SEX DIFFERENCES IN RESPONSE TO A COMPETITIVE SITUATION

BY

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The undersigned certify that they have read, and recommend to the Faculty of Arts for acceptance, a thesis entitled "Sex Differences in Response to a Competitive Situation", submitted by Catherine G. Precosky in partial fulfillment of the requirements for the degree of Master of Arts.

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Abstract

This thesis was undertaken with two goals in mind: to examine possible sex differences in response to competition, and to explore what effects the sex of the competitor had upon an individual in competition. Four male and four female confederates acted as competitors against 80 introductory psychology students (40 male and 40 female). After subjects performed seven practice trials on a digit-letter task alone, they were randomly assigned to one of four groups based on the sex of the subject and the sex of the competitor. The effects of the competition and the sex of the competitor on performance, physiological response, rating of pleasantness, feelings of rivalry, and estimated success were analyzed. Performance effects were measured by the digit-letter task, physiological response to stress by heart rate, and ratings of pleasantness, feelings of rivalry, and estimated success by self-report rating scales. It was found that competition increased female performance more than male performance and male heart rate more than female heart rate. It therefore appears that females are dealing with the stressful demands of the situation in a physiologically more economic way. No sex differences were found with regard to rating of pleasantness of the competition, desire to win, or estimated success. No effects due to the sex of the competitor were found to be significant.

The effects of the presence of others on an individual's performance is a primary question that has intrigued psychologists for almost 100 years. Triplett in 1897 found that paced as opposed to unpaced bicycle racers made better time. An unpaced race was one in which a person merely tried to beat an established record while in a paced race one bicycle rider would be in front setting a pace for another rider. The goal in both the paced and unpaced race was to beat set time records. In a third type of race, the paced competition, riders tried to keep up with the pacemaker plus beat the times of other contestants. Riders in the paced competition made a 3.5 per cent gain in average time per mile over the paced only riders. Triplett concluded that both the bodily presence of a competitor as well as the sight and sound of the other participant acted as a stimulus to the racer in arousing a competitive instinct (Triplett, 1897).

The increase in response merely from the sight and sound of others making the same movements has been called social facilitation by Allport (Allport, 1924). According to Allport social facilitation and rivalry comprise the two social factors in competitive performance with rivalry being defined as ". . . an emotional reinforcement of movement accompanied by the consciousness of a desire to win" (Allport, 1924, p. 262). These two social factors can exist independently of

each other so that for example, the conscious awareness of rapid work of others is enough to facilitate an individual's performance without the inclusion of a cognitive desire to out-perform others (Allport, 1924). Allport concluded that social facilitation combined with rivalry produces an increase in the quality and quantity of the product of the individual. A series of studies by Allport (1920) found that the presence of a co-working group did increase the number of free associations to a stimulus word and the quantity of controlled associations in response to a thought-provoking statement.

Since Allport, numerous studies have been undertaken on the effects of the presence of others on an individual's performance. These studies have grown in specificity as the meaning of the effects of the presence of others has been more precisely defined to distinguish between the effects due to either an audience, coaction (two or more people performing the same task simultaneously but independently of each other), or competition, or any combination of the three.

Zajonc (1965) proposed that the presence of others as either coactors simultaneously performing the same task or as a passive audience increases a person's general arousal and drive level to increase dominant responses. Dominant responses are those which have the highest probability of occurrence and can be either appropriate or inappropriate responses. For example, when first learning a task,

inappropriate responses are the most frequent responses or the dominant responses until the task is mastered and appropriate responses become the dominant ones. Zajonc made no distinction between arousal produced by an audience and that arising from coaction. Arousal in both settings can be attributed to the mere presence of others.

Zajonc proposed that learning is impaired by the presence of others while the performance of learned responses is enhanced. By this Zajonc meant that when learning a task in front of an audience many mistakes will be made, more than if learning the task alone. Once a task is learned, however, the presence of spectators will increase performance on the task. Numerous studies that support the facilitation effect of the audience upon performance can be found (Travis, 1925; Dashiell, 1930; Cottrell, Rittle, and Wack, 1967; Cottrell, Wack, Sekerak, and Rittle, 1968; Martens, 1969; Zajonc, Wolosin, Wolosin, and Loh, 1970). Early studies by Triplett (1897) and Allport (1920) led the way with indications of coaction increasing the performance of an individual. In the presence of three coactors performing a simple muscular endurance task individuals performed significantly better than those performing alone or in dyads (Martens and Landers, 1969). Other studies have also shown coaction to improve an individual's performance (Carment, 1970; Fish, 1978) and to facilitate specific social behavior (Chapman, 1973). Research with

animals has also revealed the social facilitation effect of coaction. Cottrell (1972) cites studies showing coaction increasing the amount of earth dug and reduced latency of digging by ants (Chen, 1937) and the social facilitation of eating and drinking (Harlow, 1932; James, 1953; Stamm, 1961; Tolman and Wilson, 1965).

Cottrell (1972) however also gives examples of coaction impairing the performance of cockroaches (Gates and Allee, 1933) and birds (Allee and Masure, 1936) in learning a maze and the inability of greenfinches to discriminate between two types of food (Klopfer, 1958). An explanation for the difference between those studies which found coaction to improve performance and those which found coaction to impair performance lies in the familiarity with the behavior being performed. Coaction was found to impair performance on new responses which were not either instinctual or already well learned. The social facilitation effects of coaction only appear for behaviors that are well learned or instinctive (Cottrell, 1972).

Studies using human subjects have also demonstrated the inability of coaction alone to always improve performance (Klinger, 1969; Carment and Latchford, 1970; Wankel, 1972). Cottrell (1968, 1972) proposed that the mere presence of others is not sufficient to enhance the performance of an individual. The presence of others in an audience or as

coactors will enhance the emission of dominant responses only when the possibility of evaluating an individual's performance exists. It is the anticipation of positive or negative outcomes produced by the presence of others that increases an individual's drive level.

This thesis did not attempt to resolve the dispute between Zajonc and Cottrell. If the mere presence of another is sufficient to arouse an individual and influence performance, then the addition of overt evaluation as emphasized in a competition should not diminish the stressfulness of the situation but increase any effects it might have. In this thesis the author was interested in establishing the most stressful, intense situation in which one person's presence had the possibility of influencing another. To accomplish this a competitive situation in which two individuals were coacting in front of an experimenter was used.

In a competitive situation the evaluation of one person's performance is relative to the performance of one or more others. In this thesis competition referred to a situation in which one person wins and another loses. Whether the motivation to perform well in competition is determined by feelings of rivalry only or rivalry and social facilitation combined was not examined in this thesis. It was hypothesized that the presence of a competitor and the emphasis on evaluation would have an effect on the performance of the competitors

and would also increase the susceptability to stress and feelings of rivalry. Rivalry is defined here as the cognitive desire to out-perform others while stress refers to "the non-specific response of the body to any demand" (Selye, 1976, p. 1). Possible sex differences with regard to performance, physiological response to stress, and feelings of rivalry due to the competitive situation were examined. The degree to which participants found the competitive and noncompetitive trials to be either pleasant or unpleasant was also explored. The effects of competition were investigated further by employing both male and female confederates to act as competitors against male and female experimental subjects.

A review of previous research shows that positive effects of competition on performance have been reported by writers such as Triplett (1897), Dashiell (1930), Church (1962), Wilmore (1968), Carment (1970), Freischlag (1973), Evans and Bonder (1973), Evans (1977), Hill (1977), and Fish (1978). A few studies have found no effect of competition on performance (Evans, 1966; Evans, 1971; Wood, 1974) and a smaller number have reported negative effects (Whittemore, 1924; Allen and Boivin, 1976). Generally speaking the results of the empirical work in this area indicate that competition has improved performance.

Competition has been studied not only by examining its effects on performance but also by examining its physiological

effects on an individual. A stressful situation, such as participation in a competition, creates a state of generalized physiological arousal (Selye, 1974) which can be detected through various physiological measures. Stress brought about by another person or other people can be referred to as psychosocial stress (Evans, Cox, and Jamieson, 1977). For this thesis the psychosocial stressor of interest was competition.

Competition has been shown to increase heart rate (Evans, 1968; Evans, 1972; Evans and Bonder, 1973; Evans, 1977; Fish, 1978). The stressfulness of a competitive situation has also been indicated by increases in palmar skin conductance (Church, 1962; Ober, 1977).

Even though a competitive situation has been shown to improve performance and affect physiological responses, people respond differently to the same competitive situation. Triplett, as early as 1897, found individual differences and particularly sex differences, in response to a competitive situation. He found that the proportion of girls (61.5%) influenced positively by competition was greater than the proportion of boys (28.6%).

> The gross amount of the effect of competition is also greater in girls. When they were stimulated and had control they made greater gains than the boys and when over-stimulated their losses were greater than

those made by the boys. (Triplett, 1897)

Triplett's competitive situation consisted of subjects turning a crank on a fishing reel to move a small flag through four circuits of a four-meter course. Performance on this task was timed for each subject under both an alone and a competitive situation.

Though Triplett gave an early indication of possible sex differences with regard to competition, until recently little research has pursued this topic. North American society has developed a fasted paced competitive atmosphere particularly in the professional, academic, and business worlds. Within the last decade women have emerged to compete not only with other women but also with men for positions of prestige. Do women have the "competitive instinct" necessary to climb the business ladder to success? What has been the effect of their entry into the competitive arena upon themselves and their male counterparts? Are the effects of competition the same for men and women? What effect does the sex of a competitor have upon behavior? These are just a few of the questions that relate to these important issues. In this thesis an attempt was made to answer the latter two questions.

Maccoby and Jacklin (1974) in their classic work <u>The Psychology of Sex Differences</u> surveyed the research on sex differences in competitiveness and concluded that this area has not yet been explored adequately. There are few studies

of competition in young children that have looked for sex differences and in those that have, boys usually are found to be more competitive (Maccoby and Jacklin, 1974, p. 353). Males appear to be more interested in competitive sports (Maccoby and Jacklin, 1974, p. 247) and the activity level for boys increases when in a group as compared to solitary play while the activity level of girls shows no change (Maccoby and Jacklin, 1974, p. 147). Because of this latter finding Maccoby and Jacklin conclude that boys are more influenced by the presence and actions of a peer than girls:

> Males do not appear to have generally greater achievement motivation, although they may show more arousal of this motivation under directly competitive conditions. (Maccoby and Jacklin, 1974, p. 149).
>
> It appears probable that in situations in which competitiveness produces increased individual rewards males would be more competitive, but this is a guess based on common-sense considerations, such as male interest in competitive sports, not upon research in controlled settings. (Maccoby and Jacklin, 1974, p. 353).

With regard to empirical research Carment (1970) agrees with the criticism of Maccoby and Jacklin that research in the area of sex differences in competition is lacking:

> Surprisingly, sex of the Ss has not been taken into consideration in coaction research. It seems reasonable

> to expect, given North American socialization practices, that females might perform quite differently from males under conditions of coaction and competition. (Carment, 1970).

Carment offers two suggestions for why this difference in performance may exist, citing studies which show that females are more socially sensitive (Crowne and Marlow, 1964) and less competitive than males (Uesugi and Vinacke, 1963). Carment's (1970) own study in which male and female subjects performed a simple motor task under one of four conditions (noncompetitive alone, noncompetitive together, competitive alone, competitive together) found a significant main effect due to the sex of the subject with a greater overall number of responses being made by males. Carment also found a significant Sex X Coaction interaction which showed females to be more affected by the coactor. No difference in the competitiveness of males and females was detected since both sexes increased their rate of responding under competition. For both sexes, coacting subjects who were also competitively motivated by means of verbal instructions to compete increased their performance more than coacting noncompetitive subjects.

While Carment realized the importance of possible sex differences with regard to coaction and competition and criticized the lack of research in this area, his study also

fell short in that he limited his competitive situation to like-sexed dyads ignoring the very possible effects of the competitor's sex. This limitation to competitors of the same sex is seen in many of the previously mentioned studies of competition (Church, 1962; Evans, 1966; Wilmore, 1968; Evans, 1971; Evans, 1972; Wankel, 1972; Evans and Bonder, 1973; Fish, 1978). The studies by Evans (1966), Wilmore (1968), Evans (1971), and Wankel (1972) used only male subjects and male competitors excluding both the possibility of differential effects of competition on females and the effects a female competitor may have had on a male subject. Church (1962), Evans (1972), and Evans and Bonder (1973) used male and female subjects in same-sexed competitive dyads but did not discuss any possible sex differences or similarities in response to competition. Therefore, from these studies of like-sexed dyads, no conclusions can be drawn regarding possible sex differences or similarities in response to competition.

A recent study by Fish (1978) employing like-sexed dyads found some significant and nearly significant sex differences. Fish studied performance and heart rate under two competitive situations - one being composed of rivalry the other rivalry and coaction. A Coaction X Sex interaction while not significant did show a trend indicating that female performance increased more than male performance in the coaction plus

rivalry group, while in the rivalry alone condition male performance increased more than female performance. Significant heart rate data showed females to be more relaxed prior to competition than males as well as a greater increase in heart rate for males under competition than females. A scale devised by Fish to rate the degree to which subjects were thinking about being in a competition during a relaxation period prior to the competition indicated a possible trend in that males tended to think more about being in the competition than females, though this result did not quite reach the standard level of significance ($p<.09$). Fish suggests that the variables manipulated in his investigation differentially influenced males and females and that one must be cognizant of possible sex differences in this type of research.

It might be, as Carment (1970) says, that males and females perform differently under competition due to the North American socialization practices and more specifically that these differences may be influenced by the sex of the competitor. Allen and Boivin (1976) contend that in achievement-oriented situations (especially when in competition with men) females have a tendency to become anxious:

> If anxiety about success, that is anxiety about competitiveness and its aggressive over-tones, is a major determining factor of sex-differences in achievement

> related research, then the differences should be maximized in competitive as opposed to noncompetitive situations, especially those in which competition is against men. (Bardwick, 1971, pp. 180-181).

High anxiety has been shown to be associated with slower reaction time (Durganand and Varma, 1972) and studies have found that women competing against men had slower reaction times than women competing against other women or alone (Hyatt, Cooper, and Allen, 1970; Allen and Boivin, 1976). However, neither of these studies offer any insight into the performance of males competing against females in a reaction time task.

Only a few studies have varied the sex of the competitors and examined the effect on performance (Freischlag, 1973; Wood, 1974; Krauss, 1975; Hill, 1977; Ober, 1977). The study by Ober (1977) was the only one of the above studies to include changes in physiological arousal due to the sex of the competitor along with performance changes.

In a study by Freischlag (1973) males and females competed with either opposite or same-sexed subjects on a rotary pursuit tracking task. The overall effect of competition was found to increase the performance of males more than females. The highest task scores for both males and females were attained when competing against a male subject.

Wood (1974) found no effect on male and female performance

scores on a discrimination reaction-time task due to the sex of the competitor but did find competition to effect the relationship between the two performance measures for females. For females in competition with both males and females, greater speed of responding was associated with less accurate performance. For females working alone, greater speed was associated with greater accuracy.

Krauss (1975) and Hill (1977) used children to study performance differences due to the sex of the competitor. Hill using children in grades seven, eight, and nine found that the sex of the competitor did not affect performance scores on a series of mazes. Hill proposed that the age of his subjects and the school setting for the study may have contributed to the lack of any significant effects. Hill contends that it is still permissible for girls to be competitive at this age and in the school setting prior to college. Krauss (1975) using 5th and 12th-grade subjects performing masculine and feminine stereotyped manual tasks found only 12th-grade females to be affected by the sex of the competitor. These females performed feminine tasks more quickly than masculine tasks. Interestingly females improved in performance on masculine tasks when competitors were males and decreased in performance when competitors were females. No explanations for this finding were given. There was no difference in male's performance due to the sex of the

competitor.

Ober (1977) studied the effects of three competitive conditions on the motor performance and physiological arousal of males and females. Motor performance for each subject was measured by grip strength, reaction time, maximum anaerobic power, hand-eye coordination, and hand steadiness under three competitive conditions: same sex competition, cross sex competition, and self competition. Physiological arousal was measured by the Palmar Sweat Index in each condition. Ober found that both male and female performance was more positively facilitated and physiological arousal increased more by male competitors than by female competitors.

It appears then that the research into the effects of varying the sex of the competitors and general sex differences with regard to response to competition is limited and inconclusive. Freischlag (1973) and Ober (1977) found both male and female subjects to perform better against a male competitor. Wood (1974) found no effect on performance due to the sex of the competitors. Hill (1977) using school children found no effect of the competitor's sex on performance while Krauss (1975) also using children found 12th-grade females to be affected by the sex of the competitor.

Research into the effects of the presence of an individual upon another person's performance has ignored what in this thesis was considered an important variable- the sex of

the individuals involved. The purpose of this thesis was twofold: to examine possible sex differences in response to competition and to examine what effects the sex of the competitor had upon an individual in competition. Male and female confederates acted as competitors against experimental subjects. The effects of the competitor's sex on performance, physiological response, ratings of pleasantness, feelings of rivalry, and estimated success were analyzed. Performance was measured on a digit-letter task; physiological response to stress by heart rate; and ratings of pleasantness, feelings of rivalry, and estimated success by self-report measures.

Method

Subjects

Subjects (40 males and 40 females) were recruited from introductory psychology classes at Lakehead University. Participation was on a voluntary basis and each subject was given a credit toward their final mark in introductory psychology. Booklets were distributed in various classes to allow participants to sign up for preferred times. Separate booklets were circulated for males and females. One male and one female subject were unable to complete the experiment when the confederates scheduled for the sessions failed to appear. These subjects are not included in the numbers mentioned above.

Design

This experiment used a 2 X 2 factorial design. The two factors were the sex of the subject and sex of the competitor. The conditions for the critical trial were male subject versus male competitor (MM), male subject versus female competitor (MF), female subject versus male competitor (FM), and female subject versus female competitor (FF). The competitor was a confederate of the experimenter who was introduced as another introductory psychology student prior to the commencement of the critical trial. Four male and four female introductory psychology students were employed to serve as competitors and were briefed on the nature of the

research. They were instructed to keep their behavior relatively uniform throughout the experiment.

No noncompetitive group was used as a control because it has been shown repeatedly that competition on this task generally causes increases in heart rate and performance (Evans and Bonder, 1973; Evans, 1977; Fish, 1978). All subjects were treated identically from trials one to seven inclusive. The first six of the eight trials served as practice trials to allow performance and heart rate to stabilize. The data from the first six trials were not analyzed. Performance, heart rate, and pleasantness data from the seventh trial served as basal data. After the completion of trial seven and the introduction of the confederate the critical trial (eighth trial) took place. The changes in performance, heart rate, and pleasantness from trials seven to eight were the main focus of this experiment.

Apparatus and Materials

Two separate experimental rooms at Lakehead University were used in this study. Only one room was used for the experimental subjects performing both the practice trials and the competitive trials while the other room housed the confederates until one was needed for the competitive trial. Throughout the practice trials the subjects sat at one side of the table in the experimental room. During the competitive trial the confederate sat opposite the subject at the

same table allowing a clear view of the progress of each other on the task. A buzzer was used to signal the beginning and end of the practice and critical trials.

The digit-letter task used to measure the subject's performance is similar to the WAIS digit-symbol task except that letters rather than symbols are used. This task requires the subject to match the appropriate letter with each digit. Eight different forms of the digit-letter task were used in this study. All subjects used the same eight forms with the eighth form duplicated for the competitor. Performance scores consisted of the number of letters correctly printed under the numbers in one minute. For each incorrect letter one point was subtracted from the total score obtained. An example of the digit-letter task is presented in Appendix A.

The subject's heart rate was measured by a Gilson two-channel dynograph with a finger pick-up transducer.

A self-report rating scale devised by the experimenter was used to measure the subject's feelings of rivalry prior to the competitive trial. The rating scale asked the subject to indicate, by choosing one of four alternative statements on a four point scale, his/her cognitive desire to out-perform another and be declared the winner. The choices ranged from 0---"Not at all" to 3---"To a great degree". Appendix B illustrates the rating scale used.

A rating scale devised by the experimenter to measure the subjects' estimations of how well they thought they did.

relative to their competitors was also used in this experiment. This rating scale asked the subjects to select one of five choices in describing their performance relative to their opponents. The choices ranged from 0---"I did significantly worse than my opponent" to 4---"I did significantly better than my opponent". This scale was completed after the eighth and critical trial but before the declaration of a winner in the competition. Appendix C illustrates this rating scale of estimated relative success.

A pleasantness scale was presented throughout the experiment at different times to determine how pleasant or unpleasant the participants found a particular part of the experiment. This rating scale was presented after the two relaxation periods, following each of the seven practice trials, and following the critical trial. This scale was a self-report rating scale which asked subjects to indicate by choosing a number from 1 to 21, inclusive, how pleasant the previous task was. For example, a subject choosing number 11 would be indicating that the previous experience was neither pleasant nor unpleasant. The pleasantness scale is shown in Appendix D.

Procedure

Upon arriving at the designated waiting room the subject was greeted by the experimenter and led into the experimental room. Here the subject was seated and informed of the heart

rate apparatus and recording that would be employed throughout the session. Subjects were informed that no harm would come to them and that any questions they might have during the session would be answered at the end of the session. The heart rate apparatus was then put into operation and explained to the subject. An explanation of the pleasantness scale and how to use it was given. Subjects were told that throughout the session they would be asked to rate the pleasantness of events they would participate in.

After making sure that the subject was comfortable and willing to proceed the subject was instructed to relax for five minutes. This relaxation period was marked by an event recorder on the heart rate record. The experimenter sat behind a series of book shelves separating the subject from the heart rate apparatus and the experimenter so that the subject felt more alone during the relaxation period. After the relaxation period the pleasantness scale was presented to the subject who was asked to indicate how pleasant the last few seconds of the relaxation period were. Following this the first digit-letter task was presented to the subject. First instructions and a demonstration on how to perform the task were provided. Then the digit-letter task was presented face down to the subject and was turned over at the sound of the buzzer. After one minute performance was stopped with the buzzer and the task turned face down.

An event recorder marked the one minute interval on the heart rate record. The task was timed with a stop watch. The subject was asked to rate the pleasantness of doing the task. Performance was then scored and the results given to the subject. Seven identical trials in all were presented each following the procedure of trial one. A different digit-letter form was given in each trial.

After the seventh trial subjects were informed that in the next trial they would be competing against another person doing the same task. One male and one female confederate arrived at each scheduled session 10 to 15 minutes after the subject had started the experiment. This was done to ensure that the subject and confederate did not meet each other prior to the competition. Confederates appeared at the sessions according to time available in their own university timetables with each confederate totalling 20 hours of attendance by the end of the experiment. Prior to trial number eight the experimenter entered the office of the two confederates, tossed a coin and had one of the confederates select either heads or tails to determine who was to be the competitor. The chosen competitor then entered into the experimental room with the experimenter. The selection of the competitor was done in a manner which ensured that the creation of each of the four different conditions of the critical trial was accomplished every four trials. Since male and female subjects were alternately scheduled for the experiment the first

male and female subjects were assigned to competitors by tossing the coin while the next male and female subjects were automatically assigned to either a male or female competitor.

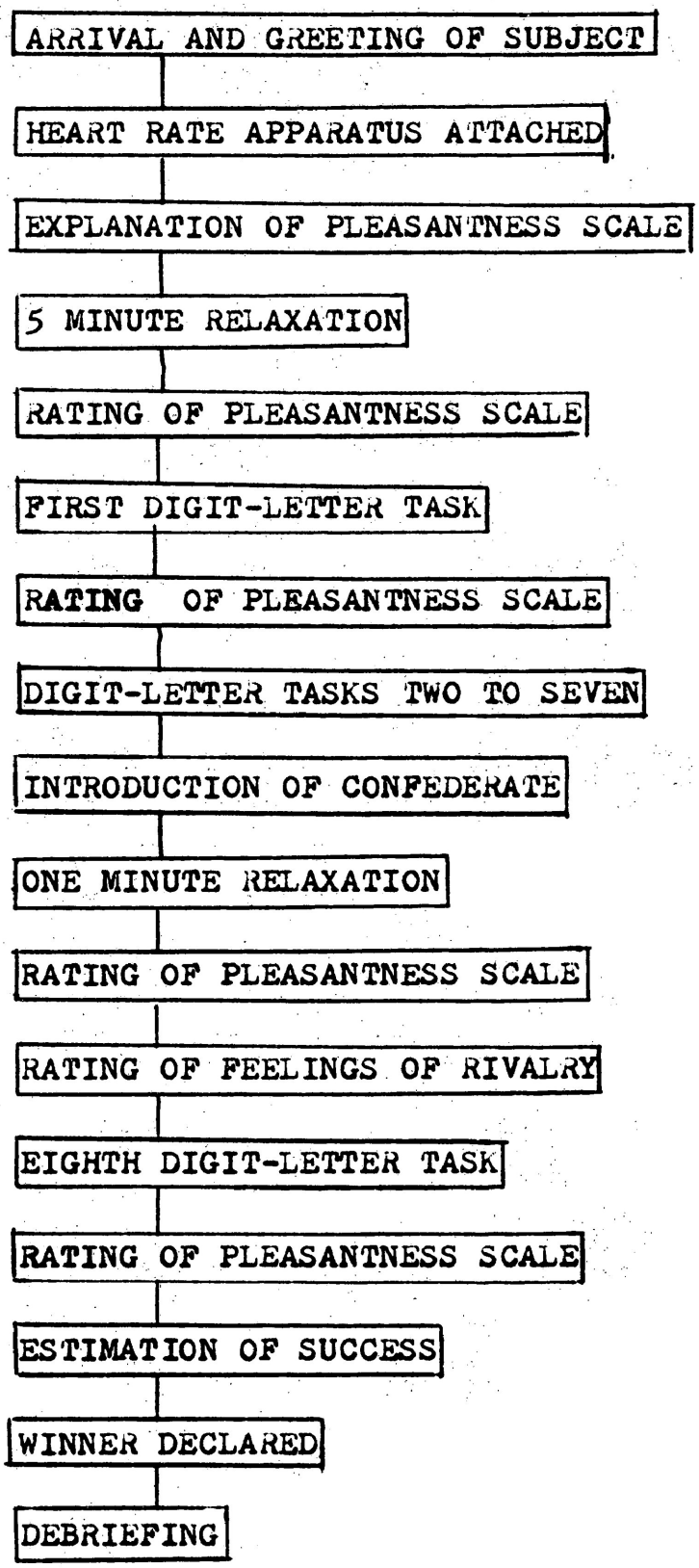
The confederate, who was introduced as an introductory psychology student, sat opposite the subject and the heart rate apparatus (plethysmograph) was attached to the finger of his/her least preferred hand. The plethysmograph was attached to the confederate's finger to add authenticity to the experiment but did not actually pick up the confederate's heart rate. The subject was told that the confederate had been performing the digit-letter tasks in another room with another experimenter and that for this trial the two of them were going to compete on the same digit-letter tasks to see who could correctly complete the most transformations. The competitive nature of the situation was emphasized as the subjects were told to do their very best and informed that their performance would be compared after the trial. They were instructed to work as quickly as they could and to try to do better than their opponent in the goal of being declared the winner. After these instructions the confederate and subject were told about and given a one minute relaxation period. After the relaxation period first the subject then the confederate gave a rating of pleasantness for the last few seconds of the relaxation period. Both then

completed the self report rating scale on their feelings of rivalry. The final trial then commenced. The same rules for starting, stopping, and turning over the tasks used in the rest of the experiment applied also in trial number eight.

After completing the task the participants were asked for a final pleasantness rating of the task and were given a self report rating scale to complete on their estimated level of success relative to their opponent. After the rating scales were completed the winner of the eighth trial was declared. All subjects were debriefed, thanked for their participation, told not to disclose the nature of the experiment to others, questioned about any prior knowledge of the experiment, and allowed to ask any questions they might have had. One experimental session lasted about 45 minutes. Figure 1 provides a schematic representation of the experimental procedure. Appendix E contains a copy of the verbatim experimental procedure used with each subject.

Figure 1

Flow Chart of Experimental Procedure



Results

Data were collected on each subject's performance, heart rate, rating of pleasantness, desire to win, and estimated success. Performance measures included performance score on the seventh trial which will be referred to as performance one (P1) and performance score on the eighth trial which will be referred to as performance two (P2). Heart rate measures were collected on the following: the seventh trial which will be referred to as performance heart rate one (PHR1), the eighth trial which will be referred to as performance heart rate two (PHR2), the first relaxation period which will be referred to as relaxation heart rate one (RHR1), and the second relaxation period which will be referred to as relaxation heart rate two (RHR2). Pleasantness scores were obtained for the seventh trial which will be referred to as performance pleasantness one (PPLEAS1), the eighth trial which will be referred to as performance pleasantness two (PPLEAS2), the first relaxation period which will be referred to as relaxation pleasantness one (RPLEAS1), and the second relaxation period which will be referred to as relaxation pleasantness two (RPLEAS2). Desire to win on the eighth trial will be referred to as desire (DESIRE) and estimated success on trial eight will be referred to as success (SUCCESS). The means and standard deviations for these measures are presented in Appendix F.

The seven dependent variables examined in this experiment were: change in performance score from trial seven to eight which will be referred to as performance change (PΔ), change in heart rate from trial seven to eight which will be referred to as performance heart rate change (PHRΔ), change in heart rate from the first to second relaxation period which will be referred to as relaxation heart rate change (RHRΔ), change in pleasantness from the first to second relaxation period which will be referred to as relaxation pleasantness change (RPLEASΔ), change in pleasantness from trial seven to eight which will be referred to as performance pleasantness change (PPLEASΔ), desire to win on trial eight (DESIRE), and estimated success on trial eight (SUCCESS). Appendix G gives the means and standard deviations of the dependent variables.

Change scores were used as dependent variables to accommodate for any initial differences in performance and heart rate that may have existed before the experimental manipulation. This decision to use change scores was confirmed as appropriate upon the discovery of trends indicating initial differences among males and females with regard to heart rate and performance.

The appropriateness of the use of change score analysis is often a topic of debate among researchers. Cronbach and Furby (1970) caution that change scores might be faulty indicators of the true theoretical concept which the experimenter wants to examine. One criticism by Cronbach and Furby that

relates specifically to the present study is the view that the change score varies systematically with the initial score. Change scores are subject to a regression toward the mean which creates problems. For example there may be a ceiling effect where a subject who is high on the pre score cannot move any further in the same direction. However, in a study by Evans (1972) in which both subjects with high and low resting heart rates were stressed by the introduction of competition the increase in heart rate was virtually the same for both groups. No evidence of a ceiling effect appeared and the relationship between the competition and heart rate was not found to be affected by initial heart rate level. This study lends support to the use of change scores in the present study.

Other researchers also support change score analysis as the most common way of analyzing the nonequivalent control group design (Kenny, 1975; Kessler, 1977). "Numerous writers have emphasized the unreliability of difference scores, which results from summation of measurement errers (Bereiter, 1963; Lord, 1963; Webster and Bereiter, 1963). While this may be a problem for certain types of correlational studies, it is not a cause for concern in the use of simple difference scores to measure treatment-induced change in experimental research" (Overall and Woodward, 1975).

Initial Differences

Analyses of initial differences looked for differences

among the following four groups prior to the introduction of the competitor:

Group one: male subject/male competitor

Group two: male subject/female competitor

Group three: female subject/male competitor

Group four: female subject/female competitor

Since the competitor was not introduced until after trial seven any initial differences that appear among the four groups should be due to the sex of the subject.

A randomized groups analysis of variance for the four different groups revealed a significant difference among groups with respect to performance on trial seven before the introduction of the competitor, $F(3,76)=3.330$, $p<.05$. To investigate this difference further a Newman-Keuls test for post-hoc comparisons was used to determine which groups differed significantly from the others. It was found that the mean of group three ($M=54.20$) differed significantly at the .05 level of significance from the means of groups one ($M=48.65$) and two ($M=48.00$). Group three did not differ significantly from group four ($M=51.90$). These results suggest the development of a trend that indicates female performance to be better than male performance initially on the task. Table 1 presents a summary of the analysis of variance.

A randomized groups analysis of variance was also done on heart rate during the seventh trial. It was found that

the groups differed significantly with regard to heart rate, $F(3,76) = 2.96$, $p < .05$. Upon further investigation of the source of the difference a Newman-Keuls test failed to indicate any significant differences among the groups. Since Newman-Keuls is a conservative test in that it reduces the number of type I errors it may also fail to detect real differences when they are present (type II error). Therefore, a less conservative test was utilized to pursue the difference. A Duncan test for post-hoc comparisons revealed the mean of group three ($M=87.75$) to differ significantly from the means of groups one ($M=80.10$) and two ($M=79.85$) at the .05 level of significance. Group three did not differ significantly from group four ($M=86.35$). These results suggest the development of a trend indicating that females had a higher heart rate than males while performing the seventh trial of the digit-letter task. Table 2 presents a summary of the analysis of variance.

Table 1

A Randomized Groups Analysis of Variance

For Performance Scores on Trial Seven

SOURCE	DF	SS	MS	F	PROB.
BETWEEN GROUPS	3	503.6219	167.8740	3.330	.0239
WITHIN GROUPS	76	3831.5435	50.4150		
TOTAL	79	4335.1641			

Table 2

A Randomized Groups Analysis of Variance

For Heart Rates on Trial Seven

SOURCE	DF	SS	MS	F	PROB.
BETWEEN GROUPS	3	1021.31	340.4375	2.964	.0373
WITHIN GROUPS	76	8728.64	114.8506		
TOTAL	79	9749.95			

Group differences in resting heart rate during the first relaxation period were also discovered. A randomized groups analysis of variance on the four groups revealed a significant difference in heart rate among the groups, $F(3,76)= 4.41$, $p<.01$. Further analysis using a Newman-Keuls test indicate the mean of group one ($M=70.70$) to be significantly different from the means of groups three ($M=80.05$) and four ($M=79.85$). Group one did not differ significantly from group two ($M=72.65$). From these results it can be said that a trend appears to be developing which suggests that females have a higher resting heart rate than males as recorded during the first relaxation period. Table 3 presents a summary of the analysis of variance.

A randomized groups analysis of variance indicated no significant difference between males and females with respect to either the rating of pleasantness for the first relaxation

period, $F(3,76)=1.991$, $p>.10$, or the rating of pleasantness for trial seven, $F(3,76)=1.530$, $p>.10$. Summaries of these analysis are shown in Table 4 and 5 respectively.

Table 3

A Randomized Groups Analysis of Variance For Heart Rate During First Relaxation Period

SOURCE	DF	SS	MS	F	PROB.
BETWEEN GROUPS	3	1407.8902	469.2966	4.414	.0065
WITHIN GROUPS	76	8080.2434	106.3190		
TOTAL	79	9488.1328			

Table 4

A Randomized Groups Analysis of Variance For Rating of Pleasantness of First Relaxation Period

SOURCE	DF	SS	MS	F	PROB.
BETWEEN GROUPS	3	64.1000	21.3667	1.991	.1225
WITHIN GROUPS	76	815.6989	10.7329		
TOTAL	79	879.7988			

To summarize, the results on initial differences between males and females suggest the possibility of initial

differences with regard to heart rate on both trial seven and the first relaxation period and with regard to performance on trial seven. Trends indicated female performance to be better on trial seven than male performance and female heart rates to be higher than male heart rates on trial seven and the first relaxation period. Had the author chosen to use a less conservative test such as the Duncan test, rather than the Newman-Keuls test for post-hoc comparisons in analyzing differences in performance on trial seven and heart rate for the first relaxation period, the trends found would probably have reached the standard level of significance.

Table 5

A Randomized Groups Analysis of Variance For Rating of Pleasantness of Trial Seven

SOURCE	DF	SS	MS	F	PROB.
BETWEEN GROUPS	3	32.5496	10.8499	1.530	.2136
WITHIN GROUPS	76	538.9996	7.0921		
TOTAL	79	571.5491			

Analysis of Change Scores

As stated previously, there were five change scores that were dependent variables of interest in this experiment. The effects of the sex of the subject, the sex of the competitor,

and any possible interaction of these two factors upon the dependent variables were examined.

A 2 X 2 factorial analysis of variance with the two factors being male subject/female subject and male competitor/female competitor was done on performance change scores (PA). This analysis was done to see if females and males differed in their change in performance on the task under competition and to see if the male or female competitors had any influence on change in performance. From this analysis a significant effect due to the sex of the subject was found, $F(1,76)=4.397$, $p<.05$. Female performance ($M\Delta=4.87$) changed more than male performance ($M\Delta=3.42$) under competition. No significant effects due to the sex of the competitor or interaction effects were found. Table 6 presents a summary of this analysis.

A second 2 X 2 factorial analysis of variance with the same two factors was done on heart rate change scores from trial seven to eight (PHRΔ). This dependent variable was used to determine if heart rate scores during performance were influence by the sex of the subject or the sex of the competitor. A virtually significant effect due to the sex of the subject was found, $F(1,76)=3.78$, $p=.056$ indicating a greater heart rate increase for males ($M\Delta=26.17$) than females ($M\Delta=20.95$) when in competition. No significant differences were detected between male and female competitors and no interaction was indicated. Table 7 summarizes this analysis.

Table 6

A 2 X 2 Factorial Analysis of Variance
On Performance Change Scores From
the Seventh to the Eighth Trial

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	42.050	42.050	4.050	.039
SEX OF COMPETITOR(SC)	1	7.200	7.200	.753	.388
SS X SC	1	.050	.050	.005	.943
RESIDUAL	76	726.893	9.564		
TOTAL	79	776.193	9.825		

Table 7

A 2 X 2 Factorial Analysis of Variance
On Heart Rate Change Scores From
the Seventh to the Eighth Trial

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	546.012	546.012	3.780	.056
SEX OF COMPETITOR(SC)	1	4.512	4.512	.031	.860
SS X SC	1	227.812	227.812	1.577	.213
RESIDUAL	76	10977.234	144.437		
TOTAL	79	11755.574	148.805		

A 2 X 2 factorial analysis of variance with the two factors being sex of subject and sex of competitor was done on heart rate change scores from the first to the second relaxation period (RHRΔ). This was the dependent variable used to determine if heart rate during the relaxation was influenced by the two factors sex of subject and/or sex of competitor. A significant effect due to the sex of the subject was revealed $F(1,76)=4.049$, $p<.05$, indicating a greater heart rate increase for males ($M\Delta=2.500$) than for females ($M\Delta=-.9750$) during the second relaxation period. No significant effects due to the sex of the competitor or the interaction were indicated. Table 8 provides a summary of this analysis.

Table 8

A 2 X 2 Factorial Analysis of Variance on Heart Rate Change Scores From the First to the Second Relaxation Period

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	241.512	241.512	4.049	.048
SEX OF COMPETITOR(SC)	1	4.512	4.512	.076	.784
SS X SC	1	59.512	59.512	.998	.321
RESIDUAL	76	4532.926	59.644		
TOTAL	79	4838.465	61.246		

A 2 X 2 factorial analysis of variance utilizing the same two factors was done on pleasantness change scores from the first to the second relaxation period (RPLEASΔ). This dependent variable was used to determine if pleasantness rating during the relaxation was influenced by the sex of the subject or the sex of the competitor. No significant effects due to the sex of the subject or the sex of the competitor were found. The sex of subject X sex of competitor interaction while not significant was found to be approaching significance, $F(1,76)=2.918$, $p=.092$. A trend in the data indicated that for males their decrease in rating of pleasantness when they were competing against a male ($M\Delta=-1.35$) was greater than when they were competing against a female competitor ($M\Delta=-.85$). For females their decrease in rating of pleasantness was greater when competing against a female competitor ($M\Delta=-3.0$) than against a male competitor ($M\Delta=-.75$). Table 9 provides a summary of this analysis.

Another 2 X 2 factorial analysis of variance with the same two factors was done on pleasantness change scores from the seventh to eighth trial (PPLEASΔ). This was the dependent variable used to determine if pleasantness rating during the trials was influenced by the two factors sex of the subject and sex of the competitor. Results of this analysis reveal no significant effects due to the sex of the subject, the sex of the competitor, or interaction effects.

Table 10 summarizes this analysis.

Table 9

A 2 X 2 Factorial Analysis of Variance on Pleasantness Change Scores From the First to the Second Relaxation Period

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	12.012	12.012	.927	.339
SEX OF COMPETITOR(SC)	1	15.312	15.312	1.182	.280
SS X SC	1	37.812	37.812	2.918	.092
RESIDUAL	76	984.843	12.958		
TOTAL	79	1049.980	13.291		

Table 10

A 2 X 2 Factorial Analysis of Variance on Pleasantness Change Scores From the Seventh to Eighth Trial

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	2.450	2.450	.182	.671
SEX OF COMPETITOR(SC)	1	.0	.0	.0	1.000
SS X SC	1	.200	.200	.015	.903
RESIDUAL	76	1025.293	13.491		
TOTAL	79	1027.943	13.012		

Self-report Measures

As well as the five change scores used as dependent variables two self-report measures also served as dependent variables. Subjects were asked to report their desire to win prior to trial eight and their estimated success after this trial.

A 2 X 2 factorial analysis of variance with the two factors being sex of subject and sex of competitor was done on desire to win scores (DESIRE). This was the dependent variable used to determine if desire to win was influenced by the sex of the subject or sex of the competitor. No significant effects were found due to the sex of the competitor or the interaction. The effect due to the sex of the subject was found to be approaching significance, $F(1,76)=3.314$, $p=.073$ though still not significant. The mean desire to win for males ($M=1.100$) indicated a trend of being higher than the mean desire to win for females ($M=.775$). Table 11 contains a summary of this analysis.

A final 2 X 2 factorial analysis of variance was done on estimated success scores (SUCCESS) utilizing the same two factors. This dependent variable was used to determine if estimated success was influenced by the two factors sex of subject and sex of competitor. No significant effects due to the sex of the competitor or the interaction were revealed. The effect due to the sex of the subject was

again found to be approaching significance, $F(1,76)=3.108$, $p=.082$ but still short of the acceptable level of significance of .05. It can therefore be said that a trend in the data indicated that the mean estimation of success for females (M=1.825) tended to be higher than for males (M=1.500). Table 12 summarizes this analysis.

Table 11

A 2 X 2 Factorial Analysis of Variance on Desire to Win on Trial Eight

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	2.112	2.112	3.314	.073
SEX OF COMPETITOR(SC)	1	1.512	1.512	2.373	.128
SS X SC	1	.612	.612	.961	.330
RESIDUAL	76	48.450	.637		
TOTAL	79	52.687	.667		

Table 12

A 2 X 2 Factorial Analysis of Variance

on Estimated Success on Trial Eight

SOURCE	DF	SS	MS	F	PROB.
SEX OF SUBJECT(SS)	1	2.112	2.112	3.108	.082
SEX OF COMPETITOR(SC)	1	.012	.012	.018	.892
SS X SC	1	.112	.112	.116	.685
RESIDUAL	76	51.650	.680		
TOTAL	79	53.887	.682		

Correlations

Intercorrelations were computed among the seven dependent variables: performance change from trial seven to eight (PΔ), heart rate change from trial seven to eight (PHRΔ), pleasantness change from trial seven to eight (PPLEASΔ), heart rate change from first to second relaxation period (RHRΔ), pleasantness change from first to second relaxation period (RPLEASΔ), desire to win on trial eight (DESIRE), and estimated success on trial eight (SUCCESS). These correlations were computed to examine the relationship among performance, heart rate, rating of pleasantness, desire to win, and estimated success under a competitive situation. These correlations are presented in Table 13.

Table 13

Correlation Matrix For Seven Dependent Variables

	PΔ	PHRΔ	PPLEASΔ	RHRΔ	RPLEASΔ	DESIRE	SUCCESS
PΔ		.1159	.1638	-.0202	-.1408	.0037	.1812
PHRΔ			-.2737*	.4834***	-.1375	.2768*	-.0224
PPLEASΔ				-.1901	.3971***	-.0886	.0417
RHRΔ					-.2184*	.2254*	-.0537
RPLEASΔ						-.1847	-.0890
DESIRE							.0059
SUCCESS							

*p<.05
**p<.01
***p<.001

Discussion

Initial Differences

An analysis of initial differences before the introduction of the competitor revealed a trend which suggests that females performed better than males on trial seven of the digit-letter task. The digit-symbol or digit-letter task is a commonly used task for studying the effects of stress on performance (Evans, 1977; Fish, 1978). The findings of previous research had not led the experimenter to believe that males and females would perform differently on the digit-letter task under a nonstressful situation (Fish, 1978). However, the digit-letter task is based on the digit-symbol subtest of the Wechsler Adult Intelligence Scale which, the author later learned, Zimmerman and Woo-Sam (1973) contend "appears considerably easier for women" (p. 128). No explanation for this finding is given. Wechsler (1958) and Shaw (1965) found that the digit-symbol favoured women. The author had not speculated on the digit-letter task favouring female performance particularly in light of its use in previous research. The digit-letter task was thought to be a neutral task free from sex-role stereotyping as either a male or female task. It now appears that the factors operating in favour of superior female performance on the digit-symbol task may also be present with regard to the digit-letter task. What these factors are however is

beyond the scope of this paper and can only be speculated on here. The digit-symbol task measures the ability to learn an unfamiliar task. A good memory and the use of verbal mediation will aid a speedy performance on this task. Since females are known to be better than males in verbal abilities females may be at an advantage. However performance on the digit-symbol task is also affected by visual acuity and visual motor coordination and dexterity which might favour those who are better in spatial orientation which would support superior male performance. If both verbal and spatial orientation abilities are an important part of performance on this task then males and females should be equally suited to perform the task. It appears that this issue is a controversial one and again beyond the scope of this paper. The appearance of a trend towards an initial difference between male and female performance in the present study confirmed the use of change scores as appropriate for the dependent variables.

The trend towards an initial difference between males and females with regard to heart rate was also found. Females tended to have higher heart rates than males during both trial seven and the first relaxation period. This trend is not surprising since it is known that the heart rate of females is generally faster than males (Tuttle and Schottelius, 1961; Kimber, Gray, Stackpole, and Leavell, 1961).

Therefore, trends indicating initial differences between males and females are suggested for both the performance and physiological measures of importance in this study. This did not, however, negate the use of the performance on the digit-letter task or the heart rate measures as indicators of response to a psychosocial stressor since the change scores for the performance and the heart rate measures were used as dependent variables.

Analysis of Change Scores

Five change scores comprised seven of the dependent variables of interest in this experiment. The effects of the sex of the subject and the sex of the competitor upon these change scores were examined. These analyses were undertaken in an attempt to examine possible sex differences in response to a stressful situation and to investigate what effects the sex of the competitor had upon an individual in competition. These analyses represent the main focus of this experiment.

An analysis of variance done on performance change scores (PΔ) revealed female performance to have increased more than male performance under competition. This finding is in agreement with the results of a pioneer in this field of research, Triplett, who in 1897 found that the proportion of girls (61.5%) influenced positively by competition was greater than the proportion of boys (28.6%). The finding

of the present study however contradicts some of the more current research which has found either no difference in male and female performance under competition (Carment, 1970; Krauss, 1975; Ober, 1977) or a significant increase in male performance as compared to female performance (Freischlag, 1973; Hill, 1977). Exactly why the performance of females increased significantly over that of males in this experiment is not known. It might be speculated that under a stressful situation initial competency on a task may be increased to an even greater amount. Since females indicated a trend of superior initial performance on the digit-letter task as compared to males, this superior performance may have been heightened or further increased under the competition. This would have led to females experiencing a greater increase in performance than males. This however is only speculation and would have to be evaluated by future research.

Competition is known to increase performance in most cases (Triplett, 1897; Whittemore, 1924; Dashiell, 1930; Church, 1962; Wilmore, 1968; Carment, 1970; Freischlag, 1973; Evans and Bonder, 1973; Evans, 1977; Hill, 1977; Fish, 1978) but has not been examined extensively for its effects on males and females separately. The conflicting findings revealed by the research on sex differences in performance under stress justifies and encourages future research in this area. This research should pay attention to the nature of

the task from which performance scores are obtained and to be cautious of selecting a task which tends to favour one sex more than the other as might be the case with the digit-letter task.

The fact that females increased their performance on the digit-letter task under competition indicates that females are not shying away from succeeding in a competitive situation as some researchers have suggested (Horner, 1972). More importantly their success appears to be the same whether they are competing against a male or female competitor. For neither male nor female subjects was the sex of the competitor found to have any influence upon performance. This has also been the finding of Wood (1974) and Hill (1977). It does not appear that females are suffering from the anxiety that would limit their performance especially against male competitors as hypothesized by Allen and Boivin (1976). Also, the unhealthy picture of women painted by Horner (1972) does not emerge from this present study:

> Among women, the anticipation of success especially against a male competitor poses a threat to the sense of femininity and self-esteem and serves as a potential basis for becoming socially reject - in other words, the anticipation of success is anxiety provoking and as such inhibits otherwise positive achievement-directed motivation and behavior. In order to feel or appear

> more feminine, women, especially those high in fear of success, disguise their abilities and withdraw from the mainstream of thought, activism and achievement in our society. This does not occur, however, without a high price, a price paid by the individual in negative emotional and inter-personal consequences and by the society in a loss of valuable human and economic resources. (Horner, 1972)

In the present study women are not avoiding success. That they exhibit success whether competing against a male or a female competitor reveals that they are not in such an unhealthy state as Horner may believe. It is also significant that female and male competitors are influencing subjects in the same way. Previous studies found male competitors to increase the performance of male and female subjects more than female competitors (Freischlag, 1973; Ober, 1977). Krauss (1975) found females increased their performance on masculine tasks when the competitors were males and decreased their performance when the competitors were females. These studies bring into question the extent to which female competitors were seen as a genuine threat to both male and female subjects in the competition. In the present study the finding of no significant effect due to the sex of the competitor indicates that both females and males are being treated as genuine competitors posing a threat to the performance of all subjects under stress. Perhaps the "women's

liberation movement" and the appearance of so many more women in the competitive areas of business and sports has increased the confidence of women and their expectations to now automatically be subjected to competition. The novelty of competing against a male or female may be becoming a necessity and common occurence for both men and women and in fact part of their expectations. Because of conflicting findings further research should be done to examine the effect of both male and female competitors on performance particularly in areas more closely resembling actual competitive encounters outside of the experimental room.

A second analysis of variance done on heart rate change scores from trial seven to eight (PHRΔ) found a greater increase in heart rate for males than females when in competition. Competition has been shown to increase heart rate (Evans, 1968; Evans, 1972; Evans and Bonder, 1973; Evans, 1977; Fish, 1978) and also palmar skin conductance (Church, 1962; Ober, 1977). These studies unfortunately, however, did not focus on any possible sex differences in heart rate change under stress. Similarily several studies that considered sex differences in performance under competition failed to examine sex differences in physiological responses to stress (Carment, 1970; Freischlag, 1973; Wood, 1974; Krauss, 1975; Hill, 1977). Studies employing stressful situations other then competition have found both no significant

sex differences in heart rate under stress (Frankenhaeuser, Dunne, and Lundberg, 1976) and a greater increase in female heart rate under stress (Collins and Frankenhaeuser, 1978). The scarcity of research on sex differences in physiological responses to competition and the significant finding of the present study supports the need for future research in this area.

It is important to note that the sex of the competitor had no effect on the physiological response of either male or female subjects. Subjects found competing against a female competitor as equally as stressful as competing against a male competitor. The lack of any significant effect on a subject's performance due to the sex of the competitor as previously stated supports this idea also.

The results of a study by Ober (1977) using the Palmar Sweat Index as a measure of arousal in a competition are in disagreement with the findings of the present study. Ober found that the physiological arousal of both males and females was more positively facilitated by male competitors than by female competitors. Because of the contradictory findings and lack of research in this area, further studies should be undertaken to examine the stress response of subjects to male and female competitors.

The fact that males experienced a greater heart rate increase than females during the competition indicates that

the males were more physiologically aroused by the stressfulness of the competition. This is not to say that females are immune to the effects of competition for as previously mentioned they experienced a greater increase in performance under stress. As stated previously, stressful situations such as a competition, are known to improve performance (Church, 1962; Wilmore, 1968; Carment, 1970; Freischlag, 1973; Evans and Bonder, 1973; Evans, 1977; Hill, 1977; Fish, 1978). It may be as Collins and Frankenhaeuser (1978) suggest that the coping strategies of males and females in stressful situations may differ in some fundamental ways. Examining the results on performance and heart rate change together, physiologically males appear to be more stressed than females under competition but do not make the performance gains that females make. Both of these findings are in agreement with the trends reported by Fish (1978). The high heart rate and low performance change scores of males when compared to females may indicate that males have been stressed past an optimal level of performance. Exploring this possibility the author plotted male performance against male heart rate when under stress. The distribution of points did not resemble the inverted U (Malmo, 1959; Cox, 1978) which would have lent support to the hypothesis of males being stressed beyond their optimal level of performance. Females by increasing their performance under competition

without concomitant heart rate increases appear to be dealing with the stressful demands of the situation in a physiologically more economic way than males. This has also been the conclusion of Frankenhaeuser et al. (1978) in their study of sex differences in catecholamine secretion in a stressful situation.

Male heart rate change was also found to be greater than female heart rate change from the first to the second relaxation period ($\bar{R}HR\Delta$). It appears that males were more stressed prior to the competition than females which was also indicated by Fish (1978). The author knows of no studies examining sex differences in physiological arousal once the knowledge of a forthcoming competition has been introduced, but still prior to the actual competition. Whether it is the mere presence of another person introduced into the experiment (Zajonc, 1965), or the evaluation apprehension induced by the impending competition (Cottrell, 1968), that causes an increase in physiological arousal is debatable and cannot be answered here. It can be concluded, however, that males were more physiologically aroused and stressed by the knowledge of the forthcoming competition and the presence of the competitor than were females. This difference between males and females should be explored further.

As previously stated due to individual differences in heart rate and to prevent the law of initial value (Wilder,

1967) from influencing the results change in heart rate scores from the seventh to eighth trial were used. One might speculate however that because females tended to have a higher initial heart rate than males that they might have very little room to further increase their heart rate. However, this possibility is contraindicated by the fact that an examination of the actual initial relaxation heart rate scores for females (M=79.95) was relatively low compared to maximum heart rate. This suggests that heart rates for the females were not too high to prevent a further increase.

As in the case of performance heart rate change, relaxation heart rate change was not affected by the sex of the competitor. As previously stated, this indicates the acceptance of males and females equally as potential competitors for there is no difference in the stress response they elicit from subjects.

Pleasantness change scores from the first to the second relaxation period (RPLEASΔ) revealed a nearly significant sex of subject X sex of competitor interaction. For males their decrease in rating of pleasantness was greater when they were faced with competing against a male competitor than when facing competition against a female competitor. For females their decrease in rating of pleasantness was greater when they would be competing against a female competitor than against a male competitor. It therefore appears that subjects are rating as slightly more pleasant the relaxation periods

prior to competition against a member of the opposite sex. This is a surprising finding considering that the literature on sex roles and competition leads one to speculate that females would rate as less pleasant the relaxation period prior to competition against a member of the opposite sex. Research implies that it would be more anxiety provoking for a female to contemplate competition against a male competitor (Horner, 1968; Allen and Boivin, 1976) therefore it should be seen as less pleasant. The author thinks that the interpretation of this result lies not in the fact that competition against a member of the same sex is unpleasant per se but that the possibility of competing against a member of the opposite sex may add a new dimension to the experiment which may make it more pleasant. If women are now emerging into male dominated areas of society this tendency may represent a healthy attitude in both men and women towards a potential confrontation and integration of the two in a productive environment. It must be remembered however that this finding cannot be over-emphasized or even accepted since it does fail to reach the .05 level of significance and represents a trend only. However, it may be something of interest to follow-up in further research.

Analysis on the final change score, change in pleasantness from the seventh to eighth trial (PPLEASΔ), showed this dependent variable to not be influenced by either the sex

of the subject or the sex of the competitor. Both males and females found the competition equally unpleasant. There is no indication of males liking competition more than females as indicated by a difference in pleasantness rating which some studies suggest (Maccoby and Jacklin, 1974, p. 247). It may be that males and females generally regard competition in a similar way. Equally as important is the finding that the sex of the competitor faced had no bearing on how pleasant or unpleasant the stressful situation was perceived. This indicates that subjects are responding to characteristics of the stressful situation other than the sex of the competitor, in arriving at their rating of pleasantness.

Self-Report Measures

The final two dependent variables examined in this experiment were the two self-report measures, desire to win (DESIRE) and estimated success in the competition (SUCCESS).

Examining the effects of the sex of the subject on desire to win, a trend indicating a greater desire to win for males than for females was found. This finding did not quite reach the acceptable .05 level of significance ($p < .08$). Desire to win is interpreted as an individual's cognitive desire to out-perform the other person and succeed in the competition. The nearly significant ($p < .08$) sex difference may indicate a tendency for males to be more competitive and success oriented than females. However, it does fall

short of significance and cannot be accepted as unequivocal.

That no effect due to the sex of the competitor was found is also important to note. It appears that males and females can face either an individual of the same or opposite sex in a competition and maintain the same desire to win. It seems likely that it would be important for a male to be declared the winner both against another male, who might be considered an expected and natural competitor, and against a female, for reasons of self-esteem or as one subject said: "I'd be embarrassed to lose against a woman". Subjects were free to compete with little risk of losing a friend since competitors were strangers and there was no opportunity in the experiment to form friendships. That females indicated a desire to win regardless of whether they were facing a male or female competitor is significant. Some researchers like Horner (1968) have hypothesized that some women fear success in a competition because of its negative unfeminine consequences, particularly when in competition with a male. If this was true in the present study then females should have indicated a low desire to succeed when facing a male competitor. That they did not, indicates a healthy attitude for women if they are to expand into male dominated spheres where they might have to compete for positions. However, the fact that females indicated an equal desire to win against either sex may also be an indication of a lack of

sufficient negative consequences for winning against a male competitor in the present study. This hypothesis can only be speculated upon here since its validation is beyond the scope of this study.

A study by Parker (1972) contrary to the present study, found that females indicated that the importance of doing well was related to the sex of the competitor. It was most important to do well when working alone and least important to do well when in competition against a male. No explanation for this finding was given and since only female subjects were used, no conclusions can be drawn as to male importance of doing well as related to the sex of the competitor. No other studies in this area are known by the author but should be done, particularly in light of the nearly significant finding encountered in the present study.

For the final dependent variable, estimated success, a nearly significant ($p<.09$) effect due to the sex of the subject was also found. Females were found to give a higher estimation of their success on trial eight than males, though the significance of this difference did not attain the acceptable .05 level of significance. This tendency for females to rate their success higher than males may be explained by the fact that females did perform significantly better than males on the eighth digit-letter task. An analysis revealed females to have performed an average of 58 transformations

and males 52 on trial number eight. The author had hypothesized that though the subject and competitor were performing the tasks openly in front of each other, the degree of concentration and attention required to one's own task would not allow the subject to compare his/her performance to that of the competitor's. Also the competitor was instructed to immediately turn over his/her task at the end of the trial to eliminate the comparison of performance. The author now believes that subjects were in fact able to gauge their performance relative to their opponent's. Some subjects reported that they know when an opponent started a new row on the task and could tell if they were ahead or behind in performance. This source of feedback may have affected the stressfulness of the competition and the subject's performance. The author had instructed the confederates to perform about 50 of the digit-letter transformations during the competition which is the average number completed in one minute. Since female subjects completed an average of 58 transformations during the competition, compared to the male average of 52, they may have been in a better position to estimate their success over their opponents.

Rather then estimating their success at the end of the competition, it may have been more valuable to have asked subjects to estimate how successful they thought they would

be, relative to their opponent, before undertaking the competition. It has been found that women express less self-confidence about how they will perform on tasks that they are about to undertake, even when using tasks at which women characteristically succeed (Maccoby and Jacklin, 1974, p. 155). Maccoby and Jacklin (1974, p. 154) outline studies that have shown university men more likely than university women to expect to do well on tasks, and to judge their own performance more favorably when finished the task. However, none of these studies had subjects performing the tasks in competition and estimating their predicted success relative to opponents of the same or opposite sex. Therefore, future research should pursue this topic.

Correlations

Intercorrelations were computed among the seven dependent variables yielding six significant correlations.

A significant positive correlation was revealed between heart rate change during the performance and heart rate change during the relaxation periods. Those individuals who experienced an increase in heart rate in the relaxation period prior to the competition also experienced an increase in heart rate during the competition. This indicates a consistency in an individual's response to stress.

A significant positive relationship was detected between performance heart rate change and desire to win. A great

desire to win when under stress was therefore associated with an increase in physiological response in an individual. This implies a positive relationship between a cognitive desire to win (rivalry) and physiological arousal under stress.

A significant negative relationship was found between pleasantness and heart rate change scores for the trials and between pleasantness and heart rate change scores for the relaxation periods. A decrease in the rating of pleasantness associated with an increase in heart rate indicates that as a person became more physiologically aroused the situation was perceived as less pleasant.

The final correlation revealed a positive relationship between pleasantness change during the relaxation and pleasantness change during the trials. Those individuals who rated the relaxation period prior to the competition as less pleasant also rated the actual performance of the task under competition as less pleasant. This shows an intra-subject consistency in rating of pleasantness.

Generally, the correlations indicate an intra-subject consistency in response to stress which supports the validity of the measurements used as indicators of stress. Also, the significant correlations produced intuitively seem natural. It seems reasonable that the greater a person's desire to win the more physiologically aroused he/she becomes so that both cognitively and physiologically the individual is aroused

by the stressful situation. The physiological arousal was associated with a rating of unpleasantness, a feeling not uncommon for individuals in a stressful situation.

It may be significant to note that no correlation was found between performance and heart rate change as was indicated in the study by Fish (1978). One might speculate that as performance increased under stress so would physiological arousal. In the present study the examination of sex differences in competition being the main focus of the experiment, led to the creation of a larger sample size than was used by Fish (1978). The larger sample size used in the present study allowed the sex differences in the competitive situation to emerge. Female performance increased more than male performance under stress but male heart rate increased more than female heart rate. This sex difference in performance and heart rate under stress may cancel out the possibility of a significant correlation between performance and heart rate change.

Conclusion

This thesis was undertaken with two main goals in mind: to examine possible sex differences in response to a competitive situation and to explore what effects the sex of the competitor has upon an individual in competition.

It was found that males and females did differ in their performance and physiological response to the competition.

These performance and physiological differences were detected in a study by Fish (1978) but did not quite reach the .05 level of significance at that time. By making the analysis of sex differences the main focus of this experiment and increasing the number of subjects for this analysis, the author created a more powerful design in the present thesis which was better equipped to examine this question. Therefore, the findings on sex differences in competition approaching significance in the Fish (1978) study succeeded in becoming significant in the present study. It is also important to note that in the present study eight confederates (four males and four females) were employed to act as competitors rather than one male and one female as in the previously mentioned study (Fish, 1978). This was done to avoid the influence of any unique characteristics of a single confederate upon a subject in competition. An ideal situation would have been to have had a male co-experimenter administering the same experimental procedure to 80 other subjects. The competitive trial would then have consisted of two naive subjects competing either before a male or female experimenter. This would have provided information from two subjects rather than just one for each experimental session and would have allowed examination of the effects of the sex of the experimenter. Actually the use of a number of experimenters would be needed as well as many confederates.

Considering the present finding of no significant effect due to the sex of the confederate one might speculate that the sex of the experimenter would have little effect on an individual in competition. This, however, is a question that future research will have to answer.

The present study did reveal some sex differences in response to a competitive situation. Female performance increased more than male performance under stress. Psysiologically, the heart rate increase for males was found to be significantly greater than for females under stress. These two findings together can be interpreted as an indication of females ability to deal with the demands of the stressful situation in a physiologically more economic way than males.

No sex differences were detected in the cognitive desire to win in the competition. Males rated the competition equally as pleasant or unpleasant as females. These two findings suggest that males and females cognitively respond to competition in the same way. Neither sex liked competition more than the other and the cognitive desire to outperform an opponent and succeed in the competition was the same for males and females.

The fact that no sex differences in competition were found, except for the performance and heart rate differences which favour females, leads to the conclusion that males and

females are equally suited for performing in our competitive society. Females may, however, be at an advantage if they can maintain a low level of physiological arousal while still increasing their performance on other tasks under stress. Future research might try to determine if this theory of economics exists in other stressful situations using different performance and physiological measures.

The second main goal of this experiment, to explore what effects the sex of the competitor had upon an individual in competition, revealed no significant findings. The null hypothesis is therefore not rejected. This means that neither the performance, heart rate, rating of pleasantness, desire to win, nor estimated success on the task were effected by the sex of the competitor an individual faced. The male and female confederates employed in the study were treated equally as threatening competitors. Knowing that the sex of the competitors has a very slight if any effect on a subject's response, researchers in the area will not have to worry about the sex of the individuals they employ as confederates. Beyond the experimental room this may indicate that individuals see males and females both as threatening and real competitors to be treated as such.

It is significant to note that no significant interactions between sex of subject and sex of competitor were found. Whether females or males were facing either male or

female competitors had no statistically detectable effect on the dependent variables. As stated earlier, this has important implications for potential confrontations between and among women and men in competitive areas in our society.

While this study does provide significant information on sex differences in competition and the indication of a healthy relationship between men and women in competition, caution must be exercised when discussing the societal implications of this study. This note of caution is not unique to the present study. Many studies, including the present one, use university students as experimental subjects. This is advantageous to the researcher who can easily find a subject pool in an introductory psychology class. However, in generalizing the conclusions of such studies one must remember that university students are a select group with some characteristics not representative of the general population. The sample used in this study was composed largely of white, middle class Canadian university students 18 to 21 years of age. Therefore, the conclusions discussed in this study are made in reference to this select group. Other experiments using different populations should be done to determine the degree of generalization of the present findings.

The societal implications of this study are also restricted by the specific task at which the subjects competed. This is a restriction that plagues all competition research and

should be kept in mind when attempting to generalize beyond the experimental room.

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List of Appendices

Appendix A

The Digit-Letter Task

0	1	2	3	4	5	6	7	8	9
N	W	X	H	K	L	V	T	A	E

5	1	0	6	6	2	0	6	9	9	2	9	7	5	9	5	3	2	0	5	7	7	3	4
6	9	8	2	6	6	2	2	4	2	4	0	1	5	9	6	7	4	9	0	7	5	8	9
5	0	1	4	9	0	9	6	6	3	3	6	7	4	6	9	0	9	6	3	3	4	8	8
1	9	9	8	0	8	5	2	8	2	6	3	7	2	9	2	9	2	3	6	5	0	2	6
8	6	7	0	0	0	2	2	1	5	0	1	9	3	9	9	5	9	1	6	2	3	7	7
1	3	0	1	3	5	7	4	2	8	3	6	3	6	7	3	0	5	8	8	7	2	2	9
3	7	4	8	3	1	4	4	6	8	0	2	3	7	3	1	2	5	2	9	6	3	6	7
6	2	3	0	4	8	2	9	6	3	8	3	5	2	2	3	8	1	6	6	4	0	9	4

Appendix B

Feelings of Rivalry

How important is it for you to be declared the winner in the upcoming competition?

0 . . . Not at all

1 . . . To a slight degree

2 . . . To a moderate degree

3 . . . To a great degree

Answer ____

Appendix C

Estimated Success

Comparing my performance to my opponent's I think:

0 . . . I did significantly worse than my opponent

1 . . . I did slightly worse than my opponent

2 . . . I did as well as my opponent

3 . . . I did slightly better than my opponent

4 . . . I did significantly better than my opponent

Answer ____

Appendix D

Pleasantness Scale

21

20

19 extremely pleasant

18

17 very pleasant

16

15 pleasant

14

13 slightly pleasant

12

11 neither pleasant nor unpleasant

10

9 slightly unpleasant

8

7 unpleasant

6

5 very unpleasant

4

3 extremely unpleasant

2

1

Appendix E

Experimental Procedure

--greet the subject in the waiting room, introduce yourself and escort subject into the experimental room

--ask the subject to be seated and to make him/herself comfortable

--explain consent form and get subject to sign this form and a list recording his/her participation in the experiment

--explain that a recording of the subject's heart rate will be kept throughout the experiment. Explain that this involves no harm to the subject and that after awhile he/she will probably even forget that his/her heart rate is being recorded. Place the plethysmograph on the index finger of the subject's least preferred hand and inform him/her that the plethysmograph must be kept still if it is to work properly. Encourage the subject to just relax and not worry about anything in the experiment and to ignore any noise outside this room if there is any.

--after attaching the heart rate apparatus turn on the machine and give the following explanation concerning the pleasantness scale:

"Now, make yourself as comfortable as you can and just relax while I explain a few things to you. Throughout the experiment I am going to ask you how pleasant you found something that you just participated in. Posted here (on

subject's right) is a Pleasantness Scale with varying degrees of pleasantness indicated. What I want you to do is give me a number from the Pleasantness Scale that tells me how pleasant or unpleasant you found a certain task. For example, if you found sitting in the waiting room unpleasant you would say seven or if you found it very pleasant you would say seventeen. If you cannot decide if something was pleasant or unpleasant you would say eleven. So that when I ask you how pleasant something was you will give me a number from the scale. The number can vary from 1 to 21. Do you have any questions about this or how to use the scale? Do you understand what I want you to do?"

--encourage questions and answer any that arise

--once this is settled instruct the subject to relax:

"Now you will have a five minute relaxation period. Make yourself as comfortable as possible so that you will be able to stay still during the relaxation period. Any final questions? OK just relax."

--go behind the shelves and start stop watch and mark off relaxation period with event recorder. Remain quiet and hidden from subject's view.

--after five minutes say:

"OK. . . the relaxation period is over. Now I would like you to tell me how pleasant the last few seconds of the relaxation period were using the Pleasantness Scale."

--record the subject's response

--bring out the first digit-letter task (remember special procedure for left handed subjects) and say:

"The is called a digit-letter substitution task. See these boxes at the top. Each box has a number and a letter in it. For each different number, from 0 to 9, there is a different letter (point to the numbers and letters). Down here (point) there are numbers but no letters. What you are to do is put the correct letter in each of the boxes below the numbers. These boxes at the top show which letters go with which numbers. You are to start here (point) and continue across the row and then go on to the next row (point). Fill in the boxes one right after the other and try not to leave any out. Try to work as quickly and as accurately as you can and remember to keep the plethysmograph as still as possible (turn the task face-down). When we are ready to begin I will say. . . turn over you task. . . and you should turn the task over with your free hand. Then I will say. . . ready?. . . and when you are ready to begin doing the task you should say. . . Yes. After you have said yes I will say OK and then I will buzz the buzzer like this (demonstrate). When I buzz the buzzer begin doing the task as quickly and as well as possible. When the time is up I will buzz the buzzer again (demonstrate) and you will have to stop immediately, put your pencil down and turn over

the task. Any questions?"

--answer any questions then say:

"Turn over you task. . . Ready?. . . OK (buzz the buzzer)."

--run the first trial (time one minute on stop watch)

--after trial number one ask:

"How pleasant was doing this task?"

--record answer

--score task, point out errors if any and tell score to the subject

--bring out second digit-letter task and place it face down in front of the subject and say:

"Here is another form of the same task for you to do. You are to do this the same way as the last one. Work as quickly and as accurately as you can. Remember to stop and turn over the task when you hear the second buzzer."

--run the second trial

--after the one minute interval ask:

"How pleasant was doing the task?"

--score, point out any errors, give the subject the score

--bring out the third task and put it face down in front of the subject and say:

"Here is another form of the same task for you to do."

--run the task

--repeat the same procedure until completion of the scoring of the seventh trial on the digit-letter task. Then say:

"Now for the next task you will be competing against another student doing the same task. Excuse me for a moment while I see if the other student is ready."

--leave and return with competitor. Introduce the competitor as an introductory psychology student from another class. Sit confederate in chair opposite the subject and attach the the heart rate apparatus. Explain that both of them have done several digit-letter tasks (the confederate having completed these tasks in another room with another experimenter) and that on the next one they will be competing to see who can correctly complete the most transformations. Explain that they are to do their very best to beat their opponent and be declared the winner at the end of the competition. After the competitive nature is emphasized say:

"You will now be given a one minute relaxation period before the competition. I want you to just sit here and relax. Make yourself as comfortable as possible. You may close your eyes if you wish."

--experimenter stands behind the shelves and times the one minute relaxation

--after the one minute relaxation period is over say:

"The relaxation period is now over."

--ask the subject first then the confederate:

"How pleasant were the last few seconds of this relaxation period?"

--record responses then administer rating scale on feelings of rivalry to both the subject and confederate.
--place two tasks face-down in front of subject and confederate and say:

"Both of you have now performed this task several times. On this next task you are to do another form of the same task now only instead of just doing the task as quickly as you can I want you to try and do it faster than the other person. Therefore I want you to try and do your very best and beat your opponent. After the competition I will declare the winner. Work as quickly and as accurately as you can and try to beat the other person. When the time is up I will buzz the buzzer and you will stop immediately and turn over your task. Are there any questions?"

--answer any questions then run the competition
--after the trial ask each person (the subject first):

"How pleasant was doing this task?"

--distribute the self report rating scale on estimated level of success to the competitor and subject
--score tasks and declare a winner
--thank competitor and ask him/her to return to the other room stating that you will be with him/her in a moment
--debrief the subject in a post-experiment interview:

-what thoughts did you have about the experiment?

-what do you think it was about?

-did you hear anything about it before?

-any ideas or suggestions?

-explain experiment

-can't be in experiment again

-will be credited

-please keep it confidential or it is a waste of time

-ask again- had you heard about it?

-get a verbal commitment to confidentiality

-thanks

Appendix F

Means and Standard Deviations For Raw Scores

GROUP	n	P1		P2		HR1		HR2	
		M	SD	M	SD	M	SD	M	SD
Male Confederate									
Male Subject	20	48.65	5.78	52.40	6.34	80.10	10.27	108.20	20.13
Female Subject	20	54.20	6.14	59.35	5.78	87.75	10.60	107.13	17.13
Female Confederate									
Male Subject	20	48.00	7.52	51.10	7.05	79.85	9.72	104.10	15.39
Female Subject	20	51.90	8.59	56.50	8.60	86.35	12.12	108.75	18.63

		RHR1		RHR2		PPLEAS1		PPLEAS2	
	n	M	SD	M	SD	M	SD	M	SD
Male Confederate									
Male Subject	20	70.70	8.88	74.30	12.36	10.85	2.56	9.45	3.27
Female Subject	20	80.05	9.85	78.45	9.02	12.05	2.60	10.40	2.44
Female Confederate									
Male Subject	20	72.65	10.64	74.05	11.01	12.35	2.56	11.05	4.02
Female Subject	20	79.85	11.66	79.50	10.73	11.05	2.91	9.30	3.18

Appendix F Continued . . .

GROUP	n	RPLEAS1		RPLEAS2		DESIRE		SUCCESS	
		M	SD	M	SD	M	SD	M	SD
Male Confederate									
Male Subject	20	13.25	3.94	11.90	3.38	1.15	.93	1.45	.89
Female Subject	20	13.20	3.14	12.45	2.80	1.00	.65	1.85	.74
Female Confederate									
Male Subject	20	12.45	3.22	11.60	3.42	1.05	.82	1.55	.82
Female Subject	20	14.90	2.67	11.90	3.62	.55	.76	1.80	.83

Code	Variable
P1	Performance score on seventh trial
P2	Performance score on eighth trial
HR1	Heart rate on seventh trial
HR2	Heart rate on eighth trial
RHR1	Heart rate for first relaxation period
RHR2	Heart rate for second relaxation period
PPLEAS1	Pleasantness of seventh trial
PPLEAS2	Pleasantness of eighth trial
RPLEAS1	Pleasantness of first relaxation period
RPLEAS2	Pleasantness of second relaxation period
DESIRE	Desire to win on eighth trial
SUCCESS	Estimated success on eighth trial

Appendix G

Means and Standard Deviations of Dependent Variables

GROUP	n	PΔ		HRΔ		RHRΔ		RPLEASΔ	
		M	SD	M	SD	M	SD	M	SD
Male Confederate									
Male Subject	20	3.75	3.23	28.10	16.12	3.60	9.03	-1.35	4.36
Female Subject	20	5.15	2.64	19.50	9.35	-1.60	4.34	-.75	2.59
Female Confederate									
Male Subject	20	3.10	3.11	24.25	10.11	1.40	8.07	-.85	3.98
Female Subject	20	4.60	3.35	22.40	11.33	-.35	8.54	-3.00	3.21

	n	PPLEASΔ		DESIRE		SUCCESS	
		M	SD	M	SD	M	SD
Male Confederate							
Male Subject	20	-1.40	3.59	1.15	.93	1.45	.89
Female Subject	20	-1.65	3.20	1.00	.65	1.85	.74
Female Confederate							
Male Subject	20	-1.30	4.50	1.05	.82	1.55	.82
Female Subject	20	-1.75	3.24	.55	.76	1.80	.83

Appendix G Continued . . .

Code	Variable
PΔ	Change in performance from trial seven to to trial eight
PHRΔ	Change in heart rate from trial seven to trial eight
RHRΔ	Change in heart rate from first to second relaxation period
RPLEASΔ	Change in pleasantness from first to second relaxation period
PPLEASΔ	Change in pleasantness from trial seven to trial eight
DESIRE	Desire to win on trial eight
SUCCESS	Estimated success on trial eight