THE EFFECTS OF WIN-LOSS RATIO ON PERFORMANCE, AROUSAL AND SATISFACTION

BY

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ABSTRACT

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The purpose of this study was to investigate the effects of different win-loss ratios on performance, arousal and satisfaction.

Hypotheses about performance and arousal scores under various win-loss ratios were generated from the experimental literature. Further hypotheses were developed concerning satisfaction with performance and future predictions of performance. In order to test these hypotheses, seventy male elementary school subjects were divided into five treatment groups. The five different win-loss percents of the treatment groups were W10, W30, W50, W70 and W90. A simple tapping board task was used to stimulate performance in a competitive, physical task. Subjects received ten trials against each of four opponents. Performance and arousal measures were recorded only on the last day of competition. Subjects responded to a satisfaction questionnaire prior to the final set of competitions. Results indicated that

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a) there were no statistically significant differences between win-loss ratio group means for the variable of performance and arousal; b) there was no significant relationship between perceived performance and satisfaction; c) there was a significant relationship between performance and predicted future performance in the thirty percent win condition only; and d) a definite linear trend was observed between win-loss ratio and satisfaction data (i.e. the higher the win ratio, the higher the satisfaction).

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CHAPTER I

INTRODUCTION

Competition in our present educational system takes such various forms as interim reports, contests, class rankings and scholarship awards. Recognition may be formal or informal; competitors may be homogeneous or heterogeneous; the competitive nature of the task may be clearly defined or merely assumed. A student's performance is usually compared to that of his classmates, to a local or national norm, or to his own previous performance. In many instances, competitors are not of the same level of ability. The fact that competitors may be of greater or lesser ability can lead to varied experiences of success and failure.

Educational theorists have often asked the question, "What is the best success/failure environment for students?" The response to this type of question has varied. Some have indicated that it was valuable to have students fail to force them 'to pick up their socks and get going'. Yet it is known that continuous failure results in decreased performance, (Sears, 1932; Zeller, 1950). This has led some theorists to propose that students should not be exposed to high proportions

of failure. Recent studies (Martens, 1972; Church, 1968; Swingle, 1969; Brunning and Metee, 1966), have indicated that subjects who consistently won (i.e. experienced continual success) in a competitive situation performed better than those who consistently lost. They also found that consistent winners performed at lower levels than subjects who won and lost an equal number of competitions.

The answer to the question of which success/failure environment is most suitable for the student's performance should lead to a more stimulating and rewarding educational system. Research is one means of bringing educators closer to the answer of this question and to its ultimate implementation.

Need for the Study

The majority of competition studies have found that competition signficantly affected performance. However, research investigating the effects of competition reported conflicting results. Some studies, (Church, 1962; Church, Millward and Miller, 1963; Wilmore, 1968), report that competition facilitated performance. Conversely, (Whittemore, 1924; Dashiel, 1930; Petrie and Galloway, 1966; Shaw, 1958), others reported negative effects of competition upon performance. Still others, (Strong, 1963; Evans, 1966;

1968), reported that competition had no significant effect upon performance.

Several studies, (Martens, 1972; Church, 1968; Swingle, 1969; Brunning and Metee, 1966), have investigated the effects of competition in various win-loss ratios and have found consistent results. They found that subjects in the fifty percent win condition out performed all other subjects. Although arousal was not measured, Martens' (1972) subjects indicated that the fifty percent win condition was the most challenging and supposedly the most arousal producing.

Where conflicting results were found in competitive literature, the effect of competition upon performance may have been based on another variable. Lazarus, Deese and Osler (1952) suggested that other variable to be arousal. There is evidence to indicate that competition resulted in increased arousal relative to a non-competitive situation. This increase in arousal may have enhanced or disrupted performance. The relationship between arousal and learning is curvilinear (Zajonc, 1965), and there is some evidence that the relationship between arousal and physical performance is also curvilinear (Clifford, 1972; Atkinson and O'Connor, 1966; Bruner, Matter and Papanek,

1965; Yerkes and Dodson, 1908). Extreme arousal may suppress performance (Shaw, 1958; Swingle, 1969; Petrie and Galloway, 1966). It may, however, have no measurable effect at all (Evans, 1966; Church, 1962; Martens, 1969). Increased performance is generally assumed to be a result of increased arousal, but win-loss ratio studies have failed to include measurements of arousal during competition. Thus the need for this study to measure win-loss ratio and performance and to include a measure of arousal during competition.

In this study subjects competed against their peers. Previous studies, (Martens, 1972; Church, 1966; Swingle, 1969; Brunning and Metee, 1966) used adult subjects in very formal laboratory settings. Subjects made appointments for competitions and competed against opponents they didn't know or couldn't see. In this study, an attempt was made to deformalize the experimental setting somewhat by having subjects compete against and view their peers. Subject age was lowered in an attempt to replicate the findings of Martens et. al. (1972) but with a younger age level.

Martens (1972) investigated task satisfaction and opponent satisfaction and found that subjects who won fifty percent of the time were the most satisfied. Locke

(1965) has suggested that satisfaction, or liking for a task, is dependent upon performance. An investigation of the 'best environment' (or best win-loss ratios) for student performance should include a measure of subject satisfaction to be completed. A fixed environment (in terms of win-loss ratio) which stimulates a student to his highest level of performance may also stimulate a high level of satisfaction.

Purpose of the Study

The present study investigated two primary problems, together with two secondary or sub-problems:

1) To determine which win-loss ratio treatment was most beneficial for performance of a motor skill.

2) To determine which win-loss ratio treatment provided the most beneficial level of arousal for performance of a motor skill.

Sub-problems

1) To determine the relationship between perceived performance and satisfaction.

2) To determine the relationship between perceived performance and prediction of future performance.

Research Hypotheses

1) The mean performance score decreases as the win-loss ratio becomes progressively different from unity.

2) The mean arousal score decreases as the win-loss ratio becomes progressively different from unity.

3) There is a positive relationship between ratings of perceived performance and ratings of satisfaction.

4) There is a positive relationship between ratings of perceived performance and ratings of predicted performance.

Definition of Terminology

Competition: That situation in which two individuals attempt to reach a common goal where only one can succeed. Success was determined by some characteristic of one individual's response relative to that of another individual.

In this study, success was dependent upon the score recorded during the tapping game (i.e. one subject won and the other lost).

Arousal: The extent of release of potential energy stored in tissues of an organism, as this is evidenced in the activity of response. A subject's arousal level in this study was operationally defined by absolute pulse and galvanic skin response scores.

Simple Task: The simple task was the standard tapping board and connecting counter. The score was counted by a number of taps that each subject made from the onset of competition until the finish.

Win-loss Ratio: Operationally defined as the number of wins recorded out of ten competitions as opposed to the number of losses.

Perceived Performance Rating: A rating assigned by the subject to his performance on the competitive task. Performance information was given to the subject by the experimenter. This should be distinguished from the subject's actual performance which was recorded by the task counter.

Satisfaction Rating: A rating assigned by the subject which indicated how happy or satisfied he was with his performance.

Predicted Performance Rating: A rating assigned by the subject which indicated how well he thought he would perform in the ensuing competition.

Limitations of the Study

1. There was no pretest administered to determine whether groups were equal. The study relied on the principle that random assignment of subjects equated treatment groups.

2. The amount of practice a subject engaged in outside the treatment sessions could not be controlled. Subjects were asked by the experimenter to refrain from practicing during that time.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter is comprised of related literature derived from four principle sources; studies dealing with the effect of competition upon performance, studies dealing with the effect of win-loss ratio upon performance, studies dealing with the relationship between arousal and win-loss ratio and studies dealing with the effect of win-loss ratio upon satisfaction.

Competition and Performance

In this study, competition was designed to be a one-to-one rivalry. Wankel (1971) defined rivalry as only one facet of competition. The present study was not designed to measure the presence of coaction or audience effects. The review of literature is limited to those studies investigating the effect of one-to-one competition upon performance.

As a result of reviewing the competition literature, it is evident that there is no clear consensus of the effect of competition on performance. One group of researchers found a significant increment in performance (e.g. Church, 1968; Church et. al., 1963; Plunkett, 1967; Wilmore, 1968; Moede, 1924 and Nelson, 1962). While other researchers have found a decrement in performance (e.g. Whittemore, 1924; Petrie and Galloway, 1966 and Shaw, 1958). Still others

have found no significant effect in either direction (e.g. Dashiel, 1930; Hesse, 1955; Evans, 1966; 1968; Wankel, 1971 and Martens and Landers, 1970).

Church (1968) and Church et. al. (1963) found that male students improved their performance on simple discriminative reaction-time tasks as a result of one-to-one competition. Plunkett (1967) found that female college students improved their performance on a tennis reaction-time movement task under similar conditions. Wilmore, using an ergocycle output task, found that male college students significantly improved their performance under the same competitive situation. Again under similar competitive conditions, Moede (1924) found that hand grip scores were improved and Nelson (1962) found endurance increased in an elbow flexion endurance task.

Although the six previously mentioned studies found that competition had a positive effect on performance, other investigators (e.g. Whittemore, 1924; Petrie and Galloway, 1966 and Shaw, 1958) have reported that competition impeded performance. Whittemore (1924) found that college students increased their speed on type setting tasks when competition was introduced. Whittemore attributed this

decrement in performance to a decrease in accuracy. The net result was lower performance scores in the one-to-one competitive situation. Petrie and Galloway (1966) reported that performance on a complex motor task (slot car racing) was adversely affected by competition. The major factor contributing to the competitive decrement was the tendency for operators to run their cars at excessive speeds, thereby increasing the frequency with which cars went off the track. Using a pursuit rotor task, Shaw (1958) also found that one-to-one competition resulted in decreased performance. The heightened arousal associated with the competitive situation appeared to hinder, rather than improve performance.

To add to this discrepancy, other studies (e.g. Dashiel, 1930; Hesse, 1955; Evans, 1966; 1968; Wankel, 1971; and Martens and Landers, 1970) reported that competition neither improved nor hindered performance in any significant manner. The tasks used in these respective studies were cognitive tests such as multiplication analogies and word associations and gross motor tasks such as the long jump, thirty yard dash, reaction time, stabilometer balancing and coincidental timing.

Although, there is lack of agreement with regard to the effect of competition on performance, the following trends seemed to be present.

1) Competition generally facilitated performance on simple motor tasks.

2) Competition tended to facilitate speed of performance at the expense of accuracy when time was an important factor.

3) Performance of more complex motor skills, which required greater degrees of precision and coordination, were not significantly affected by rivalry although examples of both facilitative and detrimental effects were reported.

Performance and Win-Loss Ratio

Four studies have investigated the effect of win-loss ratio on performance. Martens (1972) studied the influence of win-loss ratio on performance, satisfaction and preference for opponents. The subjects won either 10% (W10), 30% (W30), 50% (W50), 70% (W70) or 90% (W90) of their contests against an "informed" opponent. The subjects' performances on a balance maze task were superior in the W50 condition to all other treatment groups. The W90 and W70 conditions were not significantly different from the W30 or W10 conditions. Using conditions of W20, W50 and W80, Church (1968) found that reaction times of subjects in the W20 and W50 conditions to be

significantly superior to those in the W80 condition. Swingle (1969) used a lever pressing task which measured the speed of response of subjects in the W10, W50 and W90 conditions. Swingle added another dimension by placing subjects in a very close race with opponents (high challenge) and a not so close race (low challenge). He reported that the average total speed increased directly with the frequency of winning. Challenge was found to have no effect on the W90 subjects, the W50 subjects responded faster under high challenge and the W10 subjects responded faster under low challenge. In the fourth study, Brunning and Metee (1966) arranged the win-loss ratio to create three conditions. The first condition was to win significantly more often than one's opponent; the second was to win as often as one's opponent; while the third was to win significantly less often than one's opponent. On a reaction time task, the group winning an equal number of contests performed better than either the high-win or low-win groups.

Additional studies which have considered the effect of consistent failure on performance are those of Sears (1932) and Zeller (1950). Sears found that groups who failed consistently did not perform as well as others who experienced success. The poorer performance was interpreted to indicate that subjects suffered from conflicts caused by anticipation of failure. Frequently,

conflicts in subject response lowered performance below what had been expected. Subjects adjusted or modified their method of attack and in doing so created a new choice which further hindered success. Zeller (1950) found that general failure had no more disruptive an effect on an individual's performance than failure generalized from a specific situation. However, he did find that induced failure decreased performance and that induced success increased performance on the task of relearning fifteen semi-nonsense syllables.

Experimental results reported in the literature tend to indicate the following trends:

1) Consistent winners perform significantly better than consistent losers.

2) In competitions where the outcome was continuously in doubt, performances were significantly better than those where consistent winning or losing was experienced.

Arousal and Win-Loss Ratio

The notion of the "neck-in-neck" race and of one runner "breathing down the neck" of the other

suggests that high challenge situations should give rise to improved performances as a direct result of increased arousal. However, the results of studies reported in the literature indicate that arousal and performance have a curvilinear relationship. Clifford (1972) cited numerous studies which demonstrated the curvilinear relationship between arousal and performance (e.g. Atkinson and O'Connor, 1966; Bruner, Matter and Papanek, 1955; and Yerkes and Dodson, 1908). Clifford explained the curvilinear relationship between performance and motivation by adding a further dimension of task difficulty. Clifford concluded that competition resulted in improved performance with simple speed related tasks. For power or complicated problem solving tasks (mathematical or verbal in nature) a one-to-one competitive situation resulted in decreased performance.

Similarly, Lazarus, Deese and Osler (1952) suggested that arousal may have energizing and directive components. The energizing component tended to increase performance output, the directive component tended to protect the self-esteem of the subject. In studies reviewed by Miller (1948) and Wickert (1947), where an improvement in performance was observed, they attributed this improvement to the

energizing aspect of arousal. They found that an increase in arousal resulted in an increase in performance output. This increase in output improved performances in simple speed related tasks but decreased performance in complicated or difficult tasks.

Competition in speed related tasks has been shown to increase performance (Chapman and Feeder, 1917; Clayton, 1964; Clifford, 1971; Harlock, 1927; and Muller, 1929). These studies used simple tasks, such as movement time, reaction time and a wall volley test. Conversely, others (Petrie and Galloway, 1966; Shaw, 1958; and Swingle, 1969) have found that a competitive situation resulted in decreased performance for more difficult and complex motor performance tasks.

Petrie and Galloway (1966) found that the introduction of increased arousal through the use of a competitive situation had a very marked, detrimental effect upon slot car racing. Operating slot cars at a high speed is a difficult and precise task. Petrie attributed the decrease in performance to basically one item. Subjects tended to increase speed around the track and this resulted in more instances of cars going off the track.

Shaw (1958) concluded that competition resulted in decreased performance because it aroused a stronger desire to achieve, which, rather than improving performance, actually interfered with it. On tasks which utilized a perceptual motor skill, increased arousal was detrimental to performance. Emotional factors seemed to be involved in several ways. In competitive and individual situations, responsibility for poor performance could not easily be shifted to another person. Shaw suggested this probably resulted in a condition which was threatening to the subject's self-esteem. In the competitive situation there existed an additional threat in the form of the competitor which resulted in the competitive situation being relatively more stressful. Stress usually produced a decrement in performance as measured by accuracy scores. Stronger arousal led to increased efforts but less than perfect performance. Frustration initiated responses inappropriate to the task which interfered with the task relevant responses.

Lazarus, Deese and Osler (1952) considered decrements in performance to be a result of the energizing aspects of arousal. A number of studies were reported in which increased arousal resulted in decreased performance (Lindsley, 1946; Lazarus and Eriksen, 1952; Patrick, 1934; and Rosenweig, 1944). The varying studies

offered different reasons for explaining this effect. In general, Lazarus felt that increased arousal resulted in an increase in the speed of performance as well as an increase in the number of errors. He suggested that a considerable portion of the decrements in performance reported in other studies have been due to an increase in performance output.

Lazarus and Eriksen (1952) suggested an additional way in which arousal produced a decrement in performance. They suggested that reactions to frustration or failure may be "need-persistent" or "ego-defensive". Need-persistent meant that the individual centered his efforts upon the frustrated need, and ego-defensive meant that the individual was primarily concerned with the maintenance of self-esteem. The ego-defence resulted in a decrement in performance because the subject found the competition threatening. It also led to complete withdrawal from the competitive situation in order that the subject could justify his failure on the grounds that he really didn't try. Further, the subject could be aroused to the point that the autonomic overflow in strong emotional situations made physical performance difficult or impossible.

Another group of researchers, (Evans, 1966; 1968; Church, 1962 and Martens, 1969) have reported no distinct effect of arousal on performance. In these studies

physiological measures of heart rate and/or palmar skin sweating were taken but no significant correlation between the measures was found. Evans (1968) explained the result as follows:

> "The occurrence of the inverted 'u' phenomenom makes it difficult to demonstrate the effects of increased arousal on performance. Furthermore, it may be that the inverted 'u' phenomenom was responsible for the lack of correlation between activation and performance. As activation increased some subjects' performance improved and some subjects' performance deteriorated, negating any overall group correlations." (p. 142)

Although results conflict with respect to the effect of arousal on performance, general tendencies are evident as follows:

1) On simple tasks increased arousal tended to increase performance.

2) On difficult or precision tasks increased arousal tended to increase output but decrease the quality of performance.

The validity of the majority of measures of arousal have been shown to be suspect, at best. Duffy (1966) suggested that if it was desired to measure the intensity of arousal, the measurement should be made from the physiological process involved, e.g. palmar skin sweating,

palmar skin conductance, heart rate. Research varied, however, as to which method was best suited for measuring arousal.

Martens and Landers (1970) used palmar sweating and heart rate and found a curvilinear relationship to tracking performance as the arousal theory predicted.

Evans (1966) found no significant difference in either reaction time or heart rate scores for competitive and non-competitive test conditions. He also found that significant correlations did not exist between the measures. In a later study (1968) Evans found that heart rate was significantly higher for rivalry than for non-rivalry conditions.

Church (1962) found that competition had a significant effect upon palmar skin conductance. Similarly Martens (1969) found that competition with an added audience effect significantly increased palmar sweating.

Wankel (1971) found that heart rate for all rivalry conditions increased more than those of non-rivalry conditions. Audience effect did not have a significant effect upon heart rate.

In summary, arousal intensity appeared to be an important dimension which influenced performance. The use of physiological measurements to determine the intensity of arousal was accepted for this study. It was felt desirable to derive as much information as possible about the arousal strength of each competitive treatment. Measures of galvanic skin response and heart (pulse) rate appeared to be the measures most widely accepted as physiological indicators of the intensity of arousal and thus the best techniques available at the time.

Satisfaction and Win-Loss Ratio

Experiments directly related to win-loss ratio and satisfaction are limited. Early satisfaction research concentrated on satisfaction in job situations. Herzberg et. al. (1959) found that for engineers and accountants the major (reported) determinant of liking for or satisfaction with the job was the feeling of achievement in one's work. Achievement was defined as success at some aspect of the work. More recently Myers (1964) replicated these findings with employees working at five different types of jobs.

In addition, Mace (1935) found that subjects who liked an arithmetic task the least did more poorly on it than those who liked it the most. Gebhard (1948) found that subjects increased their liking for tasks on which they had experienced success or on which they expected to experience success in the future. Similarly Locke (1965) reported four laboratory experiments which examined the relationship between degree of task success and degree of liking for and satisfaction with the task. A number of different tasks, measures and situations were used. In all cases, there was clear evidence for significant positive linear relationships between success and measures of liking and satisfaction. He also suggested that task satisfaction was (among other things) a result of task performance, though the degree to which it functioned as an independent variable was not determined.

Martens (1972) studied various success-failure (win-loss) ratios and found that task satisfaction and opponent satisfaction were greatest at the W50 condition. He hypothesized that as the win percentage increased, the task satisfaction would also increase. The results indicated, however, that although it was important to win it was equally important to defeat someone who had high incentive motivation. The satisfaction was higher

in conditions where the percentage of wins equalled the percentage of losses (W50).

Trends in the literature tend to indicate that:

1) The amount of satisfaction is dependent upon the amount of success experienced. Success is most frequently determined by performance and achievement.

2) As the success at a task increased so did the amount of satisfaction.

3) In certain instances where there was no clear winner or loser, satisfaction was at its greatest.

CHAPTER III

RESEARCH METHODS

The primary purposes of this study were to determine which win-loss ratio, if any, was most beneficial for performance of a motor skill and which win-loss ratio, if any, provided the most beneficial level of arousal for performance of a motor skill. The two sub-problems under investigation were; does a relationship exist between a performance rating and a satisfaction rating and does a relationship exist between a performance rating and a predictive performance rating.

The Subjects

The sample of seventy elementary school males was drawn from Sir Winston Churchill Public School in the Parkwood Hills area of Nepean Township. Parkwood Hills is a residential area located close to Ottawa, Ontario. The subjects ranged in age from 11 to 13 years (grades seven and eight). Random sampling was used. Subjects were drawn from the total senior elementary male population of 150. Subjects were not familiar with the task.

All subjects completed the pre-experimental sessions but one subject was not available for the experimental session.

Apparatus and Equipment

The Tapping Board:

The competitive task was a speed measurement apparatus which consisted of a combination electrical console, connecting counter and tapping board. The electrical console consisted of a cord and plug which connected to a 110 DC bolt outlet, a 4" by 4" counter with a maximum of four digits and two metal poles on the counter. One of these poles connected to the tapping board consisted of a piece of wood 10" x 3" x 1/2" and two metal plates, 3" x 3", fixed at each end. The metal plates were wired such that they connected to the second metal post of the electrical console. With the console switch in the 'on' position, contact of the metal tip of the stylus to the metal plate on the board would result in initiation of the counter (Figure 1). An additional piece of wood was placed perpendicularly across the tapping board. This structure was 3 1/2" x 2 1/2" x 1 1/2" and made it necessary that subjects used an arm lifting action rather than a wrist action. The board was positioned

at the edge of a table 30" high. Two identical sets of apparatus were used in the experiment. Both were positioned on the same table and separated by a 2' x 2' x 6" partition. This partition prevented subjects from viewing the actual performance of the other person (Figure 1 A,B,C).

Lafayette Polygraph:

The measurements of arousal were obtained with a lafayette, four channel polygraph, the 76114 four channel datagraph model F. The four channels accommodated four sets of electrodes (2 per subject). The electrodes were GSR silver metal electrodes, model 76602 and the E4 Photo-electric Plethysmograph leads. The plethysmograph leads measured the pulse of the subject through the optical density of the finger. The GSR silver metal electrodes measured the galvanic skin response of the subject. The signals were recorded by four pneumatic recording pens (2 per subject, 1 GSR, 1 pulse) on data-graph paper. The polygraph and amplifiers were located on the same table as the tapping boards.

Satisfaction Scales:

The satisfaction scale consisted of three questions. In the first question, the subject rated how he felt he had performed in the previous competitions. The second

FIGURE I

SUBJECTS AT THE TAPPING BOARD TASK

A)

B)

FIGURE I

(Continued)

C)

D)

question required the subject to rate how happy he was with his performance in the previous competitions. The final question asked the subject to rate how he thought he would do on the final set of competitions.

Competition Counter:

During each session, a track and field lap counter (Figure I A and B, in centre top of photograph) recorded the number of wins by each subject. The lap counter ranged in numbers from one to nine on both sides with one side assigned to each competitor. The experimenter declared a winner by verbally indicating the number of taps recorded by each subject. The winners side of the counter was then increased by one. Should the competitors have been allotted to the W90 and W10 conditions, at the end of the session one side of the counter would have read 9, the other side 1. The counter was located 5' above the ground, 2' above the competitors and clearly visible to both.

Procedure

Subjects were contacted the last teaching day previous to the beginning of the study. At that time

the experimenter explained that a number of males would be selected from the class to compete in a new game. The experimenter explained that his purpose in being at the school was to see how male students reacted to the new game.

Subjects competed against an opponent with the outcome of each contest controlled by the experimenter. Subjects won or lost according to a pre-determined win-loss ratio. Subjects were randomly assigned to one of five treatment groups. The five different win levels were 10%, 30%, 50%, 70% and 90% (W10, W30, W50, W70 and W90). The opponents were other students known to the competitor. A subject in the W10 condition competed against a subject in the W90 condition. Similarly a subject in the W30 condition competed against a subject in the W70 condition. Subjects in the W50 condition competed against each other. The experimenter was an adult male. The testing period was from Tuesday through Friday of one week. The time of day for each session was consistent over the four testing days to within two hours.

The sequence of treatments was developed so that subjects would compete against a different opponent

each day. The sequence was arranged as in Table I and subjects in the left hand columns rotated one position in each successive treatment. Subjects competed against four opponents in four separate experimental sessions. Ten contests were held in each session.

The first, second and third sessions were termed treatment or pre-experimental sessions. In these sessions, two subjects were obtained by name from their classrooms and asked to go to the competition room. After the experimenter introduced himself, he explained that subjects would compete four times, once that day and on the next three days. The experimenter then demonstrated how the tapping game was played and read the tapping game instructions (Appendix A). These instructions were posted on the partition separating the subjects. The subjects were instructed to sit at the edge of the table and grasp the stylus with their dominant or writing hand. Subjects then maneuvered the stylus in a side-to-side fashion attempting to contact the metal plates as many times as possible in a 20 second span. The experimenter started the timer and tapping board counter on the command "go". The timer sounded when the interval was finished and the experimenter switched the electrical counter to "off". Subject score was the total number of taps recorded. The electrical timer and counter

TABLE I

SCHEDULE OF COMPETITIONS FOR WIN-LOSS GROUPS

Day 1

W10+(W30)	vs.	W90+(W70) (Same for W30	vs.	W70)
S1		S1		
S2		S2		
-		-		
-		-		
-		-		
S13		S13		
S14		S14		

W50	vs.	W50
S1		S1
S2		S2
-		-
-		-
S6		S6
S7		S7

Day 2

W10+(W30)	vs.	W90+(W70)	W50	vs.	W50
S2		S1	S2		S1
S3		S2	S3		S2
-		-	-		-
-		-	-		-
S14		S13	S7		S6
S1		S14	S1		S7

Day 3

W10+(W30)	vs.	W90+(W70)	W50	vs.	W50
S3		S1	S3		S1
S4		S2	S4		S2
-		-	-		-
-		-	-		-
S14		S12	S7		S5
S1		S13	S1		S6
S2		S14	S2		S7

Day 4

Continued the rotation one more.

were positioned so they were not visible to the subjects. Subjects completed 5 practice trials and then 10 experimental trials against their opponents. Subjects were then reminded that they would compete the following day.

In the next three sessions, the subjects competed against three different opponents. The experimenter controlled the win-loss ratio so that subjects won according to a fixed schedule (Appendix B) and according to the grouping to which subjects had been randomly assigned. This was accomplished by the experimenter giving incorrect information to the subject about the opponent's score or number of taps. The experimenter verbally indicated the subject's score and attempted to keep it as close to the real score as possible. The differences between scores were not varied systematically but the opponent's score was always 1 to 10 percent below or above the subject's score.

The experimental session was conducted on the fourth day of competition. All other conditions remained the same except that subject's arousal and performance levels were recorded. The arousal level was recorded through the use of the Lafayette Polygraph. The subjects were instructed to be seated and to remain as quiet as possible for four minutes. During this time 2 sets of G.S.R. electrodes were attached to the first two fingers of

subjects' non-dominant hand. The Plethysmograph leads were attached to the fourth finger of that same hand. As the lead was photo-electric in nature, it required that the entire non-dominant hand be placed in a black, light-proof mitten. The subjects were instructed to place the covered hand across their laps with the palm facing up and to keep it as still as possible. During the remaining time, the G.S.R. was tuned to the skin response sensitivity of the subject and a pre-competition level was recorded. The pulse measurement was sensitized to the strength of the signal from the subject and a pre-competition level was recorded. The responses of subjects previous to, and during competition were recorded simultaneously (Figure I, A and D). The chart speed of the recorder was set at three inches per minute. Subject competition arousal level was obtained by averaging ten measurements spaced equally through the competition for the G.S.R. and measurements of sixty second duration for pulse rate. The performance was recorded throughout the ten competitions. Immediately prior to the final experimental session subjects completed a satisfaction scale (Appendix C). Subjects were asked to respond to the three questions on the scale and to explain why they responded the way they did.

After all subjects had undergone the final experimental session, they were informed as to the deceptive nature of the study.

Treatment of Data

a) Hypothesis One:

The mean performance score decreases as the win-loss ratio becomes progressively different from unity. A one way analysis of variance (Keith, 1972) was employed to determine whether significant differences existed between group means of the performance variable. Significance was tested at the .01 level. All calculations were computed on A.P.L.

b) Hypothesis Two:

The mean arousal score decreases as the win-loss ratio becomes progressively different from unity. A one way analysis of variance was calculated to test for significance at the .01 level on both absolute pulse and galvanic skin response group means.

Sub-Problems

c) Hypotheses Three and Four:

i) There is a positive relationship between ratings of perceived performance and ratings of satisfaction.

ii) There is a positive relationship between ratings of perceived performance and ratings of predicted performance. Pearson Product Correlations were estimated to indicate relationships between; (a) perceived performance and satisfaction, (b) perceived performance and predicted performance.

CHAPTER IV

RESULTS

Results pertaining to the four hypotheses under investigation will be presented in this chapter.

Hypothesis One:

The mean performance score decreases as the win-loss ratio becomes progressively different from unity.

Table 2 represents the performance means and standard deviations for the five win-loss ratio treatment conditions. The highest mean performance was found in the W50 condition (58.31) and the lowest in the W10 condition (56.67).

TABLE 2

PERFORMANCE MEANS AND STANDARD DEVIATIONS
FOR THE FIVE WIN-LOSS RATIO CONDITIONS

Win-Loss Ratio	W10	W30	W50	W70	W90
Mean	56.67	58.30	58.31	58.23	57.86
Standard Deviation	9.18	5.39	8.96	8.12	6.45

Figure 2 represents the mean performance trend as groups move from low win ratio to high win ratio.

FIGURE 2

GRAPH OF MEAN PERFORMANCE SCORES OVER TEN TRIALS
FOR THE FIVE WIN-LOSS RATIO TREATMENT
CONDITIONS

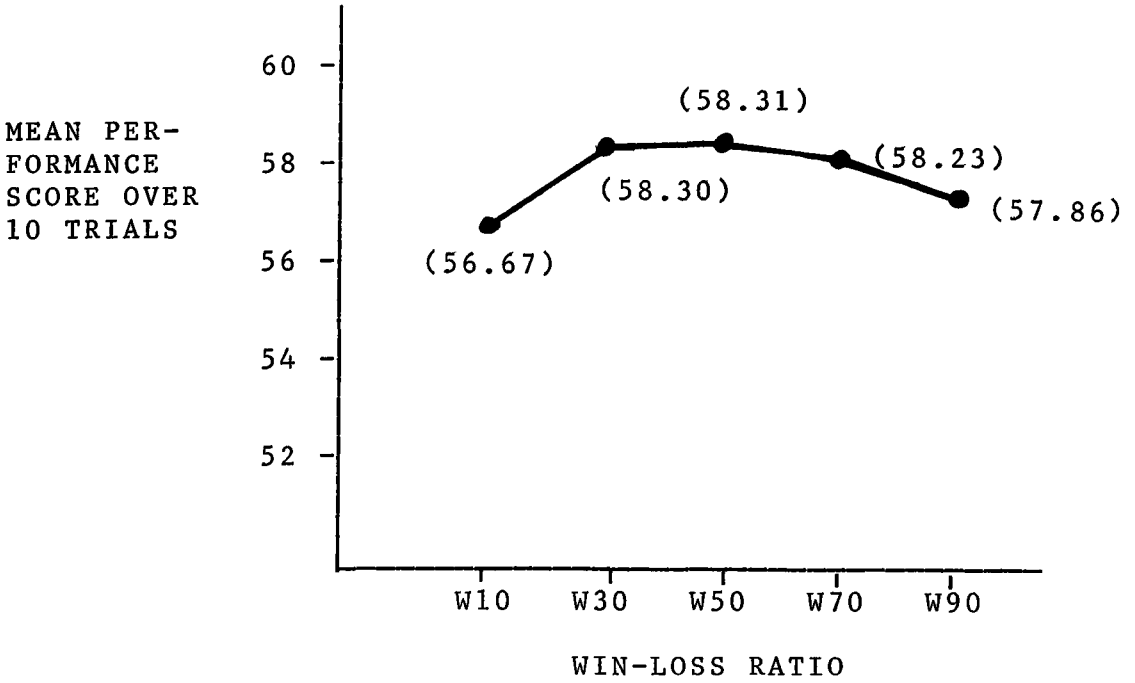


Table 3 presents the one way analysis of variance computed for the performance scores of the five win-loss ratio treatment conditions. Significant differences were not noted for the variable of performance.

TABLE 3

A ONE WAY ANALYSIS OF VARIANCE FOR THE PERFORMANCE SCORES OF THE FIVE WIN-LOSS RATIO CONDITIONS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between	4	2918.94	729.40	.12
Within	65	421611.00	6486.32	
Error	69	424529.94		

Alpha level required for significance at .01 level is 3.65 with 4, 65, df.

Hypothesis one was rejected.

Hypothesis Two:

The mean arousal score decreases as the win-loss ratio becomes progressively different from unit.

Table 4 presents the arousal means (pulse rate) and standard deviations of these scores for the five win-loss ratio treatment conditions. The highest arousal score was found in the W10 condition (131.9 beats per minute), the lowest in the W70 condition (118.4 beats per minute).

TABLE 4

AROUSAL MEANS (PULSE RATE) AND STANDARD DEVIATIONS FOR THE FIVE WIN-LOSS RATIO CONDITIONS

Win-Loss Ratio	W10	W30	W50	W70	W90
Mean	131.86	129.08	121.43	118.43	128.71
Standard Deviation	16.89	20.69	17.39	17.46	17.03

Figure 3 indicates the mean pulse rate scores as the five win-loss ratio groups underwent their series of ten competitions. Five separate measurements were taken in one minute intervals. The graph is plotted from means presented in Appendix D, P89. The lowest mean score was recorded in measurement number 2 in the W70 condition (114.0 beats per minute), and the highest in measurement number 5 in the W10 condition (134.7 beats per minute).

FIGURE 3

GRAPH OF MEAN PULSE SCORES RECORDED AT FIVE SEPARATE INTERVALS ACROSS THE FIVE WIN-LOSS RATIO TREATMENTS DURING COMPETITION

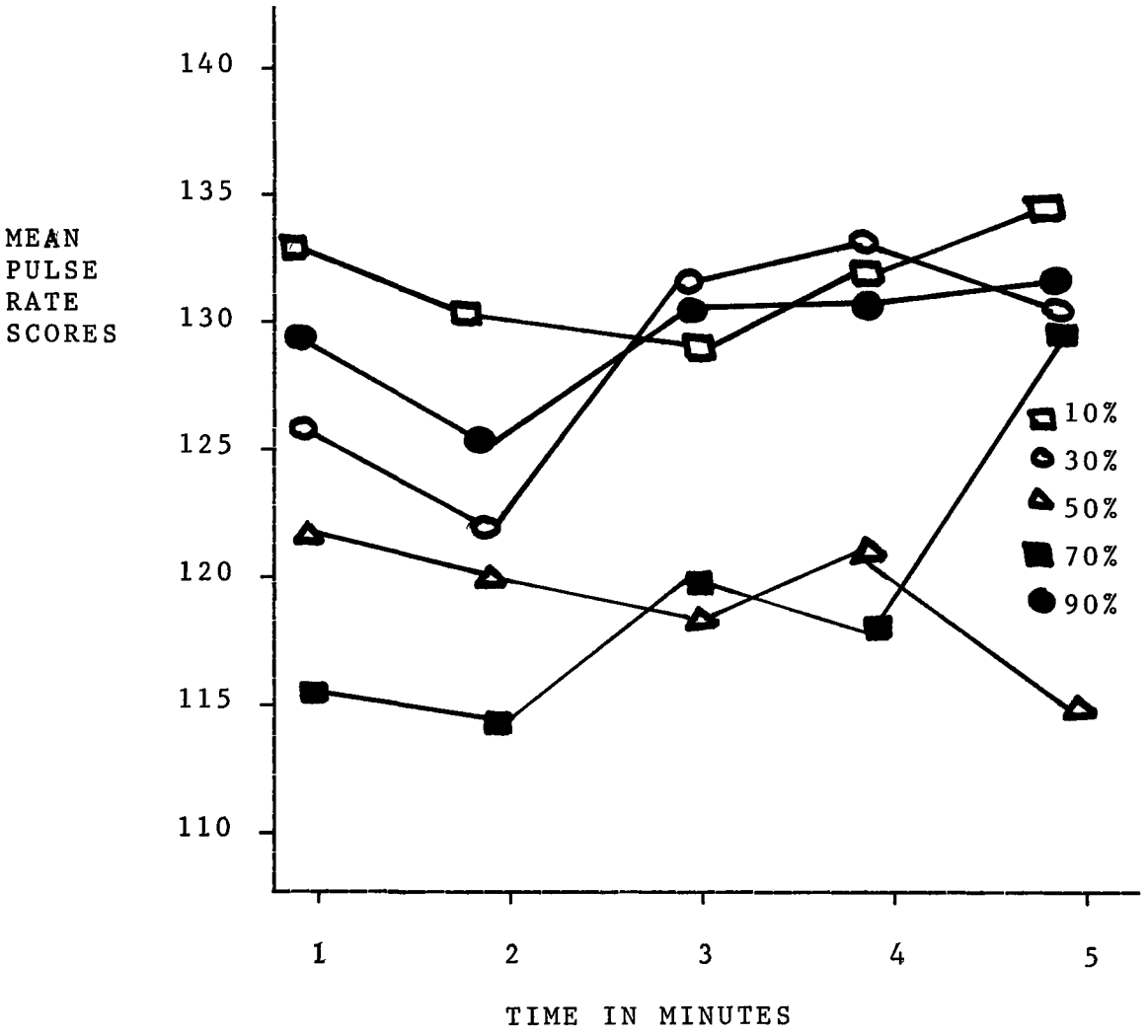


Table 5 presents the one way analysis of variance computed for the pulse rate scores of the five win-loss ratio conditions. Significant differences were not noted for this variable of arousal.

TABLE 5

A ONE WAY ANALYSIS OF VARIANCE FOR THE AROUSAL SCORES (PULSE RATE) OF THE FIVE WIN-LOSS RATIO CONDITIONS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between	4	1800.20	450.05	1.30
Within	65	22116.35	345.57	
Error	69	23916.55		

Alpha level required for significance at the .01 level is 3.65 with 4, 65, df.

Table 6 presents the arousal means (galvanic skin response) and standard deviations of these scores for various win-loss ratio conditions. The highest mean score was found in the W90 condition (180.10) and the lowest in the W50 condition (77.14).

TABLE 6

AROUSAL MEANS (GALVANIC SKIN RESPONSE) AND STANDARD DEVIATIONS FOR THE FIVE WIN-LOSS RATIO CONDITIONS

Win-Loss Ratio	W10	W30	W50	W70	W90
Mean	90.97	97.95	77.14	103.62	108.07
Standard Deviation	33.27	20.22	18.88	31.51	41.58

Figure 4 presents the mean arousal (G.S.R.) scores as the five win-loss ratio groups underwent their series of ten competitions. Ten separate measurements were taken at thirty second intervals. The graph is plotted from means presented in Appendix D, page 95. The lowest mean score was recorded in measurement number 4 in the W50 condition (74.7), and the highest in measurement number 7 in the W90 condition (111.9).

FIGURE 4

GRAPH OF MEAN GALVANIC SKIN RESPONSE SCORES AT TEN SEPARATE INTERVALS ACROSS THE FIVE WIN-LOSS RATIO TREATMENTS DURING COMPETITION

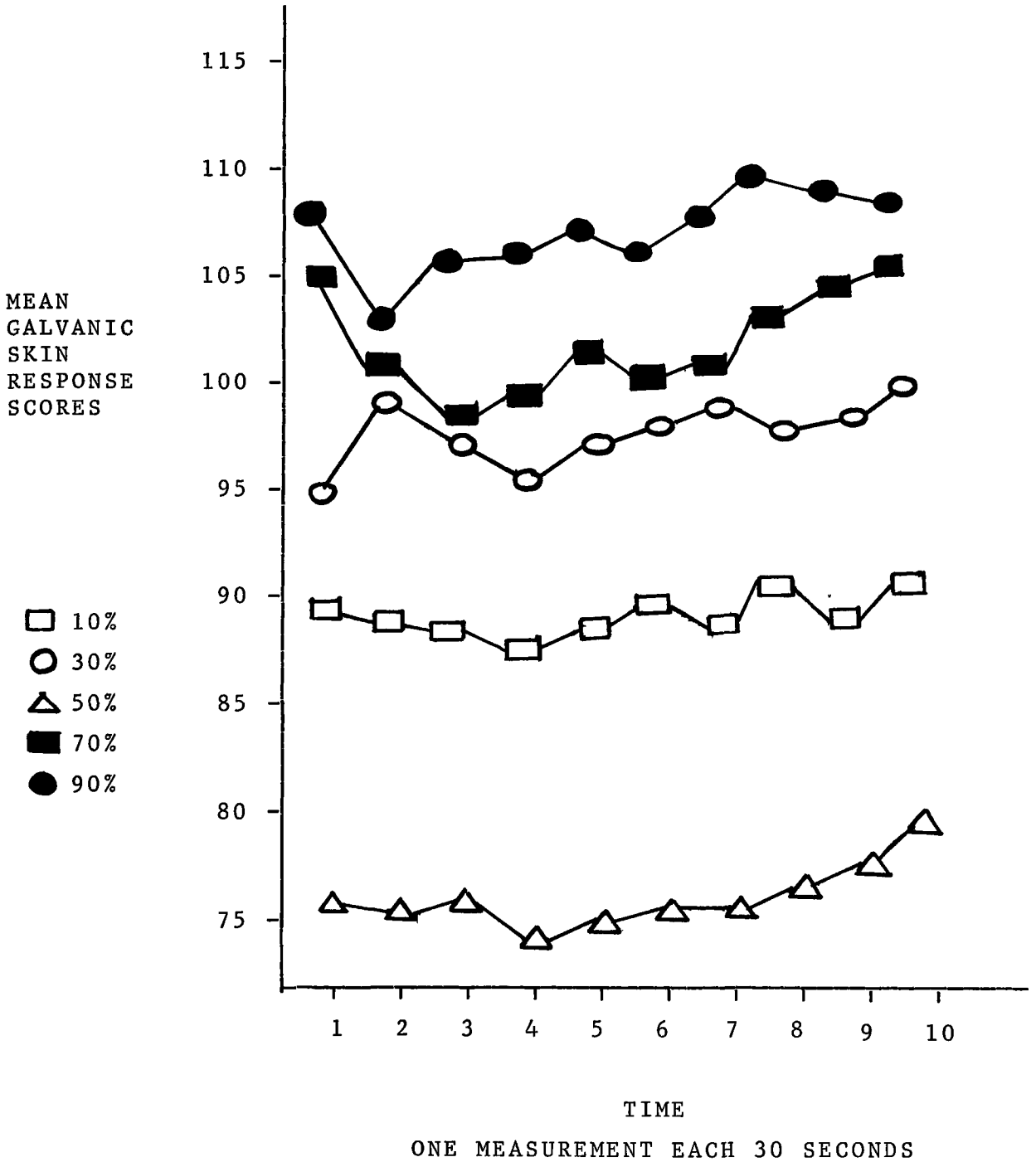


Table 7 presents the one way analysis of variance computed for the galvanic skin response scores of the five win-loss ratio groups. Significant differences were not noted for the arousal variable of galvanic skin response.

TABLE 7

A ONE WAY ANALYSIS OF VARIANCE FOR THE AROUSAL SCORES (GALVANIC SKIN RESPONSE) OF THE FIVE WIN-LOSS RATIOS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between	4	8234.89	2058.72	2.062
Within	64	63909.95	998.59	
Error	69	72144.84		

Alpha level required for significance at the .01 level is 3.65 with 4, 65, df.

Hypothesis two was rejected for both pulse rate and galvanic skin response arousal scores.

Sub-Problems

Hypothesis Three:

There is a positive relationship between ratings of perceived performance and ratings of satisfaction.

Table 8 presents the correlation coefficients for the perceived performance rating and the satisfaction rating for the five win-loss ratio groups.

TABLE 8

CORRELATION COEFFICIENTS FOR PERCEIVED PERFORMANCE AND SATISFACTION FOR THE FIVE WIN-LOSS RATIO CONDITIONS

Win-Loss Ratio	W10	W30	W50	W70	W90
Correlation Coefficients	.1289	.1777	.4065	.1126	.1090

The relationship between perceived performance and satisfaction was seen to vary from a low of .1090 (W90) to a high of .4065 (W50). As noted, the highest correlation was found for the W50 group (.4065) and this accounts for only 16% of the variability, which suggested there was little relationship between the two measures for any combination of win-loss ratios.

Figure 5 presents the mean perceived performance trend from low win ratio to high win ratio.

FIGURE 5

GRAPH OF MEAN PERCEIVED PERFORMANCE RESPONSE FOR THE FIVE WIN-LOSS RATIO CONDITIONS

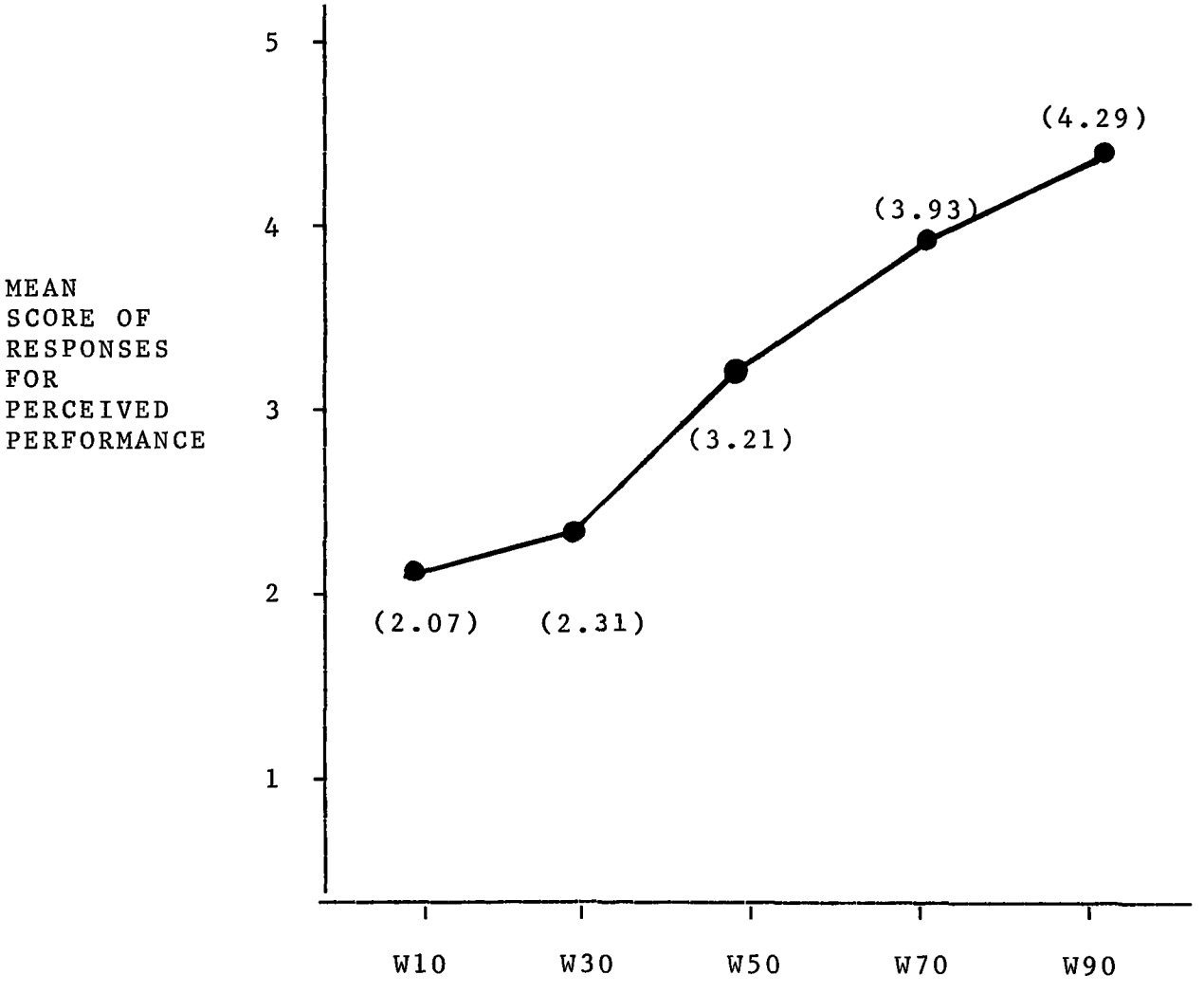
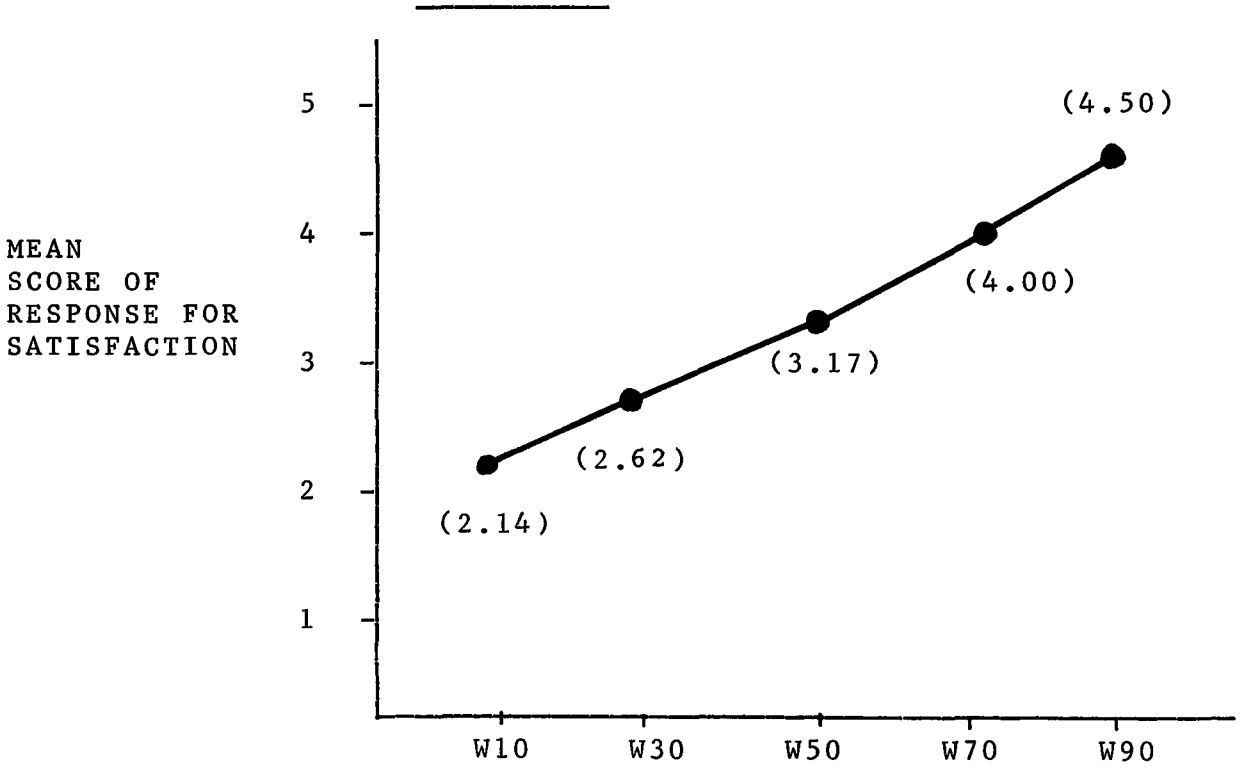


Figure 6 presents the mean satisfaction trend from low win ratio to high win ratio.

FIGURE 6

GRAPH OF MEAN SATISFACTION RESPONSE FOR THE FIVE WIN-LOSS RATIO CONDITIONS



Hypothesis Four:

There is a positive relationship between ratings of perceived performance and ratings of predicted performance.

Table 9 presents the correlation coefficients for perceived performance and predicted performance of the five win-loss ratio groups.

TABLE 9

CORRELATION COEFFICIENTS FOR PERCEIVED PERFORMANCE AND PREDICTED PERFORMANCE OF THE FIVE WIN-LOSS RATIOS

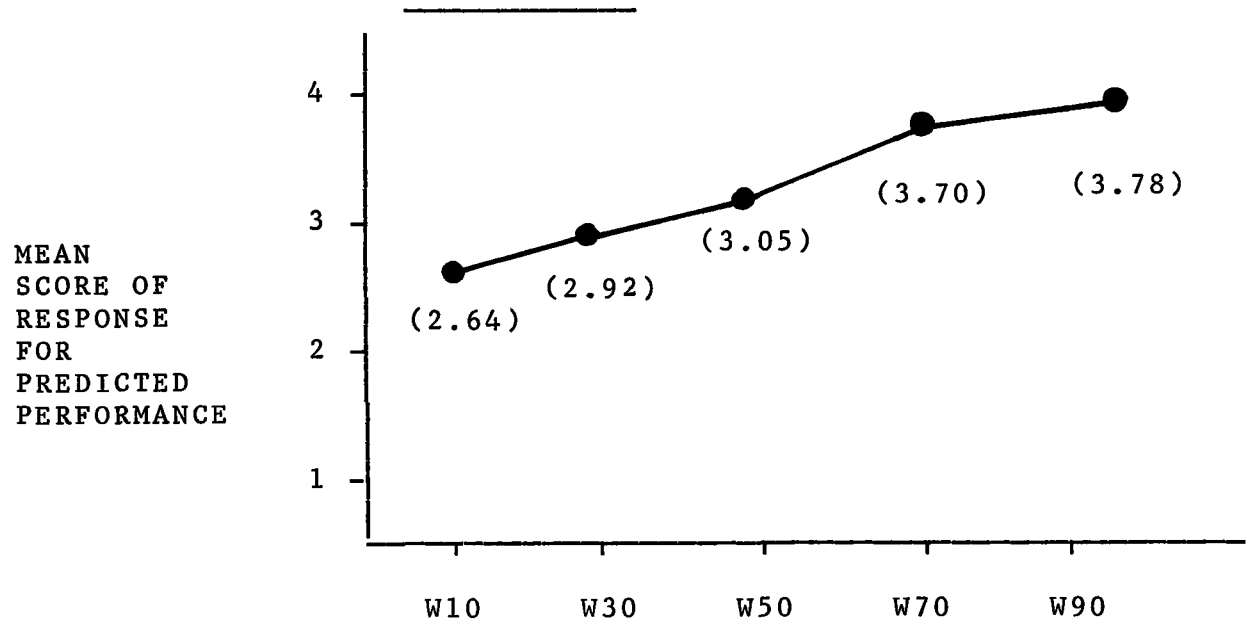
Win-Loss Ratio	W10	W30	W50	W70	W90
Correlation Coefficients	.4479	.8116	.1741	.1946	.2989

The relationship between perceived performance and predicted performance is seen to vary from a low of .1741 (W50) to a high of .8116 (W30). As noted the highest correlation is found in the W30 group (.8116) and accounts for 64% of the variability. This suggests commonalty between the two variables in the W30 condition but little relationship between the two measures for any other combination of win-loss ratios.

Figure 7 represents the mean predicted performance trend from low win ratio to high win ratio.

FIGURE 7

GRAPH OF MEAN PREDICTED PERFORMANCE RESPONSE FOR THE FIVE WIN-LOSS RATIO CONDITIONS



Hypothesis four was accepted for the thirty percent (W30) win condition only. The hypothesis was rejected for all other win conditions.

After examination of the satisfaction graphs (figures 5, 6 and 7), it was felt desirable to extend the analysis due to the seemingly clear positive linear relationship between win-loss ratio and the satisfaction data. The following question was raised, "Do the group satisfaction

means increase significantly in a linear fashion with increases in the win-loss ratio treatment variable?"

A number of non-parametric tests for linearity were considered but did not prove feasible due to the nature of the data and the structure of the experiment.

CHAPTER V

DISCUSSION OF THE RESULTS

Hypothesis One:

The results of this study do not support the hypothesis that the mean performance score decreases as the win-loss ratio becomes progressively different from unity, and thus differ from the results of Martens (1972), Church (1968), Swingle (1969) and Brunning and Metee (1966). The above studies reported significant differences in performance for the W50 condition over all other groups. Performances were superior at the .05 level.

Subject age may explain the largest part of the difference in the findings of this study compared to others. In previous studies subjects were of college age. In this study subject age ranged from eleven to thirteen. This difference in age may also represent a difference in attitude towards competition. Martens (1972) explained his results by indicating that for his subjects, winning was important, but it was also important to defeat someone of equal ability or someone with incentive value. In the written response to the satisfaction questionnaire administered in this study (Appendix C), subjects' performance rating most frequently depended upon winning or losing (58%).

Only 12% specifically mentioned that their satisfaction decreased because of the magnitude by which they won or lost. Where Martens' subjects tended to value only very close or very difficult wins, subjects in this study were not as discriminative. This would tend to suggest that as we mature, we redefine or refine our competitive goals. When 12 or 13 years old "winning at all costs" or winning on the scoreboard may better describe the primary goal of one-on-one competition. In later years winning may be important, but the victory must also be over someone of equal ability.

The experimental environment of the study may also account for the difference in findings. The subjects performed against recognized and known competitors (i.e. peers), which may have affected subject performance. Having previous knowledge and preconceived notions about each new competitor, the subjects may have been stimulated to a performance which negated overall treatment effects. In previous studies subjects were not familiar with opponents (Martens, 1972; Church, 1968, Swingle, 1969; Brunning and Metee, 1966). In this study, as the competitor met and recognized each new challenger, additional incentive may have been generated.

Another possibility which may account for the difference in results is the length of time taken to conduct the study. Three treatment sessions and one experimental session was initially deemed to be an acceptable period of time. With the deceptive nature of the study, prolonged administration of treatment sessions ran the risk of discovery. At the conclusion of the study, subjects were informed of the deception and when questioned as to whether they suspected any manipulation, 7% indicated they felt something was wrong, but not specifically that the competitions were fixed. This information was given three days later than anticipated as subjects were absent day four. Three days of rest (Friday, Saturday and Sunday) were unavoidable. This had negligible statistical bearing on the results, however, as subjects were from the W30, W50 and W70 treatment conditions. Slight differences can be seen between groups and perhaps with a longer treatment period these differences might have been increased.

A number of reactions were observed by the experimenter after subjects were notified of the nature of the deception. One subject was particularly crestfallen at finding he was not truly a "winner". In other instances, subjects seemed relieved to know they had not performed as poorly as they had thought. These reactions bring to consideration

various ethical questions about experimenting 'with' subjects. Should future investigation desire to continue along this line, it might be suggested that researchers move into the field to find groups with the desired win-loss ratios. This action should remove most ethical concerns.

The difference in expected results might also be explained by the suitability of the task. The tapping task was first deemed a very appropriate task in that a great deal of learning or improvement did not take place from one session to the next. Subjects improved their performance but this improvement was limited. The task required a neurological response and this limiting factor was deemed acceptable. This meant that any changes that occurred in the performance variable would have been strictly due to the treatment conditions. The task provided differentiation between subjects but in retrospect this variability may not have been large enough to allow for significant differences in performance between treatment groups.

Hypothesis Two:

The results of this study do not support the hypothesis that the mean arousal score decreases as the

win-loss ratio becomes progressively different from unity. Results from previous win-loss ratio studies are difficult to compare as arousal was not measured. Previous studies (Martens, 1972; Church, 1968; Swingle, 1969), however, do suggest that the W50 condition presented the most beneficial level of arousal due to the closeness of competition.

Subject age may again explain the difference in expected results. Although not significantly different, mean galvanic skin response scores (figure 4) increased proportionately to increases in the percentage of wins. However, the W50 condition contradicted this trend. If winning was of key importance to subjects of this age, the W50 group may then record the lowest measurement of arousal as no clear winner or loser was defined. The results of this study suggested that it is more arousal producing to lose than to tie. Extensive losing (W10) would seem to be more arousal-producing than having no defined winner or loser.

As was the case with Swingle (1969), all subjects in this study won or lost by a very small margin. Although the amounts were not varied systematically, subjects did not lose by more than 10% of their total score. A subject

might have lost nine out of ten competitions during one session yet in each individual competition was very close to winning. With continually being close, there was the distinct possibility that a subject might win the next competition. Losing by a small amount may have aroused subjects in the losing win-loss ratio treatment groups to a point that negated treatment effects.

The pulse rate measure of arousal was not consistent with that of galvanic skin response. Initially, due to the lack of agreement in the literature on how best to measure arousal, it was felt desirable to obtain as much information as possible. For this reason both pulse and galvanic skin response were measured. Pulse rate is a measure of activation and hence a measure of arousal. The task itself required an amount of activation which affected pulse rate. At the present time, the activation due to the task and the activation due to win-loss ratio cannot be separated. As the amount of activation due to win-loss ratio cannot be determined, interpretations of the results are difficult to make.

A final possibility which may account for the difference in expected results is again the length of time taken for the study. A longer treatment may have increased the differences between groups.

Hypothesis Three:

The results of this study do not support the hypothesis that there is a positive relationship between ratings of perceived performance and ratings of satisfaction. Results of previous studies are difficult to compare as they are not directly applicable. Previous studies have measured task satisfaction and found that increases in success were directly proportional to increases in satisfaction (Mace, 1935; Gebhard, 1948; Locke, 1965). Both Mace and Locke suggested that a large part of the satisfaction experienced was determined by the success of the subject's performance. Locke further suggested that there is evidence indicating a positive linear relationship between satisfaction and performance.

In attempting to explain the difference in expected results, reference must be made to the written responses of the satisfaction questionnaire. The responses indicated that performance is only one variable that success may be dependent upon and that what constitutes a successful performance varies from person to person. On the satisfaction questionnaire subjects were asked to explain why they responded the way they did. Thirty percent indicated winning or losing as the reason; thirty-four percent indicated fun as the reason; thirty percent indicated achievement or some positive

aspect of themselves. This last category included responses which indicated successful performances other than just winning or losing. Examples are: "Improved my score"; "I thought I did very good"; and "Improved the more times I did it". These responses indicate that what constitutes a successful performance to one subject may be completely foreign to another. Successful performance is subjective to individual interpretation and is only one indicator of individual satisfaction.

Hypothesis Four:

The results of this study do not support the hypothesis that there is a positive relationship between ratings of perceived performance and ratings of predicted performance in four of the five treatment groups. The only significant relationship was found in the W30 condition. Results cannot be compared as directly applicable literature is not available at this time.

It was expected that as subjects continued in the treatment conditions they would categorize themselves or depict themselves as winners or losers. Results indicated that this categorization developed in the W30 condition only. A possible explanation of this result is that treatment

conditions were not applied long enough for categorizations to develop in other win-loss ratio conditions.

Although not part of the original intent of the study, a definite linear trend was evident between win-loss ratio and satisfaction (figures 5, 6 and 7). Subjects' evaluations of performance, satisfaction with that performance and predicted future performance increased directly with the percentage of wins. In an attempt to attach statistical meaning to the linear trend various statistical tests were attempted but found inappropriate for the data. The data, structured as it was, did not fulfill the requirements or criteria of the statistical tests. Any statistic derived from using these methods would, therefore, have been meaningless. Future research should closely investigate the relationship between win-loss ratio and satisfaction. In this study subjects were deceived as to their 'real performance' scores. The results tend to indicate that where satisfaction is concerned, real scores are not important. As long as subjects thought they performed well they felt well satisfied.

Finally, there are a number of points for future consideration:

1) Further investigation in this area should attempt to locate subjects in the 'real world' situation of winning and losing. This would increase the difficulty of the study but it could eliminate any ethical questions concerning manipulation of subjects to suit the environment. This would then allow an increase in time allotted for treatment conditions without unnecessarily endangering the mental health of subjects.

2) If, as this study suggests, we redefine our competitive goals as we mature, then future research might investigate differing age groups to determine if and when this redefinition takes place.

3) In the event that researchers continue to investigate win-loss ratio and arousal, it will necessitate the development of more adequate and consistent measures. Research in arousal tends to indicate that arousal producing situations are individualistic in nature. Perhaps future measurements of arousal could include a battery of physiological indices combined in multivariate analysis. Further, treatment groups could be matched through the use of personality variables, performance scores, need achievement tests or competitive anxiety measures.

4) Another possible direction for future research would be to determine the components of satisfaction most important to an individual and how educational curricula may be designed to take advantage of this knowledge.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

Purpose and Hypotheses

The purpose of this study was to investigate the effects of five win-loss ratio conditions on performance and arousal of grade seven and eight males. Two hypotheses were proposed: 1) the mean performance score decreases as the win-loss ratio becomes progressively different from unity and 2) the mean arousal score decreases as the win-loss ratio becomes progressively different from unity.

Two further sub-problems were investigated and formed hypotheses three and four: 3) there is a positive relationship between ratings of perceived performance and ratings of satisfaction and 4) there is a positive relationship between ratings of perceived performance and ratings of predicted performance.

Procedures

One school was selected from the Parkwood Hills area, Ottawa, Ontario. The total sample (N = 70) included

grades seven and eight males. The subjects underwent three treatment sessions and were then administered an experimental session to determine treatment effects. A one way analysis of variance was employed to determine whether significant differences existed between group means for the performance and arousal scores at the .01 level of significance. Pearson product correlations were estimated to indicate relationships between, a) perceived performance and satisfaction and b) perceived performance and predicted performance.

Results

1) There were no statistically significant differences between treatment conditions for the variable of performance.

2) There were no statistically significant differences between treatment conditions for the variable of arousal as measured by pulse rate and galvanic skin response.

3) There was no significant relationship between perceived performance and satisfaction.

4) There was a significant relationship between perceived performance and predicted performance in the W30 condition but no significant relationship in the other conditions.

5) Although not a stated aim of the study, a direct positive relationship was found between win-loss ratio and satisfaction.

Conclusions

As a result of the findings of this investigation and within the limitations of this study, the following conclusions were drawn:

1) The mean performance scores were not significantly different across five win-loss ratio groups.

2) The mean arousal scores were not significantly different across five win-loss ratio groups.

3) Perceived performance and satisfaction were not related.

4) Perceived performance and predicted performance were related only in the W30 win-loss ratio condition.

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APPENDIX A

Standard Instructions For Subjects

The Tapping Game

1. Sit down in your chair.

2. Pull the chair in so you are comfortable.

3. Take the red metal pencil in front of you in the hand you write with.

4. Touch the tip of the pencil to the centre of the metal plate on your right. The contact must be as close to the centre as possible.

5. Now tap the metal plate on your left, then back to the right.

6. Attempt to get as many taps as possible in the time given.

7. Try to score more taps than your partner.

8. Two taps on the same side will not be recorded.

9. Wait for the command, 'ready...go'. Stop when you hear the buzzer. Good luck.

APPENDIX B

Schedule of Wins for Treatment Conditions

Schedule of Wins For

Treatment Conditions

DAY 1

W10 - Won number 3 competition

W90 - Won numbers 1,2,4,5,6,7,8,9 and 10

W30 - Won numbers 2,3 and 5

W70 - Won numbers 1,4,6,7,8,9 and 10

W50 - Half won numbers 1,3,5,7 and 9

Half won numbers 2,4,6,8 and 10

DAY 2

W10 - Won number 5

W90 - Won numbers 1,2,3,4,6,7,8,9 and 10

W30 - Won numbers 1,2 and 6

W70 - Won numbers 3,4,5,7,8,9 and 10

W50 - Half won numbers 1,2,5,6 and 9

Half won numbers 3,4,7,8 and 10

DAY 3

W10 - Won number 7

W90 - Won numbers 1,2,3,4,5,6,8,9 and 10

W30 - Won numbers 4,5 and 6

W70 - Won numbers 1,2,3,7,8,9 and 10

W50 - Half won numbers 1,2,3,9 and 10

Half won numbers 3,4,5,6,7 and 8

DAY 4

W10 - Won number 2

W90 - Won numbers 1,3,4,5,6,8,9 and 10

W30 - Won numbers 2,5 and 6

W70 - Won numbers 1,3,4,7,8,9 and 10

W50 - Half won numbers 1,3,4,7 and 8

Half won numbers 2,5,6,9 and 10

APPENDIX C

Standard Satisfaction Scales

Satisfaction Scales

1. Performance Rating

Now that the competition is finished for today I would like you to indicate on the scale below how well you think you have performed the last couple of days on the tapping game.

The rating ranges from very poor to very good, please put a check in the box you feel most appropriate.

very poor — very good

Why did you rate yourself this way?

2. How happy are you with how you have done on the tapping game over the past few days?

very unsatisfied — very satisfied

Why do you feel this way?

3. How do you think you will do on the final session?

very poor

very good

APPENDIX D

Raw Data

Subjects Overall Performance Score on Tapping Game

S*	W10	W30	W50	W70	W90
1.	530	520	529	572	603
2.	656	654	640	497	617
3.	663	545	652	513	627
4.	586	584	558	639	568
5.	592	561	725	603	540
6.	636	---	515	712	614
7.	625	650	604	641	614
8.	487	493	613	542	580
9.	308	518	445	471	552
10.	493	637	573	477	397
11.	664	665	430	654	516
12.	583	540	595	671	645
13.	583	608	754	675	658
14.	528	605	530	485	570
Sum	7934	7580	8163	8152	8101
Mean	56.67	58.30	58.31	58.23	57.86

S* = Subjects

Pulse Recordings By Groups During Competition

S*	Five Readings for W10 Group				
	I	II	III	IV	V
1.	150	162	96	114	108
2.	102	96	93	90	93
3.	120	105	117	120	108
4.	160	162	138	162	168
5.	126	174	144	144	132
6.	168	144	150	156	162
7.	150	120	120	138	120
8.	126	138	156	114	174
9.	108	105	111	129	132
10.	126	132	150	150	144
11.	138	126	126	150	132
12.	141	129	153	150	162
13.	129	117	126	129	---
14.	117	123	117	114	117
Sum	1861	1833	1797	1860	1752
Mean	132.9	130.9	128.4	132.9	134.7

S*	Five Readings for W30 Group				
	I	II	III	IV	V
1.	117	108	129	120	132
2.	180	180	180	---	---
3.	114	105	123	144	132
4.	144	114	144	144	150
5.	150	162	150	144	168
6.	---	---	---	---	---
7.	135	129	144	138	141
8.	117	138	126	147	129
9.	102	108	105	---	102
10.	93	102	---	111	---
11.	117	105	102	102	93
12.	117	102	126	138	126
13.	126	---	129	135	129
14.	---	123	135	129	---
Sum	1512	1476	1593	1452	1302
Mean	126.0	123.0	132.9	132	130.2

S*	Five Readings for W50 Group				
	I	II	III	IV	V
1.	120	120	114	120	129
2.	156	150	132	126	---
3.	123	108	105	126	117
4.	72	87	87	90	90
5.	123	114	105	96	90
6.	99	108	123	108	93
7.	120	120	132	144	150
8.	126	132	---	---	---
9.	126	126	120	126	---
10.	171	150	159	168	165
11.	123	123	120	117	120
12.	120	126	126	132	111
13.	---	120	114	114	105
14.	129	---	120	123	99
Sum	1608	1584	1557	1590	1269
Mean	123.6	121.8	119.8	122.3	115.4

S*	Five Readings for W70 Group				
	I	II	III	IV	V
1.	75	120	129	105	126
2.	132	120	126	126	156
3.	120	78	84	120	108
4.	156	150	144	135	138
5.	153	126	150	156	144
6.	96	102	102	108	126
7.	120	150	150	120	180
8.	117	123	120	129	135
9.	105	---	105	105	---
10.	102	---	---	96	120
11.	84	81	96	---	87
12.	132	90	---	120	96
13.	120	123	129	---	129
14.	114	105	111	120	---
Sum	1626	1368	1446	1440	1545
Mean	116.1	114	120.5	120	128.8

S*	Five Readings for W90 Group				
	I	II	III	IV	V
1.	126	123	114	117	120
2.	114	99	96	120	108
3.	144	114	114	142	138
4.	156	156	138	144	114
5.	138	153	156	138	138
6.	132	132	129	180	132
7.	138	132	132	132	144
8.	126	138	156	114	174
9.	96	108	105	111	123
10.	150	144	180	180	150
11.	144	120	144	135	144
12.	120	102	99	111	108
13.	126	120	129	111	---
14.	93	---	---	108	105
Sum	1803	1641	1692	1843	1698
Mean	128.8	126.2	130.2	131.6	130.6

Average Pulse Recording Per Subject By Group

S*	W10	W30	W50	W70	W90
1.	126	121	121	111	120
2.	95	180	141	132	107
3.	114	124	116	102	130
4.	158	139	85	145	142
5.	144	155	106	146	145
6.	156	---	106	107	141
7.	130	137	133	144	136
8.	142	131	129	125	142
9.	117	104	125	105	109
10.	140	102	163	106	161
11.	134	104	121	87	137
12.	147	122	123	110	108
13.	125	130	113	125	122
14.	118	129	118	113	102
Sum	1846	1678	1700	1658	1802
Mean	131.86	129.08	121.43	118.43	128.71

Galvanic Skin Response Recordings By Group During Competition

S*	Base and Ten Readings for W10 Group										
S*	Base	I	II	III	IV	V	VI	VII	VIII	IX	X
1.	52	61	59	55	57	57	55	55	57	57	58
2.	90	105	110	108	107	105	106	101	105	109	107
3.	43	50	48	48	47	48	50	53	54	55	53
4.	32	49	52	47	52	42	53	56	57	57	57
5.	61	106	101	106	96	91	106	99	98	96	96
6.	125	155	150	150	150	169	160	153	170	151	170
7.	70	93	88	95	95	98	104	105	105	103	104
8.	78	103	80	97	98	89	88	91	88	78	78
9.	62	93	74	82	77	75	75	68	72	72	72
10.	64	79	89	89	89	89	90	89	89	97	99
11.	45	45	55	55	55	56	55	59	58	60	61
12.	51	66	83	73	76	81	78	81	96	76	96
13.	120	137	145	145	144	145	157	160	160	165	165
14.	64	104	99	89	86	89	87	86	84	84	86
Sum	957	1246	1243	1239	1229	1234	1264	1256	1293	1260	1302
Mean	68.4	89.0	88.0	88.5	87.8	88.1	90.3	89.7	92.4	90	93

S* Base and Ten Readings for W30 Group

S*	Base	I	II	III	IV	V	VI	VII	VIII	IX	X
1.	44	66	59	63	65	64	61	61	64	64	62
2.	61	66	106	106	101	106	96	96	96	106	104
3.	62	82	82	69	68	77	78	77	72	67	72
4.	67	79	84	82	82	80	80	86	88	90	91
5.	50	65	68	64	68	70	73	75	75	77	78
6.	---	---	---	---	---	---	---	---	---	---	---
7.	52	97	95	87	85	82	89	92	95	87	92
8.	68	98	103	109	114	108	110	117	110	117	103
9.	77	122	122	122	122	122	122	122	122	122	122
10.	74	119	119	117	114	121	124	125	122	119	122
11.	80	122	120	118	105	115	120	110	110	110	120
12.	120	130	139	130	126	130	125	134	130	130	135
13.	67	93	97	96	97	95	97	99	95	96	101
14.	69	97	101	96	96	99	97	99	101	100	99
Sum	891	1236	1295	1259	1243	1269	1272	1293	1280	1285	1301
Mean	68.5	95.1	99.6	96.8	95.6	97.6	97.8	99.5	98.5	98.8	100.1

S* Base and Ten Readings for W50 Group

S*	Base	I	II	III	IV	V	VI	VII	VIII	IX	X
1.	58	70	78	88	88	88	83	86	88	93	95
2.	67	74	89	91	83	92	95	92	97	97	97
3.	22	37	42	49	44	42	37	37	42	35	52
4.	88	131	98	88	88	85	94	96	98	103	98
5.	59	79	69	69	69	71	73	69	69	74	73
6.	50	56	54	53	53	55	54	53	55	55	57
7.	54	64	67	69	69	70	70	70	71	72	73
8.	74	91	87	89	89	94	91	94	92	98	99
9.	53	58	53	53	52	48	48	48	48	53	53
10.	74	116	117	117	114	116	117	117	114	117	117
11.	50	70	75	80	75	75	75	70	80	87	90
12.	57	77	77	76	70	72	72	76	74	80	78
13.	59	75	71	74	76	76	76	77	80	79	85
14.	61	79	77	78	76	77	77	78	80	81	83
Sum	826	1077	1054	1074	1046	1061	1062	1063	1088	1124	1150
Mean	59	76.9	75.3	76.7	74.7	75.8	75.8	75.9	77.7	80.3	82.1

S* Base and Ten Readings for W70 Group

S*	Base	I	II	III	IV	V	VI	VII	VIII	IX	X
1.	57	77	62	74	74	72	67	66	72	72	72
2.	82	97	89	89	89	99	101	104	87	87	97
3.	80	115	100	96	90	103	105	105	105	108	106
4.	55	80	69	65	67	72	68	70	70	70	70
5.	48	60	63	63	63	63	58	63	68	69	68
6.	56	66	76	74	79	78	79	80	81	79	81
7.	61	96	86	71	85	91	78	79	85	77	76
8.	82	127	112	109	107	112	107	107	112	117	112
9.	127	177	177	177	177	177	177	177	172	177	177
10.	92	117	125	122	124	126	127	129	180	187	189
11.	92	127	127	129	132	132	129	127	131	132	129
12.	105	135	139	135	139	135	137	135	140	140	140
13.	72	99	98	95	97	99	97	98	99	100	100
14.	68	97	92	89	91	93	91	92	93	94	94
Sum	1077	1470	1415	1388	1414	1452	1421	1432	1495	1509	1511
Mean	76.9	105	101	99.1	101	103.7	101.5	102.3	106.6	107.8	107.9

S* Base and Ten Readings for W90 Group

S*	Base	I	II	III	IV	V	VI	VII	VIII	IX	X
1.	58	73	70	69	68	68	71	71	69	71	72
2.	54	59	54	59	54	59	59	61	64	64	49
3.	61	79	76	75	76	76	73	76	76	76	72
4.	65	70	74	80	80	80	80	78	75	78	80
5.	79	114	119	119	119	117	114	119	124	121	119
6.	86	111	118	101	109	111	112	116	119	120	120
7.	102	122	112	122	121	122	127	128	132	129	138
8.	84	101	94	101	110	101	104	108	117	114	114
9.	89	106	105	104	111	114	109	109	114	94	116
10.	77	87	87	87	86	86	87	87	88	90	92
11.	59	76	78	74	74	76	74	76	79	82	83
12.	101	141	128	131	126	131	131	135	143	130	135
13.	187	232	232	232	232	232	232	232	232	232	232
14.	89	134	129	134	129	134	129	129	134	129	134
Sum	1191	1505	1476	1488	1495	1507	1502	1525	1566	1530	1556
Mean	85.1	107.5	105.4	106.3	106.8	107.6	107.3	108.9	111.9	109.2	111.1

Average G.S.R. Recording Per Subject By Group

S*	W10	W30	W50	W70	W90
1.	57.1	62.9	85.7	70.8	70.2
2.	106.3	98.3	90.7	93.9	58.2
3.	50.6	74.4	41.7	103.3	75.5
4.	52.2	84.2	97.9	70.1	77.5
5.	71.3	71.3	71.5	63.8	118.5
6.	157.8	---	54.5	77.3	111.7
7.	99.0	90.1	69.5	82.4	125.3
8.	89.0	108.9	92.4	112.2	106.4
9.	122	122.0	51.4	176.5	108.2
10.	89.9	120.2	116.2	142.6	87.7
11.	55.9	115.0	77.7	129.5	77.2
12.	80.8	130.9	75.2	137.5	133.1
13.	152.3	96.6	76.9	98.2	232
14.	89.4	98.5	78.6	92.6	131.5
Sum	1273.6	1273.3	1079.9	1450.7	1513.0
Mean	90.97	97.95	77.14	103.62	108.07

Subjects Response From Satisfaction Questionnaire

W10 Group

S* Question	1	2	3
1.	2	1	3
2.	2	1	4
3.	2	1	3
4.	2	1	2
5.	3	3	3
6.	2	2	2
7.	3	2	3
8.	1	1	3
9.	2	2	2
10.	2	2	2
11.	3	3	3
12.	1	3	4
13.	3	3	2
14.	1	5	1
Sum	29	30	37
Mean	2.07	2.14	2.64

W30 Group

S* Question	1	2	3
1.	4	1	4
2.	2	3	3
3.	2	2	2
4.	2	3	3
5.	3	4	4
6.	-	-	-
7.	2	3	3
8.	3	4	3
9.	2	2	3
10.	2	3	3
11.	1	1	1
12.	3	3	4
13.	2	3	3
14.	2	2	2
Sum	30	34	38
Mean	2.31	2.62	2.92

W50 Group

S* Question	1	2	3
1.	4	4	3
2.	3	3	3
3.	4	4	4
4.	3	4	4
5.	3	5	4
6.	3	4	3
7.	3	4	4
8.	3	4	3
9.	3	2	3
10.	3	3	3
11.	4	5	4
12.	3	3	4
13.	3	4	3
14.	3	3	4
Sum	45	52	49
Mean	3.21	3.71	3.5

W70 Group

S* Question	1	2	3
1.	3	2	3
2.	5	5	5
3.	4	4	3
4.	3	5	5
5.	3	5	5
6.	4	2	3
7.	4	3	3
8.	4	4	3
9.	5	4	5
10.	4	5	4
11.	4	5	4
12.	4	4	4
13.	4	3	3
14.	4	5	4
Sum	55	56	52
Mean	3.93	4	3.7

W90 Group

S* Question	1	2	3
1.	5	4	4
2.	5	5	4
3.	5	5	5
4.	5	5	4
5.	4	4	3
6.	3	5	4
7.	5	4	3
8.	3	4	4
9.	4	5	4
10.	4	2	4
11.	4	5	3
12.	5	5	4
13.	3	5	3
14.	5	5	4
Sum	60	63	53
Mean	4.29	4.5	3.78