EFFECTS OF FRUSTRATION ON PERFORMANCE IN ADULT HUMAN SUBJECTS

by

Ted L. Miller

B.A., Morehead State University, 1970

ABSTRACT OF THESIS

Submitted in partial fulfillment of the requirments for the degree of Master of Arts in Psychology in the Graduate School of Morehead State University

December, 1972

The purpose of this study was to examine the effect of frustration on performance levels in adult human Ss. Sixty-four college freshmen were each randomly assigned to one of four treatment groups and introduced to a button pushing task analogous to runway studies. The task was designed such that performance following frustrated and nonfrustrated conditions could be measured. One-half of the 64 Ss were consistently reinforced (control groups) while the remaining 32 Ss (experimental groups) received frustrative nonreward by means of intermittant nonreinforcement. Start times (time from onset of cue light to first button push) and run times (time to completion of the three push sequence) were recorded to the nearest millisecond. The hypothesis, that frustration produced from nonreinforcement of a previously rewarded response would yield a performance increment, was substantiated as the performance of the experimental group was superior to that of the control group. However, a classical frustration effect was not observed in that the performance of the experimental group was initially superior following reward than nonreward. The results of the study were interpreted as supportive of Amsel's theory of the motivational effects of frustration resulting from nonreinforcement.

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TLM

Accepted by the faculty of the School of Education, Morehead State University, in partial fulfillment of the requirements for the Master of Arts degree.

Director of Thesis

Master's Committee: _____, Chairman

August 2, 1972
(date)

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INTRODUCTION

Amsel (1958, p. 103) has defined frustration as a "primary, aversive, motivational condition...a hypothetical, implicit reaction elicited by nonreward after a number of prior rewards." Working from this construct, recent studies involving frustration have suggested that if frustration is assumed to be a motive, it should be capable of increasing the amplitude of behavior; that is, an organism should evidence a more vigorous response following frustration rather than nonfrustration conditions (Kimble, 1961, p. 310). The primary interest of this study was to examine the effects of frustrative nonreward on the speed of performance of adult human Ss.

The postulated motivational increment following nonreinforcement of a previously rewarded response or "frustration effect", as discussed by Amsel (1958; 1962), was first tested by Amsel and Roussel (1952). These investigators utilized a modified straight alley consisting of a start box, two runways, and two goalboxes. The apparatus was arranged so that start times (elapsed time from the opening of the goal box door until Ss traversed the first one foot of the second alley) and run times (time required for Ss to negotiate the remaining eight feet of the second alley) were recorded. The hypothesis tested was as follows: if a running response elicited by hunger motivation has frustration added to the previous motivational level, a faster running speed will be established. Their procedure

consisted of training Ss in the double alley until performance had reached asymptotic levels in the second alley. Frustration was then introduced by randomly reinforcing Ss in the first goal box 50% of the time. The results supported the experimental hypothesis in that Ss displayed faster start and run times in the 100% reinforced second alley following nonrewarded trials than following rewarded trials in the first alley. This increase in speed in the second alley following nonreward in the first alley was termed the frustration effect by Amsel (eg. 1958).

One attempt to account for the motivational qualities of frustration has been Amsel's frustration theory which employs the fractional anticipatory goal response hypothesis. D'Amato in summarizing Amsel's frustration theory (1970, Pp. 286-288) has described this hypothesis from the standpoint that the S-R sequence may be a series of responses in an alley, bar pressing response or other suitable instrumental sequence. During the instrumental sequence a portion of R_g (the consumatory response), for example salivation, is "released." This fraction of the total goal response is symbolized as r_g. With repeated trials r_g becomes conditioned to cues immediately preceeding R_g and ultimately is elicited very early in the response sequence. At this point r_g is referred to as the "fractional anticipatory goal response" and since any response made by S may be assumed to have stimulus consequences, the fractional anticipatory goal response always appears with associated stimuli s_g. An anticipation of reward is developed in this manner and frustration r_f and associated drive stimuli s_f, are assumed to occur when the anticipated

reward is not available. Frustration, an irrelevant drive arising from this chain of events, summates with relevant motivation (i.e. hunger) and an increased response amplitude results. Amsel and Hancock (1957) manipulated the strength of r_g before introducing frustrative nonreward. Since the magnitude of the frustration effect depends on the magnitude of r_g, presumably those manipulations which result in greater r_g such as high similarity of alley 1 -goalbox 1 or increasing amounts of training, should result in a larger frustration effect. These investigators hypothesized that optimal conditions for development of r_g should exist when cues associated with the instrumental and consummatory (reinforcing) activities were identical. Minimal opportunity would be presented by the total dissimilarity of conditions. In this study the strength of antedating cues (preliminary alley cues) was examined by varying the similarity of either of two sides of alley 1 and goalbox 1. Procedure was identical in experiments I and II except for the amount of constant reinforcement prior to the introduction of frustrative nonreward. Subjects in experiment I received 100% reinforcement in goalbox 1 for the first 54 trials followed by 50% reinforcement, whereas Ss in experiment II always received 50% reinforcement in goalbox 1. In each experiment one-half of the Ss were run in one side of alley 1 similar to goalbox 1 (identical floor and color) while the remaining half were run in a second side of alley 1 dissimilar to goalbox 1 (different floor and color). All Ss' performance was measured in alley 2 which was constructed of a material dissimilar to either side of alley 1. Amsel and Hancock predicted from Amsel's frustration theory that performance

would be superior for Ss experiencing similar alley 1 -goalbox 1 cues, as the conditioning of r_g should occur more rapidly under these conditions. Further, 100% reinforcement from the onset should allow greater development of r_g prior to the introduction of nonreward than if no prior training were given. The results affirmed Amsel's frustration theory in that 50% reinforcement in goalbox 1 eventually resulted in faster running speeds in alley 2 following nonreinforcement than following reinforcement in goalbox 1. In addition the size of the frustration effect in either 50% or 100% reinforcement groups trained with similar alley 1 -goalbox 1 cues was larger than the effect in groups with dissimilar alley 1 -goalbox 1 cues.

Several researchers (Carlson, 1968; Hines & Osborne, 1970) have been able to demonstrate a frustration effect in an operant analog of the conventional alley. The S's approach to the terminal response (barpress) in a ratio schedule is considered analogous to running to a goal in an alley, while time of lever retraction of Bar 1 and Bar 2 represents detention time in goalbox 1 and goalbox 2, respectively. Using this method response speeds on Bar 2 have been shown to be significantly faster following nonreinforcement than following reinforcement on Bar 1. Similar behavior has been reported in monkeys (Davenport & Thompson, 1965) and pigeons (Staddin & Innis, 1966). These authors have concluded that the frustration effect can be studied in situations other than alleyways and with species other than rats. However, generalization of the results of infrahuman frustration effect studies to human Ss requires empirical evaluation. To date, a considerable amount of effort has been directed to the study of the xfrustration effect with children as Ss.

Penny (1960) utilized children on a lever pulling apparatus analogous to the runways of previous studies (e.g. Amsel & Roussel, 1952). The S had to move one lever to the left for the first reinforcement (marble) than pull a second lever down to produce the second reinforcement in a single trial. Following preliminary training, Ss were given different amounts of training on lever 1 alone (10 trials for the high habit group or 1 trial for the low habit group) and two additional trials using both levers. The testing phase consisted of introducing partial reinforcement following lever 1 and constant reinforcement following lever 2. The dependent variable was the speed of lever 2 movement during the test trials. Evidence was obtained which supported Amsel's frustration theory, that is, the high-habit Ss (10 rewarded trials before encountering nonreward) tended to perform faster following nonreward than low-habit Ss (1 rewarded trial before encountering nonreward). Further, response speed for the high-habit group was consistently faster following nonrewarded trials than following rewarded trials. Therefore, the frustration effect originally described by Amsel and Roussel (1952) with rats, was replicated by Penny with children Ss.

Holton (1961) examined frustrative nonreward in a task in which three groups of preschool children were tested in a simple spatial discrimination problem. Children were rewarded with marbles which could be used to purchase a toy of their choice. Mean force exerted on a stimulus window for four trials following reward was compared to mean force exerted for four trials immediately following nonreward. Results were supportive of Amsel's frustration theory in that children

receiving a relatively large number of reinforcements before encountering nonreward produced a significantly greater amplitude of responding following nonreward. Holton also noted a cumulative increase in motivational level. Amsel's frustration theory assumes that r_g generalizes backwards through the response sequence through higher order conditioning, that is, fractional anticipatory responses are considered to be stronger near the goal. Conversely r_g would be expected to be weaker earlier in the response sequence. Thus maximal elicitation of r_g and hence greater frustration, should occur near the end of the response sequence. In support of this Holton (1961) also found that Ss encountering nonreward closer to the goal responded significantly faster than those Ss encountering nonreward at a greater distance from the goal. Further evidence that the strength of the frustration effect is in part a function of the distance from the goal at which nonreward is introduced can be found in a study by Haner and Brown (1955).

Following these early investigations, a considerable volume of literature has been devoted to examining the specific conditions necessary to establish the frustration effect in human Ss. Ryan and Watson (1968) in a review of the frustration literature in children to that time, quoted two unpublished studies (Penny & Ryan, 1960; Ryan, 1960) which failed to elicit the frustration effect in children. These failures were attributed to excessive massing of trials and short intertrial (20 sec) intervals. The authors postulated that due to the extremely short intertrial intervals employed, the motivational effect following nonreward did not dissipate. Thus performance on ensueing rewarded trials may have been influenced by the persistence of the motivational increment following nonreward.

Ryan (1965) utilized kindergarten children on a dual lever task. The experimental group received 50% reinforcement on the first lever and the control group received 100% reinforcement on this lever. Both groups received 100% reinforcement on the second lever. A within group comparison of the experimental group indicated most trials were superior following nonreward. A between group comparison indicated that the overall performance of the experimental group was faster than the control group. Thus the overall performance of the experimental group was enhanced by frustrative nonreward. This result is supportive of results noted by Holton (1961) and Ryan and Watson (1968).

Watson and Ryan (1966) varied the interval between the first and second lever response. Faster response speeds on the second lever following frustrative nonreward on the first lever were found for the shortest interval (5 sec) employed while neither of the longer intervals (10 nor 20 sec) produced the frustration effect. These results are similar to those by MacKinnon and Amsel (1964) with rats.

However Pederson and McEwan (1970), Endsley (1966), and Pederson (1971) were not able to demonstrate a frustration effect on tasks utilizing short intervals and failure, or blocking of an expected reward. An operational distinction has been made between failure and nonreward tasks. A failure task generally involves thwarting the Ss' attainment of the goal. Nonreward, is simply the omission of an expected reward. Pederson (1971) has suggested that both nonreward and failure elicit competing responses and that the interfering effects of failure may be of longer duration than those of nonreward. Presumably these responses produce a decrement in performance following nonreward

by competing with the appropriate second task response. Therefore the motivational effects of frustration can be of two types: first frustration can enhance performance through an increase in motivational drive level (frustration effect); second frustration can reduce performance through the elicitation of competing responses (as observed in the failure studies). Which of these two effects occur would appear to depend on task variables. One of the most important of these task variables seems to be whether or not failure, as compared to nonreward, is experienced.

Although the majority of authors have cited Amsel's frustration theory as the logical explanation for an increase in response amplitude following nonreward, other hypotheses have been offered. Brown (1961) and Bolles (1967) outlined explanations based on associative factors while Marzocco (1951) suggested that the results were produced by regression. Blixt and Ley (1969) undertook an empirical examination of the three hypotheses using children as Ss where pressure exerted on a lever pulling task was measured. Group Heavy-Light was reinforced for a heavy response for ten trials followed by ten trials of reinforcement for a light response. Group Light-Heavy was reinforced for a light response on ten trials followed by reinforcement for a heavy response on ten trials. Groups Light-Light and Heavy-Heavy were reinforced for all light or all heavy responses, respectively, on all trials. The investigators postulated that if a frustration hypothesis were to account for the results, nonreward should initiate heavy responses for all groups; that is, frustrative nonreward should result in an increase in drive level and hence an increase in response

magnitude following cessation of an anticipated reward. The associative hypothesis would predict results based upon associative factors, excluding motivational variables. In this explanation the S's response following nonreward is based on (associated to) his previous history of reward. For example, for the heavy-light group if a light response does not obtain reinforcement, a lighter one may. Thus the associative hypothesis would predict that Light-Heavy group would increase pressure and the Heavy-Light group would decrease pressure. The regression hypothesis, in postulating a return to previously reinforced behavior patterns would predict group Heavy-Light should increase pressure while group Light-Heavy's responding should decrease in pressure. Results appeared to confirm Amsel's frustration theory as Ss from all groups increased the amplitude of their responding following the first nonrewarded trial.

These studies have suggested that the frustration effect is obtainable in children on a variety of tasks although all of the relevant variables have not been completely explored. However, little is known of the conditions neeessary, or the possible effects of frustrative nonreward in adults. The primary purpose of this study was to examine the behavior of adults in a situation analogous to those which have elicited a frustration effect in children. It was hypothesized that (1) frustration effects similar to those observed in children should be demonstrable in adults, and (2) this effect should be susceptable to the amount of prior practice.

METHOD

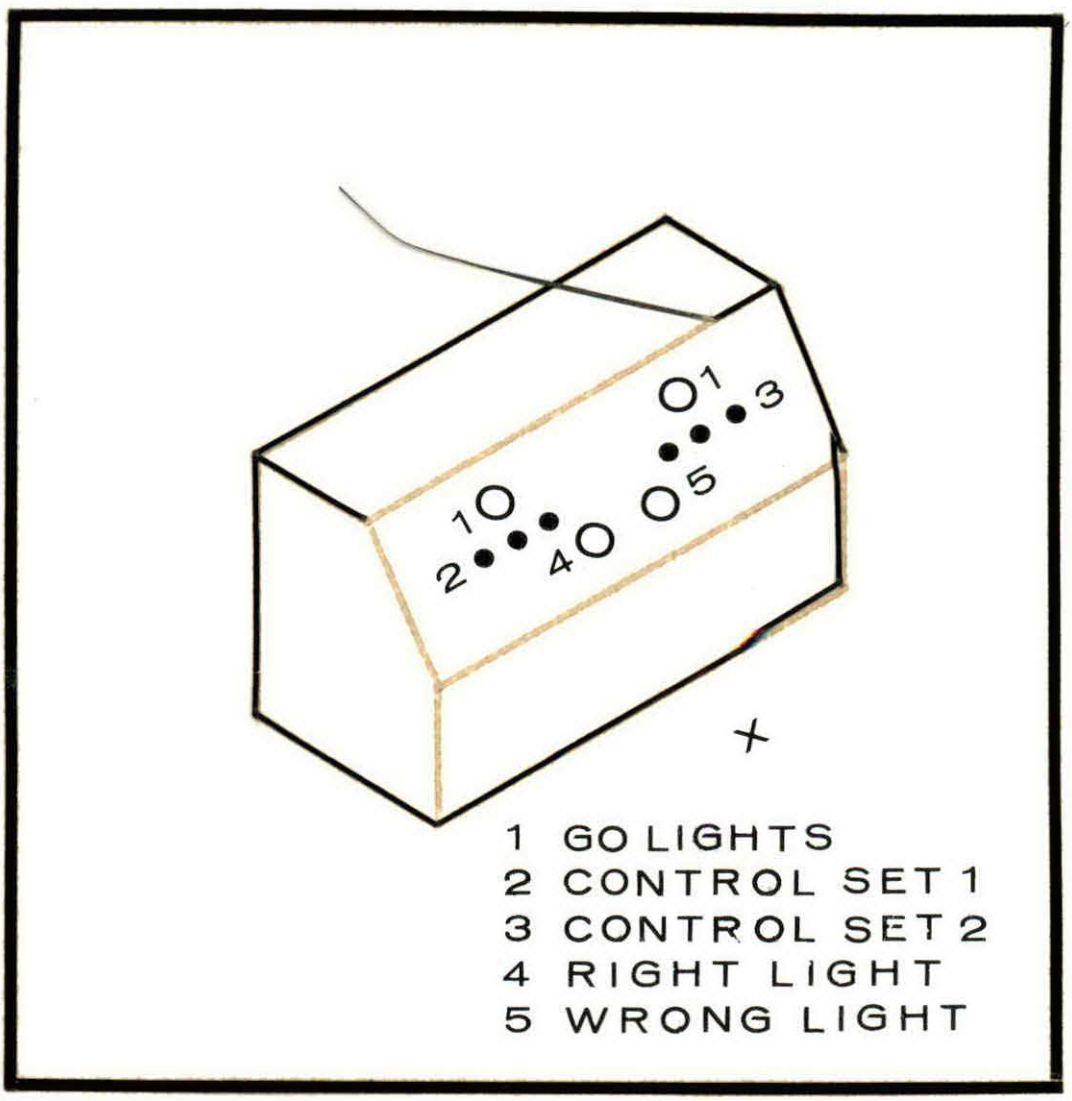
Subjects

The Ss were 64 college freshmen enrolled in General Psychology courses at Morehead State University. The Ss volunteered in order to earn credit toward their grade. In all, 30 male and 34 female Ss volunteered to participate in the study. No other population variables were delineated. Experimental session times ranged from 8:00 A.M. to 9:00 P.M. The study was conducted over a five day period.

Apparatus

The equipment consisted of a Bud metal chassis box (24 in x 12 in x 12 in) placed on a 29 in high table. Figure 1 depicts the apparatus and indicates the relative position of the controls on the chassis. Six push button switches were installed; three grouped on the left side of the front panel of the box (Control set 1) and three on the right (Control set 2). A cue light was placed directly above each group of switches and when illuminated displayed the word "GO". A second pair of cue lights was placed between and slightly below the two groups of push buttons. Illumination allowed display of the word "RIGHT" on the left light and "WRONG" on the right light. In addition, a Lehigh Valley digital counter was placed on top of the chassis box in easy view of the S, and an X was drawn on the table 3 in in front of the apparatus, approximately 7 in from the buttons. Appropriate electromechanical programing equipment was automated to provide consistent intertrial and midtrial intervals as well as

Figure 1. Schematic diagram indicating relative positions of switches and lights on experimental apparatus.


1
3
2
4
5
X
1 GO LIGHTS
2 CONTROL SET 1
3 CONTROL SET 2
4 RIGHT LIGHT
5 WRONG LIGHT

reward schedules. Response latencies were recorded to the nearest millisecond by a General Radio electronic timer (1191-B) and automatic printer (1137-A).

Design

The experimental design was a 2 x 2 factorial. The number of reinforced pretrials (10 or 20) before the test trials and the reinforcement schedule (50% or 100%) on Control set 1 for the remaining 20 (test) trials constituted the factors. Thus, test trials for all Ss consisted of the last 20 trials while the pretrial period involved only the first 10 or the first 20 trials depending on the pre-practice condition. In this way the four groups in this design were established as follows: one experimental group which received 10 reinforced pretrials and 50% random reinforcement on Control set 1 for the 20 test trials (E-10) and a second experimental group which received 20 reinforced pretrials and 50% reinforcement on Control set 1 for the 20 test trials (E-20). Two control groups were formed which differed only in the number of reinforced pretrials: one control group which received 10 reinforced pretrials (C-10) and a second control group which received 20 reinforced pretrials (C-20). Both control groups experienced 20 reinforced test trials on Control set 1 (i.e. 100% test trial reinforcement). All groups received 100% reinforcement on Control set 2 on all trials.

Procedure

Each of the 64 Ss was randomly assigned to one of four treatment groups. All Ss were run individually. Upon arriving at the laboratory each S was ushered immediately into the experimental cubicle. Each S was seated in front of the apparatus and the following instructions were read:

"This is a problem that you can solve to gain credit toward your grade in Psychology. Your performance will determine the number of points you earn. The instructions will be read to you only once, listen carefully and we will begin. In front of you are two sets of controls, each consisting of three push buttons with a plastic panel directly above. Your task is to discover the sequence of button pushes that will earn you a point on each opportunity. For example the sequence for the left control might be 3 - 2 - 1, and the sequence for the right control 1 - 2 - 3. By following these patterns you would receive one point on each opportunity for each seperate control. The panels below will inform you if your decision was right or wrong. You may push the buttons you've selected only when the upper plastic panel is illuminated and you may select only three buttons on each opportunity. In making your decision use only the index finger of your preferred hand --- that is, the hand you write with. It is important that you return your index finger to the X drawn on the table immediately following each selection. The counter above will inform you of the number of opportunities you have used and the number of points you have earned. You will have (80 or 60) opportunities to earn points, and you must earn at least (70 or 50) before you will receive any credit. We have found that few people have difficulty in attaining a score this high and anything you earn above (70 or 50) will be given you toward your grade in Psychology. For example if you earn (75 or 55) points I'll give you five points toward your grade. In order to maximize your opportunity to gain points you must work carefully. The equipment will shut down automatically when your opportunities are expended."

In this study, then, a trial consisted of two "opportunities" presented in the following manner. Fifteen sec after the experimenter started the equipment, the "GO" light over the left set of switches (Control set 1) was illuminated allowing the S to select a sequence. This constituted the first opportunity for the S and the first half of trial 1. After any three push sequence was completed the S returned his index finger to the X drawn on the table and 5 sec later the "GO" light above the right set of switches (Control set 2) was illuminated. The 5 sec period constituted the midtrial interval while the illumination of the cue light above

Control set 2 signaled the beginning of the S's second opportunity and the second half of trial 1. After the S completed this three push sequence and returned his hand to the X he was required to wait 15 sec until the Control set 1 "GO" light was again illuminated signalling the S to begin. This 15 sec period in which no activity took place was referred to as the intertrial interval. For all Ss, Control set 2 was consistently reinforced, that is following any three push sequence the panel labelled "RIGHT" was illuminated for two sec. All control Ss always received reinforcement on Control set 1. Thus one-half of the 64 Ss never experienced failure on either Control set 1 or Control set 2. All experimental Ss, regardless of the number of pretrials received, differed from control Ss only in that 50% of the responses to Control set 1 during the test trials were not reinforced. On nonreinforcement trials, the "WRONG" light was illuminated for 2 sec for all experimental Ss. Following either 20 trials (E-20) or 10 trials (E-10) in which both Control set 1 and Control set 2 were consistently reinforced, experimental Ss were subjected to a prearranged order[1] of 10 failures on Control set 1.

The digital counter recorded, for all Ss, each opportunity expended (2 per trial), and points earned when the S was presented with illumination of the "RIGHT" light panel. In this manner Ss could observe throughout the session the total number of opportunities

[1]The Gellerman series of correct and incorrect responses selected is presented in Appendix A.

expended and the total number of points earned.

Although Ss were instructed that their performance would determine the number of points earned, the Ss could in no way influence the prearranged reward schedule. That is, any possible three push sequence provided by the S could not affect the outcome. Thus control Ss (C-10 and C-20) left the experimental session having earned 100% (60 or 80, respectively) of the points available to them while experimental Ss (E-10 and E-20) completed the session with 10 points less than maximum (50 or 70, respectively). For experimental groups, Ss believed this constituted failure to acquire any credit toward their grade in General Psychology.

During the session two measures were recorded on each three push button sequence: start time (time elapsed from onset of cue light to completion of the first push on a switch) and run time (time elapsed from the first button pushed until the third, last, button was pushed). After completing the task each S was thanked for coming, informed that the nature of the task would be explained later in class, and ushered from the experimental cubicle.

RESULTS

Because response latencies are not normally distributed (a violation of the analysis of variance) a reciprocal (1/latency) transformation was applied to all scores to satisfy this basic assumption. In this transformation, faster scores (shorter latencies) are represented by smaller transformed scores. Thus, speed increases (latency decreases) as the magnitude of the reciprocal increases. Since the analysis of variance is computed on relationships and not absolute values, all scores were multiplied by a factor of 1,000 to eliminate decimals and allow easier computation.

Preliminary investigation of the data suggested that control and experimental group performance was not equivalent prior to the introduction of nonrewarded trials. Since no differential treatment had been applied, further investigation was in order. An examination of Control set 1 start and run time scores on test trial 1 for experimental and control groups, within respective conditions (i.e. C-10 versus E-10 and C-20 versus E-20), revealed that experimental and control groups were significantly different in three of four comparisons. The experimental groups were significantly faster than the appropriate control groups in both start time comparisons (C-10 versus E-10 start time: $t = 2.73$, $df = 30$, $p < .05$ and C-20 versus E-20 start time: $t = 2.63$, $df = 30$, $p < .05$). For run times, only the 20 pretrial condition produced faster times for the experimental group than for the control group (C-20 versus E-20 run time: $t = 2.72$, $df = 30$, $p < .05$). The run times for the 10 pretrial groups did not differ significantly ($t < 1.00$). Since these differences existed and because differential

treatment had not been applied to the groups at this point, the Control set 1 data was analyzed but not interpreted.[2]

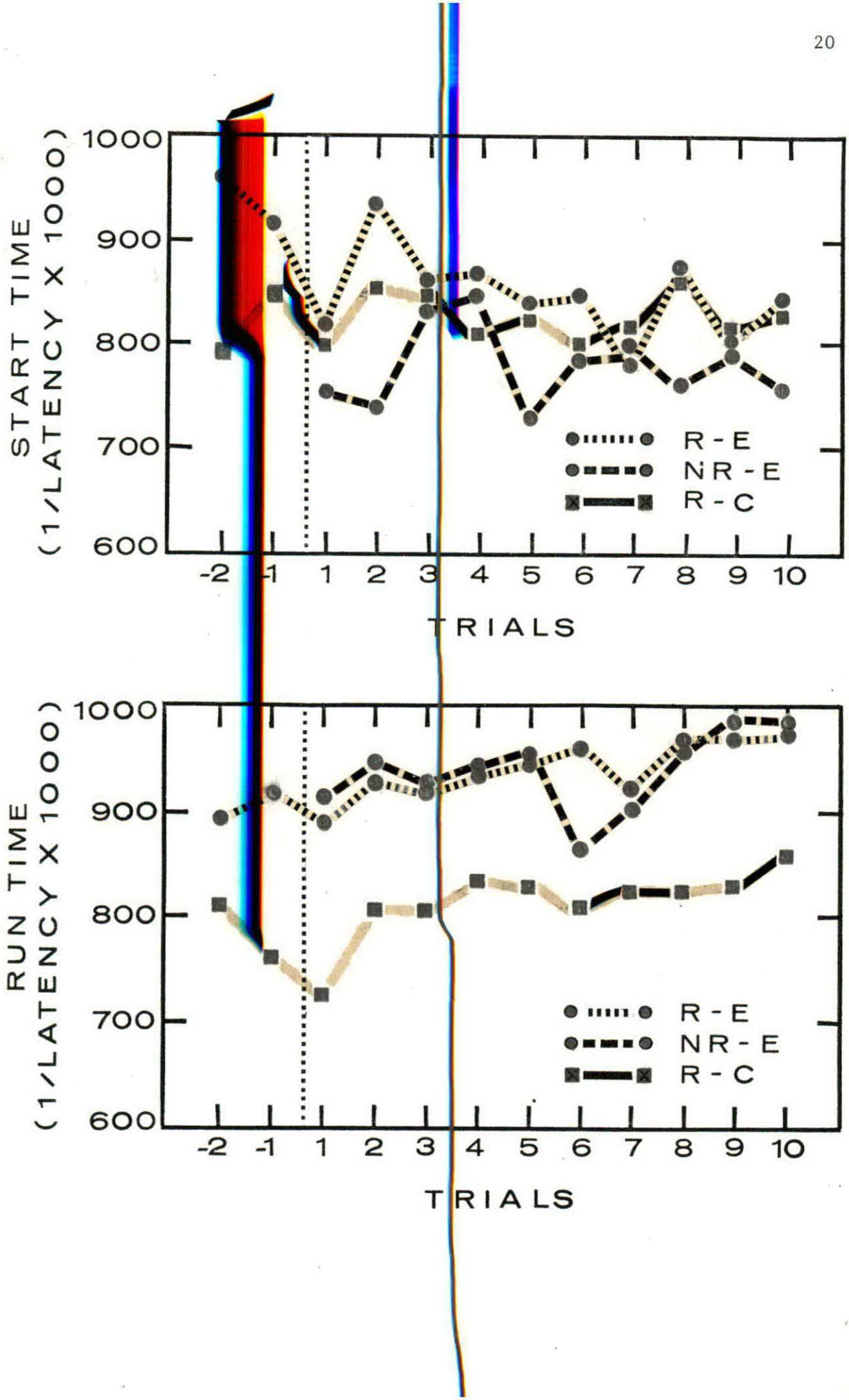
Control set 2 scores were analyzed in a similar manner to Control set 1, but because subjects had received differential treatment on test trial 1, a mean of the last two pretrials prior to introduction of nonreward was computed and utilized in the analysis. Examination of the same comparisons as described for Control set 1 revealed no reliable differences between experimental and control groups. Since reliable differences did not exist before the experimental treatments were instituted, Control set 2 data was analyzed and evaluated.

Because the Ss' sex may have influenced results, an examination was conducted to determine if sex was a relevant variable. Groups E-10 and C-20 had an evenly matched number of males and females, 8 males and 8 females each, while groups C-10 and E-20 were slightly uneven, 7 males and 9 females each. Sex comparisons were based on start and run time scores for the last pretrial before introduction of test trials. The results of these analyses were all non-significant. Since it was concluded that performance did not vary as a function of sex, this variable was omitted in the remaining analyses.

Figure 2 presents start and run speeds for groups C-10 and E-10 on Control set 2. Since control (R-C) Ss did not experience nonreward, a mean of corresponding rewarded and nonrewarded trials was plotted

[2]Control set 1 analyses may be found in Appendices G and H.

Figure 2. Experimental and control start and run time speeds for groups E-10 and C-10 on Control set 2.


START TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2
-1
1
2
3
4
5
6
7
8
9
10
TRIALS
R-E
NR-E
R-C
RUN TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2
-1
1
2
3
4
5
6
7
8
9
10
TRIALS
R-E
NR-E
R-C

for graphical presentation. However, this distinction between trials was retained in the data analysis. The graphical presentation of the experimental group's performance represents mean speeds following rewarded (R-E) and nonrewarded (NR-E) trials. Table 1 depicts actual trial numbers for experimental groups for reward and nonreward conditions as well as illustrating the trials utilized in obtaining means for graphical presentation of the control group's performance.

Start speeds for nonrewarded trials on Control set 2 appear to be generally slower than either rewarded trials or control performance. However, the rewarded trials for the experimental group appear to be somewhat faster than the continuously rewarded (control) group. A 1-between and 2-within analysis of variance[3] (Winer, 1962) with control-experimental groups (100% - 50% reinforcement) as the independent measure and the ten trials and two reward conditions as repeated measures was computed. The results of this examination provided evidence of a reliable difference between speeds following reward and speeds following nonreward (F= 7.43, df= 1/30, $p < .05$). A significant interaction between groups, trials, and reward condition was obtained and examined (F= 2.10, df= 9/270, $p < .05$). Separate analyses of variance (Winer, 1962) were utilized in examining the interactions. The trial factor was held constant and a significant reward condition by experimental group interaction was sought on each trial. A significant interaction was

[3]A summary of the analysis of variance performed on start time scores on Control 2 for groups C-10 and E-10 may be found in Appendix I.

TABLE 1

SUMMARY OF ACTUAL AND GRAPHICAL TRIAL NUMBERS FOR REWARDED AND NONREWARDED TEST TRIALS

Experimental Group											
Reward	Graphical	1	2	3	4	5	6	7	8	9	10
	Actual	2	3	6	7	10	12	15	16	17	20
Nonreward	Graphical	1	2	3	4	5	6	7	8	9	10
	Actual	1	4	5	8	9	11	13	14	18	19
Control Group											
Graphical Trial No.		1	2	3	4	5	6	7	8	9	10
Mean of Trials No.		2&1	3&4	6&5	7&8	10&9	12&11	15&13	16&14	17&18	20&19

observed on trial 2 (F= 9.60, df= 1/30, $p<.01$) and trial 10[4] (F= 5.19, df= 1/30, $p<.05$). Each of these significant interactions was then further examined for significant simple effects. Related t-tests (Winer, 1962) were run between reward and nonreward scores within the experimental and within the control group while independent t-tests (Winer, 1962) were utilized to examine differences between experimental and control groups on either rewarded or nonrewarded conditions. A reliable difference was found between reward-nonreward conditions within the experimental group (t= 2.87, df= 15, $p<.05$) on trial 2. No other significant comparisons were noted on trial 2 and none on trial 10. Therefore, the triple interaction between groups, trials, and reward condition appears to be a function of the poorer performance for the experimental group following nonreward on trial 2.

Run speeds for group C-10 and E-10 appear to indicate a substantial increase in response speed for the experimental group when compared to control performance. Experimental Ss' performance following rewarded or nonrewarded trials did not appear to differ substantially. Both control and experimental response speeds appear to have increased during the session. A 1-between and 2-within analysis of variance[5] (Winer, 1962) was computed on run time data. Only the group factor (F= 4.27, df= 1/30, $p<.05$) produced a reliable difference, indicating that the experimental Ss' run time performance was significantly faster than the controls.

[4]A summary of trial 2 and trial 10 analysis is presented in Appendix I.

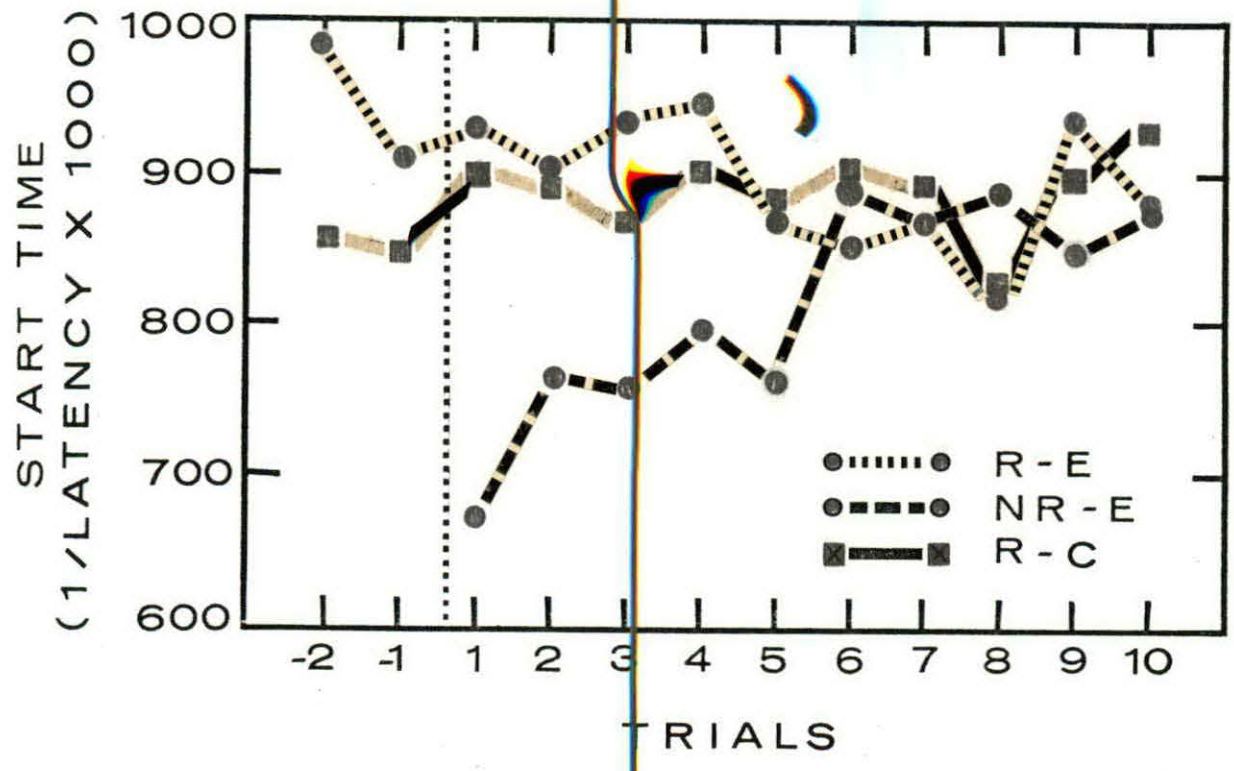
[5]A summary of the analysis of variance performed on run time data for groups C-10 and E-10 is presented in Appendix I.

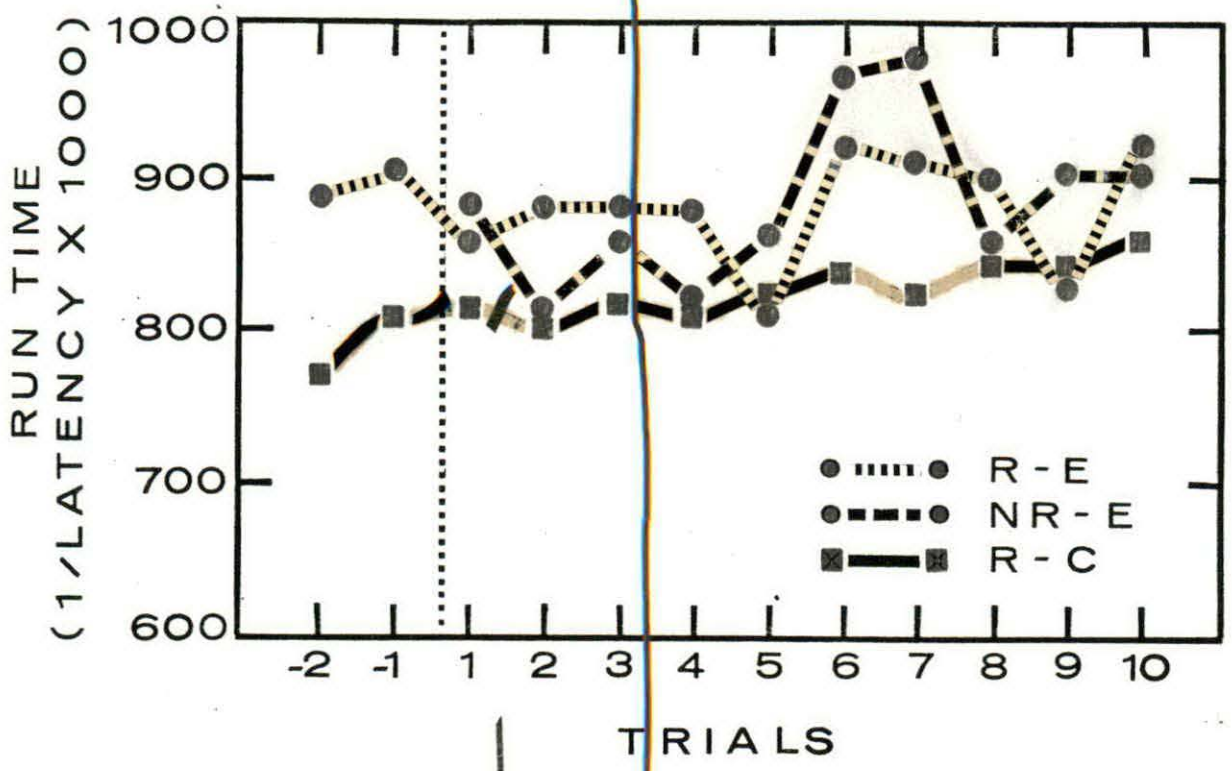
Figure 3 presents start and run time speeds for groups C-20 and E-20 on Control set 2. Control Ss' scores (R-C) were plotted as means in an identical manner to that used on Figure 1 (see Table 1). Start time speeds for the experimental group appear slower following nonreward than reward, though this difference was negligible by trial 6. Differences were analyzed, as before, by means of a 1-between and 2-within analysis of variance. The experimental-control comparison served as the independent measure with 10 trials and 2 reward conditions as repeated measures. The reward-nonreward comparison[6] demonstrated a reliable difference. However, the interaction between groups, reward conditions, and trials was significant (F= 10.62, df= 9/270, $p<.01$). An interaction analysis was undertaken as before. Separate analyses of variance were computed with experimental-control groups as the independent factor and reward-nonreward as the repeated factor. In this manner the effect of trials was held constant and significant components could be examined. Significant reward condition-experimental group interactions were found for start times on trial 1,[7] (F= 12.85, df= 1/30, $p<.01$), trial 3, (F= 4.21, df= 1/30, $p<.05$) and trial 4, (F=4.91, df= 1/30, $p<.05$). Consequently, these trials received further analysis. Independent t-tests were utilized to examine differences between experimental and control groups on respective

[6]A summary of the analysis of variance performed on start time scores is presented in Appendix J.

[7]A summary of the analyses performed on trials 1, 3 and 4 is presented in Appendix J.

Figure 3. Experimental and control start and run time speeds for group C-20 and E-20 on Control set 2.


START TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C


RUN TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C

reward-nonreward conditions while related t-tests were employed to examine differences between rewarded and nonrewarded trial speeds within each group. Analysis of trial 1 data indicated that the experimental group start times following nonreward were significantly slower than the experimental group start times following reward ($t = 4.17$, $df = 30$, $p < .01$) or the control group performance on the equivalent trials ($t = 2.22$, $df = 30$, $p < .05$). Examination of the interaction on trials 3 and 4 yielded no reliable differences although the t-test comparison between reward-nonreward conditions within the experimental group on trial 4 approached the conventional significance level ($t = 2.00$, $df = 30$, $.10 > p > .05$). Therefore, the significant triple interaction between groups, trials, and reward condition appears to be a function of the poorer performance by the experimental group following nonreward on trial 1. These results are similar to those found for the 10 pretrial experimental start times. Substantial differences between groups or reward conditions were not readily apparent during the latter stages of the session.

Figure 3 indicates that run times for the 20 pretrial experimental group were generally faster than the run times for the 20 pretrial control group regardless of reward or nonreward conditions. These results are similar to the results observed for the 10 pretrial conditions. Scores for all groups tended to become faster during the experimental session. A 1-between and 2-within analysis of variance was computed as before. This analysis[8] indicated that the trial factor

[8]A summary of the analysis of variance performed on run time scores for groups C-20 and E-20 is presented in Appendix J.

(F= 1.90, df= 9/270, p<.05) was statistically significant, while all other comparisons, including the experimental-control group contrast, failed to achieve standard levels of statistical significance.

In summary, start speeds for both experimental groups (E-10 and E-20) were slower on Control set 2 following nonreward than following reward on Control set 1 during the early test trials. However this discrepancy became negligible before the completion of the session. Run time speeds for the experimental group appears to have been generally superior to the control performance regardless of reward condition. However, substantial differences between experimental performance following reward and nonreward were not observed. These conclusions concerning run time performance seem justified for the 10 pretrial group but were not statistically significant for the 20 pretrial group.

DISCUSSION

The results of this study indicated a within and a between group effect of frustrative nonreward. The within group effect consisted of an initial decrement in start time performance following nonrewarded relative to rewarded trials for the experimental group. The between groups effect consisted of an overall increment in performance for the experimental group's run times relative to the control group's run times.

Several factors may have contributed to the absence of the classic Amsel frustration effect in this study. The majority of previous investigators demonstrating the frustration effect have employed a task analogous to Amsel and Roussel's (1952) study in that levers, switches and appropriate intervals have been utilized to replicate the runway conditions in that study. Despite the analogy of the present task to several previous studies, conclusive evidence that the procedure used in this study is capable of eliciting a frustration effect has not been demonstrated.

Most investigators (eg. Amsel & Roussel, 1952) have employed distinctively different stimulus conditions for task 1 and task 2. However, the present study utilized two identical stimulus situations for the two tasks, one result of which may have been stimulus generalization from task 1 to task 2. Should this have occurred it may have masked or eliminated response increments on task 2 following frustrative nonreward on task 1. Thus the disruptive effects of task similarity in this study may have eliminated the Amsel frustration effect.

A third factor influencing the results of this study may be the dependent variable measure. Many studies (Ryan, 1965; Pederson & McEwan, 1970; Whiteley & Ryan, 1967; Watson, 1970) have used latencies as a response measure. Despite this, a motivational increment in performance following nonreinforcement could be expressed by the S in a variety of ways that excluded a decrease in response latency. For example Ss may have increased the amount of pressure exerted on the apparatus following nonreward, or increased the amplitude of response in some manner that the equipment utilized in this study was not designed to detect. Some evidence has been collected which suggests children differ in their response to frustration as a function of age. Ryan and Watson (1968) have cited several studies noting disparate results using identical measurement procedures on differing mental and chronological age groups. Ryan, for example, failed to find compatible results using preschool and kindergarten Ss on an identical lever pulling task while Stevenson and Weir (1961) analyzed data from earlier studies and concluded that older Ss tended to change their responses following nonreinforcement more often than younger Ss. These studies appear to indicate that chronological and mental age modify reactions to frustration. Thus detection and quantification of adult reactions to frustration may require more sensitive response measures.

An examination of the data of this study indicated that experimental Ss' start speeds were slower following nonreward than reward for the initial test trials. This result is very similar to those results observed by Pederson (1971) in a task employing failure rather than nonreward. Typically, start speeds have been most sensitive

in detecting the frustration effect, however nonreward in the present study had it's major disruptive effect on start speeds. Further, the degree of expectancy of reward (r_g) was manipulated in the present study by varying the number of pretrials (10 versus 20). Previous studies have shown that increasing the degree of expectancy increases the magnitude of the frustration effect (Amsel & Hancock, 1957; Penny, 1960). The present results indicate that the disruption in start speeds following nonreward was greater in the 20 pretrial than the 10 pretrial condition. Perhaps the increase of frustrative nonreward in the present study served to amplify responses or habits which competed with the desired instrumental response. That is, following initial introduction of nonreward, Ss may have re-evaluated their response strategies on succeeding responses. This could have resulted in a decrease in start speeds but would not necessarily have detracted from run speeds once a response strategy was chosen. This is compatible with the competing response explanation of Ryan and Watson (1968) and Pederson and McEwan (1970).

Despite the fact that a frustration effect was not apparent, some indication that nonreward enhanced overall performance was observed. The experimental groups' run speeds were generally faster than those of the control groups' regardless of reward condition. This result is similar to those obtained by Holton (1961) and Ryan (1965). It seems possible that once the experimental Ss selected a response strategy, the motivational increment as a result of frustrative nonreward served to enhance performance. This may have resulted in faster experimental group response speeds relative to respective control groups. One

difficulty with this interpretation is the failure of the 20 pretrial group to achieve faster run times than the appropriate control group. This may have been a function of the persistence of the greater start time disruption displayed by the 20 pretrial group.

The results of this study did not indicate a measurable increment in performance following nonreinforcement (Amsel's frustration effect), but evidence was collected which substantiated the motivational properties of frustration in adult human Ss. Previous investigations have indicated a variety of factors capable of modifying the effect of frustration on subsequent performance levels in infrahumans and children, and it appears that similar factors contributed to the results obtained in this study. Further research, utilizing several age groups, and various tasks, may be able to delineate the specific task and S parameters which would result in a consistent Amsel frustration effect.

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APPENDIX A

SUMMARY OF REWARD SCHEDULE FOR GROUPS E-10 AND E-20 ON CONTROL 1 FOLLOWING CONTINUOUS REINFORCEMENT

TABLE 2

SERIES OF REWARDED AND NONREWARDED TRIALS FOR GROUPS E-10 AND E-20 ON CONTROL 1.

TRIAL	CONDITION
1	Nonreward
2	Reward
3	Reward
4	Nonreward
5	Nonreward
6	Reward
7	Reward
8	Nonreward
9	Nonreward
10	Reward
11	Nonreward
12	Reward
13	Nonreward
14	Nonreward
15	Reward
16	Reward
17	Reward
18	Nonreward
19	Nonreward
20	Reward

APPENDIX B

SUMMARY OF PRETRIAL -2 AND PRETRIAL -1 RAW DATA

TABLE 4

SUMMARY OF PRETRIAL -2 AND -1 START AND RUN SPEEDS (1/LATENCY) FOLLOWING REWARD FOR EXPERIMENTAL AND CONTROL SUBJECTS IN GROUPS C-20 AND E-20 ON CONTROL 1.

	PRETRIAL -2				PRETRIAL -1			
	CONTROL		EXPERIMENTAL		CONTROL		EXPERIMENTAL	
	ST	RT	ST	RT	ST	RT	ST	RT
Subject 1	.841	.637	.731	.650	.866	.855	.814	.625
2	.781	.798	1.222	1.168	.925	.884	1.225	1.267
3	.981	.807	1.234	.949	1.046	.904	1.096	.804
4	.744	.683	1.172	.913	.837	.719	.946	.935
5	.647	.673	.780	.909	.772	.611	.792	.936
6	.947	.373	1.245	1.137	.745	.884	1.300	1.194
7	.400	.648	.811	.930	.240	.566	.922	9.82
8	.963	.839	.381	.924	.933	.703	.249	.638
9	.931	.718	.704	.639	.845	.984	.663	.790
10	1.102	.685	.892	1.102	1.123	.710	.890	1.043
11	1.158	.887	.789	.798	1.101	.816	.957	.853
12	.859	.682	.904	.697	.544	.587	.863	.754
13	.607	.524	.754	.375	.577	.615	.644	.315
14	.985	.781	.820	.813	.950	.809	1.106	.821
15	.892	.613	.769	.817	.804	.625	.823	.746
16	.743	.759	1.116	1.144	.779	.822	1.161	1.128

TABLE 5

SUMMARY OF PRETRIAL -2 AND -1 START AND RUN SPEEDS (1/LATENCY) FOLLOWING REWARD FOR EXPERIMENTAL AND CONTROL SUBJECTS IN GROUPS C-10 AND E-10 ON CONTROL 2.

	PRETRIAL -2				PRETRIAL -1			
	CONTROL		EXPERIMENTAL		CONTROL		EXPERIMENTAL	
	ST	RT	ST	RT	ST	RT	ST	RT
Subject 1	1.081	.851	1.206	1.082	1.108	.778	.946	1.077
2	1.204	.898	.593	.745	1.012	.935	.706	.768
3	.539	.637	.801	.668	.284	.428	.821	.729
4	.548	.579	.868	.759	.969	.612	.823	.765
5	.676	.994	.751	1.180	.949	.879	.525	1.257
6	1.060	.883	1.008	.904	.668	.900	.978	.897
7	.273	1.141	.853	.788	.881	1.096	1.040	.836
8	.544	.558	1.018	.943	.780	.658	1.254	1.001
9	.855	.846	1.248	1.145	.897	.191	1.064	1.267
10	1.121	1.016	.896	.706	1.377	.841	.845	.874
11	.681	.756	.968	.787	.639	.783	.584	.734
12	.903	.599	1.072	1.342	.956	.702	.898	1.086
13	.961	.195	1.085	.762	.954	.859	1.114	.740
14	.786	.998	1.594	.904	.823	1.069	1.369	1.008
15	.727	.739	.854	.864	.712	.722	1.108	.878
16	.769	.632	.744	.734	.562	.722	.641	.778

TABLE 6

SUMMARY OF PRETRIAL -2 AND -1 START AND RUN SPEEDS (1/LATENCY) FOLLOWING REWARD FOR EXPERIMENTAL AND CONTROL SUBJECTS IN GROUPS C-20 AND E-20 ON CONTROL 2.

	PRETRIAL -2				PRETRIAL -1			
	CONTROL		EXPERIMENTAL		CONTROL		EXPERIMENTAL	
	ST	RT	ST	RT	ST	RT	ST	RT
Subject 1	.788	.882	.720	.687	.862	1.001	.775	.671
2	.865	.812	1.406	1.112	.863	.992	1.362	1.230
3	1.035	.845	1.015	.998	.885	1.074	.816	.904
4	.597	.787	1.230	.282	.892	.806	1.007	1.009
5	.632	.630	.932	1.036	.679	.661	.938	.040
6	1.041	.998	1.168	1.189	.425	1.052	1.136	1.239
7	.639	.790	1.070	1.048	.623	.615	.838	1.036
8	1.172	.911	.914	1.085	1.133	.780	.749	.719
9	1.153	.666	.850	.722	1.209	.762	.905	.720
10	1.037	.523	1.101	1.251	1.094	.761	1.153	1.022
11	1.142	.905	.860	.886	1.254	.901	1.067	.913
12	.393	.497	.940	.668	.749	.692	.913	.803
13	.687	.813	.590	.381	.673	.601	.654	.381
14	1.055	.896	1.160	.827	.858	.782	1.136	.833
15	.744	.639	.939	.877	.625	.660	.933	.982
16	.838	.802	1.226	1.154	.896	.847	1.381	1.200

APPENDIX C

SUMMARY OF CONTROL 1 START AND RUN TIME RAW DATA FOR GROUPS C-10 AND E-10

TABLE 7

START TIME SCORES (1/LATENCY) FOR GROUP C-10
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.759	.831	.817	.909	.838	.732	.835	.701	.931	.854	.820	.072
2	.968	.956	.944	.968	.857	1.024	1.060	.954	1.024	1.054	.980	.061
3	.521	.562	.565	.841	.700	.639	.714	.705	.736	.641	.662	.096
4	.661	.562	.692	.569	.727	.597	.152	.416	.262	.518	.515	.187
5	.874	.960	.783	.761	.859	.792	.777	.698	.740	.646	.789	.090
6	.666	.803	.822	.765	.764	.849	.723	.815	.848	.888	.794	.066
7	.548	.899	.888	.493	.317	.483	.657	.882	.327	.665	.615	.220
8	.583	.725	.719	.674	.694	.780	.855	.725	.786	.776	.731	.074
9	.905	.914	1.044	.923	1.022	.907	.865	.809	.914	.919	.922	.067
10	.797	.908	.795	1.042	.904	1.008	.973	1.137	.991	1.123	.967	.118
11	.693	.693	.667	.688	.757	.713	.689	.757	.706	.682	.704	.030
12	1.038	.951	.859	1.008	.980	.928	.948	.965	.993	.736	.940	.086
13	.785	.814	.755	.710	.800	.590	.641	.922	.746	.844	.760	.096
14	1.046	.861	.948	.757	1.011	.908	.869	1.027	1.041	1.057	.952	.101
15	.643	.852	.804	.948	.919	.735	.896	.864	.851	.781	.829	.091
16	.593	.455	.561	.388	.423	.715	.687	.623	.844	.750	.603	.149

TABLE 8

START TIME SCORES (1/LATENCY) FOR GROUP C-10 ON CONTROL 1 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.839	.799	.810	.821	.877	.729	.817	.881	.930	.824	.832	.054
2	.808	.914	.903	.981	1.039	.951	.966	1.025	1.010	.983	.958	.068
3	.424	.509	.691	.589	.709	.648	.768	.714	.788	.549	.638	.118
4	.518	.725	.315	.599	.260	.431	.484	.388	.388	.423	.453	.136
5	.932	.762	.200	.766	.786	.697	.836	.673	.739	.687	.707	.194
6	.938	.970	.773	.883	.945	.722	.972	.932	.767	.754	.865	.099
7	.996	.557	.782	.884	.527	.813	.617	.667	.367	.854	.706	.192
8	.560	.627	.804	.706	.718	.741	.694	.637	.773	.823	.708	.082
9	.948	.945	1.096	.918	.973	.999	.962	.930	.631	.759	.916	.130
10	.976	1.116	1.113	1.027	1.070	1.164	.986	1.097	1.068	.936	1.055	.072
11	.693	.696	.663	.728	.711	.700	.773	.724	.708	.735	.713	.029
12	.999	.908	.919	.879	.958	.923	.823	.840	1.057	1.068	.937	.083
13	.722	.740	.780	.511	.699	.780	.720	.757	.636	.807	.715	.086
14	.918	.887	.949	.995	1.000	1.024	.840	1.025	1.039	1.075	.975	.074
15	.852	.878	.812	.868	.887	.991	.889	.898	.944	1.007	.902	.060
16	.482	.532	.739	.567	.597	.759	.798	.796	.593	.712	.657	.116

TABLE 9

RUN TIME SCORES (1/LATENCY) FOR GROUP C-10
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.703	.871	.795	.726	.841	.916	.722	.728	.823	.835	.796	.072
2	.904	.826	.923	.825	.926	.895	.899	.896	.925	.929	.894	.038
3	.777	.558	.659	.567	.749	.616	.751	.559	.622	.602	.646	.084
4	.592	1.692	.714	.329	.924	.759	.548	.923	.369	.562	.741	.390
5	.756	.853	.747	.888	.691	.783	.794	.722	.796	.813	.784	.058
6	.662	.837	.636	.771	.931	.964	.733	.826	.881	.807	.804	.107
7	.664	.780	.680	.335	.861	.989	.699	.801	.545	.920	.727	.190
8	.546	.769	.750	.651	.685	.802	.809	.954	.953	.767	.768	.125
9	.738	.842	.782	.879	.891	.909	.874	.881	.874	.853	.852	.053
10	.722	.761	.651	.872	1.004	.791	.846	.808	.771	.975	.820	.108
11	.769	.691	.757	.761	.719	.749	.754	.709	.705	.710	.732	.028
12	.850	.816	.662	.753	.763	.727	.611	.660	.794	.829	.746	.080
13	.403	.549	.511	.583	.724	.559	.581	.628	.619	.593	.575	.082
14	.841	.822	.830	1.098	1.026	.914	.860	.848	.968	.958	.916	.093
15	.618	.761	.800	.865	.811	.729	.800	.799	.853	.746	.778	.070
16	.783	.733	.769	.709	.718	.714	.699	.693	.636	.685	.713	.041

TABLE 10

RUN TIME SCORES (1/LATENCY) FOR GROUP C-10 ON CONTROL 1 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.824	.756	.904	.888	.915	.853	.789	.712	.847	.762	.825	.068
2	.821	.831	.846	.896	.886	.841	.911	.921	.858	.879	.869	.034
3	.321	.565	.626	.564	.584	.600	.623	.457	.519	.692	.555	.103
4	.556	.580	.583	.505	.656	.451	.409	.857	.742	.600	.593	.133
5	.830	.846	.811	.668	.821	.751	.901	.802	.738	.816	.798	.064
6	.841	.714	.783	.899	.995	.816	.893	.884	.773	.828	.842	.079
7	.733	.273	.732	.911	.112	.656	.830	.711	.941	1.035	.693	.291
8	.640	.834	.664	.750	.870	.738	.678	.954	.970	.830	.792	.117
9	.853	.868	.912	.938	.920	.956	.925	.798	.794	.738	.870	.073
10	.654	.915	.821	1.081	.855	.850	.570	.925	.937	.792	.840	.145
11	.715	.681	.673	.700	.707	.691	.704	.697	.771	.730	.706	.027
12	.880	.775	.452	.707	.634	.733	.796	.701	.876	.933	.748	.139
13	.423	.524	.451	.554	.555	.650	.607	.632	.641	.676	.571	.085
14	.841	.827	.818	.943	.881	.990	.939	.981	.939	.916	.907	.062
15	.750	.819	.881	.619	.823	.823	.781	.810	.871	.891	.806	.079
16	.545	.669	.741	.545	.711	.747	.424	.526	.742	.832	.648	.129

TABLE 11

START TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.938	1.055	1.003	1.072	1.054	1.094	1.047	.939	.983	.946	1.013	.058
2	.626	.868	.825	.871	.407	.958	.626	.554	.940	.780	.745	.182
3	.760	.756	.764	.859	.799	.798	.783	.700	.817	.784	.782	.042
4	.855	.853	.859	.851	.765	.794	.772	.475	.800	.809	.783	.113
5	.714	.507	.603	.796	.697	.484	.660	.594	.463	.442	.596	.120
6	.933	.966	1.002	.934	.964	.982	.962	.895	.921	.956	.951	.031
7	.789	.820	1.019	.995	.832	.936	1.014	.868	.754	.772	.879	.103
8	.197	1.050	1.000	1.144	1.041	1.090	1.031	.977	1.024	.996	.955	.270
9	.052	1.007	1.072	1.038	.961	1.011	1.035	1.017	.984	.997	.917	.305
10	.874	.499	.912	.798	.755	.765	.927	.924	.914	.985	.835	.140
11	.917	.841	.873	.800	.851	.846	.824	.680	.868	.809	.830	.062
12	.862	.767	1.001	.709	.811	.809	.938	.813	.887	.830	.842	.083
13	.986	1.054	1.026	1.079	.970	.904	.892	1.038	.962	.967	.987	.061
14	.986	.728	.992	1.098	.756	.718	.977	.780	.416	1.015	.846	.204
15	1.060	1.119	1.108	1.164	1.209	.954	.938	1.020	1.090	1.141	1.080	.088
16	.954	.955	.565	.925	1.044	1.034	.603	.553	.706	.794	.813	.194

TABLE 12

START TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 1 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	1.031	1.086	.860	1.042	1.062	.958	.723	.969	.950	.976	.965	.107
2	.553	.788	.788	.545	.628	.749	.772	.724	.303	.884	.673	.169
3	.671	.690	.807	.762	.783	.815	.803	.661	.819	.850	.766	.067
4	.737	.775	.789	.871	.848	.849	.750	.310	.523	.708	.716	.173
5	.723	.317	.712	.716	.255	.453	.768	.390	.398	.539	.527	.190
6	.864	.848	1.028	.979	.896	.860	.906	.968	.972	.970	.929	.061
7	.871	.762	.952	.965	.885	.753	1.122	.807	.892	.886	.889	.108
8	1.059	1.141	1.109	1.242	.996	1.140	.989	.871	.921	1.013	1.048	.112
9	1.111	1.044	1.059	.961	.965	1.084	.743	.983	1.054	1.090	1.009	.107
10	.822	.398	.859	.811	.460	.881	.798	.831	.801	.912	.757	.177
11	.881	.777	.850	.861	.778	.677	.801	.701	.778	.868	.797	.069
12	.811	.736	.809	.868	.795	.678	.751	.884	.662	.834	.782	.074
13	.963	1.014	.732	.724	.829	1.036	.968	.979	.872	.819	.893	.114
14	.622	.816	1.083	.767	.671	.707	.726	.912	.719	.702	.772	.135
15	1.091	1.129	1.042	1.223	1.169	1.169	1.041	1.212	1.154	1.154	1.138	.063
16	.946	.731	.916	.991	.841	.603	.902	.746	.442	.683	.780	.172

TABLE 13

RUN TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	1.096	1.193	1.210	1.189	1.230	1.121	1.168	1.123	1.259	1.070	1.165	.061
2	.591	.789	.391	.779	.922	.760	.746	.841	.733	.892	.744	.154
3	.729	.682	.627	.711	.728	.755	.701	1.162	1.305	1.362	.876	.282
4	.697	.677	.726	.668	.749	.717	.648	.647	.604	.646	.677	.044
5	1.150	.795	1.385	1.042	.858	1.006	.510	.719	.472	.428	.836	.314
6	.933	.896	.937	.925	.964	.809	.977	.966	.956	.965	.932	.049
7	.664	.755	.667	.766	.879	.714	.761	.749	.725	.659	.733	.065
8	1.029	.936	.973	1.119	1.039	1.038	1.009	1.049	1.008	1.048	1.024	.048
9	1.090	.841	1.011	.991	.991	.958	1.219	.772	1.204	1.278	1.035	.163
10	.728	.609	.577	.580	.686	.728	.744	.575	.771	.798	.679	.086
11	.896	.823	.779	.825	.836	.793	.865	.943	.862	.803	.842	.050
12	.799	1.140	1.189	.998	.871	1.158	1.349	.897	.840	.611	.985	.222
13	.705	.884	.946	.934	.874	.870	.917	.844	.854	.854	.868	.067
14	.982	.675	.931	1.076	.905	.986	1.303	1.061	.821	1.295	1.003	.194
15	.853	.904	.849	.977	.780	.956	.806	.720	.890	.821	.855	.078
16	.707	.764	.736	1.038	1.102	1.057	.863	.762	.964	.833	.882	.146

TABLE 14

RUN TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 1 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	1.199	1.121	1.194	1.124	1.231	1.132	1.084	1.200	1.124	1.116	1.152	.048
2	.636	.661	.723	.810	.756	.842	.894	.868	.844	.506	.748	.116
3	.653	.727	.771	.682	.774	.683	.754	1.239	1.278	1.355	.891	.279
4	.694	.739	.769	.668	.656	.577	.645	.708	.674	.627	.675	.055
5	1.422	.659	.904	1.291	.980	.458	.729	.653	.417	.924	.843	.329
6	.871	.844	.884	.885	.852	.966	.934	.888	1.027	.956	.910	.058
7	.800	.799	.837	.859	.696	.619	.956	.731	1.133	.834	.826	.142
8	1.015	.990	1.012	1.090	.972	1.048	1.040	1.059	.986	.885	1.009	.056
9	1.014	.979	.985	1.000	.895	1.082	.881	1.154	.969	.958	.991	.080
10	.683	.713	.607	.612	.638	.643	.565	.714	.719	.777	.667	.064
11	.819	.512	.854	.940	.726	.904	.914	.766	.838	.912	.818	.127
12	1.126	1.037	.876	1.013	.993	.991	1.101	1.253	.938	1.342	1.067	.142
13	.738	.823	.871	.938	.900	.816	.881	.700	.958	.892	.851	.082
14	.896	.818	1.166	.645	.734	.836	.900	.809	1.270	1.107	.918	.199
15	.846	.963	.848	.859	.943	.892	.924	.884	.759	.928	.884	.059
16	.991	.843	.933	.690	.825	.847	.818	.689	.919	.741	.829	.101

APPENDIX D

SUMMARY OF CONTROL 1 START AND RUN TIME RAW DATA FOR GROUPS C-20 And E-20

TABLE 15

START TIME SCORES (1/LATENCY) FOR GROUP C-20
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.949	.913	.983	.967	.860	.897	.894	.938	.951	.994	.934	.042
2	1.007	1.028	.863	1.018	.668	.912	.915	.994	1.000	1.072	.947	.116
3	.975	1.033	1.081	1.026	1.038	1.023	1.083	.925	1.050	1.017	1.025	.047
4	.780	.856	.781	.764	.900	.886	.945	.887	.885	.837	.852	.060
5	.869	.775	.667	.780	.821	.612	.771	.741	.875	.744	.765	.081
6	.948	.955	.952	.931	.911	.833	.951	.820	.902	.946	.914	.050
7	.601	.665	.738	.836	.851	.751	.695	.946	.959	.912	.795	.123
8	1.001	1.001	.869	.951	.887	.996	.886	.932	1.002	.988	.951	.054
9	.823	.911	.868	.753	.945	.959	1.019	.914	.912	.832	.893	.076
10	.956	.815	1.077	1.123	1.035	.977	1.079	1.154	1.160	1.200	1.057	.116
11	1.039	1.039	.892	.945	.978	.894	.865	.815	.458	.811	.873	.167
12	.219	.698	.343	.660	.635	.773	.803	.889	.478	.765	.626	.214
13	.454	.719	.632	.481	.561	.672	.823	.621	.668	.346	.597	.140
14	.975	.961	.794	1.030	.932	1.022	.929	.983	.977	.868	.947	.071
15	.725	.736	.724	.849	.565	.871	.734	.796	.795	.830	.762	.087
16	.696	.739	.716	.591	.772	.759	.372	.572	.816	.510	.654	.139

TABLE 16

START TIME SCORES (1/LATENCY) FOR GROUP C-20 ON CONTROL 1 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.973	.933	.874	.923	.827	.884	.942	.937	1.042	1.008	.934	.063
2	.830	.838	.938	.867	1.014	.880	1.121	1.020	1.035	.977	.952	.097
3	1.067	.959	1.018	1.068	.996	1.086	.894	1.064	.924	1.051	1.012	.067
4	.803	.839	.810	.790	.909	.849	.881	.925	.888	.895	.858	.047
5	.646	.617	.741	.848	.706	.804	.796	.720	.739	.714	.733	.070
6	.874	.917	.939	.839	.919	.798	1.019	.900	.761	.835	.880	.075
7	.416	.835	.774	.888	.727	.704	.823	.892	.809	.848	.771	.139
8	.936	.971	.905	.851	.870	.991	1.052	.956	.776	.840	.914	.082
9	1.426	1.436	1.858	1.375	1.451	1.371	1.543	1.798	1.639	1.225	1.512	.199
10	1.089	1.069	1.118	1.071	1.103	1.112	1.148	1.248	.913	1.048	1.091	.084
11	1.100	1.149	1.012	1.035	.934	.953	.803	.894	.855	.723	.945	.132
12	.458	.202	.127	.474	.524	1.000	.926	.859	.856	.595	.602	.302
13	1.003	.695	.796	.373	.725	.877	1.148	1.173	.962	.683	.843	.242
14	.966	.942	.651	.976	.766	.999	1.016	1.018	1.020	1.019	.937	.126
15	.692	.807	.649	.724	.759	.738	.683	.769	.603	.772	.719	.062
16	.764	.888	.832	.720	.693	.717	.863	.782	.939	.751	.794	.082

TABLE 17

RUN TIME SCORES (1/LATENCY) FOR GROUP C-20
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.741	.791	.836	.888	.825	.896	.693	.828	.882	.865	.824	.066
2	.683	.739	.932	.915	.748	.767	.921	.750	.860	1.038	.835	.113
3	.862	.763	.853	.938	.966	.909	.852	.872	.853	1.102	.897	.090
4	.761	.856	.770	.762	.759	.777	.836	.847	.749	.813	.793	.040
5	.765	.724	.687	.707	.784	.712	.666	.684	.770	.658	.715	.044
6	.816	.772	.853	1.020	.905	.756	1.052	.808	.747	.909	.863	.106
7	.743	.735	.674	.726	.710	.685	.768	.813	.789	.780	.742	.045
8	.750	.662	.874	.782	.815	.693	.754	.844	.888	.887	.794	.080
9	.963	.821	.925	.809	.905	1.009	.853	.836	.783	.919	.882	.073
10	.566	.686	.606	.662	.740	.770	.698	.955	.718	.682	.708	.105
11	.873	.955	.904	.908	.819	.865	.771	.711	.750	.736	.829	.083
12	.580	.606	.490	.536	.475	.771	.783	.680	.671	.732	.632	.112
13	.488	.670	.718	.773	.492	.601	.573	.609	.686	.619	.622	.092
14	.865	.732	.803	.784	.791	.864	.745	.813	.817	.822	.803	.043
15	.683	.586	.686	.716	.652	.776	.651	.747	.641	.774	.691	.062
16	.563	.730	.804	.619	.674	.811	.766	.805	.780	.868	.742	.095

TABLE 18

RUN TIME SCORES (1/LATENCY) FOR GROUP C-20 ON CONTROL 1 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.895	.823	.868	.883	.866	.897	.841	.860	.958	.870	.876	.036
2	.816	.814	.800	.796	.898	.800	.945	1.035	.996	.982	.888	.094
3	.812	.839	.871	.996	.862	.800	.964	.933	1.128	.892	.909	.099
4	.747	.698	.781	.788	1.184	.755	.743	.829	.731	.763	.801	.138
5	.674	.745	.727	.610	.791	.619	.737	.667	.716	.706	.699	.056
6	.885	.959	.918	.803	.618	.775	.987	.807	.918	.836	.850	.107
7	1.094	.771	.636	.744	.825	.706	.778	.746	.817	.817	.793	.120
8	.809	.840	.875	.777	.712	.693	.758	.841	.835	.740	.788	.061
9	.832	.836	.963	.814	.841	.813	.871	.946	.900	.759	.857	.063
10	.742	.778	.776	.715	.720	.684	.918	.924	.619	.668	.754	.100
11	.853	.888	.866	.872	.871	.787	.751	.789	.776	.725	.817	.058
12	.295	.728	.187	.439	.678	.737	.451	.907	.848	.742	.601	.242
13	2.000	.515	.569	.314	.532	.610	.729	.739	.649	.509	.716	.467
14	.811	.808	.841	.828	.829	.862	.801	.798	.647	.778	.800	.058
15	.656	.674	.729	.783	.725	.695	.542	.774	.823	.716	.711	.078
16	.761	.802	.740	.645	.807	.860	.803	.919	.686	.803	.782	.079

TABLE 19

START TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.816	.746	.808	.856	.769	.790	.809	.868	.852	.825	.813	.038
2	1.176	1.183	1.277	1.165	1.246	.929	1.190	1.180	1.225	1.200	1.177	.093
3	1.108	.881	1.049	.803	.956	.897	.862	.944	1.044	1.089	.963	.104
4	1.055	1.114	1.150	1.128	1.104	1.166	1.059	1.091	1.160	1.298	1.132	.069
5	.960	.835	.898	.874	.834	.846	.744	.965	.771	.992	.871	.082
6	1.162	1.219	1.379	1.392	1.259	1.336	1.331	1.016	1.189	1.236	1.251	.114
7	.931	.693	.800	.859	.873	.966	.955	.976	.859	.765	.867	.093
8	.893	1.000	.890	.494	.597	1.075	.714	.404	1.057	.952	.807	.240
9	.714	.812	.603	.881	.938	.838	.970	.886	.912	.864	.841	.109
10	.800	.697	.893	.960	1.075	.984	.646	.635	.738	.709	.813	.154
11	.896	.914	.928	.996	.808	.884	.794	1.035	.882	1.035	.917	.084
12	.883	.869	.927	.878	.834	.919	.904	.895	.857	.884	.885	.028
13	.584	.621	.629	.690	.564	.711	.470	.462	.554	.620	.590	.082
14	.961	1.011	.970	.946	.958	.757	.773	.936	.926	.933	.917	.083
15	.751	.706	.657	.637	.396	.468	.669	.462	.455	.341	.554	.144
16	1.293	1.277	1.225	1.183	1.262	1.219	1.040	1.203	1.100	1.142	1.194	.080

TABLE 20

START TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 1 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.717	.856	.843	.828	.792	.771	.866	.708	.874	.871	.812	.062
2	1.239	1.221	1.149	1.146	1.221	1.124	1.004	1.322	1.189	1.162	1.177	.084
3	.957	.930	1.004	.937	.876	.963	.941	.914	.982	1.050	.955	.048
4	1.030	1.085	1.213	1.112	1.154	1.030	1.213	1.142	1.118	1.092	1.118	.064
5	.853	.791	.898	.847	.822	.738	.901	.856	.925	.876	.850	.055
6	1.213	1.280	1.277	1.091	1.288	1.081	1.308	1.280	1.162	1.172	1.215	.084
7	.801	.775	.953	.904	.900	.956	1.013	.939	.983	.889	.911	.075
8	1.111	.777	.972	1.034	.927	.334	.294	.244	1.102	.695	.749	.342
9	.562	.836	.592	.906	.862	.829	.926	.843	.842	.503	.770	.154
10	.731	.918	.868	.838	.465	.695	.391	.597	.798	.778	.707	.173
11	.920	.938	.861	.994	.914	.932	.954	1.117	1.001	1.023	.965	.071
12	.761	.789	.908	.907	.813	.825	.856	.868	.925	.853	.850	.053
13	.524	.554	.478	.603	.516	.590	.538	.465	.580	.567	.541	.046
14	1.017	.822	.681	.992	.702	.897	.830	1.018	.805	.819	.858	.121
15	.718	.620	.687	.608	.624	.547	.574	.594	.424	.664	.606	.082
16	1.160	1.182	1.119	1.128	1.150	1.180	1.075	1.112	1.124	1.127	1.135	.032

TABLE 21

RUN TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 1 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.700	.669	.626	.637	.602	.632	.714	.679	.748	.614	.662	.047
2	1.215	1.233	1.035	1.030	1.170	1.161	.924	1.109	1.054	1.129	1.106	.095
3	.757	.729	.789	.693	.791	.859	.762	.974	1.029	.867	.825	.107
4	.836	.968	1.005	.947	.949	.989	.909	1.036	1.025	.921	.958	.060
5	.878	.903	.925	.869	.915	.823	.838	.639	.669	.811	.827	.098
6	1.237	1.002	.973	1.168	1.121	1.018	.941	1.072	1.038	1.028	1.059	.091
7	.967	1.076	.879	1.016	1.162	.974	.733	.952	1.014	1.021	.979	.114
8	1.180	.360	1.116	1.060	.819	.983	1.248	.473	1.146	1.146	.953	.307
9	.700	.657	.680	1.057	.956	.937	.901	.994	.967	.946	.879	.144
10	1.358	1.161	1.029	1.040	.953	1.021	1.084	.942	.699	.831	1.011	.178
11	.789	.845	.775	.742	.915	.944	1.027	1.018	1.046	.852	.895	.111
12	.744	.518	.747	.664	.768	.809	.791	.709	.732	.694	.717	.082
13	.377	.307	.321	.434	.243	.359	.361	.150	.249	.316	.311	.080
14	.794	.829	.800	.777	.861	.756	.777	.819	.831	.804	.804	.031
15	1.106	.714	.682	.571	.523	.648	.507	.474	.505	.556	.628	.186
16	1.166	1.070	1.063	1.104	1.055	1.005	1.007	.853	1.124	1.068	1.051	.085

TABLE 22

RUN TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 1 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.614	.682	.640	.632	.633	.714	.688	.656	.701	.651	.661	.033
2	.767	.882	1.051	.889	.993	.860	1.034	1.204	1.104	.882	.966	.132
3	.752	.877	1.000	.796	.594	.662	.718	.551	.837	.930	.771	.144
4	.939	.943	.963	.994	.868	.970	1.025	.937	.932	1.088	.965	.059
5	.919	.840	.815	.727	.934	.927	.957	.876	.860	.973	.882	.075
6	1.023	1.122	1.081	.975	1.059	1.044	1.035	.998	1.098	1.037	1.047	.044
7	1.049	.399	.974	1.070	.959	.959	.950	.919	1.175	.884	.933	.205
8	.966	.950	.996	1.283	1.002	.604	.462	.272	.950	.307	.779	.342
9	.621	.533	1.016	.945	.946	.845	.990	.877	.874	.871	.851	.156
10	1.067	1.092	1.317	.970	.724	1.100	.858	1.054	1.015	1.016	1.021	.156
11	.837	.895	.945	1.016	.874	.765	.955	.955	.975	.961	.917	.074
12	.628	.700	.756	.804	.848	.693	.779	.719	.766	.824	.751	.067
13	.372	.371	.303	.262	.264	.319	.374	.215	.328	.379	.318	.057
14	.807	.755	.735	.834	.777	.845	.884	.821	.877	.742	.807	.053
15	.769	.549	.725	.470	.508	.554	.481	.564	.416	.554	.559	.109
16	1.081	.968	.995	1.126	1.033	1.023	1.031	1.157	1.019	1.123	1.055	.062

APPENDIX E

SUMMARY OF CONTROL 2 START AND RUN TIME RAW DATA FOR GROUPS C-10 AND E-10

TABLE 23

START TIME SCORES (1/LATENCY) FOR GROUP C-10
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	1.008	1.052	1.039	.853	1.047	1.131	1.108	1.152	1.095	1.061	1.054	.083
2	1.153	1.066	1.085	1.037	.998	1.186	1.231	1.140	1.170	1.100	1.116	.072
3	.413	.621	.693	.668	.628	.698	.483	.772	.405	.486	.586	.129
4	.974	1.035	1.029	.310	.476	.362	.565	.274	.503	.615	.614	.295
5	1.027	.780	.497	.778	.980	.982	1.016	.931	1.018	.376	.838	.232
6	.734	.586	.834	1.172	.846	.942	.794	.993	.893	1.029	.882	.164
7	.727	.980	.866	.499	.757	.586	.896	.939	.946	.644	.784	.167
8	.917	.812	.714	.588	.837	.791	.874	.885	.542	.979	.793	.140
9	.935	.895	.867	.925	1.074	.799	.874	.851	.919	.636	.877	.111
10	1.156	1.149	1.240	1.406	1.388	1.228	1.112	1.095	1.014	1.113	1.190	.126
11	.713	.694	.676	.702	.753	.799	.797	.896	.734	.818	.758	.068
12	.778	.940	.921	.906	.727	.833	.946	.868	.877	.874	.867	.070
13	.744	.771	.451	.829	.888	.526	.829	.829	.680	.499	.704	.158
14	.770	.648	.857	.772	.834	.643	.813	.742	.802	.750	.763	.071
15	.696	.852	.876	1.069	.803	.846	1.054	.889	.995	.995	.907	.118
16	.469	.488	.664	.909	.591	.655	.717	.846	.620	.778	.673	.143

TABLE 24

START TIME SCORES (1/LATENCY) FOR GROUP C-10 ON CONTROL 2 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.974	.980	1.108	.888	1.081	.919	.772	.810	.958	1.136	.962	.121
2	1.083	1.100	1.136	1.187	1.090	1.059	.967	1.160	1.267	1.096	1.114	.080
3	.266	.698	.567	.458	.749	.520	.772	.656	.616	.521	.582	.151
4	.718	.983	.859	.484	.366	.297	.242	.490	.310	.768	.551	.261
5	.794	1.088	.707	.915	.901	.634	1.012	.601	1.000	.498	.815	.198
6	.726	1.055	1.137	1.054	.604	1.121	.798	.815	.841	.719	.887	.189
7	.323	.807	.698	.782	.495	.636	.736	.672	.717	.955	.682	.173
8	.713	.919	.768	.741	.730	.891	.715	.806	.887	.935	.810	.089
9	.942	.785	1.124	1.009	1.070	.998	.983	1.113	.845	.887	.975	.112
10	1.207	1.082	1.186	.426	1.243	1.141	.944	1.040	1.076	1.300	1.064	.247
11	.659	.656	.767	.701	.768	.745	.738	.772	.749	.698	.725	.043
12	.854	.884	.896	.938	.922	.818	.926	.924	.938	.786	.888	.053
13	.722	.788	.773	.797	.664	.810	.640	.868	.173	.836	.707	.201
14	.750	.799	.761	.705	.746	.716	.786	1.150	.822	.904	.813	.131
15	.874	.935	.847	.988	.844	.882	.875	.979	.926	.923	.907	.051
16	.461	.613	.514	.489	.587	.528	.526	.689	.644	.909	.596	.131

TABLE 25

RUN TIME SCORES (1/ LATENCY) FOR GROUP C-10
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.827	.935	.993	.945	.884	.922	.846	.822	.868	.780	.882	.066
2	.804	.865	.896	.949	.902	.850	.790	.918	.956	.882	.881	.055
3	.463	.611	.635	.596	.698	.386	.657	.578	.656	.780	.606	.112
4	.680	.733	.859	.387	.742	.488	.938	1.041	.901	.670	.743	.201
5	.934	.912	.854	1.122	.777	.689	.999	.733	.761	.733	.851	.138
6	.986	.925	.889	.980	1.096	.927	1.016	.848	1.003	.968	.963	.070
7	.691	.864	.884	.603	.843	.923	1.019	.828	.997	.983	.863	.133
8	.757	.797	.720	.746	.900	.801	.981	1.038	.965	.940	.864	.113
9	.722	.781	.858	.831	.925	.917	.844	.890	.854	.782	.840	.064
10	.835	.621	1.092	1.129	1.068	1.022	1.081	.919	.912	.908	.958	.153
11	.808	.761	.728	.808	.796	.734	.751	.802	.754	.789	.773	.030
12	.749	.900	.732	.845	.579	.694	.850	.763	.721	1.013	.784	.121
13	.388	.538	.486	.735	.862	.634	.701	.668	.576	.761	.634	.141
14	.942	1.047	.948	1.025	1.060	1.047	.690	.977	1.003	.978	.971	.107
15	.599	.796	.548	.846	.780	.773	.832	.836	.843	.891	.774	.112
16	.738	.703	.631	.719	.795	.763	.594	.732	.678	.805	.715	.067

TABLE 26

RUN TIME SCORES (1/LATENCY) FOR GROUP C-10 ON CONTROL 2 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.816	.896	1.008	1.013	1.018	.970	.796	.860	.865	.875	.911	.083
2	.793	.947	.868	.834	.920	.909	.931	.925	.993	.911	.903	.057
3	.378	.736	.649	.586	.683	.683	.590	.498	.618	.692	.611	.106
4	.599	.841	.708	.948	.581	.713	.664	.723	.846	.784	.740	.115
5	.937	.889	.807	.798	.774	.896	.904	.878	.798	.864	.854	.055
6	.814	.934	.982	1.020	1.061	1.127	.946	1.000	1.028	.885	.979	.089
7	.676	.858	.899	.738	.796	.741	.630	.634	.749	1.123	.784	.147
8	.676	.827	.816	.720	.828	.782	.889	.769	.850	1.060	.821	.104
9	.330	.794	.834	.841	.915	.835	.852	.855	.775	.750	.778	.164
10	.939	1.041	1.060	1.212	.910	.927	1.066	1.737	1.009	.960	1.086	.245
11	.758	.797	.700	.778	.769	.778	.757	.766	.747	.794	.764	.027
12	.905	.746	.654	.751	.636	.874	.744	.635	.940	.914	.779	.119
13	.413	.415	.374	.738	.581	.728	.597	.800	.632	.676	.595	.150
14	.838	.898	1.088	1.052	1.018	.993	1.038	1.072	.938	1.069	1.000	.083
15	.798	.758	.881	.740	.757	.758	.726	.811	.758	.816	.780	.046
16	.734	.698	.728	.698	.652	.703	.707	.600	.632	.675	.682	.042

TABLE 27

START TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	.979	.968	.976	.831	.778	.995	.916	.905	.790	.921	.905	.080
2	.606	.677	.581	.859	.769	.398	.459	.844	.916	.673	.678	.171
3	.798	.754	.804	.771	.838	.731	.712	.759	.618	.892	.767	.074
4	.874	.735	.689	.763	.759	.687	.628	.705	.630	.546	.701	.090
5	.366	.665	.500	.709	.375	.549	.472	.625	.427	.658	.534	.125
6	.823	.880	.769	.952	.937	.851	.950	.921	.844	.942	.886	.063
7	.836	.706	.879	.776	.837	.683	.722	.979	.700	.886	.800	.098
8	1.054	1.081	.984	1.197	1.090	1.076	.981	.901	.958	1.194	1.051	.097
9	1.138	1.140	1.251	1.206	1.116	1.069	1.101	.842	.951	1.165	1.097	.120
10	.494	1.112	.825	.718	.893	.825	.749	.968	.945	.990	.851	.172
11	.697	.641	.564	.714	.479	.837	.338	.886	.690	.581	.642	.162
12	.575	.959	.745	.766	.756	.900	.803	.789	.816	.612	.772	.115
13	.831	.885	.774	.869	.731	.813	.637	1.042	.836	1.078	.849	.132
14	1.017	1.453	1.257	1.029	.946	1.267	1.256	1.009	.931	.968	1.113	.179
15	1.088	1.404	1.043	1.204	1.108	1.245	1.144	1.092	1.190	1.020	1.153	.113
16	.929	.912	.906	.560	.871	.721	.643	.505	.713	.600	.736	.159

TABLE 28

START TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 2 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.741	.874	.963	1.098	.877	.848	.939	.931	.943	.292	.850	.216
2	.342	.284	.577	.400	.592	.815	.725	.515	.578	.763	.559	.178
3	.672	.458	.631	.823	.859	.778	.794	.708	.757	.859	.733	.123
4	.509	.846	.756	.634	.649	.740	.833	.754	.670	.683	.707	.100
5	.684	.602	.455	.738	.537	.555	.349	.622	.850	.713	.610	.145
6	.762	.735	.786	.813	.781	.710	.905	.793	.887	.829	.800	.061
7	1.042	.675	1.245	.621	.786	.789	.849	.508	.553	.940	.800	.229
8	1.133	.968	1.113	.926	1.035	1.085	1.054	1.034	1.033	.978	1.035	.065
9	1.138	1.104	1.010	1.047	1.006	1.055	.875	1.037	1.199	1.041	1.051	.086
10	.810	.126	.893	.981	.222	.667	.293	.266	.979	.484	.572	.333
11	.369	.783	.580	.848	.561	.566	.655	.771	.556	.572	.626	.141
12	.726	.913	.668	.969	.744	.873	.704	.980	.915	.821	.831	.114
13	.763	.832	.856	.859	.879	.856	.819	.878	.908	.990	.864	.059
14	.833	1.062	1.273	1.029	.620	1.060	1.176	.972	.511	.804	.934	.240
15	.898	.964	.983	1.196	1.128	.916	1.071	.862	.699	.896	.961	.143
16	.806	.598	.772	.655	.465	.472	.825	.628	.726	.633	.658	.126

TABLE 29

RUN TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	1.176	1.180	1.052	1.086	1.273	1.308	1.173	1.091	1.112	1.068	1.151	.086
2	.463	.931	.887	.843	.755	.856	.464	.904	.859	.851	.781	.173
3	.639	.691	.698	.756	.823	.710	1.253	1.282	1.340	1.369	.956	.310
4	.760	.714	.728	.714	.697	.611	.603	.600	.602	.651	.668	.061
5	.805	.944	1.293	1.225	1.290	1.253	1.107	.968	1.064	1.193	1.114	.166
6	.865	.904	.966	1.011	.962	1.070	.961	.934	1.074	1.001	.974	.066
7	.840	.670	.664	.744	.806	.791	.911	.803	.701	.795	.772	.078
8	1.022	.980	1.023	1.106	1.060	1.043	1.059	1.024	1.060	1.140	1.051	.045
9	.868	1.180	1.004	1.052	1.006	1.050	1.018	1.079	1.131	1.106	1.049	.085
10	.865	.775	.548	.716	.712	.783	.704	.819	.791	.686	.739	.088
11	.895	.819	.816	.823	.876	.959	.918	.911	.916	.980	.891	.057
12	1.278	1.288	1.282	1.169	1.138	1.267	1.074	1.358	1.307	1.468	1.262	.112
13	.873	.876	.881	.875	.859	.936	.936	.858	.834	.928	.885	.035
14	.929	1.009	1.015	1.003	.924	.997	.907	1.060	.855	.812	.951	.078
15	.896	.931	.881	.946	1.039	.944	.965	.859	.902	.934	.929	.050
16	1.082	1.000	1.038	1.029	1.011	.864	.791	.812	.946	.665	.923	.134

TABLE 30

RUN TIME SCORES (1/LATENCY) FOR GROUP E-10
ON CONTROL 2 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	1.007	1.109	1.216	1.207	1.153	1.067	1.142	1.190	1.118	1.262	1.147	.075
2	.705	.981	.772	.980	.763	.806	.711	.914	.954	.976	.856	.115
3	.636	.452	.703	.630	.780	.731	.781	1.064	1.351	1.453	.858	.326
4	.738	.743	.724	.737	.735	.693	.623	.652	.645	.656	.694	.046
5	1.404	1.400	1.506	1.242	1.355	1.246	.919	1.197	1.257	.925	1.245	.194
6	.886	.927	.997	.899	.928	.990	.977	.925	.938	1.030	.949	.046
7	.846	.846	.623	.948	.871	.646	.877	.819	.818	.900	.819	.104
8	1.012	1.049	1.067	1.081	1.014	1.048	1.061	1.084	1.088	1.020	1.052	.028
9	.991	1.043	.913	1.022	.989	.880	1.072	1.061	1.092	1.083	1.014	.071
10	.763	.709	.715	.884	.738	.624	.715	.651	.909	.815	.752	.092
11	.789	.807	.761	.783	.817	.857	1.058	.787	.834	.932	.842	.089
12	1.193	1.328	1.353	1.180	1.345	.520	.968	1.239	1.344	1.272	1.174	.257
13	.797	.888	.743	.871	.810	.903	.969	.941	.997	1.004	.892	.088
14	1.060	1.113	.968	.773	.959	.911	.892	.983	1.256	1.064	.997	.133
15	.831	.955	.916	.938	1.013	1.047	.988	.932	.896	.874	.939	.065
16	.940	.896	1.016	.874	1.081	.836	.853	.920	.884	.619	.891	.121

APPENDIX F

SUMMARY OF CONTROL 2 START AND RUN TIME RAW DATA FOR GROUPS C-20 AND E-20

TABLE 31

START TIME SCORES (1/LATENCY) FOR GROUP C-20
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	1.103	1.108	.956	1.150	1.064	.974	1.053	.757	1.042	1.128	1.033	.115
2	.868	.767	.686	.873	.941	.914	.959	.926	.835	.878	.864	.084
3	.903	.924	.923	.946	.962	1.179	.988	1.034	.985	1.097	.994	.086
4	.771	.871	.861	.786	.846	.886	.968	.909	.874	.965	.873	.064
5	.748	.455	.411	.692	.607	.654	.715	.562	.652	.764	.626	.119
6	1.015	.887	1.037	1.100	1.231	.959	.812	.653	.956	1.085	.973	.162
7	.601	.625	.759	.716	.600	.470	.736	.632	.629	.613	.638	.083
8	.941	.952	.926	1.006	1.124	.956	.950	.985	1.061	1.059	.996	.065
9	1.132	1.128	1.072	.966	1.118	1.213	1.123	1.187	1.057	1.014	1.101	.075
10	1.257	1.261	1.336	.874	1.040	1.132	1.240	1.024	1.295	.966	1.142	.158
11	1.336	1.122	1.106	.633	1.113	.929	.947	.997	1.020	.975	1.017	.180
12	.431	.431	.511	1.079	.746	1.009	.597	.477	.465	1.385	.713	.334
13	.647	.542	.509	.722	.594	.759	.691	.641	.693	.451	.624	.099
14	.930	1.142	.925	.938	.994	1.275	1.175	1.158	1.170	1.216	1.092	.131
15	.883	.919	.722	.704	.793	.769	.536	.842	.720	.833	.772	.109
16	.964	.841	.739	.906	.793	.793	.685	.683	.963	.920	.828	.107

TABLE 32

START TIME SCORES (1/LATENCY) FOR GROUP C-20 ON CONTROL 2 FOLLOWING THEORETICAL NONREWARD

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.953	.995	.986	.942	.876	.917	.750	.987	1.140	1.079	.962	.106
2	.851	1.001	.853	.622	.926	.797	1.042	.871	.791	.967	.872	.121
3	.929	.991	.892	.931	1.129	1.026	.954	.971	1.008	1.043	.987	.068
4	.906	.894	.908	.816	.281	.832	.277	.978	.848	.938	.767	.262
5	.580	.819	.692	.926	.453	.723	.694	.250	.653	.576	.636	.188
6	1.021	.777	1.010	1.101	1.049	1.003	.995	1.008	.701	.959	.962	.124
7	.626	.674	.554	.655	.553	.498	.560	.614	.758	.494	.598	.082
8	1.016	.922	1.017	1.040	.980	.712	.993	1.066	.958	1.058	.976	.102
9	1.100	1.156	.966	1.251	1.176	.916	1.191	.838	1.209	1.075	1.087	.138
10	1.078	1.261	.884	1.209	1.098	1.070	1.129	1.259	1.172	1.034	1.119	.114
11	1.290	1.355	1.141	1.026	.991	.998	.923	.838	1.009	.978	1.054	.161
12	.494	.706	.551	.681	.822	1.088	1.336	.456	.925	.975	.803	.281
13	.530	.653	.609	1.035	.713	.821	1.453	.773	.500	.573	.766	.288
14	1.201	1.013	1.254	1.173	1.077	1.090	.813	.668	1.027	1.066	1.038	.177
15	.790	.750	1.148	.661	.843	.806	.651	.415	.835	.929	.782	.191
16	.965	.774	.919	.958	.975	.922	.773	.998	.848	.913	.904	.080

TABLE 33

RUN TIME SCORES (1/LATENCY) FOR GROUP C-20
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\overline{X}$	SD
Subjects												
1	1.126	.995	1.074	.974	1.029	1.128	.981	1.121	1.066	.961	1.045	.066
2	.846	.853	.824	.889	.881	.924	.728	.851	.834	.978	.860	.065
3	1.078	.821	.783	.954	.914	.774	.954	1.061	.927	1.031	.929	.109
4	.798	.792	.766	.753	.814	.782	.872	.856	.842	.863	.813	.042
5	.673	.673	.771	.640	.635	.643	.741	.663	.670	.714	.682	.045
6	.931	.910	1.129	1.206	.853	.853	.642	.747	.988	.904	.916	.165
7	.447	.739	.578	.569	.836	.765	.675	.751	.760	.796	.691	.122
8	.896	.814	.886	.811	.778	.740	.897	.817	.846	.838	.832	.051
9	.935	.823	.892	.919	1.117	.925	.955	.814	.866	1.095	.934	.101
10	1.025	.856	.945	.801	.803	1.024	.984	.918	.740	.636	.873	.128
11	.968	.959	1.013	1.108	.823	.758	.663	.730	.840	.742	.860	.144
12	.338	.509	.565	.626	.637	.657	.784	.784	.761	.896	.655	.161
13	.766	.549	.889	.455	.698	.829	.652	.691	.741	.653	.692	.127
14	.920	.773	.840	.841	.925	.884	.886	.838	.824	.807	.853	.049
15	.589	.691	.706	.708	.741	.759	.871	.871	.775	.816	.752	.086
16	.794	.788	.781	.657	.836	.854	.859	.885	.797	.812	.806	.062

TABLE 34

RUN TIME SCORES (1/LATENCY) FOR GROUP C-20 ON CONTROL 2 FOLLOWING THEORETICAL NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.956	1.059	.973	.931	.912	1.144	.976	1.025	1.053	1.100	1.012	.075
2	.960	.999	.896	.893	.773	1.165	.990	.952	1.062	.993	.968	.104
3	.878	.863	.850	.890	.958	1.006	.789	.914	.978	.990	.911	.070
4	.813	.919	.799	.831	.805	.782	.792	.816	.868	.857	.828	.042
5	.732	.720	.674	.611	.722	.671	.723	.741	.672	.726	.699	.040
6	.900	.940	1.009	1.005	1.067	.968	1.020	.978	.938	1.084	.990	.057
7	.742	.770	.510	.402	.841	.739	.741	.821	.761	.742	.706	.139
8	.825	.865	.848	.789	.789	.892	.794	.853	.925	.830	.841	.045
9	1.025	.941	.970	1.033	1.020	.940	.928	.733	.987	1.069	.964	.093
10	.716	.763	.896	1.028	.834	.710	.845	1.064	.684	.645	.818	.143
11	.870	.940	.917	.945	.789	.796	.716	.746	.758	.732	.820	.089
12	.415	.488	.462	.522	.567	.773	.769	.725	.828	.877	.642	.169
13	.798	.677	.727	.806	.565	.739	.688	.791	.594	.631	.701	.085
14	.857	.808	.881	.827	.946	.856	.803	.892	.795	1.424	.908	.186
15	.749	.686	.569	.786	.746	.640	.832	.751	.803	.686	.724	.079
16	.793	.812	.805	.734	.789	.811	.858	.794	.904	.869	.816	.048

TABLE 35

START TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.703	.641	.944	.718	.668	.641	.797	.934	.698	.851	.759	.115
2	1.264	1.285	1.698	1.449	1.196	1.196	1.154	1.312	1.231	1.162	1.294	.166
3	.755	.925	.586	.949	.690	.425	.514	.290	.993	.247	.637	.270
4	1.164	.865	1.152	1.078	1.176	1.219	1.175	1.138	1.149	1.303	1.141	.113
5	.894	.892	1.043	.950	1.010	.579	.686	.875	.807	.959	.869	.144
6	1.191	1.428	1.033	1.420	1.272	1.009	1.034	1.145	1.353	1.098	1.198	.161
7	.797	.969	.918	.892	.584	.773	.775	.740	.820	.912	.818	.111
8	1.216	1.196	1.225	1.331	.757	.970	.939	.249	1.085	1.131	1.009	.315
9	.606	.749	.723	.711	.795	.932	.848	.733	.954	.881	.793	.109
10	.821	.551	.874	.749	.764	.905	.865	.991	.771	.975	.826	.128
11	1.055	1.013	.808	.964	.541	.679	.969	.898	.940	.488	.835	.200
12	.776	.855	.696	.751	.687	.944	.919	.838	.871	.844	.818	.087
13	.752	.726	.651	.128	.703	.560	.425	.362	.451	.682	.544	.200
14	1.069	.778	1.039	.959	1.170	1.117	1.142	1.161	1.129	1.025	1.058	.119
15	.783	.581	.543	.868	.821	.523	.618	.327	.666	.427	.615	.173
16	1.129	.981	1.072	1.283	1.184	1.189	1.112	1.196	1.180	1.176	1.150	.082

TABLE 36

START TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 2 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.776	.827	.570	.779	.667	.793	.833	.884	.660	.794	.758	.095
2	1.210	1.282	1.297	1.383	1.213	1.464	1.127	1.257	1.144	1.131	1.250	.110
3	.335	.251	.347	.757	.281	.928	.854	.670	.445	.189	.505	.271
4	.964	1.199	.963	1.084	1.100	1.148	1.054	.994	1.119	1.675	1.130	.206
5	.105	.118	.640	.377	.826	1.002	1.047	.944	.807	.982	.684	.361
6	1.101	1.194	1.047	1.116	1.098	.750	1.131	1.310	1.085	1.089	1.092	.141
7	.693	.537	.751	.707	.904	.836	1.100	1.029	1.071	.968	.859	.186
8	.467	1.282	1.111	.437	.375	1.209	.460	.490	1.156	1.116	.810	.388
9	.395	.569	.400	.732	.797	.931	.805	.979	.797	.790	.719	.201
10	.699	.539	.379	.659	.342	.685	.677	.884	.912	.534	.631	.188
11	1.033	.321	.663	.660	.993	.797	.934	.783	.474	.972	.763	.235
12	.711	.879	.616	.854	.816	.855	.917	.911	.910	.866	.833	.097
13	.425	.606	.542	.429	.413	.443	.553	.478	.483	.527	.489	.064
14	.816	.927	.982	1.085	.707	1.048	1.060	1.186	1.069	.844	.972	.147
15	.320	.561	.560	.517	.479	.322	.644	.485	.284	.501	.467	.119
16	.777	1.161	1.290	1.265	1.199	1.112	.836	.977	1.204	1.248	1.106	.182

TABLE 37

RUN TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 2 FOLLOWING REWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.651	.665	.683	.691	.582	.671	.688	.682	.701	.691	.670	.034
2	.829	1.161	.982	1.106	1.127	1.203	1.162	1.293	1.008	1.221	1.109	.135
3	.687	.784	.669	.794	.625	1.000	.991	.838	.858	.746	.799	.126
4	.960	.950	1.002	1.024	.982	.999	.959	1.066	1.085	1.095	1.012	.053
5	1.017	.916	.944	.961	.686	.991	.934	.966	.877	.970	.926	.092
6	1.100	1.012	1.158	1.060	.451	1.035	.834	1.091	.951	1.041	.973	.203
7	.730	.768	.943	.392	.784	.887	.807	.947	.926	.836	.802	.163
8	1.048	1.440	1.014	1.297	.962	1.307	1.223	.987	1.207	1.228	1.171	.160
9	.679	.708	.961	.928	.952	.895	.807	.845	.937	.896	.860	.100
10	1.338	1.347	1.422	1.104	.964	1.321	1.218	.845	1.160	1.335	1.205	.187
11	.843	.918	.919	.937	.998	.884	1.083	.991	.984	.978	.953	.067
12	.773	.736	.761	.789	.815	.745	.835	.778	.753	.827	.781	.034
13	.354	.304	.359	.347	.331	.370	.354	.341	.287	.398	.344	.031
14	.740	.868	.852	.772	.839	.794	.874	.911	.841	.888	.837	.053
15	.801	.473	.445	.780	.727	.548	.611	.619	.438	.488	.593	.137
16	1.109	1.126	1.059	1.117	1.170	1.219	1.203	1.216	1.140	1.103	1.146	.053

TABLE 38

RUN TIME SCORES (1/LATENCY) FOR GROUP E-20
ON CONTROL 2 FOLLOWING NONREWARD.

Trials	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Subjects												
1	.696	.731	.723	.666	.641	.701	.699	.711	.678	.673	.691	.027
2	1.067	1.077	.972	1.203	1.230	1.293	1.103	1.282	1.203	1.173	1.160	.102
3	.579	.568	.965	.904	.931	.777	.828	.840	.890	.883	.816	.138
4	1.055	1.048	.990	1.051	1.050	.979	1.031	.972	1.063	1.034	1.027	.033
5	1.002	.998	.938	.868	1.018	.904	1.011	.931	.955	.999	.962	.051
6	1.104	1.009	1.079	1.137	1.064	1.166	.924	1.033	1.048	1.138	1.070	.071
7	.931	.920	.536	.945	.424	1.090	1.179	.899	1.082	.900	.890	.237
8	1.362	1.381	1.158	.464	.443	1.029	1.278	.465	1.118	1.053	.975	.376
9	.642	.600	.821	.856	.986	.868	.884	.909	.823	.842	.823	.117
10	1.009	.821	1.019	1.058	1.406	.984	1.097	1.094	.992	1.077	1.055	.146
11	.993	.874	.925	.800	.917	1.055	.907	.879	1.025	.931	.930	.075
12	.694	.632	.821	.833	.868	.871	.919	.765	.810	.819	.803	.085
13	.386	.316	.341	.284	.252	.399	.405	.332	.352	.384	.345	.050
14	.851	.831	.791	.824	.870	.884	.933	.931	.768	.955	.863	.062
15	.995	.500	.639	.611	.564	.507	.524	.519	.458	.526	.584	.153
16	.846	.669	1.092	.580	1.179	1.204	1.200	1.182	1.152	1.112	1.021	.234

APPENDIX G

SUMMARY OF ANALYSES OF CONTROL 1 START AND RUN TIMES FOR GROUPS C-10 AND E-10

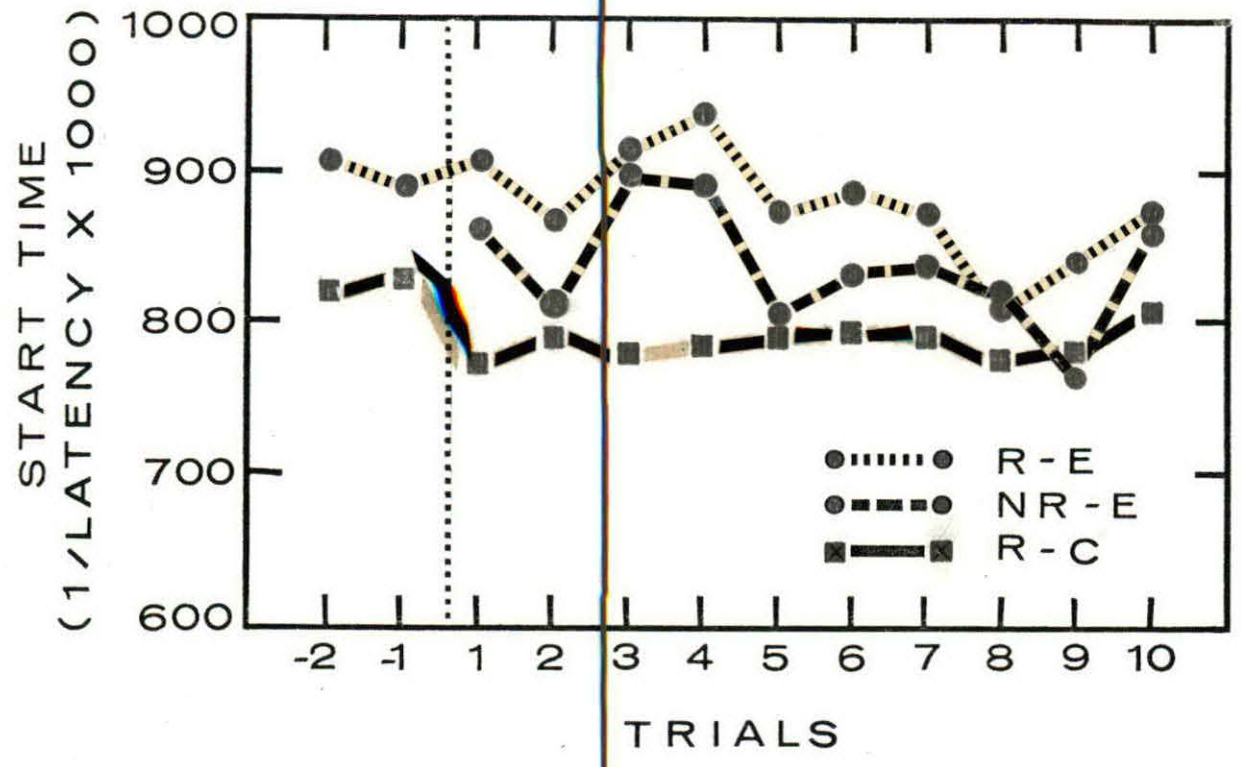
TABLE 39

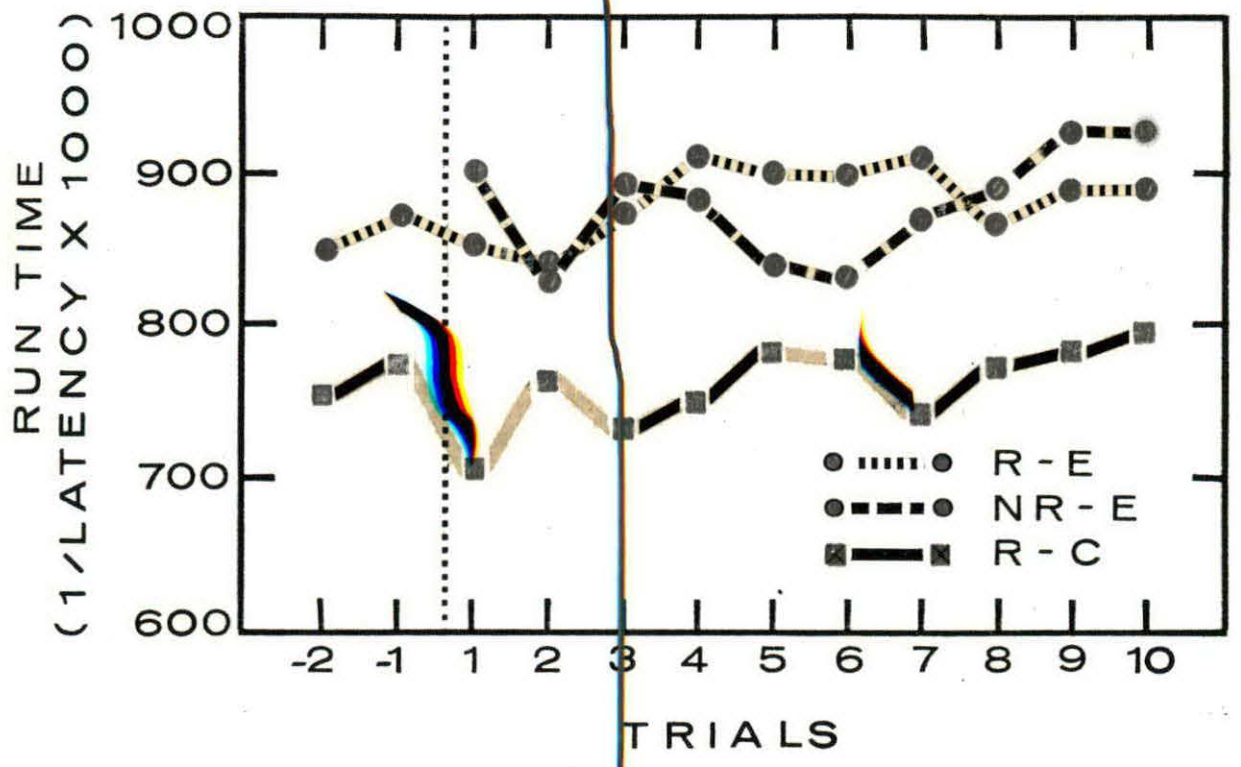
SUMMARY OF ANALYSES OF VARIANCE PERFORMED ON CONTROL 1 START AND RUN TIMES FOR GROUPS C-10 AND E-10.

Source	df	START TIMES MS	F	RUN TIMES MS	F
Between Ss	31				
E vs. C	1	757419.20	1.81	2344859.56	8.73**
Error	30	418065.48		268328.83	
Within Ss	608				
Trials	9	19780.87	1.29	25773.37	1.55
E vs. C X Trials	9	33039.94	2.16	20169.51	.90
Error	207	15276.80		22308.04	
R vs. NR	1	37991.81	3.40*	13754.82	1.20
E vs. C X R vs. NR	1	98878.16	8.85**	3985.01	.34
Error	30	11166.48		11439.18	
Trials X R vs. NR	9	4196.16	.38	25655.58	1.64
E vs. C X Trials X R vs. NR	9	5753.63	.52	8967.34	.57
Error	270	10923.03		15615.80	

*$p < .05$ **$p < .01$

Figure 4. Experimental and control start and run time speeds for groups C-10 and E-10 on Control 1.


START TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C


RUN TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C

APPENDIX H

SUMMARY OF ANALYSES OF CONTROL 1 START AND RUN TIMES FOR GROUPS C-20 AND E-20

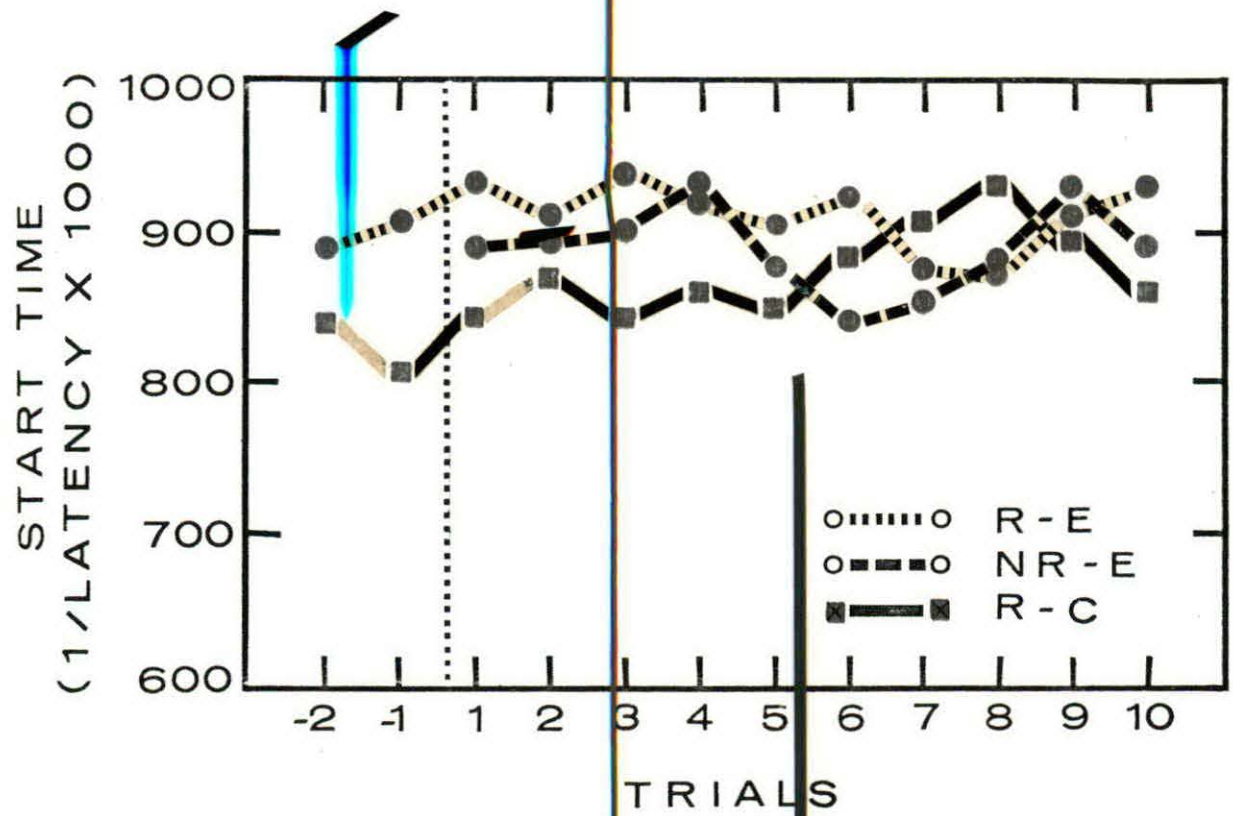
TABLE 40

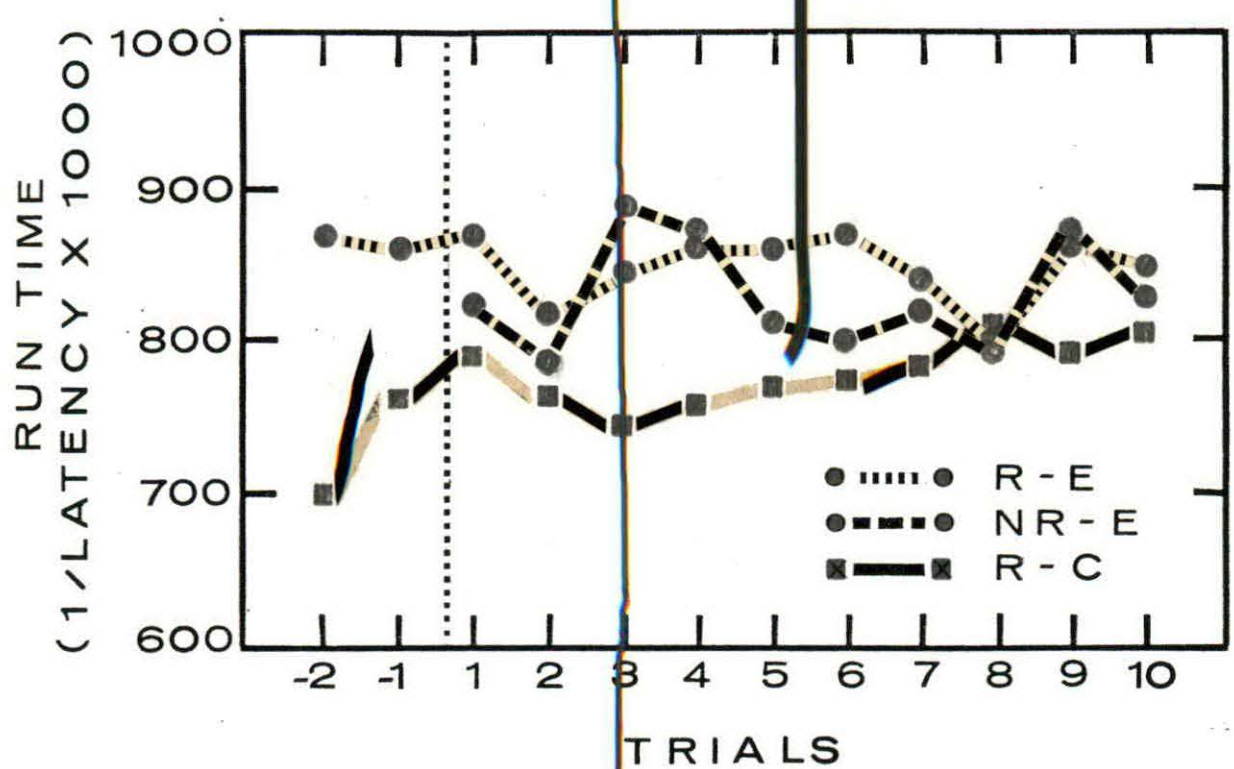
SUMMARY OF ANALYSES OF VARIANCE PERFORMED ON CONTROL 1 START AND RUN TIMES FOR GROUPS C-20 AND E-20.

Source	df	START TIMES MS	F	RUN TIMES MS	F
Between Ss	31				
E vs. C	1	96997.87	.15	58545.51	1.30
Error	30	629864.04		449197.74	
Within Ss	608				
Trials	9	7590.54	.40	14488.15	.83
E vs. C X Trials	9	40744.27	2.17*	18362.20	1.05
Error	270	18742.00		17443.94	
R vs. NR	1	34178.63	.44	1846.20	.14
E vs. C X R vs. NR	1	281946.07	3.70*	66198.56	5.27*
Error	30	76034.86		12549.72	
Trials X R vs. NR	9	26650.05	1.11	11047.51	.71
E vs. C X Trials X R vs. NR	9	8041.39	.71	28020.53	1.81
Error	270	11322.03		15416.79	

*$p < .05$

Figure 5. Experimental and control start and run time speeds for groups C-20 and E-20 on Control 1.


START TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C


RUN TIME
(1/LATENCY X 1000)
1000
900
800
700
600
-2 -1 1 2 3 4 5 6 7 8 9 10
TRIALS
R - E
NR - E
R - C

APPENDIX I

SUMMARY OF ANALYSES OF CONTROL 2 START AND RUN TIMES FOR GROUPS C-10 AND E-10

TABLE 41

SUMMARY OF ANALYSES OF VARIANCE PERFORMED ON CONTROL 2 START AND RUN TIMES FOR GROUPS C-10 AND E-10.

Source	df	START TIMES MS	F	RUN TIMES MS	F
Between Ss	31				
E vs. C	1	16615.01	.03	1817743.32	4.27*
Error	30	542554.10		425014.54	
Within Ss	608				
Trials	9	25961.32	1.02	152258.28	1.62
E vs. C X Trials	9	14604.49	.57	88186.25	.94
Error	270	25279.98		93428.60	
R vs. NR	1	242775.35	7.43*	60879.00	.70
E vs. C X R vs. NR	1	65873.51	2.01	52200.62	.60
Error	30	32662.38		86421.17	
Trials X R vs. NR	9	14197.30	.73	66158.52	.77
E vs. C X Trials X R vs. NR	9	40726.47	2.10*	71898.36	.84
Error	270	19387.91		84985.20	

*$p < .05$

TABLE 42

SUMMARY OF ANALYSES OF VARIANCE UTILIZED IN INTERACTION ANALYSIS ON GROUPS C-10 AND E-10 ON CONTROL 2 START TIME SCORES.

Source	df	TRIAL 2 MS	TRIAL 2 F	TRIAL 10 MS	TRIAL 10 F
Between	31				
Groups	1	8672.26	.11	5625.00	.07
R - NR	1	85922.26	3.38	1501.56	.07
G X R - NR	1	243912.51	9.60**	101283.06	5.19*
Error	30	25398.05		19488.91	

*$p < .05$ **$p < .01$

TABLE 43

SUMMARY OF t-TESTS UTILIZED IN INTERACTION ANALYSIS ON GROUPS C-10 AND E-10 ON CONTROL 2 START TIME SCORES.

Source	TRIAL 2 df	TRIAL 2 t	TRIAL 10 df	TRIAL 10 t
Start time : E X C	30	1.26	30	.75
Run time: E X C	30	1.86	30	1.35
Start time: R X NR	15	1.23	15	1.62
Run time: R X NR	15	2.87*	15	1.62

*$p < .05$

APPENDIX J

SUMMARY OF ANALYSES OF CONTROL 2 START AND RUN TIMES FOR GROUPS C-20 AND E-20

TABLE 44

SUMMARY OF ANALYSES OF VARIANCE PERFORMED ON CONTROL 2 START AND RUN TIMES FOR GROUPS C-20 AND E-20.

Source	df	START TIMES MS	F	RUN TIMES MS	F
Between Ss	31				
E vs. C	1	211702.50	.26	426009.59	.73
Error	30	788602.74		576368.20	
Within Ss	608				
Trials	9	34913.15	1.06	33261.60	1.90*
E vs. C X Trials	9	20828.91	.63	9154.78	.52
Error	270	32706.92		17436.09	
R vs. NR	1	251936.25	10.62**	5.62	0.00
E vs. C X R vs. NR	1	273654.30	11.53**	16402.50	.77
Error	30	23713.88		21277.45	
Trials X R vs. NR	9	34415.12	1.33	6544.89	.57
E vs. C X Trials X R vs. NR	9	69361.12	2.68**	12902.58	1.12
Error	270	25849.58		11479.17	

*$p < .05$ **$p < .01$

TABLE 45

SUMMARY OF ANALYSES OF VARIANCE UTILIZED IN INTERACTION ANALYSIS ON GROUPS C-20 AND E-20 ON CONTROL 2 START TIME SCORES.

Source	df	TRIAL 2 MS	TRIAL 2 F	TRIAL 3 MS	TRIAL 3 F	TRIAL 4 MS	TRIAL 4 F
Between	31						
Groups	1	146401.89	1.33	45156.24	.47	18123.89	.18
R - NR	1	294984.76	15.59**	13865.06	.49	31639.51	.91
G X R - NR	1	243172.26	12.85**	118336.00	4.21*	169641.01	4.91*
Error	30	18910.14		28046.09		34487.73	

*$p < .05$ **$p < .01$

TABLE 46

SUMMARY OF t-TESTS UTILIZED IN INTERACTION ANALYSIS FOR GROUPS C-20 AND E-20 ON CONTROL 2 START TIME/SCORES.

Source	TRIAL 2 df	TRIAL 2 t	TRIAL 3 df	TRIAL 3 t	TRIAL 4 df	TRIAL 4 t
Start time: E X C	30	.34	30	.40	30	.75
Run time: E X C	30	2.22*	30	1.47	30	1.48
Start time: R X NR	15	.42	15	1.07	15	1.02
Run time: R X NR	15	4.17**	15	1.76	15	2.00

*$p < .05$ **$p < .01$