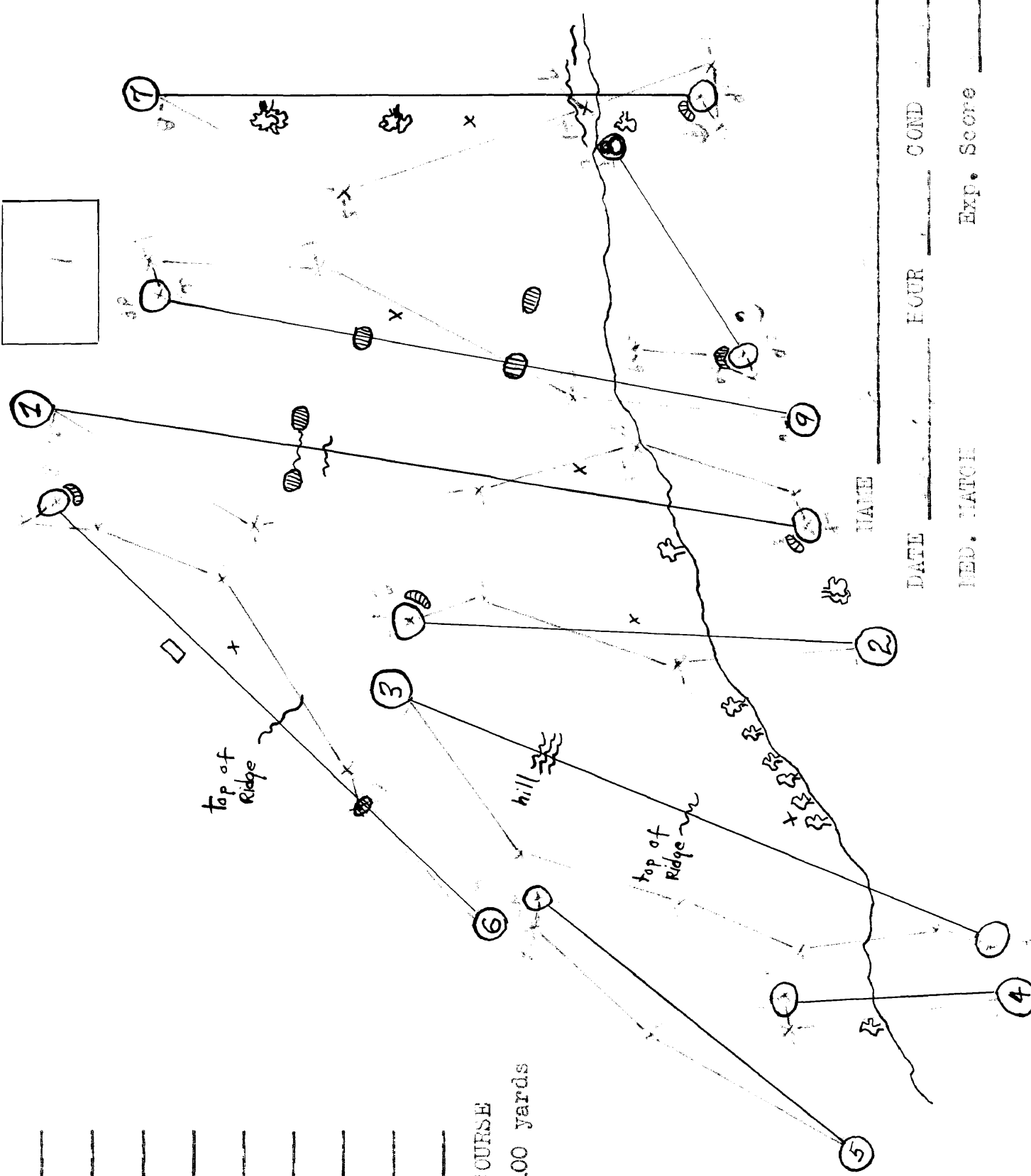
DATE _____ HOUR _____ COND _____

MED. MATCH _____ Exp. Score _____

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____

GOLF COURSE

1" = 100 yards



NAME _____

DATE _____ HOUR _____ COND _____

WED. MATCH Exp. Score _____

APPENDIX F

DISTRIBUTION SCORES OF PRELIMINARY TRIALS ON
PSYCHO-MOTOR TASK

Interval	Frequency	
1900-1915	2	
1850-1900	7	
1825-1850	10	
1800-1825	11	
1775-1800	7	
1750-1775	6	
1725-1750	8	
1700-1725	7	Range = 1187-1915
1675-1700	11	N = 116
1650-1675	5	Median = 1700
1625-1650	7	
1600-1625	10	
1575-1600	3	
1550-1575	7	
1525-1550	4	
1500-1525	2	
1400-1500	4	
1300-1400	1	
1200-1300	3	
1100-1200	1	

APPENDIX C

DISTRIBUTION OF
PSYCHO-MOTOR PRELIMINARY SCORES BY GROUPS

Level	A	B*	C	D	E	F
I	1834	1778	1707	1817	1815	1837
II	1653	1677	1689	1683	1677	1627
III	1552	1620	1613	1598	1572	1553
IV	1224	1549	1435	1298	1541	1538
Total	6263	6624	6444	6396	6605	6555
Mean	1566	1656	1611	1599	1651	1639

Level	G*	H*	J*	K*	L	M*
I	1736	1703	1779	1768	1718	1865
II	1638	1695	1693	1675	1631	1696
III	1559	1605	1624	1609	1579	1569
IV	1377	1522	1564	1400	1465	1526
Total	6307	6525	6660	6450	6593	6656
Mean	1577	1631	1665	1613	1598	1664

Level	N**	O**	P**	Q**	R**	S**
I	1832	1863	1851	1881	1825	1826
II	1787	1801	1777	1804	1797	1822
III	1715	1660	1678	1723	1694	1733
IV	1634	1187	1599	1602	1633	1653
Total	6968	6511	6905	7010	6949	7034
Mean	1742	1628	1726	1753	1737	1759

* Groups undergoing six experimental conditions

** Groups receiving monetary reward under competition conditions

APPENDIX E

SCORES FOR PRELIMINARY ROUND OF THE
GOLF TASK WITH IDENTIFICATION OF
INDIVIDUALS USED IN THE EXPERIMENT BY GROUP

Golfer	Group	Preliminary Scores				
		Round		Σ	Total	Mean
		1	2			
1	A	49	53	46	148	49.3
2	A	64	58	55	177	59.0
3		53	57	47	157	52.3
4	AA	48	45	50	143	47.7
5	A	54	50	55	159	53.0
6	A	51	51	52	154	51.3
7	AA	63	56	43	167	55.7
8	B	60	62	57	179	59.7
9	AA	60	51	57	168	56.0
10		66	68	69	203	67.7
11	B	64	65	58	185	61.7
12	BB	63	57	56	176	58.7
13	CC	74	70	69	213	71.0
14	BB	70	59	53	182	60.7
15	CC	90	85	75	250	83.3
16		63	66	69	198	66.0
17	CC	75	78	71	224	74.7
18		84	82	60	206	68.7
19	C	105	84	78	267	89.0
20		65	65	65	195	65.0
21	C	81	75	66	222	74.0
22	BB	67	68	66	201	67.0
23	B	67	66	63	196	65.3
24	C	97	84	78	259	86.3
25	BB	65	55	55	175	58.3
26	AA	49	58	54	161	53.7
27		73	72	73	218	72.7
28	B	66	71	59	196	65.3
29	C	67	70	63	200	66.7
30	CC	87	87	74	248	82.3

APPENDIX F. TOTAL SCORES OF INDIVIDUALS BY EXPERIMENTAL CONDITION; GOLF TASK

Round	Group or Level																									
	A			B			C			AA			BB			CC										
Condition*	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4						
1	53 M	44 P	46 R	52 P	63 M	75 P	80 P	72 P	65 M	62 P	82 R	86 R	53 R	47 P	68 R	62 P	66 R	59 R	66 R	66 R	62 P	53 M	62 P	70 R	76 R	89 R
2	55 M	45 R	58 R	58 R	65 M	64 P	60 P	58 P	56 M	68 R	81 R	93 R	50 M	54 P	61 P	62 P	72 P	62 M	63 M	62 R	72 P	61 P	53 M	53 R	64 R	84 P
3	48 M	54 R	50 P	48 P	50 M	72 R	66 P	60 R	67 M	80 P	80 P	91 P	47 M	47 R	58 P	67 R	78 R	53 M	58 M	53 R	78 R	56 R	63 M	63 R	73 R	88 R
4	46 M	53 P	51 R	49 R	58 M	79 R	73 R	67 R	62 M	80 R	95 P	83 P	51 M	46 R	62 P	53 R	59 P	60 M	61 M	61 R	76 P	59 P	65 M	65 R	65 R	88 R
5	48 M	45 P	59 P	52 P	70 M	81 R	68 P	72 R	56 M	69 P	70 R	91 P	50 M	53 R	66 R	49 R	67 R	54 M	54 M	50 P	67 R	61 R	65 M	64 R	70 P	71 P
6	46 M	46 P	53 R	54 R	62 M	69 R	69 R	61 P	61 M	71 R	82 R	96 R	48 M	47 R	62 R	58 P	67 R	51 M	51 M	58 R	67 P	59 P	59 M	66 P	85 P	80 P

*Condition
 M 0 - No Competition
 2 x 2 - Competition by pairs in groups of 4
 1 x 3 - Individual competition in groups of 4
 **R - Reproof or verbal discouragement and negative criticism
 P - Praise or verbal encouragement and performance cited as exemplary.

APPENDIX K. INDIVIDUAL SCORES FOR FIRST THREE HOLES BY EXPERIMENTAL CONDITION; GOLF TASK

Group or Level

Hole	A				B				C				AA				BB				CC			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	H 18	P 15	H 19	P 17	H 23	P 23	H 29	P 32	H 27	P 23	H 29	P 34	H 19	P 19	H 27	P 24	H 26	P 22	H 25	P 28	H 25	P 29	H 31	P 37
2	H 22	H 18	H 22	H 18	H 25	H 27	H 22	H 24	H 22	H 27	H 30	H 41	H 18	H 21	H 23	H 22	H 23	H 25	H 28	H 24	H 26	H 25	H 34	H 29
3	H 18	H 22	H 22	H 19	H 21	H 28	H 25	H 22	H 24	H 28	H 28	H 33	H 18	H 21	H 23	H 25	H 25	H 22	H 34	H 21	H 26	H 31	H 34	H 37
4	H 16	H 19	H 20	H 19	H 20	H 33	H 27	H 24	H 27	H 34	H 38	H 31	H 18	H 17	H 24	H 21	H 25	H 23	H 28	H 22	H 25	H 24	H 24	H 41
5	H 19	H 17	H 22	H 18	H 21	H 40	H 29	H 24	H 19	H 25	H 28	H 32	H 20	H 18	H 27	H 18	H 23	H 17	H 26	H 22	H 21	H 25	H 31	H 29
6	H 16	H 18	H 21	H 18	H 23	H 28	H 23	H 20	H 24	H 28	H 26	H 37	H 18	H 16	H 22	H 22	H 17	H 22	H 23	H 18	H 23	H 22	H 34	H 32

*Condition
 H C - No Competition
 2 x 2 - Competition by pairs in groups of 4
 1 x 3 - Individual competition in groups of 4
 **H - Reproof or verbal discouragement and negative criticism
 P - Praise or verbal encouragement and performance cited as exemplary.

APPENDIX L. INDIVIDUAL SCORES FOR MIDDLE THREE HOLDS BY EXPERIMENTAL CONDITION; GOLF TASK

Group	Group or level																		
	A			B			C			AA			BB			CC			
	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	Individual	Condition	
1	NS		1	4	2	3	1	4	2	3	1	4	2	3	1	4	2	3	4
2	NS		1	21	2	25	1	26	2	25	1	26	2	25	1	26	2	25	22
3	NS		1	17	2	19	1	18	2	18	1	18	2	17	1	18	2	17	18
4	NS		1	14	2	13	1	13	2	13	1	13	2	12	1	13	2	12	13
5	NS		1	15	2	14	1	14	2	14	1	14	2	15	1	14	2	15	16
6	NS		1	13	2	14	1	13	2	14	1	13	2	13	1	14	2	13	14

* Condition

NS = No Competition

2 x 2 = Competition by pairs in groups of 4

1 x 3 = Individual competition in groups of 4

** R = Reproof or verbal discouragement and negative criticism

P = Praise or verbal encouragement and performance cited as exemplary

APPENDIX H- INDIVIDUAL SCORES FOR LAMP BEAM HOLE BY PUNISHMENT CONDITION GOLF TASK

		Group or Level																															
		A				B				C				D				E				F											
Condition	Group	Individual				Individual				Individual				Individual				Individual				Individual											
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
1	N	21	16	12	15	20	31	26	19	20	22	28	26	17	14	21	20	22	20	25	20	22	20	25	20	22	20	25	20	22	20	25	20
2	N	17	13	19	21	20	17	19	16	19	19	18	27	19	14	21	23	23	21	20	20	23	21	20	20	23	21	20	20	23	21	20	20
3	N	18	18	16	16	20	24	24	20	22	27	30	31	13	14	19	22	17	18	21	19	17	18	21	19	17	18	21	19	17	18	21	19
4	N	15	20	17	16	20	23	25	28	19	20	27	27	17	14	18	15	17	19	27	18	17	19	27	18	17	19	27	18	17	19	27	18
5	N	15	13	18	17	26	19	20	27	20	25	21	33	15	18	19	16	19	19	19	21	19	19	19	21	18	18	18	23	18	18	18	23
6	N	17	14	19	17	20	17	28	22	16	25	30	29	16	16	20	16	18	21	23	19	18	21	23	19	18	21	23	19	18	21	23	19

* Condition
 NC = No Competition
 2 x 2 = Competition by pairs in groups of 4
 1 x 3 = Competition between individuals in groups of 4
 ** R = Reproof or verbal discouragement and negative criticism
 P = Praise or verbal encouragement and performance cited as exemplary

APPENDIX H

FINAL QUESTIONNAIRE; GOLF TASK

NAME _____ DATE _____

Indicate your interest in the game of golf at the beginning of the experiment. (Check along the line)

$\frac{1}{\text{Very inter-}} \frac{1}{\text{ested}} \quad \frac{1}{\text{Take it or}} \frac{1}{\text{leave alone}} \quad \frac{1}{\text{Not at all}} \frac{1}{\text{interested}}$

Has your interest in the game increased or decreased since the beginning of the experiment?

$\frac{1}{\text{Increased}} \quad \frac{1}{\text{Same}} \quad \frac{1}{\text{Decreased}}$

Was there any time during the experiment when your interest was especially low?

Yes _____ No _____ If yes, which round was it? _____

Why was your interest lower? _____

What score did you make that round? _____ Was there any

time when your interest was especially high? Yes _____ No _____

If yes, which round was it? _____ Why was your interest

higher? _____

What score did you make that round? _____

Is the game of golf more or less interesting than the psychomotor laboratory task? (Check along line)

$\frac{1}{\text{Very much}} \frac{1}{\text{more}} \quad \frac{1}{\text{Same}} \quad \frac{1}{\text{Very much}} \frac{1}{\text{less}}$

APPENDIX N: FINAL QUESTIONNAIRE; GOLF TASK
(Continued)

Is the psycho-motor laboratory task more interesting or less interesting when you compete for money?

$\frac{1}{\text{Very much more}}$ ————— $\frac{1}{\text{Same}}$ ————— $\frac{1}{\text{Very much less}}$