3377

NATIONAL LIBRARY

OTTAWA

BIBLIOTHÈQUE NATIONALE

OTTAWA

NAME OF AUTHOR.....JAMES....F....EVANS.....

TITLE OF THESIS....COMPONENTS.....OF.....MOTIVATION
..IN.....A.....COMPETITIVE.....
.....SITUATION.....

UNIVERSITY.....THE....UNIVERSITY....OF.....ALBERTA

DEGREE.....Ph.D.....YEAR GRANTED.....1968.....

Permission is hereby granted to THE NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

(Signed)....J. F. Evans

PERMANENT ADDRESS:

..408...REDWOOD AVENUE
...FORT...WILLIAM
....ONTARIO....

DATED.DEC.....7.....1968

NL-91

THE UNIVERSITY OF ALBERTA

COMPONENTS OF MOTIVATION IN A COMPETITIVE SITUATION

by

© JAMES FREDERICK EVANS

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY

EDMONTON, ALBERTA

AUGUST, 1968

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Components of Motivation in a Competitive Situation," submitted by James Frederick Evans in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Brendan Gail Rule
Supervisor

Richard B. Alderman

William A. Blanchard

Ron D. Walley

Robert E. Knox
External Examiner

Date August 1, 1968

ABSTRACT

The purposes of this study were threefold. One purpose was to determine whether it is possible to distinguish between at least two motivational factors involved in a situation where people are competing in the presence of one another, specifically rivalry and social facilitation. Another purpose was to investigate possible relationships between performance, the level of motivation and cognitive activity. A third purpose of this study was to investigate the effects of individual differences in competitiveness on the motivational effects of competition.

The design was a 2 x 2 factorial design with two controls. Rivalry and social facilitation were the two factors in the factorial design. The conditions for the critical trial were: rivalry and social facilitation, rivalry and no social facilitation, no rivalry and social facilitation, and no rivalry and no social facilitation. A fifth group of subjects performed the critical trial of the task all alone and a sixth group of subjects performed the critical trial with instructions that their partner was performing a different task. The behavioral variable was performance on a form board task. Heart rate was used as a measure of activation to detect motivational differences. A rating of alertness was used as an indicator of cognitive activity. A questionnaire was used to tap individual differences in competitiveness.

The heart rate data supported the conjecture that rivalry is a motivational component and suggested that social facilitation is a motivational component in a competitive situation. The behavioral data, that apparently demonstrated the inverted U phenomenon, also suggested that rivalry and

social facilitation are motivational components in a competitive situation. Ratings of alertness, even though they did not distinguish between experimental groups, were found to be positively correlated with performance. No evidence was obtained regarding individual differences in competitiveness. They hypothetical inverted U function between activation and performance was utilized in interpreting the majority of the obtained results.

Acknowledgements

I would like to thank Dr. Brendan Gail Rule very very much and express my very sincere appreciation for her guidance and help throughout my years as a graduate student and during the production of this dissertation. I would like to thank Dr. W. A. Blanchard and Dr. R. E. Walley for the help and suggestions they have given me regarding this dissertation. I would like to thank Dr. K. V. Wilson for his help during the initial stages of this work. I would like to thank Dr. R. B. Alderman and Dr. R. E. Knox for serving as members on the examining committee for the final defense of this dissertation. I would like to thank Mrs. Rosemary Robertson who has done the majority of my typing, including this dissertation, during my graduate student years. I would like to thank Mr. George Diadio who drew figure one in this dissertation. And last but very certainly not least I would like to thank all the staff members, past and present, in the Psychology Department at the University of Alberta, who have been involved in the process that eventually made the production of this dissertation a possibility.

J. F. Evans

James Frederick Evans

T O M A R I L Y N

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Social motivational[1] variables have long been the concern of psychologists. The first experiment involving a social motivational variable was performed by Triplett in 1897 (Zajonc, 1966). Triplett (1897) asked the question: what change in an individual's normal solitary performance occurs when other people are present? By having children wind fishing reels either alone or together in groups of two, Triplett found that when working together twenty of his subjects excelled their solitary record, while ten did less work apparently because they were over stimulated by the desire to win. Ten of his subjects were unaffected by the alternation of the alone and together situations. Triplett concluded that the group situation must normally be thought of as producing greater output of energy and achievement. He explained this result as follows:

> . . . the bodily presence of another contestant participating simultaneously in the race serves to liberate latent energy not ordinarily available . . . the sight of the movements of the pacemakers or leading competitors and the idea of higher speed furnished by this or other means, are probably in themselves dynamogenic factors of some consequence. (p. 533)

Triplett in his explanation, as well as his experimental design, failed to distinguish between two possible motivational factors involved in his experiment: a possibility of a cognitive desire to win on the one hand, and a possible motivational factor resulting from the sights and sounds

---

[1]Motivation as used in thesis includes both activation and cue functions (Atkinson, 1964; Duffy, 1962; Hebb, 1955) as opposed to having the term refer to just activation as proposed by Brown (1961).

of another person making the same movements, on the other. Allport (1924), after considering Triplett's work, ergographic work, dynamometric tests of hand grip, and the pacing effect in bicycle races, concluded that there were two distinct motivational factors involved when people were in a competition in the presence of one another. A competition may be defined as a situation in which an individual's success is determined by some characteristic of his response relative to that of another individual or other individuals.[2] Allport called one of the motivational factors involved in competition rivalry and the other social facilitation. Rivalry referred to "an emotional reinforcement of movement accompanied by the consciousness of a desire to win." Social facilitation referred to "an increase of response merely from the sight or sound of others making the same movements" (whether or not explained in terms of dynamogenesis). In this thesis, rivalry and social facilitation are used to refer to the two proposed different components of the motivation in a competitive situation. Rivalry will be used to refer to the cognitive aspects of this motivation, i.e., a cognitive desire to win. Social facilitation will be used to refer to the proposed motivational component resulting from the sights and sounds of another person making the same movements. This motivational component is probably primarily due to sensory input.

The work on rivalry, using explicit instructions to compete (Church, 1962; Church, Millward, and Miller, 1963; Dashiel, 1930; Hurlock, 1927;

---

[2]In many studies competition is an all-or-none situation; one person or group wins and the other person or group loses. In other competitive situations, such as non-zero sum games (Wilson and Bixenstine, 1962), the situation is more ambiguous. Besides completely winning or losing, a person may partially win and partially lose to varying degrees. In this thesis competition refers to the all-or-none situation.

Whitemore, 1924) has demonstrated that rivalry generally increases performance. The work on social facilitation is somewhat more ambiguous (Allport, 1924; Dashiel, 1930; Farnsworth, 1928; Weston and English, 1926; Zajonc, 1965) a facilitating effect occurring at times but not at others. Zajonc (1965) cites studies demonstrating that compared to an alone condition, animals eat more (Bayer, 1929; Harlow, 1932; Tolman and Wilson, 1965), ants work more (Chen, 1937), and humans write more (Allport, 1920) under conditions of social facilitation. Zajonc also cites studies demonstrating that greenfinches (Klopfer, 1958), parakeets (Alee and Masure, 1936) and cockroaches (Gates and Allee, 1933) learn less well when others are present. Zajonc accounts for these discrepancies in the social facilitation literature by proposing that performance is facilitated but learning is impaired by social facilitation.

Despite the fact that it has been four decades since Allport (1924) suggested that rivalry and social facilitation operate simultaneously in a competitive situation, no research to date has isolated the effects of these two proposed motivational factors. The conceptual distinction seems to have been ignored and whether a competitive situation involves just rivalry or rivalry and social facilitation is often ambiguous. In order to understand the behavior resulting from competitive situations, we must determine whether there are these two distinct components of motivation in a competitive situation. The present thesis will examine whether the effects of rivalry can be distinguished from the effects of social facilitation in a competitive situation, and if so, discuss the effects of the two factors operating independently and/or simultaneously.

In order to consider different motivational components, several indicators of motivation must be examined. Intensity of motivation has been tapped by examining performance, physiological responses and cognitive variables. Performance has usually been investigated in former research on rivalry and/or social facilitation. But, because increases in motivation can result in increments or decrements in performance (Duffy, 1962; Hebb, 1955; Malmo, 1959) indicators of motivation other than performance must be used.

When physiological measures have been considered indicative of motivational involvement, activation and synonymous terms such as arousal, energy mobilization, or excitation have been invoked. The neuropsychological dimension of activation is described by Malmo (1959) as follows.

> The continuum extending from deep sleep at the low activation end to "excited" states at the high activation end is a function of the amount of cortical bombardment by the ascending reticular activating system, such that the greater the cortical bombardment the higher the activation. (p. 384)

With regard to motivation Duffy (1962) says that, "If it is desired to measure the intensity (as opposed to the direction) of the motivation, measurement should be made of the physiological processes indicative of the level of activation." Although it has been suggested that multiple peripheral measures may be required to accurately indicate levels of activation (Duffy, 1962; Lacey and Lacey, 1958; Schnore, 1959), and that the concept of general activation itself may be questioned (Lacey, 1967), single physiological measures such as heart rate or the galvanic skin response may have been used to successfully distinguish between different

experimental groups expected to be differentially activated (Blatt, 1961; Buckhout, 1966; Burgess and Hokanson, 1964; Church, 1962; Doerr and Hokanson, 1965; Hokanson and Burgess, 1964; Malmo, 1959; Schnore, 1959).

Ratings of alertness and interest have been used as indicators of motivationally related activity that may be subsumed under cognition. Neisser (1966) uses the term "cognition" to refer to:

> . . . all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations. Such terms as sensation, perception, imagery, retention, recall, problem solving, and thinking, among many others, refer to hypothetical stages or aspects of cognition. (p. 4)

Assuming that alertness taps some aspect of cognitive activity related to attention, Church (1962) used ratings of alertness in his study on competition. Evans (1966) used ratings of alertness and ratings of interest in his study.

Although it has been assumed that competitive situations involve these other indicators of motivation in addition to different levels of performance, minimal evidence of this is available. Furthermore, the relationship between performance and other indicators of motivation is ambiguous. Church (1962) found that competition decreased reaction time. He also found that competition resulted in increases in the level of palmar skin conductance, and self rated alertness. No evidence for a relationship between competition and increased skin conductance or self rated alertness was found. Whether or not there was a relationship between skin conductance and self rated alertness was not mentioned.

Elliot (1965), after working with reaction time and heart rate as a function of the magnitude of an incentive and the probability of success, suggested it may be unwise to describe any general relation between activation and performance. This suggestion was based on examination of only three subjects. Evans (1966) also failed to find any relationship between activation and performance on the reaction time task. He suggested that the lack of any relationship to emerge may have been due to the simplicity of the reaction time task. He pointed out that these negative findings do not eliminate the possibility of a relationship between activation and performance on more complex tasks. An example of a more complex task is a form board task, rather than a reaction time task.

In this thesis, in order to examine the components of motivation in a competitive situation, and to examine the relationships between multiple measures of motivation, performance on a form board task, heart rate and ratings of alertness were used to assess motivation under various conditions.

Even though average performance in a competitive situation is better than average performance in a noncompetitive situation, there are individual differences as to how different people react to the same competitive situation. Even Triplett (1897), in his previously mentioned study, found individual performance to improve, degenerate or be unaffected in a competitive situation as compared to a noncompetitive situation. Various studies have been addressed to isolating individual difference variables relevant to these diverse responses in competitive situations. McKee

and Leader (1955) found boys, older children, and children of lower socio-economic status to be more competitive than girls, younger children, and children of upper middle socio-economic status. Mogar (1962) found Dominance and Succorance (measured by Edward's Personal Preference Schedule) for women, but not for men, to be positively related to the facilitation of competitive performance in a laboratory situation. Ryan and Lakie (1965) reported that when subjects were classified simultaneously on manifest anxiety (Taylor MA scale) and n Ach (French Test of Insight), the high MA scale-low n Ach group performed significantly better under noncompetitive conditions, while the low MA scale-high n Ach group made significantly greater gains during competition. Vaught and Newman (1966) demonstrated that low anxious (LA) subjects (Taylor MA scale) made fewer errors than high anxious (HA) subjects in a steadiness test and that competition exacerbated performance differences between HA and LA subjects. Other than these studies, information as to how people are differentially affected by a competitive situation is extremely sparse. To examine individual differences in this study, a questionnaire developed by the author and introductory psychology students (1966-67) was administered to all subjects. The development of the questionnaire was an attempt to measure, in a more direct manner than previously, individual differences related to competitiveness.

As evidenced above, even though research in the area of competition has been in existence for nearly a century, very basic issues remain to be clarified. One purpose of the present study was to determine whether there are in fact at least two distinguishable motivational factors involved in a competitive situation, specifically, rivalry and social

facilitation. Competition or noncompetition in conjunction with the social facilitation of a rival or a co-worker will be compared with one another in a 2 x 2 factorial design. It was anticipated that a competitive situation involving social facilitation would be the most motivating and that a noncompetitive situation not involving social facilitation would be the least motivating. Rivalry was expected to be the most singly motivating factor and because of this, the group that had rivalry but no social facilitation was expected to be more motivated than the group that had social facilitation but no rivalry. Because of some findings by Dashiel (1930) indicating that the mere knowledge of someone else simultaneously performing the same task may be motivating, two extra control groups were run. In one of these groups subjects performed the critical trial all alone. In the other control group subjects performed the critical trial with instructions that their partner was performing a different task. These groups were expected to do less well than comparable groups of subjects that were aware of the fact that another subject was simultaneously performing the same task. Conditions involving the most motivating factors were expected to reflect this by improved performance, higher heart rates and higher ratings of alertness.

A second purpose of the study was to examine the relationship between performance and other indicators of motivation, specifically, heart rate and ratings of alertness. It was expected that all the measures of motivation would be positively related.

A third purpose of this study was to investigate the effects of individual differences in competitiveness on the motivational effects

of competition. More competitive subjects were expected to be more motivated by competition. This research also served to validate the questionnaire designed to measure individual differences in competitiveness.

METHOD

Subjects

Subjects were 120 males, 17 to 21 years of age, enrolled in the Introductory Psychology course at the University of Alberta. Subjects satisfied part of a course requirement by participating in the experiment. A booklet was left on a table at a designated place so that subjects could sign up for various times. Subjects were signed up two at a time for all conditions. The requirement that subjects had to be male and 18 to 20 years of age was stated on the front of the sign-up booklets. Subjects' ages were checked at the end of each experimental session and the range was found to be 17 to 21.

Design

The design was a 2 x 2 factorial design with two control groups. Rivalry (R) and social facilitation (F) were the two factors in the factorial design. The conditions for the critical trial were: rivalry and social facilitation (R & F), rivalry and no social facilitation (R & NF), no rivalry and social facilitation (NR & F), and no rivalry and no social facilitation (NR & NF). These four groups, comprising the 2 x 2 factorial design, are referred to as the main design of the experiment. A fifth group of subjects performed the critical trial of the task all alone (AA) as a control for the NR & NF group. The subjects in the NR & NF group performed the critical trial of the task without rivalry or social facilitation, but with the knowledge that another subject was simultaneously performing the same task. A sixth group of subjects performed the critical trial with instructions that their partner was performing a different task

(DT). In the DT group, in order to expose the critical subject to only the social facilitation effects of another subject making the same movements, the critical subject was told that the other subject was performing a different task during the critical trial. The DT group was a control for the NR & F group. Subjects in the DT group performed the critical trial under identical conditions to the NR & F group except that subjects in the NR & F group were aware of the fact that the other subject was simultaneously performing the same task.

Apparatus and Materials

The study was conducted in a 13'1" x 11'11" room. A room next to the experimental room, accessible by an interconnected door, was used to store experimental equipment when subjects were not supposed to see it (see Fig. 1).

Each subject sat at a table facing one another, approximately 8'8" from one another. Each table had a 4" high board from one side to the other, 15" in from the side of the table at which the subjects sat. This guard effectively prevented subjects from seeing one another's task, when the accordion door was open. Whether or not subjects were able to see one another was controlled by means of the accordion door between them. Whether or not subjects were able to hear one another was controlled by means of Sharpe HA9-10 MK 11 earphones in which the electrical components had been removed and the chambers were packed with fiberglass. According to the experimenter's judgment and to those subjects queried in this regard, these altered earphones did not completely eliminate sounds but with the background noise of the dynograph, seemed quite effective in eliminating

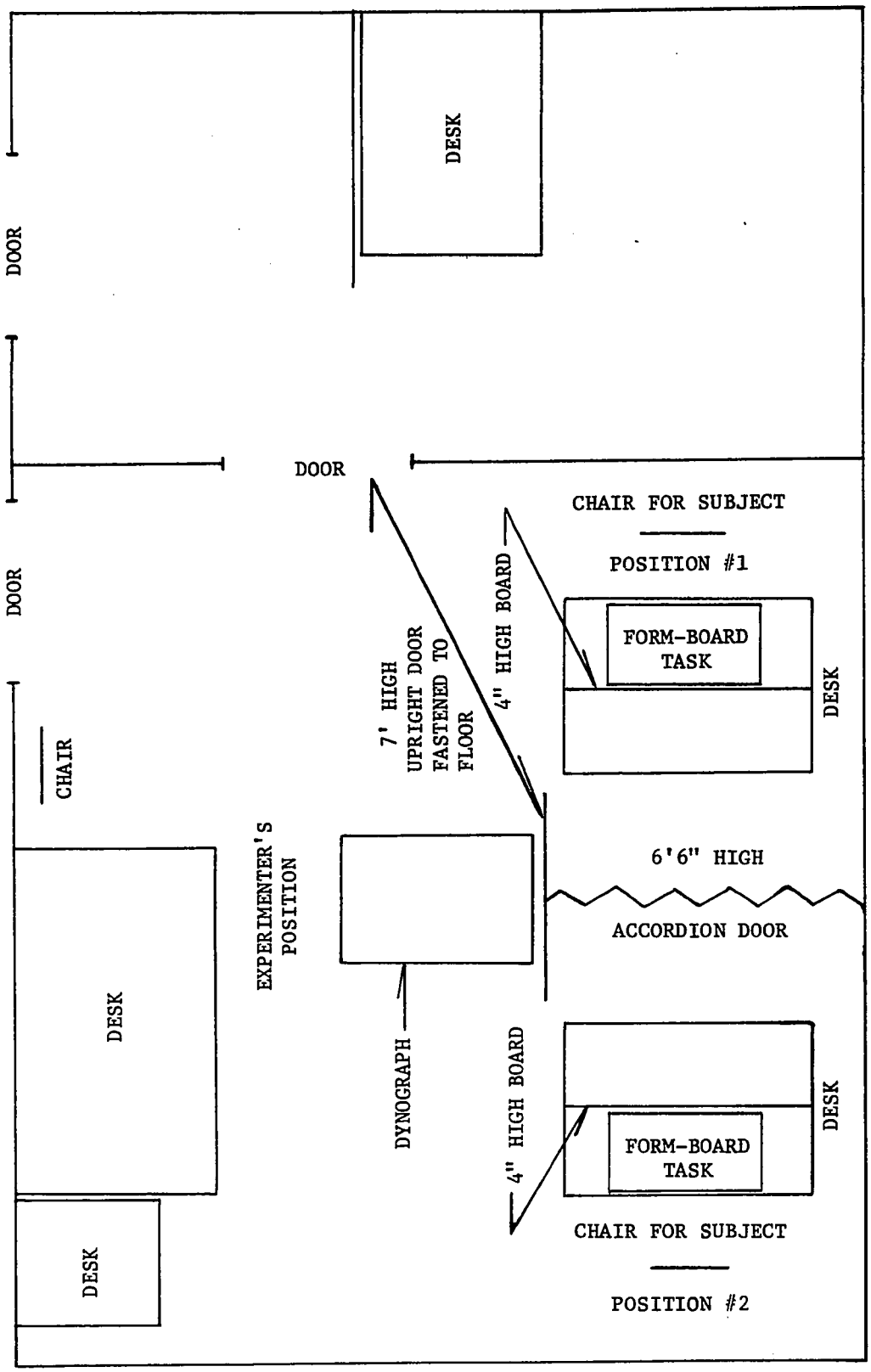


Fig. 1. The Experimental and Adjoining Room.

the sounds of one's partner performing the task, especially when one was also performing the task.

The tasks consisted of two identical form boards each with twenty-four different pieces of different shapes and sizes. Each piece had a particular slot in the board (see Fig. 2).

Heart rate was measured by means of a Beckman Offner Type R dynograph. Sanborn electrodes were attached to the subjects using Beckman Offner adhesive collars and Beckman Offner paste. Two of the electrodes crossed the subjects' hearts and ground electrodes were placed above their stomachs. The dynograph was also equipped with a marker pen with which the experimenter marked on the heart rate record the beginning and end of rest periods and trials. The recording paper moved at 150 millimeters per minute. The experimenter timed trials with a Brenet (No. 22) stopwatch.

A questionnaire which had been developed by the author and introductory psychology students (1966-67) was used to gain information regarding individual differences in competitiveness. The questionnaire had been developed as a class project. About twenty-five students and the author (instructor) initially engaged in a discussion in order to get a working notion in regards to: what is a competitive person? Only partial success was achieved in this regard. The students were then instructed to make up several statements that they thought would be related to competitiveness. They were to make up statements that would cover the range from noncompetitive through neutral to competitive. These statements were handed in to the instructor who eliminated the duplicates and had the remaining statements typed up in a "questionnaire" form. Each student

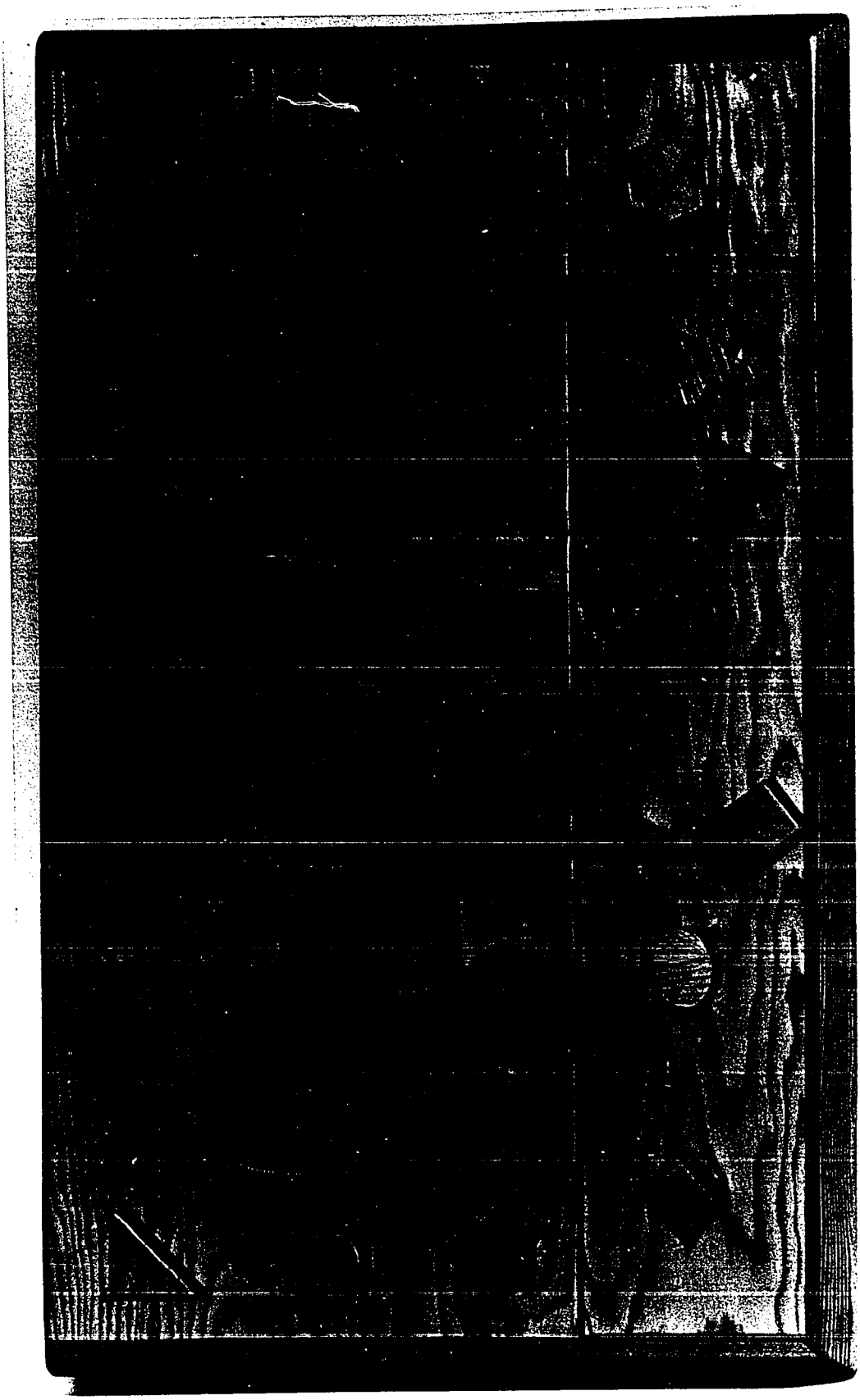


Fig. 2. The Form Board Task.

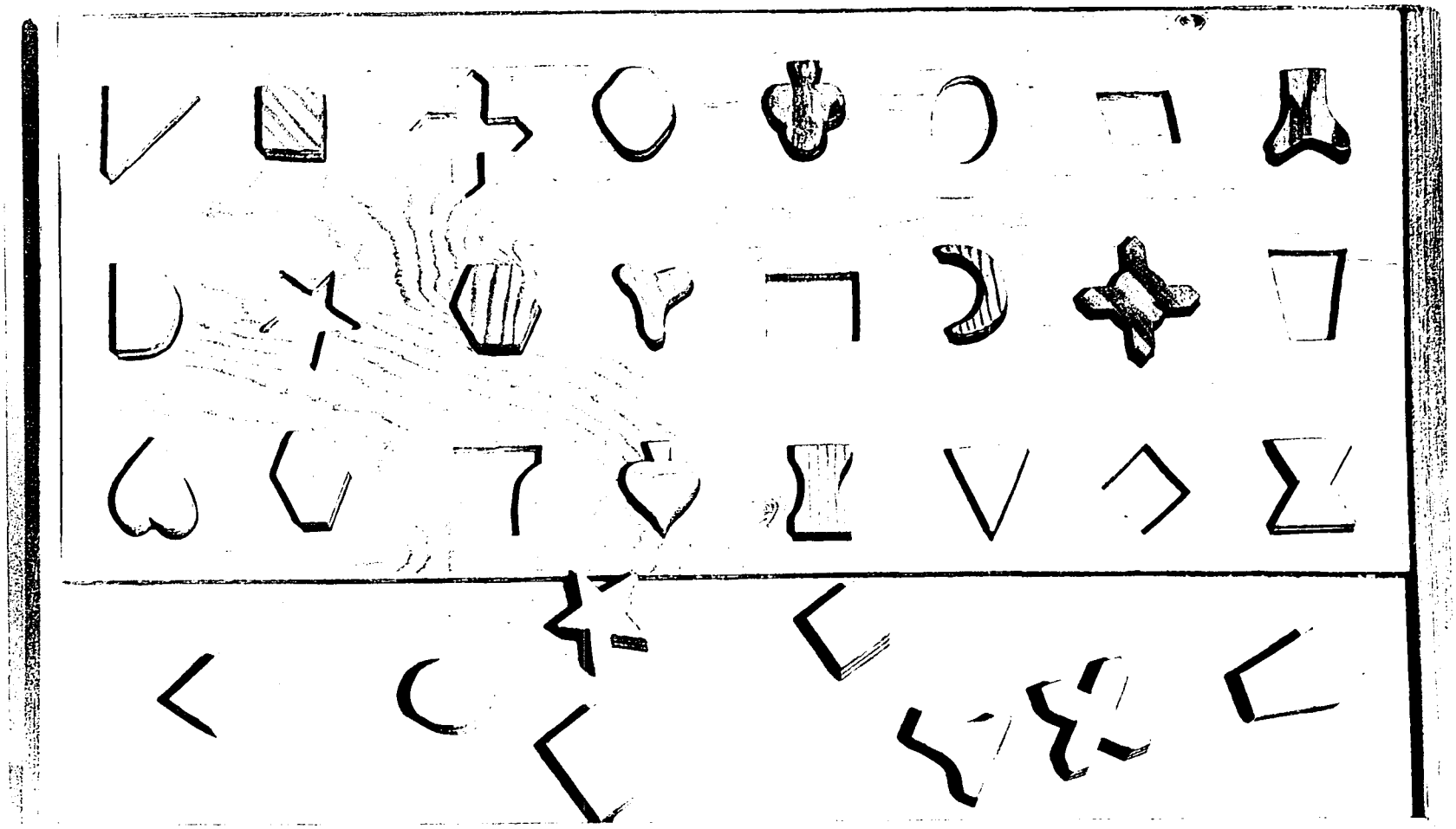


Fig. 2. The Form Board Task.

then received this "questionnaire" with about three-hundred statements on it and was to rate each statement. They were asked to assign a number to each of the statements on the sheet. The numbers were supposed to represent a series of equal intervals from 1 to 9 in which 1 was extremely noncompetitive and 9 was extremely competitive with number 5 being neutral. Only whole numbers were to be used. The students were instructed to judge the items in terms of whether agreement with the statement indicated competitiveness or not, and to refrain from letting their own attitudes influence their judgments. After all the statements were rated each student received the data from about a dozen items. For each item he had to compute the mean and the standard deviation of the ratings. The instructor then collected all the data. All the items with a standard deviation greater than 1.5 were eliminated. Out of the remaining items, 20 were selected to include a wide range of scale values, using the seemingly most appropriate items as well as trying to pick items with the lowest possible standard deviations. The present study was the validation measure for the questionnaire. Appendix A contains this questionnaire. Beside each question is the scale value a subject received if he marked the question true.

There was a rating scale for alertness ranging from 1 to 9. The end points of 1 and 9 were labelled low and high respectively and the middle point, 5, was labelled moderate. Appendix B contains this rating scale.

There was also a general questionnaire which the experimenter gave to all subjects to see if they had heard about the experiment before or asked if they had any comments about the experiment. Appendix C contains this general questionnaire.

Procedure

Subjects came to the experimental room two at a time. The first subject signed up (in the experimental booklet) was directed to position number one and the second subject was directed to position number two. The accordion door was closed so that subjects were not able to observe one another. The form board tasks and the earphones were out of sight in the adjoining room. A set of instructions were read to the subjects which explained that psychologists often use physiological measures to get more information about what they are working with and that heart rate was being used in this experiment. Subjects were then asked either to remove their sweaters or to open their shirts in order to enable the experimenter to attach the chest electrodes. The experimenter had two extra shirts to lend to subjects if they were wearing sweaters only and had to remove them. After the experimenter had attached the electrodes he read a set of instructions, instructing the subjects to relax for five minutes. The two foregoing sets of instructions may be found in Appendix D.

After the five minute rest period, the experimenter brought out the form board tasks and earphones and set one of each before the subjects. He opened the accordion door and, standing between the two subjects, read instructions, and gave demonstrations on how to perform the task. These instructions are elaborated in Appendix E.

At the completion of the instructions the experimenter put a pair of earphones on each subject, closed the accordion door and proceeded with the first trial. It consisted of the experimenter saying ready - (pause) -

go. Simultaneous with saying go, the experimenter would start the stopwatch and make a mark on the heart rate record by means of a marker pen. At the end of one minute the experimenter simultaneously said stop, stopped the stopwatch, and marked the heart rate record. At the end of the first practice trial subjects were reminded to put their hands on their knees and look down. The experimenter then went and recorded the subjects' scores. Each subject was told, after the first trial, that they were allowed to watch the experimenter count the number of correctly inserted blocks. The experimenter indicated to a subject that a block had not been counted by taking the block and putting it in the trough. After recording the scores the experimenter took the correctly inserted blocks out of their places, put them in the trough with the non-inserted blocks and mixed up the blocks, by shuffling them three times, for the next trial. The rest of the practice trials were identical to the first with the exception that the experimenter did not tell the subjects to put their hands on their knees and look down, nor to watch the experimenter count up the number of correctly inserted blocks.

At the end of the fifth practice trial, the experimenter recorded scores and mixed up the blocks as if another trial were going to occur. The experimenter then took his position in front of the dynograph and said "O.K.---please remember, I don't want you to say anything, just sit there and look down until I instruct you to do otherwise." The experimenter then took off the subjects' earphones and moved the tasks to the front of the tables with the accordion door remaining shut. The experimenter then administered the individual differences questionnaire.

After collecting and checking the individual differences questionnaire for completeness, the experimenter administered the rating scale, mentioning that the 'last trial' referred to the last trial on the form board. The experimenter then collected and checked the rating scale for completeness. Up to this point, subjects in all conditions were treated identically.

Differential instructions were then read. The R & F and R & NF groups received competitive instructions (Appendix F). The NR & F and NR & NF groups received noncompetitive instructions (Appendix G). The AA and DT group received the instructions in Appendices H and I respectively. For the AA group one of the subjects, decided by the flip of a coin, was asked to wait outside the experimental room. For the DT group, the subject in position number one was ostensibly given a different task. Following these differential instructions and appropriate manipulations, subjects relaxed for one minute.

After one minute the experimenter made the appropriate manipulations on the accordion door and the earphones. The subjects in the R & F, NR & F, and DT groups did not wear the earphones and the accordion door was opened. The subjects in the R & NF, NR & NF and AA groups wore the earphones and the accordion door was closed. Just before beginning the sixth trial (i.e., the critical trial) the experimenter said to the subjects in the R & F and R & NF groups, "O.K.---now remember, you are to try to beat your partner on this trial." To the subjects in the NR & F, NR & NF, AA, and DT groups, the experimenter said, "O.K.---now remember, do this trial the same way as you did the others," the experimenter then said "ready--(pause) --go" and the critical trial commenced.

At the end of the critical trial consisting of one minute of performing the form board task, the experimenter closed the accordion door, if it was open, or removed the earphones, if they were being worn. The experimenter then recorded the number of correctly inserted blocks, moved the tasks to the front of the tables and again administered the rating scale for alertness. After collecting the alertness scales (the subjects in the AA group who had left the room were asked to return at this point), the experimenter administered the general questionnaire asking subjects for comments about the experiment and whether they had heard about the experiment before. The critical subjects in the DT group were asked if they had any ideas about how the other person's "new task" differed from their own. This was done to see if the ostensible change of task had been successful in having the critical subject think his opponent was doing something different, during the critical trial, from what he had been doing. This concluded the experimental session.

The electrodes were removed from the subjects and the experimenter briefly explained the nature of the experiment to the subjects. The experimenter thanked the subjects and gave them a credit for participating in the experiment. All subjects were asked to please not reveal any of the fine details of the experiment to any other potential subjects. The whole experimental session lasted about forty-five minutes.

RESULTS

The dependent variables in this experiment were: number of blocks inserted into a form board, heart rate, ratings of alertness and a score on an individual differences questionnaire. The number of blocks fitted into a form board was used to measure performance. Heart Rate (HR) was used as a measure of the level of activation. Ratings of alertness were used to assess cognitive activity. The individual differences questionnaire was used to detect individual differences in competitiveness. Performance was expected to decrease sequentially for the rivalry and social facilitation (R & F), rivalry and no social facilitation (R & NF), no rivalry and social facilitation (NR & F), and no rivalry and no social facilitation (NR & NF) groups. These four groups, forming a 2 x 2 factorial design with rivalry (R) and social facilitation (F) as the two factors, are referred to as the main design of the experiment. Regarding the two extra control groups, the all alone group (AA) was expected to perform less well than the NR & NF group and the different task group (DT) was expected to perform less well than the NR & F group. HR and ratings of alertness were expected to increase when performance improved. More competitive subjects were expected to be more motivated by competition.

Performance

Performance scores consisted of the number of blocks subjects inserted during the sixth trial (which was the critical trial) minus the number of blocks they had inserted during the fifth trial, which all subjects

performed under identical conditions. Difference scores were used as a means of minimizing individual differences in performance. The mean performance scores for the R & F, R & NF, NR & F, and NR & NF conditions were -.05, .35, .85 and 1.75 blocks per minute respectively. A 2 x 2 analysis of variance indicated a difference, nearly reaching the conventional level of significance ($F = 2.86$, df 1/76, $p < .10$), due to rivalry. No differences in performance due to F or due to an interaction between R and F were indicated. Table 1 contains a summary of the analysis of variance.

Table 1

Summary of Analysis of Variance of Performance Scores

Source of Variation	Sum of Squares	df	Mean Square	F
Rivalry (R)	26.45	1	26.45	2.86*
Facilitation (F)	8.45	1	8.45	<1
R X F	1.25	1	1.25	<1
Error	703.80	76	9.26	

*$p < .10$

Duncan's Multiple Range test (Edwards, 1960) did not indicate any significant differences in performance between the individual groups in the main design of the experiment.

The mean performance score of .75 blocks per minute for the AA group was not significantly different from 1.75 blocks per minute, the mean performance score for the NR & NF group ($t = 1.08$, df 38). The mean

performance score of 1.90 blocks per minute for the DT group was not significantly different from .85 blocks per minute, the mean performance score for the NR & F group ($t = -1.19$, df 38).

Heart Rate

HR was counted for the third minute of the initial rest period, the minute during the fifth performance of the form board task, the minute subjects were asked to relax after differential instructions, and the minute during the critical performance of the form board task. All HR scores consisted of difference scores in order to minimize individual differences in HR.

HR was scored three different ways. The first HR score (HR_1) was calculated to evaluate the effects of different instructions. It consisted of the minute of HR during the rest after differential instructions minus the minute of HR counted for the third minute of rest during the initial five minute rest period. The mean HR_1 scores for the R & F, R & NF, NR & F, and NR & NF conditions were 4.05, 3.25, -.35, .60 beats per minute respectively. A 2 x 2 analysis of variance indicated a difference due to rivalry instructions ($F = 4.86$, df 1/76, $p < .05$). No differences in HR_1 due to F or due to an interaction between R and F were indicated. Table 2 contains a summary of the analysis of variance.[1]

Duncan's Multiple Range test did not indicate any significant differences in HR_1 between the individual groups in the main design of the experiment.

---

[1] A t test comparing those forty subjects who received rivalry instructions and the forty subjects who did not receive rivalry instructions gave identical results ($t = 2.23$, df 78, $p < .05$). Eventhough the t test may be the more appropriate test because the F condition had not yet been introduced, the data are reported as above to make later comparisons more meaningful.

Table 2

Summary of Analysis of Variance of Heart Rate Scores After Differential Instructions (HR_1)

Source of Variation	Sum of Squares	df	Mean Square	F
Rivalry (R)	248.51	1	248.51	4.86*
Facilitation (F)	.11	1	.11	<1
R X F	15.31	1	15.31	<1
Error	3882.05	76	51.08	

*$p < .05$

The mean HR_1 score of -1.05 beats per minute for the AA group was not significantly different from .60 beats per minute, the mean HR_1 score for the NR & NF group ($t = .81$, df 38). The mean HR_1 score of .45 beats per minute for the DT group was not significantly different from -.35 beats per minute, the mean HR_1 score, for the NR & F group ($t = -.56$, df 38).

The second HR score (HR_2) was calculated to evaluate the effects of different conditions while subjects were performing the form board task. It consisted of the HR during the critical performance of the form board task minus the HR during the fifth performance of the form board task.[2] The mean HR_2 scores for the R & F, R & NF, NR & F, and NR & NF conditions were 11.20, 9.30, 2.45 and .95 beats per minute respectively. A 2 x 2

---

[2]HR was scored another way. It consisted of the HR during the critical performance of the form board task minus the HR during the third minute of the initial rest. Since the analysis of this HR score turned out essentially identical to that for the HR_2 score, it will not be included in this paper.

analysis of variance indicated a difference due to R (F = 29.00, df 1/76, $p < .001$). No differences in HR_2 due to F or due to an interaction between R and F were indicated. Table 3 contains a summary of the analysis of variance.

Table 3

Summary of Analysis of Variance of Heart Rate Scores While Performing the Form Board Task (HR_2)

Source of Variation	Sum of Squares	df	Mean Square	F
Rivalry (R)	1462.05	1	1462.05	29.00*
Facilitation (F)	57.08	1	57.08	1.15
R X F	.80	1	.80	<1
Error	3831.30	76	50.41	

*$p < .001$

Duncan's Multiple Range test ($p < .05$) indicated the difference between the rivalry and nonrivalry groups but did not reveal any other significant differences between the individual groups in the main design of the experiment.

The mean HR_2 score of -.20 beats per minute for the AA group was not significantly different from .95 beats per minute, the mean HR_2 score for the NR & NF group (t = .78, df 38). The mean HR_2 score of 3.05 beats per minute for the DT group was not significantly different from 2.45 beats per minute, the mean HR_2 score for the NR & F group (t = .30, df 38).

The third HR score (HR_3) consisted of HR_2 minus HR_1. That is, the HR scores for the period after differential instructions were subtracted

from the HR scores for the critical performance of the form board task. These scores were calculated to determine whether there was a differential change in HR between conditions, after the post differential instruction period. The mean HR_3 scores, for the R & F, R & NF, NR & F and NR & NF conditions were 7.15, 6.05, 2.80 and .35 beats per minute respectively. A 2 x 2 analysis of variance indicated a difference due to rivalry ($F = 7.04$, df 1/76, $p < .01$). No differences in HR_3 due to F or due to an interaction between R and F were indicated. Table 4 contains a summary of the analysis of variance.

Table 4

Summary of Analysis of Variance of Heart Rate Scores Obtained by Subtracting HR_1 from HR_2 Scores (HR_3)

Source of Variation	Sum of Squares	df	Mean Square	F
Rivalry (R)	505.01	1	505.01	7.04*
Facilitation (F)	63.01	1	63.01	<1
R X F	9.11	1	9.11	<1
Error	5453.25	76	71.75	

*$p < .01$

Duncan's Multiple Range test indicated that the R & F and R & NF groups were significantly different ($p < .05$) from the NR & NF group. None of the other differences, in HR_3, between the individual groups in the main design of the experiment were significant.

The mean HR_3 score of .85 beats per minute for the AA group was not significantly different from .35 beats per minute, the mean HR_3 score for

the NR & NF group (t = -.20, df 38). The mean HR_3 score of 2.60 beats per minute for the DT group was not significantly different from 2.80 beats per minute, the mean HR_3 score for the NR & F group (t = .09, df 38).

Alertness

Alertness scores consisted of each subject's rating of alertness for the critical performance of the form board task minus their rating of alertness for the fifth performance of the form board task, which all subjects performed under identical conditions. Difference scores were used as a means of minimizing individual differences in using the alertness scale. The mean alertness scores for the R & F, R & NF, NR & F and NR & NF conditions were .05, .35, .50 and .35 units respectively. A 2 x 2 analysis of variance did not reveal any significant differences. Table 5 contains a summary of the analysis of variance.

Table 5

Summary of Analysis of Variance of Alertness Scores

Source of Variation	Sum of Squares	df	Mean Square	F
Rivalry (R)	1.01	1	1.01	< 1
Facilitation (F)	.11	1	.11	< 1
R X F	1.01	1	1.01	< 1
Error	149.05	76	1.96	

Duncan's Multiple Range test did not indicate any significant differences in alertness scores between the individual groups in the main design of the experiment.

The mean alertness score of .35 units for the AA group was identical with the mean alertness score for the NR & NF group. The mean alertness score of .40 units for the DT group was not significantly different from .50 units, the mean alertness score for the NR & F group ($t = .25$, df 38).

Correlations

In an attempt to gain information regarding the relationship between performance and the other indicators of motivation in this study, i.e., HR and ratings of alertness; and in an attempt to get some information regarding individual differences in competitiveness, the inter-correlations between performance, HR_1, HR_2, HR_3, ratings of alertness and each subject's average scale value on the individual differences questionnaire (IDQ score), were computed for each experimental condition. These correlations are presented in Appendix J. The correlation coefficients that are significantly different from zero are indicated in the tables.

The significant correlations between HR_1 and IDQ scores for the R & F and NR & F conditions are rather perplexing for the following reasons. HR_1, the HR score for the after differential instructions rest period was collected at a time when the R & F and the R & NF groups were still identical. The NR & F and NR & NF groups were also still identical. That is, the R & F and R & NF groups had received rivalry instructions and the NR & F and the NR & NF groups had received neutral instructions. It may be noted from Appendix J (p. 50) that for the R & F group, consisting of half of the subjects who had received rivalry instructions, there was a singificant correlation between HR_1 and the IDQ scores. But, for the R & NF group (p. 51) who had received the same

rivalry instructions as the R & F group, there was a nonsignificant negative correlation between HR_1 and the IDQ scores. It also may be noted, from Appendix J (p. 52), that there was a significant correlation between HR_1 and the IDQ scores for the NR & F group and note that this group did not receive rivalry instructions. To further complicate the matter, for the NR & NF group (p. 53) who received the same neutral instructions as the NR & F group, there is a nonsignificant negative correlation between HR_1 and the IDQ scores. In an attempt to clarify this confusion the correlations between HR_1 and the IDQ scores for those subjects who received rivalry instructions and for those subjects who received neutral instructions were computed. The correlation between HR_1 and the IDQ scores for the subjects who received rivalry instructions was found to be .274, an insignificant correlation, and the same correlation for the subjects who received the neutral instructions was found to be .116, also an insignificant correlation. Thus the previously mentioned significant correlations between HR_1 and IDQ scores must be considered spurious.

Other than the correlations between performance and alertness, the other correlations that were significant were not considered theoretically important.

Qualitative Data

The qualitative data obtained from the general questionnaire administered at the end of the experiment did not reveal anything detrimental to the findings of the present study. The majority of subjects found the experiment "more interesting than most psychological experiments" and seemed to enjoy participating in the experiment.

In questioning the critical subjects in the DT group about whether they had accepted the ostensible change of task for their partner before the critical trial, it was found that all the critical subjects used in the final analysis did accept the information given. Only one of the original subjects in this group had to be replaced because he had indicated a disbelief about the ostensible change of tasks.

DISCUSSION

The present findings provide some support for the conjecture that rivalry and social facilitation are two distinct motivational components in a situation where people are competing in the presence of one another. The heart rate scores while performing the task (HR_2) distinguished between the rivalry and nonrivalry groups, demonstrating that rivalry is more motivating than nonrivalry. The direction of the means for the HR_2 scores suggest that social facilitation is also a distinct motivational component in that social facilitation tended to increase heart rate more than the lack of social facilitation. Rivalry is a much more potent motivational component than is social facilitation. The lack of any interaction, in the HR_2 data, between rivalry and social facilitation suggests that these two factors operate additively.

The obtained performance data were opposite to that predicted. The groups that were expected to be the most motivated performed the worst and the groups that were expected to be the least motivated performed the best. These findings might be expected if one assumes that the most motivated groups were motivated beyond an optimal level according to the inverted U hypothesis (Duffy, 1962; Hebb, 1955; Malmo, 1959). The inverted U function is described by Malmo (1959) as follows:

> The shape of the curve relating level of performance to level of activation is that of an inverted U: from low activation up to a point that is optimal for a given performance or function, level of performance rises monotonically with increasing activation level; but past this optimal point the relation becomes nonmonotonic: further increase in activation beyond this point produces fall in performance level, this fall being directly related to the amount of the increase in level of activation. (p. 384)

It is proposed that the inverted U phenomenon was occurring in this experiment. The fact that the supposedly most motivated groups, i.e., the R & F and R & NF groups, did, nearly significantly perform the worst and that these same groups, did, very significantly, have the highest levels of activation while performing the task, supports the notion that the most motivated groups were motivated beyond an optimal level. Assuming that the inverted U phenomenon did occur, the performance data is consistent with the HR_2 data. Again both rivalry and social facilitation appeared to have an effect on performance with rivalry being the more potent of the two motivational components.

The effects of social facilitation did not cause statistically significant differences in activation or performance. This could be due to the possibility that social facilitation is a very weak motivational component. It could also be due to the possibility that the socially facilitating effects of doing the form board task may be minimal in regard to what is required for social facilitation to be a potent motivational component. It may be that the obtained results were caused by a combination of both these possibilities. This is an empirical problem that could be settled by further research.

The occurrence of the inverted U phenomenon makes it very difficult to demonstrate the effects of increased motivation on performance. Furthermore, it may be that the inverted U phenomenon was responsible for the lack of correlation between activation and performance. As activation increased, some subjects' performance improved and some subjects' performance degenerated, negating any overall group correlations.

The data reproduced in Appendix K supports this notion. Other possibilities could account for the lack of a relationship between activation and performance to emerge. These alternative reasons include the possibility that there might not be a relationship between activation and performance (Church, 1962; Elliot, 1965). Another possibility is that one measure may not be enough to obtain an accurate indication of the level of activation (Duffy, 1962; Lacey and Lacey, 1958; Schnore, 1959). Activation and performance may be related but multiple measures of activation may be required to demonstrate the relationship. A third possibility is that the form board task may not involve enough action and/or cognitive activity for a relationship to emerge (Evans, 1966). In view of Hokanson, Burgess and Doerr's work (Burgess and Hokanson, 1964; Doerr and Hokanson, 1965; Hokanson and Burgess, 1964) that showed that the relationship between activation, measured by heart rate, and performance, on a digit symbol task, followed the inverted U function, these alternatives do not seem reasonable. Rather it is suggested that the inverted U phenomenon was responsible for the failure of the proposed relationships between activation and performance to emerge. By having groups composed of extreme homogeneous subjects in respect to initial levels of activation, it should be possible to demonstrate either positive or negative correlations between activation and performance, depending upon the groups initial level of activation. An increase in activation should produce an increment in performance for the group initially low in activation and a decrement in performance for the group initially high in activation.

The fact that ratings of alertness were positively and significantly related to performance for all groups eventhough the differences in alertness between conditions, as evidenced by an inspection of the mean alertness scores and by the analysis of variance of alertness scores, were virtually nonexistent, is an informative finding. Subjects responded twice to the alertness scale. It seems probable that subjects could remember how well they performed the fifth trial as well as their rating of alertness for the fifth trial. When subjects were asked to rate their level of alertness after the sixth trial (i.e., the critical trial) they increased their rating if their performance had improved and decreased their rating if their performance had deteriorated, hence the significant positive correlations between performance and alertness for all groups. The fact that there were no differences between groups again reflects the fact some subjects improved in performance and some deteriorated in performance as motivation increased, negating any overall group effects. This finding is opposite to Church's finding (1962) that under competitive conditions, as compared to noncompetitive conditions, self-rated alertness increased but was not correlated with the observed improvement in performance, a decrease in reaction time. This finding in conjunction with the finding of the present thesis would seem to indicate a needed focus on how people interpret "please estimate your level of alertness." In Church's study, where it was more difficult to compare performances (reaction times over trials) subjects seemed to rate their level of alertness higher when they were in a condition where they were told they were competing. In the present study, where a comparison of performances was possible,

subjects rated their level of alertness according to how well they performed, regardless of whether or not they were competing.

The individual differences questionnaire scores were included in the intercorrelation analyses between variables in this experiment in an attempt to gain some information regarding individual differences in competitiveness. No insights were gained from these analyses. Competitiveness is probably a relatively area specific phenomenon and as such should be measured in terms of different areas. For example, a person may be very competitive in an athletic situation but not very competitive in an academic situation. A general test of competitiveness may not detect these differences and a test of competitiveness in the one area may not reflect the general level of competitiveness nor the level of competitiveness in the other area.

The increased heart rate for subjects who received rivalry instructions is an interesting finding. Not only does it indicate that mere instructions do affect people but it would also seem to indicate that some of the effects of a competitive situation are a result of internal factors within a person as opposed to the external factors of the situation. The mere fact that subjects were told they were going to compete caused their heart rates to increase significantly more than those subjects who were not told they were going to compete. The fact that subjects involved in the rivalry condition showed another significant increase in heart rate (HR_3), over and above the increase that was a result of rivalry instructions, when compared to the nonrivalry groups, would seem to indicate that engaging in a rivalry situation involves more

than just internal factors. The addition of the external factors in the actual competitive situation did cause another significant change in heart rate for the competitive groups.

The data from the two extra control groups (the AA and DT groups) and their respective comparison groups, did not provide any evidence that the knowledge of someone else simultaneously performing an identical task is a motivational factor of any consequence. This is contrary to Dashiel's (1930) finding that the knowledge of other people simultaneously performing the same task does effect behavior. The present study, more sophisticated and utilizing statistical tests that Dashiel did not use, doesn't support Dashiel's findings, but again more work in the area could further clarify the matter. At the moment, it seems that the knowledge of someone else simultaneously performing the same task is not of much importance.

REFERENCES

Allee, W. C., & Masure, R. H. A comparison of maze behavior in paired and isolated shell parakeets (Melopsittacus Undulatus Shaw). The Journal of Comparative Psychology, 1936, 22, 131-156.

Allport, F. H. The influence of the group upon association and thought. Journal of Experimental Psychology, 1920, 3, 159-182.

Allport, F. H. Social psychology. New York: Houghton Mifflin, 1924.

Atkinson, J. W. An introduction to motivation. New York: D. Van Nostrand, 1964.

Bayer, E. Z. Psychology 112, 1 (1929). Cited by R. B. Zajonc, Social facilitation, Science, 1965, 149, 269-274.

Blatt, S. J. Patterns of cardiac arousal during complex mental activity. Journal of Abnormal and Social Psychology, 1961, 63, 272-282.

Brown, J. S. The motivation of behavior. New York: McGraw-Hill, 1961.

Buckhout, R. Changes in heart rate accompanying attitude change. Journal of Personality and Social Psychology, 1966, 4, 695-699.

Burgess, M., & Hokanson, J. E. Effects of increased heart rate on intellectual performance. Journal of Abnormal and Social Psychology, 1964, 68, 85-91.

Chen, S. C. Social modification of the activity of ants in nest-building. Physiological Zoology, 1937, 10, 420-436.

Church, R. M. The effects of competition on reaction time and palmar skin conductance. Journal of Abnormal and Social Psychology, 1962, 65, 32-40.

Church, R. M., Millward, R. B., & Miller, P. Prediction of success in a competitive reaction time situation. Journal of Abnormal and Social Psychology, 1963, 67, 234-240.

Dashiel, J. F. An experimental analysis of some group effects. Journal of Abnormal and Social Psychology, 1930, 25, 190-199.

Doerr, H. O. & Hokanson, J. E. A relation between heart rate and performance in children. Journal of Personality and Social Psychology, 1965, 2, 70-76.

Duffy, E. Activation and behavior. New York: John Wiley & Sons, 1962.

Edwards, A. L. Experimental design in psychological research. New York: Holt, Rinehart and Winston, 1960.

Elliott, R. Reaction time and heart rate as functions of magnitude of incentive and probability of success. Journal of Personality and Social Psychology, 1965, 2, 604-609.

Evans, J. F. A comparison of social and nonsocial competition. Unpublished Master's thesis. University of Alberta, 1966.

Farnsworth, P. R. Concerning so-called group effects. Journal of Genetic Psychology, 1928, 35, 587-594.

Gates, M. G., & Allee, W. C. Conditioned behavior of isolated and grouped cockroaches on a simple maze. The Journal of Comparative Psychology, 1933, 15, 331-358.

Harlow, H. F. Social facilitation of feeding in the albino rat. Journal of Genetic Psychology, 1932, 41, 211-221.

Hebb, D. O. Drives and the conceptual nervous system. Psychological Review, 1955, 62, 243-254.

Hokanson, J. E., & Burgess, M. Effects of physiological arousal level, frustration, and task complexity on performance. Journal of Abnormal and Social Psychology, 1964, 68, 698-702.

Hurlock, E. B. The use of group rivalry as an incentive. Journal of Abnormal and Social Psychology, 1927, 22, 278-290.

Klopfer, P. H. Influence of social interaction on learning rates in birds. Science, 1958, 128, 903.

Lacey, J. I. Somatic response patterning and stress: some revisions of activation theory. In M. H. Appley & R. Trumbull (eds.) Psychological stress. New York: Appleton-Century-Crofts, 1967.

Lacey, J. I., & Lacey, B. C. Verification and extension of the principle of autonomic response - stereotypy. American Journal of Psychology, 1958, 71, 50-73.

Malmo, R. Activation: a neuropsychological dimension. Psychological Review, 1959, 66, 367-386.

McKee, J. P. & Leader, F. The relationship of socio-economic status and aggression to the competitive behavior of pre-school children. Child Development, 1955, 26, 135-142.

Mogar, R. E. Competition, achievement and personality. Journal of Counselling Psychology, 1962, 9, 168-172.

Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1966.

Ryan, D. E., & Lakie, W. L. Competitive and noncompetitive performance in relation to achievement motive and manifest anxiety. Journal of Personality and Social Psychology, 1965, 1, 342-345.

Schnore, M. M. Individual patterns of physiological activity as a function of task differences and degree of arousal. Journal of Experimental Psychology, 1959, 58, 117-128.

Tolman, C. W., & Wilson, G. T. Social feeding in domestic chicks. Animal Behavior, 1965, 13, 134-142.

Triplett, N. The dynamogenic factors in pacemaking and competition. American Journal of Psychology, 1897, 9, 507-533.

Vaught, G. M., & Newman, S. E. The effects of anxiety on motor-steadiness in competitive and noncompetitive conditions. Psychonomic Science, 1966, 6, 517-520.

Weston, S. B., & English, H. B. The influence of the group on psychological test scores. American Journal of Psychology, 1926, 37, 600-601.

Whittemore, I. C. The influence of competition on performance: an experimental study. Journal of Abnormal Psychology, 1924, 19, 236-256.

Wilson, K. V., & Bixenstine, V. E. Forms of social control in two-person, two-choice games. Behavioral Science, 1962, 7, 92-102.

Zajonc, R. B. Social facilitation. Science, 1965, 149, 269-274.

Zajonc, R. B. Social psychology: an experimental approach. Belmont, California: Brooks/Cole, 1966.

APPENDICES

APPENDIX A

INDIVIDUAL DIFFERENCES QUESTIONNAIRE

Please read each of the following statements. If you feel the statement is true or mostly true, mark a T in the appropriate square. If you feel the statement is false or mostly false, mark an F in the appropriate square.

I do not like to win if it is going to make the other person feel bad.		2.9
I do not care about being good at sports as long as I am average.		3.8
Winning a game is very important to me.		7.7
Being last is good enough.		1.5
I work better with advice from others in how to achieve my present goal.		5.5
I would rather compete in a game rather than play just for fun.		7.4
All athletics should be for recreation only.		3.4
When watching a competition, it does not matter to me who wins.		3.8
When competing with others, I want to win no matter how hard that may be.		8.0
Winning a prize, academic or athletic, big or small, means little.		2.7
I must be interested in what I am competing in if I am to perform well.		5.4

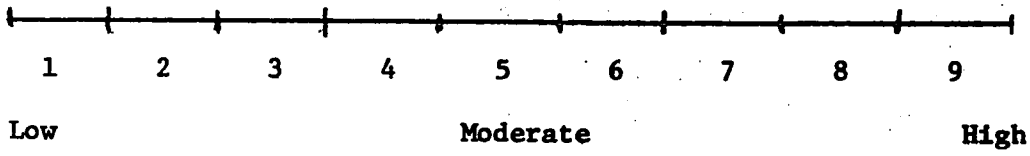
APPENDIX A (Continued)

I will spend hours of my time practising so that I can win a competition.		8.4
Once a certain task overcomes me, I enjoy trying to conquer it.		7.5
I avoid tests that disclose my real worth.		3.4
I dislike sports where there is an excessive amount of hard work.		3.7
I try my best in any contest, even with the knowledge that I will lose.		8.1
I think it is more enjoyable to play a game if no score is kept.		2.7
I always do the paper's crossword puzzles.		6.2
I like sports in which one person tries to out do another rather than team sports.		8.0
When I drive my car, I like to pass every car I come upon.		7.5

APPENDIX B

RATING SCALE FOR ALERTNESS

Please estimate your level of alertness during the last trial.



APPENDIX C

GENERAL QUESTIONNAIRE

Age_____

Faculty_____

Year_____

Please write down any comments you may have about this experiment.

Had you heard anything about this experiment before you were in it?

APPENDIX D

INITIAL INSTRUCTIONS

As you probably know, psychologists often use physiological measures to get more information about what they are working with. In this experiment we are using heart rate. I am going to attach some electrodes to you to measure heart rate. The measuring of heart rate, in this experiment, is peripheral to the main purposes of the experiment. After the electrodes are attached you can forget about them until the experiment is over.

. . . attached electrodes . . .

Now, because we are measuring heart rate, you have to sit here for five minutes and relax so that your heart rate will become stable at a base level. Please relax yourself and do not worry about anything involved in the experiment. I guarantee that you will not be hurt in any way, shape or form. So, please do relax and do not worry about anything so that your heart rate will in fact get down to a base level.

APPENDIX E

PRACTICE INSTRUCTIONS

To begin with, I want you to perform this form board task. This is how it works (demonstrate). Please be careful and do not force in the pieces (demonstrate - star & two squares). When I say GO, do the task as fast as possible. When one minute is up, I'll say STOP, and I want you to stop immediately, put your hands on your knees and look down at the floor. I'll then record how many pieces you have correctly inserted. Errors will not count (demonstrate - oval, little square in big hole). We will continue doing this task, for a number of trials, until I give you further instructions. Between trials I want you to just sit there with your hands on your knees and your gaze directed downwards. I will take the blocks out of the holes and mix them up for the next trial. Please do not ask any questions about how you are doing, how other people have done, or what the experiment is about. I do not want you to say anything until the whole experiment is over. The reason for all this ritual is that I have to keep between trial behavior as constant as possible. The complete nature of the experiment will be explained when the experimental session is all finished.

APPENDIX F

COMPETITIVE INSTRUCTIONS

Now, on the next trial, I want you to perform the form board task in the same manner as you did before. When I say GO, start the task. When one minute is up, I'll say STOP, and I want you to stop immediately, put your hands on your knees and look down at the floor. The only difference about the next trial, as opposed to the others, is that, instead of just doing the task as fast as possible, I want you to try to do it faster than your partner. We will compare performances, on this trial, at the end of the experiment. O.K.?. . . . Now, before we proceed, I want you to just sit there and relax for a few minutes.

APPENDIX G

NONCOMPETITIVE INSTRUCTIONS

Now, on the next trial, I want you to perform the form board task in the same manner as you did before. When I say GO, start the task. When one minute is up, I'll say STOP, and I want you to stop immediately, put your hands on your knees and look down at the floor. In other words, do the next trial the same way as you did the others. O.K.?. . . . Now, before we proceed, I want you to just sit there and relax for a few minutes.

APPENDIX H

ALL ALONE INSTRUCTIONS

Now, on the next trial, I want you to perform the form board task in the same manner as you did before. When I say GO, start the task. When one minute is up, I'll say STOP, and I want you to <u>stop immediately</u>, put your hands on your knees and look down at the floor. The only difference about the next trial, as opposed to the others, is that, only one of you will be doing the task. We will now flip a coin to see which one of you will stay.

. . . flipped coin, let one of the subjects wait outside the experimental room. . .

O.K.?. . . . Now, before we proceed, I want you to just sit there and relax for a few minutes.

APPENDIX I

DIFFERENT TASK INSTRUCTIONS

Now, on the next trial, subject number one here (point) is going to get a different task. I'd like you (point) subject number two, to just sit there and relax while I get subject number one's new task and give him time to read some instructions on how to perform it.

> . . . The experimenter ostensibly got a new task and instructed the noncritical subject by pointing to the instructions reproduced at the bottom of this page. Following this ostensible change of task the following instructions were read to both the critical and noncritical subjects. . .

Now, on the next trial, I want you to perform your respective tasks in the same manner as you did before. When I say GO, start the task. When one minute is up, I'll say STOP, and I want you to <u>stop immediately</u>, put your hands on your knees and look down at the floor. O.K.? . . . . Now, before we proceed, I want you to just sit there and relax for a few minutes.

<u>INSTRUCTIONS NONCRITICAL SUBJECTS READ</u>

Please do not say anything. Note that you have the same task that you had before. I want your partner to <u>think</u> that you have a different task. All that you have to do is follow instructions, do not say anything, and when the time comes perform the task exactly the same way as you did before . . . . O.K.?

APPENDIX J

CORRELATION MATRICES

CORRELATION MATRIX FOR THE RIVALRY AND SOCIAL FACILITATION CONDITION

	1	2	3	4	5	6
1. P		.014	.277	.290	.513*	.116
2. HR_1			.591*	-.454*	-.141	.581*
3. HR_2				.450*	.112	.343
4. HR_3					.28	-.264
5. A						.041
6. IDQ						

*$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX J (Continued)

CORRELATION MATRIX FOR THE RIVALRY AND NO SOCIAL FACILITATION CONDITION

	1	2	3	4	5	6
1. P		-.549*	.110	.525*	.783*	.258
2. HR_1			.256	-.567*	-.321	-.164
3. HR_2				.651*	.217	.320
4. HR_3					.437	.402
5. A						.310
6. IDQ						

*$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX J (Continued)

CORRELATION MATRIX FOR THE NO RIVALRY AND SOCIAL FACILITATION CONDITION

	1	2	3	4	5	6
1. P		.102	.105	.026	.636*	.109
2. HR_1			-.090	-.625*	-.047	.475*
3. HR_2				.834*	.156	.330
4. HR_3					.148	-.004
5. A						.051
6. IDQ						

*$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX J (Continued)

CORRELATION MATRIX FOR THE NO RIVALRY AND NO SOCIAL FACILITATION CONDITION

	1	2	3	4	5	6
1. P		.126	.051	-.084	.516*	-.012
2. HR_1			.003	-.867*	-.122	-.110
3. HR_2				.496*	.078	-.035
4. HR_3					.145	.078
5. A						-.066
6. IDQ						

$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX J (Continued)

CORRELATION MATRIX FOR THE ALL ALONE CONDITION

	1	2	3	4	5	6
1. P		-.143	.090	.166	.505*	.202
2. HR_1			-.007	-.742*	-.397	-.063
3. HR_2				.676*	-.283	.210
4. HR_3					.102	.188
5. A						.154
6. IDQ						

*$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX J (Continued)

CORRELATION MATRIX FOR THE DIFFERENT TASK CONDITION

	1	2	3	4	5	6
1. P		-.042	-.095	-.066	.493*	-.028
2. HR_1			.400	-.344	.119	-.094
3. HR_2				.723*	.251	-.426
4. HR_3					.167	-.366
5. A						-.168
6. IDQ						

*$p < .05$

Code	Variable
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX K

DATA

DATA FOR THE RIVALRY AND SOCIAL FACILITATION CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	0	2	10	8	1	6.4
2	-2	24	30	6	-1	7.3
3	-1	-2	12	14	3	5.9
4	1	1	13	12	0	6.5
5	-2	-8	6	14	0	5.5
6	-3	7	3	-4	-3	5.1
7	5	5	12	7	1	6.4
8	-2	30	20	-10	-1	7.4
9	-1	-2	16	18	-1	6.9
10	1	1	17	16	1	5.7
11	-1	3	15	12	0	6.1
12	-4	-3	0	3	-2	6.5
13	0	0	-1	-1	1	6.2
14	0	-5	13	18	0	5.6
15	-1	-4	-4	0	-3	6.4
16	0	1	7	6	2	6.9
17	4	4	5	1	2	6.4
18	1	8	7	-1	1	7.2
19	5	11	32	21	0	6.6
20	-1	8	11	3	0	6.1

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX K (Continued)

DATA FOR THE RIVALRY AND NO SOCIAL FACILITATION CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	5	4	17	13	2	6.6
2	-5	11	1	-10	-1	5.6
3	2	-1	14	15	1	6.9
4	-7	17	14	-3	-4	6.6
5	3	6	13	7	3	6.7
6	2	9	10	1	1	5.9
7	2	3	16	13	1	6.2
8	0	5	25	20	2	7.0
9	1	2	4	2	1	6.9
10	5	-13	2	15	0	7.1
11	0	-2	5	7	2	6.8
12	-3	8	8	0	-1	7.2
13	1	-4	7	11	1	5.9
14	1	-3	10	13	0	6.9
15	-1	6	22	16	-1	6.0
16	1	2	7	5	0	5.5
17	2	12	5	-7	1	6.5
18	-4	2	4	2	-1	6.1
19	4	0	5	5	2	6.4
20	-2	1	-3	-4	-2	5.1

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaires scores

APPENDIX K (CONTINUED)

DATA FOR THE NO RIVALRY AND SOCIAL FACILITATION CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	1	-7	8	15	-1	5.9
2	1	6	-13	-19	0	6.5
3	3	6	2	-4	2	7.3
4	1	6	16	10	0	7.2
5	-2	-3	-2	1	1	6.3
6	-1	4	15	11	1	6.9
7	-3	-4	-3	1	0	6.3
8	-6	1	-2	-3	-3	6.8
9	-1	0	1	1	1	5.4
10	2	-5	-1	4	2	6.8
11	1	1	4	3	1	6.6
12	1	-2	0	2	1	6.0
13	9	4	-5	-9	1	5.9
14	7	-3	10	13	2	7.5
15	-1	8	-1	-9	-1	6.8
16	0	-8	1	9	0	5.4
17	-1	-7	1	8	0	5.3
18	3	-4	8	12	2	5.7
19	1	-3	10	13	0	7.2
20	2	3	0	-3	1	6.2

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX K (Continued)

DATA FOR THE NO RIVALRY AND NO SOCIAL FACILITATION CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	1	2	4	2	0	5.4
2	8	-6	6	12	1	5.3
3	5	13	-2	-15	0	6.5
4	3	7	-4	-11	2	5.1
5	1	-7	2	9	1	5.4
6	7	6	5	-1	2	6.9
7	1	-1	-2	-1	1	6.1
8	0	2	4	2	-1	6.1
9	-1	-1	-1	0	1	6.0
10	-3	2	-2	-4	-2	5.8
11	-1	0	7	7	1	7.1
12	1	3	2	-1	0	6.7
13	4	-2	-2	0	0	6.9
14	-5	2	-3	-5	-1	6.8
15	4	6	1	-5	1	7.5
16	0	10	9	-1	0	6.0
17	3	3	2	-1	-1	6.9
18	5	1	-6	-7	1	6.4
19	2	-8	-4	4	0	7.1
20	0	-20	3	23	1	7.2

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX K (Continued)

DATA FOR THE ALL ALONE CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	-2	-14	2	16	2	5.5
2	4	6	1	-5	1	6.2
3	2	2	-1	-3	1	5.4
4	4	-1	2	3	1	5.3
5	0	-9	-5	4	1	6.5
6	4	-9	-7	2	2	6.3
7	1	-3	10	13	-1	7.3
8	-2	2	-1	-3	0	6.4
9	1	3	-12	-15	1	6.1
10	0	3	0	-3	2	5.5
11	7	-7	8	15	1	6.8
12	-1	2	7	5	0	7.4
13	2	-3	-1	2	1	6.9
14	1	5	1	-4	0	7.1
15	-2	0	1	1	-4	5.0
16	1	-1	-1	0	1	5.8
17	-4	2	2	0	-3	5.6
18	0	-8	-6	2	2	6.7
19	-1	7	-5	-12	-1	6.3
20	0	2	1	-1	0	5.6

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores

APPENDIX K (Continued)

DATA FOR THE DIFFERENT TASK CONDITION

S#	P	HR_1	HR_2	HR_3	A	IDQ
1	0	6	15	9	-1	5.3
2	-2	-1	6	7	0	5.8
3	0	-1	3	4	1	5.8
4	6	0	4	4	1	6.2
5	1	8	-1	-9	1	7.3
6	2	2	17	15	3	5.7
7	5	1	6	5	1	4.9
8	-1	-1	-4	-3	-2	5.8
9	5	-3	0	3	-1	6.9
10	5	6	-1	-7	2	6.0
11	2	-6	-3	3	1	6.6
12	3	-6	-3	3	1	6.4
13	0	1	2	1	-1	7.0
14	2	-1	2	3	0	7.8
15	2	-1	3	4	1	6.9
16	2	-2	2	4	1	6.5
17	4	0	1	1	1	7.1
18	2	8	7	-1	1	6.8
19	1	-2	4	6	0	7.2
20	-1	1	1	0	-2	7.1

Code	Variable
S#	Subject number
P	Performance scores
HR_1	Heart rate scores after differential instructions
HR_2	Heart rate scores while performing the task
HR_3	HR_2 minus HR_1 scores
A	Alertness scores
IDQ	Individual Differences Questionnaire scores