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NOVELTY AS REINFORCEMENT FOR CHILDREN

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FOREWORD

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1.0. INTRODUCTION

Both animals (Fowler, 1965) and young children (Cantor, 1963) have been shown to prefer (i.e., choose) novel stimuli (NS) over familiar stimuli (FS). The animal literature further shows that the preferred stimulus, i.e., the NS, is reinforcing: S will learn to perform an instrumental response so as to produce the NS. Comparable instrumental data, however, are lacking for children. The major problem, as Odom (1964) notes, is mainly a technical one: children cannot be kept in isolation for long periods of time, thus limiting operations of the length of novelty deprivation and/or stimulus satiation.

In response to the absence of instrumental learning data, Odom (1964) conducted a study designed to assess the effects of satiation or "deprivation" operations on children's responses for novel stimuli. In a familiarization phase, where a given set of stimuli was presented twice, Odom satiated groups of children to either visual or auditory stimuli, or to a combination of both. An additional group received no stimulation. In a subsequent test phase, the children had access to both types of stimulation via a disc-turning response. The children, 8-11 years old, showed higher rates of responding for the novel (deprived) stimuli and rate of responding increased over time of testing for all but the visual-auditory satiation control group.

Despite the fact that Odom (1964) demonstrated a learning effect, it is difficult to specify the incentive(s) involved. The stimuli which he utilized were quite varied (10 different colored lights and 10 different tones), so that it seems unlikely that the small number of presentations of any particular stimulus (two presentations per color or tone) during the satiation phase could have effectively produced adequate satiation for every stimulus of a set (visual or auditory). Consequently, in the test phase, Odom may have been assessing information reinforcement, i.e., the child's response for unpredictable stimulus events rather than for novelty alone.

To eliminate responding for information rather than for novelty, a simple design is required. An experimental paradigm which has been utilized to demonstrate the Stimulus Familiarization Effect (SFE) appears to be both suitable and easily adaptable for the purpose of assessing instrumental responding for novelty in children.

The SFE paradigm has reference to a reaction-time task where shorter reaction times are obtained in response to the NS, or conversely, longer reaction times in response to the FS. The phenomenon was initially described by the Cantors (1964) and later Bogartz and Witte (1966) labeled it the SFE. The typical SFE paradigm involves exposing children to either a red or green light in a familiarization phase (phase I). Then, in a test phase (phase II), the children are required to perform a simple, reaction-time task in response to the FS and NS presented singly.

The reaction-time tasks employed have been of three kinds: non-differentiated lever pulling (Witte, 1965; Witte & Cantor, 1967), non-differentiated button pressing (Bogartz & Witte, 1966, Study I), and differentiated button pressing. In the latter arrangement, the buttons are colored-coded to the novel and familiar stimulus (Cantor &

Cantor, 1965; Cantor & Cantor, 1966; Cantor & Fenson, 1968; Bogartz & Witte, 1966, Study II). Providing that stimulus familiarization conditions during phase I are adequate, the SFE will obtain with any of the types of reaction-time tasks utilized, i.e., shorter reaction times will prevail in initiation of the response to the NS.

The stimulus parameters which have been found to affect the SFE are (1) the number of FS presentations during phase I, (2) the duration of the FS, and (3) the degree of dissimilarity or change of the NS relative to the FS. Cantor and Fenson (1968) have studied the effects of number of presentations of the FS during the familiarization phase. These investigators found that a minimum of 18 presentations of the FS, with a 3 sec. stimulus duration, was necessary to produce the SFE. Witte (1965), on the other hand, investigated the duration of the FS and found that the minimum stimulus duration (STD) necessary was 1.5 sec., using 40 presentations. The effects of a possible interaction between number of stimulus presentations and STD have not been assessed. Kubose (1970) studied the effects of degree of NS change on the SFE. Using four colored lights (red, orange, yellow and green), representing three increasing degrees of change (NS1, NS2, NS3) relative to the FS, he found that Ss showed fastest reaction times to the most novel stimulus (NS3), intermediate reaction times to the next most novel stimuli (NS2 and NS1), and slowest reaction times to the FS. The reaction times produced by the lower degrees of change (NS1 and NS2) did not differ significantly from that produced by the NS.

Witte and Cantor (1967) demonstrated that the SFE is a durable phenomenon. These investigators employed the typical SFE paradigm, but required the children to respond to the offset, rather than to the onset, of the FS and NS. Again, the SFE obtained. In addition, the Cantors have demonstrated the generality of the phenomenon. The SFE appears to obtain regardless of the kind of stimulus modality employed. Cantor and Cantor (1964) utilized a light or a buzzer as the FS, with the other stimulus serving as the NS during the test phase. The children responded significantly faster to the NS regardless of modality.

In a study investigating the reinforcing effects of novelty within the context of the SFE paradigm, Manley and Miller (1968) showed that children, given a choice between the FS and NS, exhibited an instrumental preference for the NS. Manley and Miller varied the number of presentations of the FS (red or green light) in a geometric progression from 0-24. Then, for the choice (test) phase, they told their Ss which buttons would produce which lights. Their major finding was that familiarization increased choices of the NS on the first choice-trial, but amount of familiarization was not an effective variable in influencing choice of the NS on this trial or any of the other trials and did not affect response latency. That Manley and Miller were not able to show a significant effect of amount of familiarization on instrumental choice behavior, may have been due to the comparatively long (14 sec.) stimulus duration (STD) interval employed in both the familiarization and choice phases. The typical STD intervals employed in other SFE studies ranged from 1.5 - 4.5 sec. Thus, in the familiarization phase, a 14 sec. STD may have produced significant satiation to the FS in one trial, with further trials producing little, if any, increment in satiation. The same holds true regarding the STD for the novel stimulus in the choice phase, that is, a 14 sec. STD could have produced significant satiation to the NS in just one trial.

Despite Manley and Miller's (1968) failure to demonstrate either initial differential or sustained instrumental responding for the novel (i.e., changed) stimulus as a function of amount of familiarization, their study represents a significant improvement in the area of child studies designed to assess the effects of novelty on choice behavior. As Cantor (1963) correctly concludes from his review of the early literature in this area, the studies suffer from a number of limitations, the most serious being a failure to operationally define novelty. Apparently, none of the early studies adequately controlled for S's previous exposure to (i.e., familiarity with) the tested "novel" stimuli, so it is not surprising that the results of these studies were most often inconclusive, if not contradictory.

With the exception of the Manley and Miller (1968) study, attempts in the past few years to assess the effects of novel stimuli on children's behavior have continued to focus on simple preferences for familiarized (FS) and non-familiarized (NS) stimuli. In this research, the necessity of experimentally controlling antecedent satiation operations, that is, stimulus familiarity, has become somewhat more widely recognized. Nevertheless, a close reading of many of the studies still reveals a number of limitations, such as (1) a failure to maintain equivalent satiation conditions across Ss, i.e., Ss are permitted to control the amount of satiation they experience to the to-be-familiarized stimuli (e.g., Cantor & Cantor, 1964a; and Cantor & Cantor, 1964b), (2) a confounding of novelty and complexity, i.e., varying both factors concomitantly and attributing any changes in behavior to novelty alone (e.g., Cantor & Cantor, 1964a; and Cantor & Cantor, 1964b), and (3) a problem related to the point immediately above, a failure to vary the FS and NS systematically along clearly specified dimensions, i.e., the tendency to vary color, form, pattern, orientation, and even sensory modality simultaneously, making it difficult, if not impossible, to ascertain to what, or for what, S is responding (e.g., Cantor & Cantor, 1964a; Cantor & Cantor, 1964b; and Odom, 1964).

The Cantors' (1964a; 1964b) studies conveniently illustrate all three problems. In both of these studies, there was a failure to maintain equivalent satiation conditions across Ss. After a given number of presentations of a series of stimuli to-be-familiarized, the children were allowed to control the amount of time they wished to view any individual cartoon or figure in the familiarization series. Only after this trial was the test phase initiated. More serious is the confounding of novelty and complexity in these two studies. One study utilized Kenner Give-a-Show cartoons and the other, Welsh Figure Drawings. Both of these sets of stimuli typically show greater intra-stimulus variation, i.e., complexity, which is usually defined as within stimulus variation, rather than inter-stimulus variation, i.e., novelty, which is usually defined as between stimulus variation. Nevertheless, the authors insist on attributing any changes in the children's behavior as being due to novelty alone. A concurrent problem of confounding novelty and complexity is the failure to vary the FS and NS systematically along clearly specified dimensions. In the Cantors' studies, it can readily be noted that the cartoons varied stimultaneously in color, form, pattern, and orientation, and the Welsh Figures differed in form, pattern, and orientation, as well. The same criticism with respect to lack of systematic variation applies to the Odom (1964) study of instrumental responding for "novelty" discussed previously. Such simultaneous variation in more than one dimension makes it impossible to designate empirically to what, or for what, the children are actually responding. In general, however, the deficiencies of the Cantors' studies demonstrate two important factors which have typically been ignored: the need to operationally define novelty, and the need to experimentally control and systematically vary deprivation-satiation variables.

Another problem encountered in the novelty literature is the fragmentation and isolation of research efforts in this area. There are investigators studying novelty-preference behavior, others studying instrumental responding for novelty, and still others studying the effects of novelty on attention phenomenon. To this writer's knowledge, there are no studies attempting to assimilate these various aspects of behavior.

The SFE studies described previously, are usually treated as attention and orientation phenomena. However, placed in an experimental context such as the one Manley and Miller devised, the SFE technique adapts itself as well to the study of instrumental learning, that is, responding for novelty (stimulus change). Thus, the SFE paradigm can be viewed as providing a point of transition between and a means of assimilating the attention and reinforcing functions of novel stimuli. An additional advantage is that of experimental control. Because the SFE is basically a simple paradigm, it permits systematic control over relevant aspects of the novel and familiar stimuli. For example, only one sensory modality (visual) and two stimulus dimensions (color and form) are utilized. Variation, that is, change in relevant stimulation from familiarization to test phase, occurs in only one stimulus dimension, typically color (a red or green light). Sensory modality (visual) and the second stimulus dimension (form, e.g., square) remain unchanged. A further advantage of using the SFE paradigm in a learning context is that the major variables controlling the familiarity, or conversely novelty, of a stimulus have already been designated, namely, number of exposures (presentations), duration of exposure (STD), and degree of change of the NS relative to the FS. These variables, it is interesting to note, parallel those influential with animal Ss in the context of learning based on novelty rewards (Fowler, 1965).

2.0. STATEMENT OF PROBLEM

As described above, one of the important questions in the area of novelty and its effects on children's behavior is whether relative novelty can establish and maintain a response instrumental to the production of that novelty. A basically uncomplicated experimental design is essential, and the SFE paradigm appears to be both simple and directly adaptable to such a purpose.

The only modification needed is changing the requirements of the test phase (phase II) from a simple RT task to a simple instrumental (choice) task, upon which novelty (or familiarity) is contingent. A guide to the manipulation of the appropriate variables is provided by the SFE literature, as noted: the major variables influencing the response to the NS are (1) the degree of satiation to the FS, which varies with (a) the number of exposures or presentations, and (b) the length of exposure to the FS, that is, the STD interval; and (2) degree or amount of change of the NS relative to the FS. Consequently, to assess the effect of novelty reward on instrumental learning by children, this study varied (1) the number of stimulus exposures (10 or 20), (2) the STD interval (1 or 2 sec.), and (3) the amount of stimulus change (low or high).

The stimulus presentation values of 10 and 20 exposures and the STD intervals of 1 and 2 sec. were selected because SFE studies generally show that 18 presentations and an STD interval of 1.5 sec. represent the minimum conditions necessary to produce the SFE (Cantor & Fenson, 1968). Thus, the values of the present study ranged from below to near or at the minimum of those which have been shown to produce the SFE. The third variable, amount of change, is another direct way of varying degree of novelty relative to the FS, which is controlled by number of exposures and STD interval. Because it has been demonstrated that the SFE is differentially affected by differing degrees of novelty (Kubose, 1970), three colored lights (red, orange-yellow, and green) were used in the test phase of the present study to produce two degrees of change: low, R-OY, G-OY; and high, R-G, G-R. In view of the fact that "lower degrees" of stimulus change do not produce significantly different results from the FS, the present study collapsed these lower degrees of stimulus change into one color, orange-yellow, to represent the low-change condition.

It was anticipated that instrumental responses for the novel stimulus, the dependent measure of learning, would increase with (1) the greater number of exposures, (2) the larger STD interval, and (3) the greater degree of dissimilarity between the NS and FS. That is, learning should be maximal under the 20 exposure, 2 sec. STD, and high-change conditions.

3.0. METHOD

3.1. Subjects

The subjects were kindergarten children 4 1/2 - 5 1/2 years of age. A total of 120 Ss were studied, 60 boys and 60 girls. These Ss were obtained from local urban public schools whose student populations represent predominantly lower socioeconomic status groups. Information on IQ was not available, but teachers' estimates of the students' proficiency was that they were "slow learners." Approximately 90% of the Ss were Black children.

3.2. Apparatus

The apparatus was highly similar to that described by Cantor and Cantor (1965) and Witte and Cantor (1967). The stimulus-response unit was a box measuring 16 1/2 in. wide, 16 1/2 in. high, and 11 in. deep. A sloping horizontal panel, 16 1/2 in. wide and from 1 - 3 in. high, was attached at the base of and extended 13 1/2 in. from the front face of the box. A 4 in. square aperature, covered by a piece of 1/8 in. frosted plexiglas, was located 2 3/4 in. from the top edge and at the center of the vertical (16 1/2 in. wide by 13 1/2 in. high) surface which comprised the front face of the box from S's view. Three 25-W colored bulbs (red, orange-yellow, and green) were located on a rotating base within the box and behind the aperture.

Two circular response buttons each 2 in. in diameter, were mounted 8 in. apart on the sloping horizontal panel. Each button was 4 in. from the midline, 2 1/4 in. from the side edge and 2 1/2 in. from the top edge of the panel. A third, rectangular button (2 in. wide by 1 in. long) served as a start button, and was mounted on the midline, 1 in. from the botton edge of the panel and equidistant (9 1/4 in. diagonally) from each response button. The box, panel and buttons were all painted flat gray.

Other internal components of the apparatus included a Hunter decade interval timer, a buzzer, two precision timers, and micro-switches that were activated by the response buttons. During phase I, the interval timer regulated both the duration of each stimulus exposure (STD) and the intertrial interval. The precision timers, as well as the interval timer were utilized in phase II, the test phase. Given S's depression of the start button, E's sounding of a buzzer simultaneously activated the first precision timer. S's Start Response, i.e., lifting his hand off the start button, deactivated the first precision timer and activated a second timer. Depression of either response button (the Execution Response) deactivated the second precision timer and activated the appropriate light and the interval timer. At the end of the STD, the interval timer terminated the light. The precision timers measured S's response latencies to the nearest 0.01 sec. The buzzer was centrally located behind the front panel of the box to prevent S from associating it with any particular position.

3.3. Procedure

3.31. Phase I

Each S was individually escorted to a dimly illuminated room and was seated at the table containing the stimulus-response unit. The S was told that he could play a game with this machine. However, before he could play the game, E had to "check the machine out" to make sure it was working properly. S was told to watch the window very carefully, and if a light came on every time he heard a click, then the machine was okay, and E could tell him how to play the game. Following these instructions, E seated herself behind the apparatus, randomly assigned S to one of four familiarization conditions, and initiated the appropriate stimulus presentations.

3.32. Phase II

When the familiarization presentations ended, E instructed S in the use of the buttons. S was told that now he himself could make a light appear. E ascertained which was S's preferred hand and told S to keep that hand on the start button, and when he heard the "go" signal, a short buzzer sound, he was to lift his hand off the start button as quickly as he could and press one of the two (light) buttons above. S was further instructed that he could push whichever light button he wanted. When the light went off, he was to return his hand to the start button and wait for the next buzzer signal. The S was then given two practice trials (one on each light button with the buzzer sounding, but without the lights). Following these trials, E returned to her position behind the apparatus. Each S was given 40 learning trials with a variable time interval (average 5.0 sec.) between S's hand on the start button and onset of the buzzer signal. At light offset, E recorded the choice response and the latencies of the start and execution responses.

3.4. Design

The 120 Ss were randomly assigned, with sex balanced, to 8 groups comprising a 2 x 2 x 2 factorial design. This design varied the number of exposures to and the stimulus duration interval of the to-be-familiarized stimulus in phase I, and the amount of change provided by the novel stimulus in phase II.

In the familiarization phase (phase I), Ss received either 10 or 20 exposures to the to-be-familiarized stimulus, set at a duration of either 1.0 or 2.0 sec. per exposure. Throughout phase I, the inter-trial interval was 5.0 sec., and the FS was either a red or green light, with these alternatives balanced for the Ss' sex.

The test phase (phase II) consisted of a simple, position-learning task. On each trial, S had a choice of pushing one of two buttons. Pushing one button consistently produced the FS (either the red or green light), while pushing the other button consistently produced one of two NS (orange-yellow or green/red), which differed in degree of change, low or high, respectively, from the FS. Each S experienced only one NS, representing one of the two degrees of change. Ss in the low-change condition received either R-OY or G-OY, i.e., for those Ss experiencing red as the FS, orange-yellow was the NS; similarly, for those Ss experiencing green as the FS, orange-yellow was also the NS. Ss in the high-change condition received either R-G or G-R. The spatial relationships (R or L) of the buttons controlling presentation of the NS and FS were balanced over Ss. Given NS and FS button positions were maintained over each of the 40 learning trials for any particular S.

For all groups, the duration of the NS or FS in phase II was 0.5 sec. on each trial. Again, a variable time interval (average 5.0 sec.) was employed between S's hand on start button and onset of the buzzer ("go") signal. This variable intertrial interval was necessary so that S could not anticipate the buzzer and initiate hand withdrawal prematurely; also within this time, E had sufficient time to record the response measures. In addition to the choice response, each trial provided two latency measures: start response latency, i.e., the time from presentation of the ready signal until S lifted his hand off the start button, and the execution response latency, i.e., the time taken by S to press a response button after releasing the start button.

4.0. RESULTS

4.1. Choice Data

4.11. Mean Novel Responses (NRs)

Figure 1 presents mean NRs, i.e., responses on the novel stimulus button, in 5-trial blocks for Ss of the 1 and 2 sec. duration and 10 and 20 exposure subgroups. As shown, there was a rise in NR frequency during early training for Ss of the 20-2 sec. group, whereas Ss in the other groups performed essentially at chance. This difference between the 20-2 sec. Ss and Ss in the other conditions was maintained over the course of training. Accordingly, the results of an analysis of variance of NRs over the entire course of training (Table 1) showed a significant duration (D) x exposure (E) interaction. Apart from gender (G) considerations, all other effects relating to the experimental variables were non-significant.

Figure 1 suggests, however, that differences among the treatment conditions were maximal early in training, and that they diminished over the course of training. Thus, separate analyses of variance were performed for early and late training (i.e., trial blocks 1-4 and 5-8). These analyses showed that there was a significant D effect, as well as a significant D x E interaction, during the first half of training (Table 2), but that these effects diminished with continued training so that for the last half of training, the D effect was not reliable and the D x E interaction only marginally reliable (Table 3).

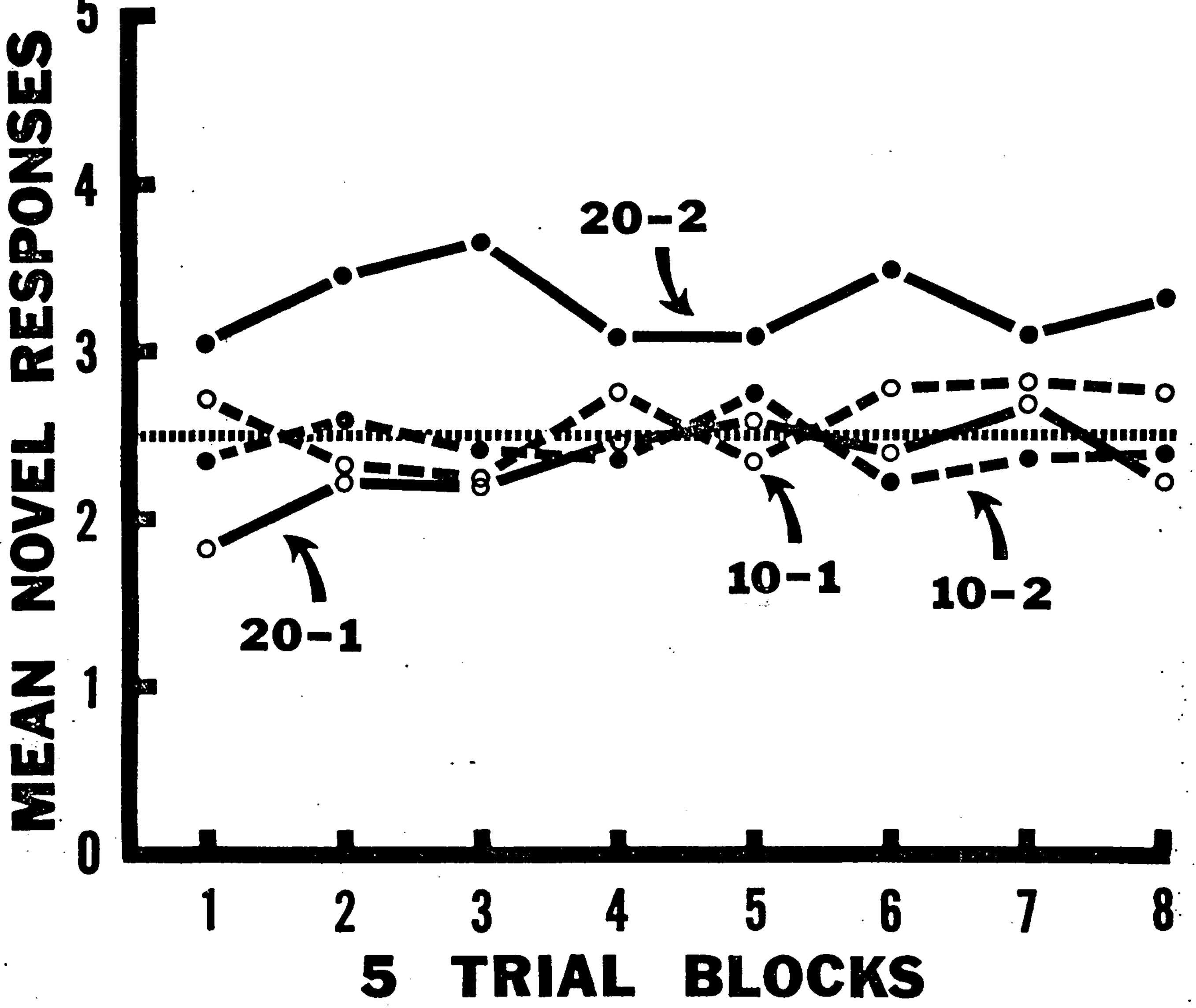

Fig. 1. Mean novel responses in 5-trial blocks for <u>S</u>s of the 10 and 20 exposure and 1 and 2-sec. duration subgroups.

TABLE 1

Analysis of Variance of Novel Responses

over Trial Blocks 1-8

Source	df	Mean Square	F	p
Between	15	205.94	2.23	----
Duration, D	1	253.50	2.74	----
Exposure, E	1	130.67	1.41	----
Change, C	1	73.50	<1.00	----
Gender, G	1	425.04	4.60	<.050
DxE	1	468.16	5.07	<.050
DxC	1	24.00	<1.00	----
ExC	1	1.50	<1.00	----
DxG	1	590.04	6.39	<.025
ExG	1	392.04	4.24	<.050
CxG	1	84.38	<1.00	----
DxExC	1	8.17	<1.00	----
DxExG	1	260.05	2.82	<.100
DxCxG	1	26.04	<1.00	----
ExCxG	1	51.04	<1.00	----
DxExCxG	1	301.04	3.26	<.100
Error	80	92.37		
Total	95	110.30		

TABLE 2

Analysis of Variance of Novel Responses

over Trial Blocks 1-4

Source		df	Mean Square	F	p
Between		15	53.24	1.21	----
	D	1	110.51	4.13	<.050
	E	1	29.26	1.09	----
	C	1	4.59	< 1.00	----
	G	1	102.09	3.82	<.100
	DxE	1	137.76	5.15	<.050
	DxC	1	23.02	< 1.00	----
	ExC	1	1.27	< 1.00	----
	DxG	1	152.52	5.71	<.025
	ExG	1	75.27	2.81	<.100
	CxG	1	21.10	< 1.00	----
	DxExC	1	.08	< 1.00	----
	DxExG	1	38.75	1.45	----
	DxCxG	1	22.99	< 1.00	----
	ExCxG	1	3.74	< 1.00	----
	DxExCxG	1	75.29	2.81	< 1.00
Error		80	26.76		
Total		95	30.93		

TABLE 3

Analysis of Variance of Novel Responses

over Trial Blocks 5-8

Source	df	Mean Square	F	p
Between	15	54.22	1.95	----
D	1	29.26	1.05	----
E	1	36.26	1.30	----
C	1	41.34	1.48	----
G	1	110.51	3.97	<.100
DxE	1	98.01	3.52	<.100
DxC	1	.02	< 1.00	----
ExC	1	.02	< 1.00	----
DxG	1	142.60	5.12	<.050
ExG	1	123.76	4.45	<.050
CxG	1	21.10	< 1.00	----
DxExC	1	10.00	< 1.00	----
DxExG	1	98.01	3.52	<.100
DxCxG	1	.08	< 1.00	----
ExCxG	1	27.08	< 1.00	----
DxExCxG	1	75.27	2.70	----
Error	80	27.84		
Total	95	32.01		

The only other significant effects with respect to mean NRS were those relating to gender. Over trial blocks 1-8 there was a significant gender (G) effect and significant D x G and E x G interactions (see Table 1). Analyses of variance of the data for the first and last halves of training (trial blocks 1-4 and 5-8) showed that the D x G interaction was significant early in training (see Table 2), and that this effect was maintained in late training, where a significant E x G interaction was also evident (see Table 3). As indicated in Table 4, these effects over the course of training (trial blocks 1-8) showed that girls exhibited more NRs, particularly under the 2 sec. duration condition, and that boys exhibited fewer NRs, particularly under the 10 exposure condition.

4.12. Difference Scores

As noted, NR performance remained relatively constant across training, indicating little if any of an acquisition effect as a result of novelty reinforcement defined either in terms of the number of exposures and/or duration of the familiar stimulus (FS) or the degree of change (low or high) provided by the novel stimulus (NS). Acquisition effects were apparent, however, very early in training (i.e., during the first few trials) but they are obscured in Figure 1 by the fact that they also diminished within the first 10 trials.

Figure 2 presents mean NRs over single trials 1-10 for Ss of the 1 and 2 sec. duration and low (L) and high (H) change subgroups. (Subsequent blocks of 5 trials are presented for comparison purposes.) This figure shows an abrupt rise in mean NRs over the first 8 trials for the H-2 sec. Ss and then a decline toward chance. A similar but re-

TABLE 4

Mean Total NRs for the Experimental Conditions over Trial Blocks 1-8, as partitioned by Gender

Males

		Low change		High change	
		Exposure		Exposure	
		10	20	10	20
Duration	1	17.7	20.5	16.8	24.5
	2	8.7	22.0	20.1	21.8

Females

		Low change		High change	
		Exposure		Exposure	
		10	20	10	20
Duration	1	23.0	15.3	24.7	13.5
	2	26.5	28.3	22.2	32.3

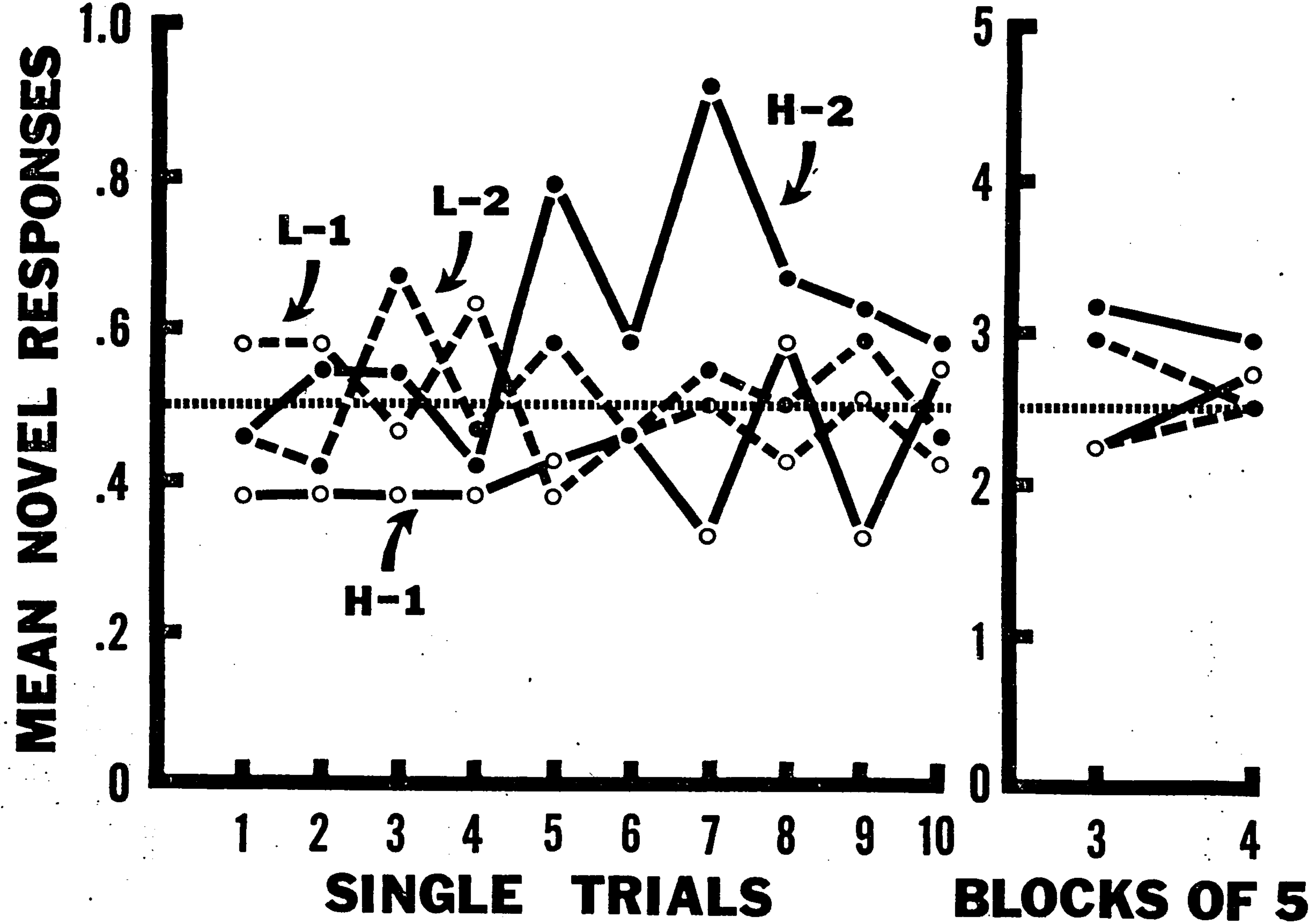

Fig. 2. Mean novel responses for single trials 1-10 (and, for comparison purposes, blocks 3 and 4) for Ss of the 1 and 2-sec. duration and low and high-change subgroups.

duced acquisition effect is apparent for the H-1 sec. Ss. To assess changes in NR performance over these early trials, an analysis of variance of the differences in the number of NRs between single trials 1-4 and 5-8 was performed. This analysis showed both a significant duration (D) and change (C) effect (Table 5); all other effects, apart from gender (G) considerations, were non-significant.

These data point up the extent to which the duration and change variables (i.e., 1 vs. 2 sec. and low vs. high change) were differentially effective in producing a change (i.e., a rise) in NR frequency over the first few trials. These effects were reduced, however, when a difference-score analysis was performed for trial blocks 1 vs. 2-4 (Table 6). Here, only the change (C) effect was significant. Furthermore, as applied to the course of training beyond the first block of trials (i.e., 2-4 vs. 6-8), a difference-score analysis showed no significant effects (Table 7), indicating that from trial block 2 on, NR frequency did not change differentially for the several groups. It should be noted that the significant rise in NR frequency for the high-change condition would not be apparent with a simple analysis of the number of NRs over the first 8 trials. As shown in Figure 2, there was a rise in NR performance for Ss of both the H-1 and H-2 sec. groups, but those Ss of the H-1 sec. condition started at a level below chance with the result that mean NRs were comparable for both low and high-change Ss.

With respect to gender, the only significant effects deriving from the difference-score analyses were as follows: a reliable change (C) x gender (G) interaction for changes in NR frequency from single

TABLE 5

Analysis of Variance of the Differences in Number of NRs between Single Trials 1-4 and 5-8

Source		df	Mean Square	F	p
Between		15	3.91	3.34	<.100
	D	1	10.01	8.56	<.005
	E	1	3.01	2.57	----
	C	1	17.51	14.97	<.001
	G	1	4.60	3.93	<.100
	DxE	1	.27	< 1.00	----
	DxC	1	.10	< 1.00	----
	ExC	1	.27	< 1.00	----
	DxG	1	.84	< 1.00	----
	ExG	1	3.01	2.57	----
	CxG	1	11.34	9.69	<.005
	DxExC	1	2.99	2.56	----
	DxExG	1	1.75	1.50	----
	DxCxG	1	1.76	1.50	----
	ExCxG	1	.25	< 1.00	----
	DxExCxG	1	.87	< 1.00	----
Error		80	1.17		
Total		95	1.60		

TABLE 6

Analysis of Variance of the Differences in Number of NRs between Trial Blocks 1 and 2-4

Source	df	Mean Square	F	p
Between	15	28.76	1.64	----
D	1	1.04	< 1.00	----
E	1	60.16	3.42	<.100
C	1	73.50	4.18	<.050
G	1	6.00	< 1.00	----
DxE	1	9.38	< 1.00	----
DxC	1	7.04	< 1.00	----
ExC	1	16.67	< 1.00	----
DxG	1	5.04	< 1.00	----
ExG	1	60.17	3.42	<.100
CxG	1	60.16	3.42	<.100
DxExC	1	45.37	2.58	----
DxExG	1	2.04	< 1.00	----
DxCxG	1	.38	< 1.00	----
ExCxG	1	.00	< 1.00	----
DxExCxG	1	84.38	4.80	<.050
Error	80	17.58		
Total	95	19.34		

TABLE 7

Analysis of Variance of the Differences in Number of NRs between Trial Blocks 2-4 and 6-8

Source	df	Mean Square	F	p
Between	15	5.58	< 1.00	----
D	1	28.16	2.44	----
E	1	1.50	< 1.00	----
C	1	1.04	< 1.00	----
G	1	4.16	< 1.00	----
DxE	1	2.67	< 1.00	----
DxC	1	12.05	1.05	----
ExC	1	1.04	< 1.00	----
DxG	1	.68	< 1.00	----
ExG	1	.17	< 1.00	----
CxG	1	2.05	< 1.00	----
DxExC	1	5.04	< 1.00	----
DxExG	1	5.99	< 1.00	----
DxCxG	1	12.02	1.04	----
ExCxG	1	5.04	< 1.00	----
DxExCxG	1	2.05	< 1.00	----
Error	80	11.52		
Total	95	10.58		

trials 1-4 to 5-8 (see Table 5) and a marginally reliable third-order interaction for changes in NR frequency from trial block 1 to 2-4 (see Table 6). As indicated in Table 8, which presents changes in NR frequency from single trials 1-4 to 5-8, the C x G interaction showed that boys exhibited a greater change (rise) in NR frequency in the high than low-change condition, whereas girls did not.

4.13. Chance Deviations

Although the above results show significant differences in the extent to which the frequency of NRs over training was altered by the experimental variables, i.e., more so by the high than low-change condition and more so by the 2 than 1-sec. duration condition, they do not indicate the extent to which the variables contributed to a learning effect, i.e., a significant preference for the NS alternative. Assessment of deviations from chance (50%) indicate, however, that a learning effect was present and that it was influenced by all of the experimental variables. Thus, whereas there were no significant deviations from chance over single trials 1-4 for the Ss taken collectively, or by individual groups, a reliable deviation above chance occurred over trials 5-8 for Ss of the high-change condition ($X^2 = 7.52$, $p < .01$), the 2 sec. condition ($X^2 = 10.32$, $p < .01$), and the 20 exposure condition ($X^2 = 5.46$, $p < .02$). Also, consistent with the results of the difference-score analyses, there were reliable differences in deviations above and below chance on trials 5-8 between the 1 and 2-sec. duration groups ($X^2 = 7.72$, $p < .01$) and the low and high-change groups ($X^2 = 4.13$, $p < .05$). Because these effects were limited to the conditions indicated, however, the deviation above chance for all Ss taken collectively was only marginally significant ($X^2 = 3.68$, $p < .10$).

TABLE 8

Mean Change in NR Frequency for Single Trials 1-4 vs. 5-8, as partitioned by Gender

Males

		Low change		High change	
		Exposure		Exposure	
		10	20	10	20
Duration	1	4.2	4.5	5.2	7.0
	2	4.7	5.3	6.3	6.3

Females

		Low change		High change	
		Exposure		Exposure	
		10	20	10	20
Duration	1	4.8	4.5	4.5	4.5
	2	5.0	5.3	5.7	5.7

It should be noted that significant deviations above chance were also present for the high-change ($\underline{X}^2 = 6.76$, $\underline{p} < .01$), 2-sec. duration ($\underline{X}^2 = 5.34$, $\underline{p} < .05$) and 20 exposure ($\underline{X}^2 = 8.34$, $\underline{p} < .01$) groups during the early stages of training (trial blocks 2-4; see Figures 1 and 2). Furthermore, these effects persisted for the high-change ($\underline{X}^2 = 5.34$, $\underline{p} < .05$) and 20 exposure ($\underline{X}^2 = 5.34$, $\underline{p} < .05$) Ss through to the end of training (trial blocks 6-8). The magnitude of these effects were such that over both early and late stages of training (trial blocks 2-4 and 6-8) a significant deviation above chance occurred for all of the Ss taken collectively ($\underline{X}^2 \geqq 4.16$, $\underline{p} < .05$, in both cases).

With respect to gender, assessment of deviations above and below chance at the start of training (trials 1-4) showed a reliable difference between the sexes, with more girls responding above chance and more boys responding below chance ($\underline{X}^2 = 6.21$, $\underline{p} < .02$). Individually considered, however, neither girls nor boys themselves deviated reliably from chance on these early trials. Furthermore, over all other stages of training (i.e., trial block 2 on), there were no significant differences between the sexes with regard to deviations above and below chance. This latter finding reflects the fact that beyond the initial stage of training, both boys and girls tended to respond above chance, although the magnitude of the effect was not reliable for boys whereas it was for girls ($\underline{X}^2 = 5.34$, $\underline{p} < .05$).

4.14. Summary of Effects (Main Variables)

Very early in training there was an initial rise in NRs to above chance for Ss of the 2-sec. duration, 20 exposure, and high-change conditions. However, these effects diminished with further training with the result that NR frequency was maintained at a relatively high level only under the 20-2 sec. condition, leading to the significant duration x exposure (D x E) interaction apparent in Figure 1. The absence of an effect of the change variable on NR frequency over training was due in part to the fact, as shown in Figure 2, that high-change Ss of the 1 sec. duration condition started at a lower NR level (relative to the other Ss) from which NRs then increased to chance.

The absence of more pronounced effects of the experimental variables was also due to a large error variance associated with the analysis of NRs. This large error variance related to a peculiarity of the data, namely, that some Ss consistently pushed one button for all 40 trials without ever trying the other; hence, their total score over the course of training was either 0 or 40 NRs. Apparently, this effect related in part to sex, because there was a significant difference in the frequency of FS and NS-type perseverators between boys and girls (X^2 = 7.60, p <.01): boys were predominantly FS perseverators, whereas girls tended to be NS perseverators. As assessed for boys or girls alone, however, only the effect for boys was reliable (sign test, p = .04).

With this peculiarity of the data, an effort was made to eliminate perseverating Ss for purposes of reducing the error variance and thereby making a more sensitive analysis of the effects of the experimental variables. A question arose, however, as to which Ss to eliminate. It is easy to determine a perseverating S if that S has all 40 responses on the FS or NS button, but what about an S who starts on one button, stays with it awhile, and then, perhaps because of his particular experimental treatment, shifts during training to the other button. Such an S might also be a "perseverator" but this fact would be obscured by the effect of his treatment. That perseveration related to the experimental variables is indicated by the fact that, when perseveration was defined as the occurrence of the same initial response for 15 consecutive trials ($p < .001$), there was a significant difference in the frequency of NS and FS-type perseverators between the 1 and 2-sec. duration conditions ($X^2 = 4.49$, $p < .05$). This difference related primarily to the greater frequency of FS perseverators in the 1 sec. condition (sign test, $p = .06$); type of perseverator was not differentiated in the 2 sec. condition.

Which Ss to eliminate centered around the question of how many initial "same" responses should be considered perseveration. It was decided to define perseveration statistically, such that 7 or more consecutive responses to the initially selected button constituted perseveration. Seven or more initial responses of the same button provides a 2-tailed p value of .016; consequently, the possibility of a type I error in classifying S as a perseverator is 2/100. Using this criterion to define perseverators, the 1-2 sec. duration differences as noted above were maintained ($X^2 = 5.09$, $p < .05$), but there were now no significant gender differences. The difference between the 1 and 2-sec. duration Ss was again attributable to the greater frequency of FS perseveration in the 1 sec. condition (sign test, $p = .05$).

4.2. Choice Data Excluding Perseverating Subjects

4.21. Mean NRs

With perseverating (P) Ss eliminated as noted above, i.e., on the basis of 7 consecutive initial responses on the same button, analysis of variance was performed on the NR data for the non-P Ss alone. However, because of the unequal number of non-P Ss per group and the associated reduction of some cells to a very small number of Ss, analysis of variance was limited to the SFE variables (i.e., 1-2 sec. duration, 10-20 exposures and low-high change), with gender collapsed. As noted, the basis by which P Ss were finally isolated and discarded showed no gender effect.

Figure 3 presents mean NRs in blocks of 5 trials for non-P Ss of the 10 and 20 exposure and 1 and 2-sec. duration subgroups. As shown, NR frequency over the course of training was higher for the 20 than the 10 exposure Ss, but was not different for the 1 and 2-sec. Ss. The results of an analysis of variance of these data (Table 9) showed that the exposure main effect was reliable, and further that the second-order interaction of the exposure (E) variable with the duration (D) and change (C) variables was also reliable.

Table 10(a) which presents mean NRs for the several groups, shows that whereas NR frequency for the L-1 sec. and H-2 sec. Ss was relatively constant across the 10-20 exposure conditions, it increased for the L-2 sec. and H-1 sec. Ss, to produce the significant second-order interaction. Thus, in contrast to the initial analyses (including P Ss) which showed a significant D x E effect, the present

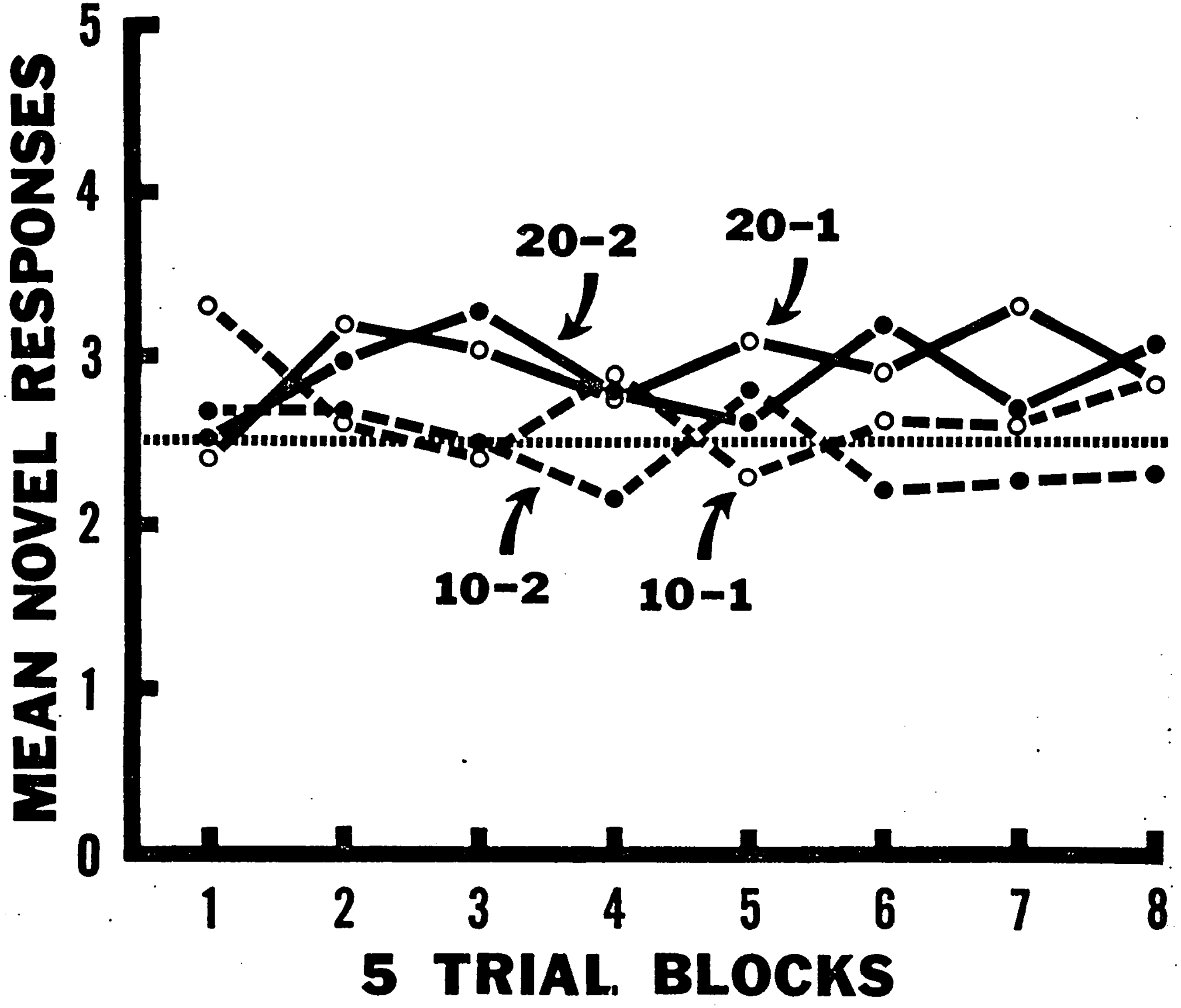

Fig. 3. Mean novel responses in 5-trial blocks for non-perseverating Ss of the 10 and 20 exposure and 1 and 2-sec. duration subgroups.

TABLE 9

Analysis of Variance of Novel Responses over Trial

Blocks 1-8 excluding Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	54.07	2.88	<.100
	D	1	9.24	< 1.00	----
	E	1	82.01	4.37	<.050
	C	1	46.07	2.45	----
	DxE	1	7.80	< 1.00	----
	DxC	1	73.14	3.89	<.100
	ExC	1	22.81	1.21	----
	DxExC	1	137.40	7.32	<.010
Error		55	18.78		
Total		62	22.76		

TABLE 10 (a)

Group Mean NRs over Trial Blocks 1-8

excluding Perseverating Ss

		Low change			High change	
		Exposure			Exposure	
		10	20		10	20
Duration	1	21.0	20.3	1	22.4	27.0
	2	17.8	24.7	2	21.7	21.5

TABLE 10 (b)

Adjusted Group Mean NRs excluding

Perseverating Ss

		Low change			High change	
		Exposure			Exposure	
		10	20		10	20
Duration	1	2.69	2.59	1	2.83	3.66
	2	2.28	3.22	2	2.84	2.87

analysis (i.e., of the non-P data) indicates that this D x E interaction was maintained for the low-change Ss but was reversed for the high-change Ss. This outcome can be related to the removal of predominantly familiar-stimulus-responding (FS) Ps from the H-20-1 sec. condition and of predominantly novel-stimulus-responding (NS) Ps from the H-20-2 sec. condition. Thus, consistent with the 1-2 sec. duration differentiation of FS and NS-type Ps, more of each of these Ss were eliminated respectively from the above designated 1 and 2-sec. duration groups. In all other conditions, removal of P Ss did not differentially affect NR scores for those conditions.

Because the present analysis of NRs without P Ss showed a significant E effect (Table 9), which was not present with the original analyses including P Ss, the data were subjected to one additional analysis in which the number of NRs made by an S was adjusted for the total number of trials S could receive once S had selected the NS button. Previously, a type of adjusted novel response score was generated by elimination of P Ss, since only those Ss showing a response to both the NS and FS buttons within the first 6 trials were retained as non-P Ss. That is to say, elimination of the P Ss has the effect of limiting the maximum number of initial exposures (trials) S could have with either the FS or NS alternative before experiencing the other alternative, and as such it tends to equalize for all Ss the opportunity (i.e., number of choice trials available) for a novel response. The present adjusted-score tabulations move a step closer toward equalizing the basis for NRs by taking into account the total number of NRs that an S could make after initially responding to the NS button.

Adjusted mean NR scores per block of 5 trials (i.e., total novel responses divided by total trials from first novel response, multiplied by 5) are presented in Table 10(b) for the 1 and 2-sec. duration and the 10 and 20 exposure subgroups; the left panel presents the data for the low-change Ss and the right panel those for the high-change Ss. As shown, mean NRs as adjusted for trials were generally higher under the 20 than 10 exposure condition, and higher under the high than low-change condition, paralleling the non-adjusted scores in Table 10(a). The results of an analysis of variance of these adjusted data, presented in Table 11, show that both of these effects were reliable. Furthermore, as indicated in Table 11, there was a reliable D x C interaction with the low-change Ss showing a higher adjusted mean NR score under the 2 sec. duration condition and the high-change Ss showing a higher score under the 1 sec. duration condition. This D x C effect, combined with that of the exposure (E) variable, led to a significant second-order interaction, with both of these interactions as before, being primarily the result of the different kinds of Ps eliminated from the 1 and 2-sec. duration groups of the H-20 condition.

4.22. Difference Scores

The non-P data were also subjected to difference-score analyses to determine whether there were any significant effects of the SFE variables on changes in NR frequency across various stages of training. Figure 4 presents mean NRs over single trials 1-10 (and over blocks 3 and 4 for comparison) for non-P Ss of the 1 and 2-sec. duration and low and high-change subgroups. As shown, changes in NR frequency over these early trials were essentially the same as those depicted in

TABLE 11

Analysis of Variance of Adjusted Mean NR Scores

excluding Perseverating Subjects

Source		*df*	Mean Square	*F*	*p*
Between		7	1.22	4.21	<.050
	D	1	.07	< 1.00	----
	E	1	2.18	7.52	<.010
	C	1	1.29	4.45	<.050
	DxE	1	.07	< 1.00	----
	DxC	1	1.33	4.59	<.050
	ExC	1	.57	1.97	----
	DxExC	1	3.03	10.45	<.005
Error		55	.29		
Total		62	.40		

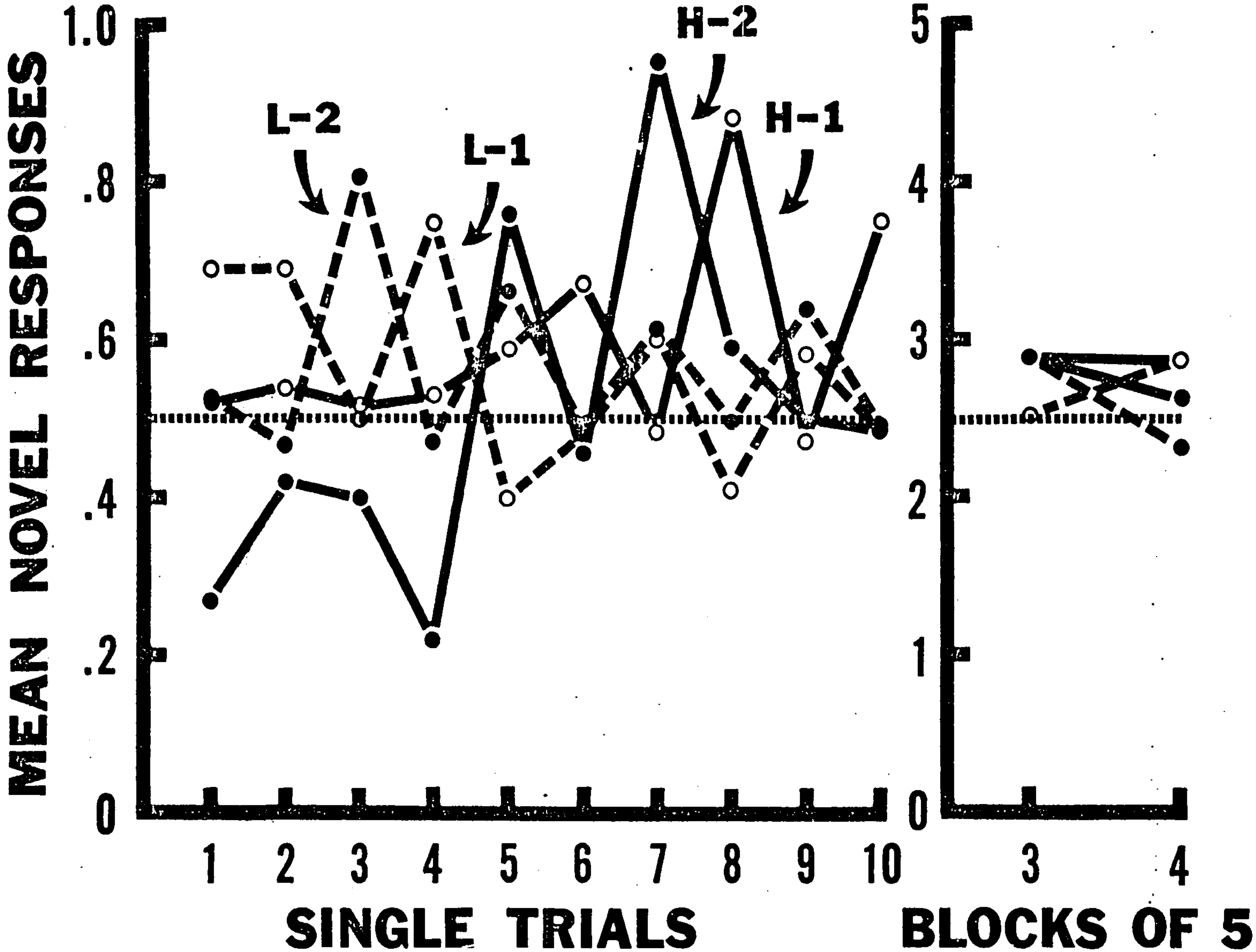

Fig. 4. Mean novel responses for single trials 1-10 (and, for comparison purposes, blocks 3 and 4) for non-perseverating Ss of the 1 and 2-sec. duration and low and high-change subgroups.

Figure 2 (i.e., the data including P Ss), since removal of P Ss related only to Ss showing the same response over the first 7 or more trials. Congruent with the F-test results on the data which included P Ss (cf. Table 5), the results of an analysis of variance of difference scores between single trials 1-4 and 5-8 for non-P Ss showed both reliable duration and change effects (Table 12), with significantly larger increases in novel responding over these early blocks of trials occurring for the high than for the low-change Ss, and for the 2 than the 1-sec. duration Ss. As with the original data including P Ss, analysis of variance of difference scores between trial blocks 1 and 2-4 showed a reliable C effect for non-P Ss as well (Table 13). In this case, however, due to the reduction in error variance resulting from elimination of P Ss, there was also a significant main effect of E with the 20 exposure group showing a larger increase in NR frequency from trial block 1 to trial blocks 2-4 than the 10 exposure group (see Figure 3). Again, as with the original data including P Ss, there were no significant effects for non-P Ss deriving from a difference-score analysis between trial blocks 2-4 and 6-8 (Table 14). Thus both sets of data show that larger increases in NR frequency during the early training trials were associated with the high-change and long-duration conditions, and for non-P Ss in particular, with the greater exposure condition.

TABLE 12

Analysis of Variance of the Differences in NRs between

Single Trials 1-4 and 5-8 excluding

Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	7.59	4.31	<.050
	D	1	13.99	7.95	<.010
	E	1	4.96	2.82	<.100
	C	1	27.58	15.67	<.001
	DxE	1	.59	< 1.00	----
	DxC	1	.00	< 1.00	----
	ExC	1	4.62	2.63	----
	DxExC	1	1.37	< 1.00	----
Error		55	1.76		
Total		62	2.41		

TABLE 13

Analysis of Variance of the Differences in NRs between Trial Blocks 1 and 2-4 excluding Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	54.21	2.60	----
	D	1	12.27	< 1.00	----
	E	1	145.74	6.98	<.025
	C	1	91.24	4.37	<.050
	DxE	1	6.47	< 1.00	----
	DxC	1	2.19	< 1.00	----
	ExC	1	53.35	2.56	----
	DxExC	1	68.21	3.27	<.100
Error		55	20.88		
Total		62	24.64		

TABLE 14

Analysis of Variance of the Differences in NRs between Trial Blocks 2-4 and 6-8 excluding Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	4.64	< 1.00	----
	D	1	4.57	< 1.00	----
	E	1	.15	< 1.00	----
	C	1	4.62	< 1.00	----
	DxE	1	1.31	< 1.00	----
	DxC	1	13.70	1.13	----
	ExC	1	8.69	< 1.00	----
	DxExC	1	.00	< 1.00	----
Error		55	12.08		
Total		62	11.24		

4.23. Chance Deviations

Assessment of deviations from chance (50%) were also performed on the NR data for the non-P Ss, so as to determine the extent to which the SFE variables produced an acquisition effect, i.e., a significant preference for the novel alternative. As with the original data including P Ss, assessments of chance deviations for non-P Ss were performed on the early trials because, as shown in Figure 4, novel responses reached a maximum within the first 8 training trials. Comparable to the original data including P Ss, the data for the non-P Ss showed that by trials 5-8 significant deviations above chance occurred under the 2 sec. duration condition ($X^2 = 11.84$, $p < .001$), the 20 exposure condition ($X^2 = 11.26$, $p < .001$), and the high-change condition ($X^2 = 18.00$, $p < .001$), with the difference in frequency of Ss above and below chance between the low and high-change conditions also being significant ($X^2 = 8.39$, $p < .01$). Further, these effects were of a magnitude such that for all Ss collectively, there was a significant deviation above chance over single trials 5-8 ($X^2 = 14.28$, $p < .001$).

To some extent, these significant early trial effects were present throughout the course of training. Thus, there was a significant difference between the 10 and 20 exposure conditions in frequency of Ss above and below chance during trial blocks 2-4 ($X^2 = 4.02$, $p < .05$), with Ss of the 20 exposure condition showing a reliable deviation above chance during these trials (blocks 2-4, $X^2 = 12.50$, $p < .001$) as well as during later stages of training (trial blocks 6-8, $X^2 = 6.12$, $p < .02$). The high-change Ss similarly showed a reliable deviation above chance during both early and late stages of training (trial blocks 2-4, $\underline{X}^2 = 10.12$, $\underline{p} < .01$; trial blocks 6-8, $\underline{X}^2 = 6.12$, $\underline{p} < .02$). However, unlike the original data including P Ss, it was the 1 sec. as opposed to 2 sec. duration Ss which showed a significant deviation above chance during both early and late training (trial blocks 2-4, $\underline{X}^2 = 7.26$, $\underline{p} < .01$; trial blocks 6-8, $\underline{X}^2 = 3.90$, $\underline{p} < .05$). Considered with the original data including P Ss, this latter effect is attributable to the elimination of differential numbers of FS and NS-type Ps from the 1 and 2-sec. duration conditions. (It will be recalled that types of Ps were differentiated on the basis of the 1 and 2-sec. duration conditions.) In this respect, it is noteworthy that elimination of the P Ss also produced a reliable difference between the low and high-change conditions in frequency of Ss above and below chance on the very initial trials (1-4, $\underline{X}^2 = 5.18$, $\underline{p} < .02$; see Figure 4), with the low-change Ss showing a significant deviation above chance ($\underline{X}^2 = 6.36$, $\underline{p} < .02$). As noted, however, these initial trial differences between the low and high-change Ss did not prevail throughout later stages of training, but in fact were reversed. Finally, for all Ss collectively, there was a significant deviation above chance throughout both early and late training (trial blocks 2-4, $\underline{X}^2 = 9.92$, $\underline{p} < .01$; and trial blocks 6-8, $\underline{X}^2 = 4.58$, $\underline{p} < .05$).

4.24. Summary of Effects

In general, the non-P analyses confirm the results of the original analyses. More specifically, however, with elimination of the error variance contributed by P Ss, the non-P analyses showed that choice performance was significantly affected by the exposure variable. And, based on adjusted mean NRs, the non-P analyses showed that, in addition to the effect of the exposure variable, choice performance was affected by the change variable and its interaction with the duration variable. As noted, the results of the difference-score analyses were essentially the same for both treatments since they were virtually unaffected by elimination of P Ss, except with respect to a reduction in error variance. Consequently, the non-P analyses showed a significant exposure effect as well as significant duration and change effects. Finally, with the elimination of P Ss, the same variables were found to produce significant deviations above chance, except in cases where types of P Ss were differentiated, as in the 1-2 sec. duration condition. In total, then, the non-P analyses were significant in showing that NR performance was sensitive to all of the SFE variables manipulated, i.e., frequency of exposure, stimulus duration interval, and degree of change.

4.3. Performance Scores

Because of the potential reinforcement variables manipulated in the present study, an effort was made to assess their effect on performance as well as learning, i.e., choice. This was accomplished through the use of start and execution speeds, i.e., reciprocal transformations of S's latencies (x 10) in releasing the "start" button and in executing a choice by pressing either the right or left button.

4.31. Start Speeds

Mean start speeds in blocks of 5 trials are presented in Figure 5 for Ss of the low and high-change and the 10 and 20 exposure subgroups. As shown, mean start speeds generally increased over the first 5 blocks of training, such that for any two-group combination of variables (e.g., L-10, H-1, etc.), as well as for all Ss collectively, there was a significant rise in start speeds between trial blocks 1 and 3-5 (in all cases, $X^2 \geqq 4.16$, $p < .05$). Individual groups, however, failed to show statistically significant increases because of the small number of Ss (12) per group. With respect to the later stages of training, comparisons of performance on trial blocks 3-5 with that on trial blocks 6-8 indicated that the groups tended to maintain their performance rate through to the end of training or, at most, to decrease somewhat. However, only Ss of the 1 sec. condition showed a reliable decrement in performance across these trial blocks ($X^2 = 4.08$, $p < .05$).

In conjunction with these relatively uniform changes in start speeds over the course of training, analyses of variance showed no significant effects of any of the main variables nor of their inter-

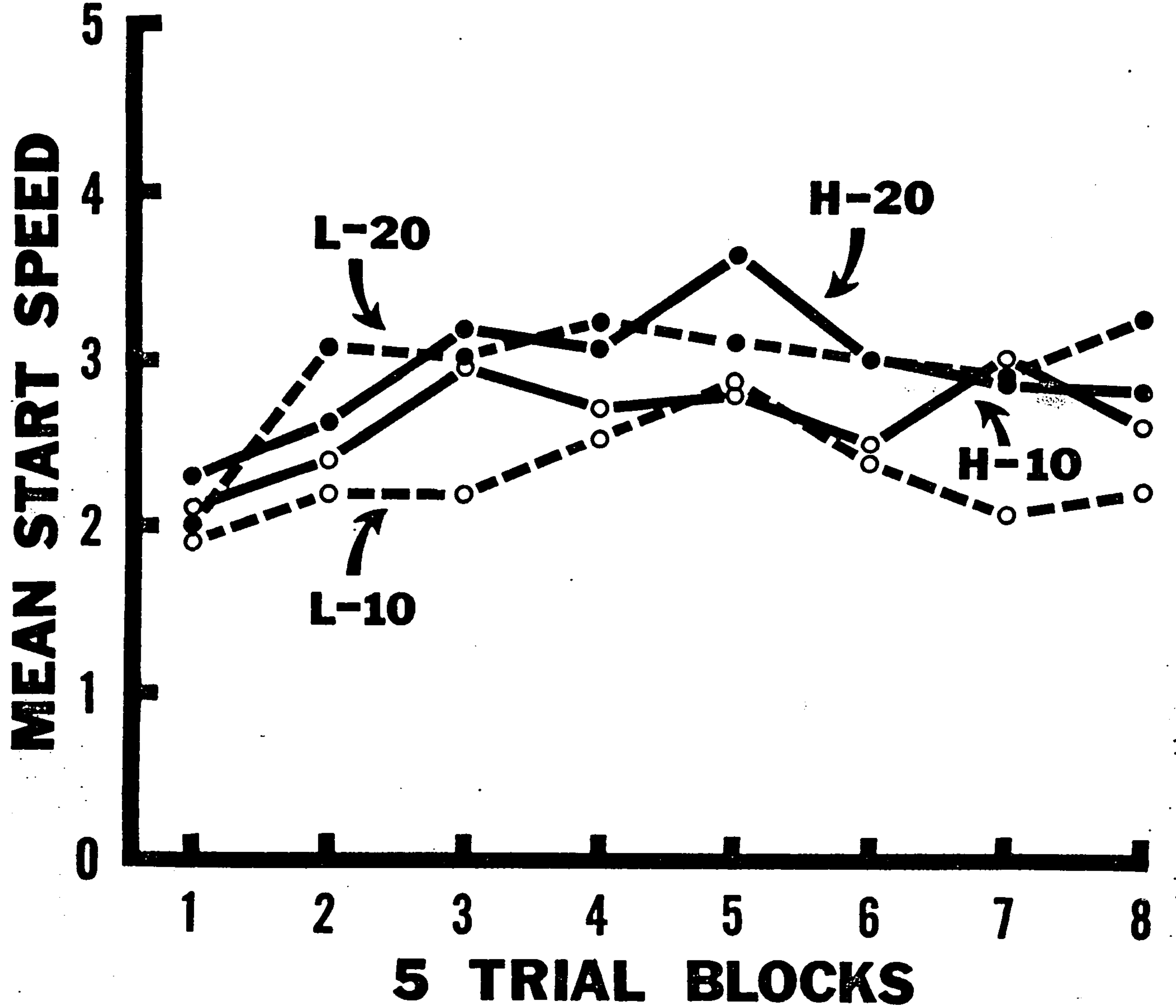

Fig. 5. Mean start speeds in 5-trial blocks for Ss of the 10 and 20 exposure and low and high-change subgroups.

action with one another (Table 15). Similarly, there were no differences attributable to gender or its interaction with any of the other variables (Table 15). Furthermore, the absence of significant differences among the groups prevailed whether assessment was made of early or late training trials, or for that matter at any stage of training. Finally, in contrast to the choice data, start speeds were unaffected by the exclusion of P Ss (see Table 16). Similarly, no significant effects prevailed as a result of difference-score analyses applied to various segments of training either with or without P Ss.

4.32. Execution Speeds

Mean execution speeds in blocks of 5 trials are presented in Figure 6 for Ss of the low and high-change and the 10 and 20 exposure subgroups. In contrast to the start speed data, Figure 6 shows that execution speeds remained relatively constant over the course of training. However, X^2 analysis of the frequency of Ss exhibiting either a rise or drop in performance from trial block 1 to trial blocks 3-5 indicated a reliable difference between the low and high-change groups ($X^2 = 4.88$, $p < .05$), with this effect being due primarily to a significant rise in the performance of the high-change Ss ($X^2 = 5.00$, $p < .05$). For the later stages of training, trial blocks 6-8 as compared with trial blocks 3-5, there were no significant changes in performance for any group or combination of groups. For all Ss collectively, as well, there were no significant changes over either early or late stages of training.

Despite the general lack of changes in performance over the course of training, Figure 6 indicates that execution speeds were

TABLE 15

Analysis of Variance of Start Speeds over Trial Blocks 1-8

Source		*df*	Mean Square	*F*	*p*
Between		15	117.51	< 1.00	----
	D	1	30.37	< 1.00	----
	E	1	306.73	1.56	----
	C	1	24.80	< 1.00	----
	G	1	23.60	< 1.00	----
	DxE	1	37.51	< 1.00	----
	DxC	1	160.18	< 1.00	----
	ExC	1	41.62	< 1.00	----
	DxG	1	124.22	< 1.00	----
	ExG	1	299.63	1.52	----
	CxG	1	360.38	1.83	----
	DxExC	1	60.14	< 1.00	----
	DxExG	1	51.62	< 1.00	----
	DxCxG	1	37.49	< 1.00	----
	ExCxG	1	198.36	1.01	----
	DxExCxG	1	6.02	< 1.00	----
Error		80	197.04		
Total		95	184.48		

TABLE 16

Analysis of Variance of Start Speeds over Trial Blocks 1-8

excluding Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	43.09	< 1.00	----
	D	1	63.14	< 1.00	----
	E	1	19.60	< 1.00	----
	C	1	33.51	< 1.00	----
	DxE	1	82.43	< 1.00	----
	DxC	1	42.37	< 1.00	----
	ExC	1	49.44	< 1.00	----
	DxExC	1	11.12	< 1.00	----
Error		55	181.29		
Total		62	165.69		

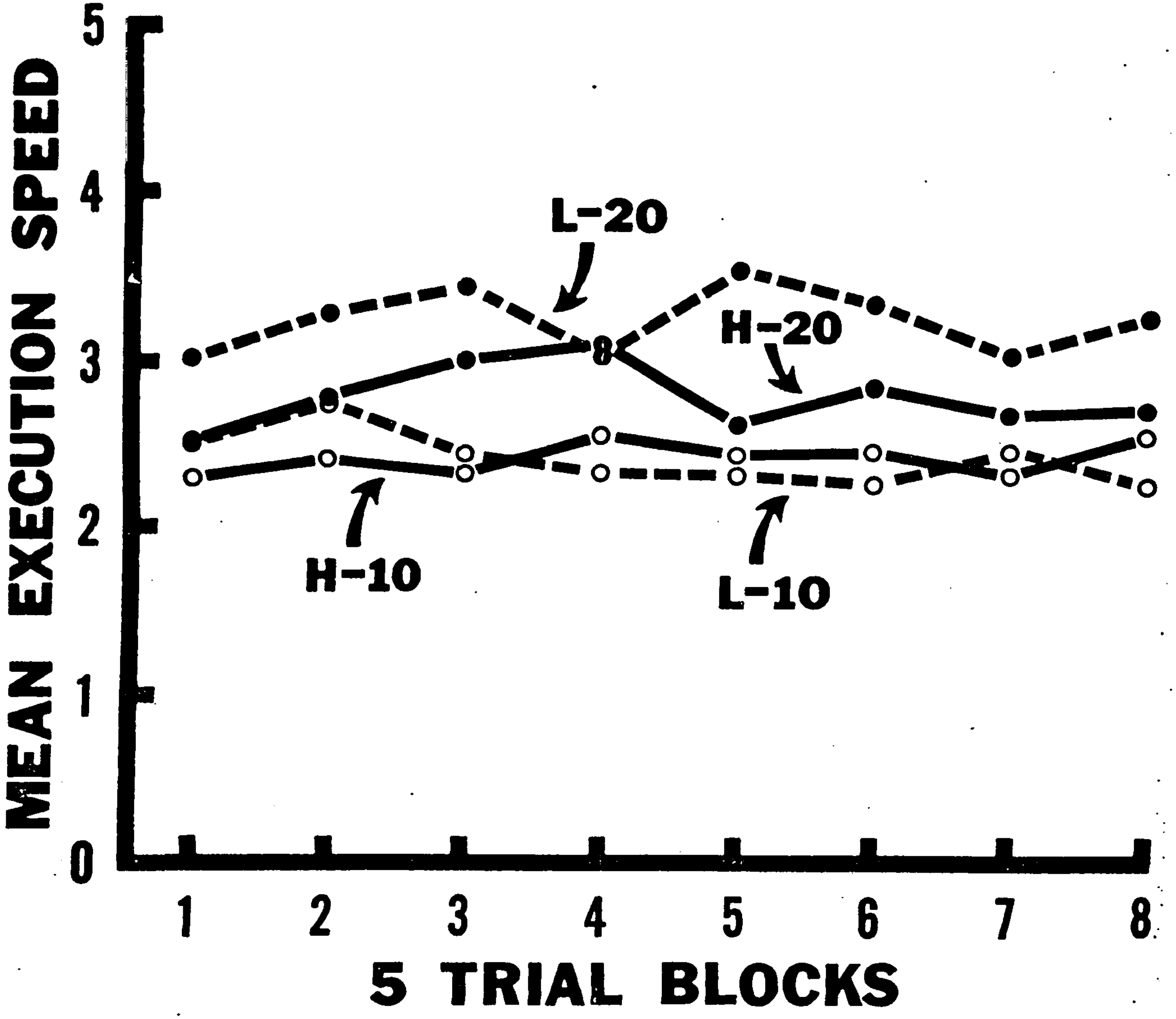

Fig. 6. Mean execution speeds in 5-trial blocks for Ss of the 10 and 20 exposure and low and high-change subgroups.

faster for Ss of the 20 than the 10 exposure condition. Analysis of variance of the data (including P Ss) showed that this effect was reliable over the course of training (Table 17). Furthermore, the effect was essentially unaltered by the exclusion of P Ss; for non-P Ss the main effect of exposure was reliable as well (Table 18). However, the effects of all other variables and of their interaction with one another were not reliable in either type of analysis, i.e., with or without P Ss.

Because Figure 6 suggests that differences between the 10 and 20 exposure groups were to some extent present at the very start of training, difference-score analyses were performed to determine whether this effect was in part a product of training. These analyses assaying changes in performance over both early and late training trials showed a significant effect of exposure for early training (trial blocks 1 vs. 3-5, Table 19) and a significant duration by exposure interaction for late training (trial blocks 3-5 vs. 6-8, Table 20). As shown in Table 21 this interaction related to a greater decrement in execution speeds from trial blocks 3-5 to 6-8 for Ss of the 10-2 sec. and 20-1 sec. conditions. These effects may be questioned, however, for with elimination of P Ss, difference-score analyses showed neither significant main effects nor reliable interactions over any stage of training.

4.33. Summary of Speed Data

Start speeds showed a significant rise for all groups over the early stages of training and then tended to be maintained or to decrease somewhat, with the 1 sec. Ss showing a reliable decrement over the later stages of training. In contrast, execution speeds remained relatively constant across both early and late stages of training, with

TABLE 17

Analysis of Variance of Execution Speeds

over Trial Blocks 1-8

Source	df	Mean Square	F	p
Between	15	106.50	1.18	----
D	1	10.87	< 1.00	----
E	1	549.61	6.09	<.025
C	1	78.67	< 1.00	----
G	1	.94	< 1.00	----
DxE	1	16.25	< 1.00	----
DxC	1	2.43	< 1.00	----
ExC	1	89.12	< 1.00	----
DxG	1	64.85	< 1.00	----
ExG	1	80.48	< 1.00	----
CxG	1	26.77	< 1.00	----
DxExC	1	202.14	2.24	----
DxExG	1	147.26	1.63	----
DxCxG	1	.25	< 1.00	----
ExCxG	1	148.76	1.65	----
DxExCxG	1	179.03	1.98	----
Error	80	90.31		
Total	95	92.87		

TABLE 18

Analysis of Variance of Execution Speeds over Trial Blocks 1-8 excluding Perseverating Subjects

Source		df	Mean Square	F	p
Between		7	104.55	1.22	----
	D	1	26.21	< 1.00	----
	E	1	405.29	4.74	<.050
	C	1	11.43	< 1.00	----
	DxE	1	.00	< 1.00	----
	DxC	1	57.45	< 1.00	----
	ExC	1	184.18	2.15	----
	DxExC	1	47.26	< 1.00	----
Error		55	85.57		
Total		62	87.71		

TABLE 19

Analysis of Variance of the Differences in Execution

Speeds between Trial Blocks 1 and 3-5

Source	df	Mean Square	F	p
Between	15	5.29	< 1.00	----
D	1	.04	< 1.00	----
E	1	27.65	4.18	<.050
C	1	6.69	1.01	----
G	1	12.56	1.90	----
DxE	1	4.23	< 1.00	----
DxC	1	1.07	< 1.00	----
ExC	1	6.03	< 1.00	----
DxG	1	7.05	1.06	----
ExG	1	4.32	< 1.00	----
CxG	1	8.94	1.35	----
DxExC	1	.00	< 1.00	----
DxExG	1	.33	< 1.00	----
DxCxG	1	.32	< 1.00	----
ExCxG	1	.04	< 1.00	----
DxExCxG	1	.14	< 1.00	----
Error	80	6.62		
Total	95	6.41		

TABLE 20

Analysis of Variance of the Differences in Execution

Speeds between Trial Blocks 3-5 and 6-8

Source		df	Mean Square	F	p
Between		15	5.48	< 1.00	----
	D	1	1.88	< 1.00	----
	E	1	2.62	< 1.00	----
	C	1	.00	< 1.00	----
	G	1	7.32	1.33	----
	DxE	1	25.44	4.63	<.050
	DxC	1	.16	< 1.00	----
	ExC	1	.17	< 1.00	----
	DxG	1	2.69	< 1.00	----
	ExG	1	8.66	1.58	----
	CxG	1	19.80	3.60	<.100
	DxExC	1	.26	< 1.00	----
	DxExG	1	2.89	< 1.00	----
	DxCxG	1	.02	< 1.00	----
	ExCxG	1	.04	< 1.00	----
	DxExCxG	1	10.22	1.86	----
Error		80	5.50		
Total		95	5.49		

TABLE 21

Mean Differences* in Execution Speeds between Trial Blocks 3-5 and 6-8 for the 1-2 sec. Duration and 10-20 Exposure Subgroups

Low and High change

		Exposure	
		10	20
Duration	1	10.30	8.94
	2	9.55	10.25

* To avoid negative values in the calculation of difference scores a constant of 10 was added to each difference score. The values in the table incorporate this constant.

only the high-change Ss showing a significant rise in performance during the early part of training.

Both analyses of variance of start speeds and difference-score analyses, whether with or without P Ss, showed no significant main effects or interactions over any stage of training. On the other hand, analyses of variance of execution speeds showed a significant effect of exposure over the course of training for the data both with and without P Ss. In addition, difference-score analyses of execution speeds with P Ss showed that the exposure variable yielded a significant main effect over the early stages of training and interacted significantly with the duration variable over the later stages of training. However, these latter effects were not maintained with difference-score analyses of the data excluding P Ss.

5.0. DISCUSSION

The choice data showed a D effect early in training and a D x E interaction throughout training. When additional analyses were performed to eliminate the high error variance produced by P Ss, or to equalize trials following the first novel response (adjusted mean scores), the choice data showed additionally that there were both reliable E and C effects and a D x C interaction. Collectively, these results indicate that more frequent responses for the NS were produced by the E and C conditions and their interactions with D. Furthermore, as shown by the difference-score analyses, all three variables influenced the extent to which there was a rise in responding on the novel stimulus button. As would be expected, these effects were limited to the early stages of training, indicating that the differential effects of the main variables (e.g., differences between high and low change) dissipated over the course of extended training. Nonetheless, the higher values of each variable was effective in maintaining choice performance at a level above chance throughout training. In total, then, the results may be described as showing a reinforcement effect that was contributed to by all of the SFE manipulations.

To some extent, this reinforcement effect was reflected in speed performance: execution speeds showed a significant rise for the high-change Ss early in training and a difference in favor of the 20 exposure Ss that was maintained over the course of training. Start speeds increased generally for all Ss over the early stages of training, but this effect might well have related to an initial "warm-up" effect or perhaps to a general reinforcement effect of "playing with the machine." The insensitivity of the start-speed measure might also relate to the distal position of the start response relative to the point of NS reinforcement. If anything, one would expect execution speeds to better reflect the differential effects of the SFE variables. The execution-speed differences in favor of the high-change and 20 exposure Ss are consistent with this expectation.

In relation to the above, it should be pointed out that the effects of the experimental variables on both choice and speed performance may have been obscured by the use of a 0.5-sec. stimulus duration (STD) in the learning phase. A STD of 0.5-sec. provided a change from both the 1 and 2 sec. STD of the familiarization phase; furthermore, this change was greater for the 2 than 1 sec. Ss. Consequently, the change in STD alone could have offset to some extent the reinforcing effect of the change produced by the novel color, especially in the case of those 2-sec. Ss who initially responded on the FS button. Relatedly, the STD change may in part account for the particular distribution pattern found among the perseverating Ss. It will be recalled that more of the familiar-stimulus-responding perseverators had experienced the 1-sec. STD condition in the familiarization phase, whereas more of the novel-stimulus-responding perseverators had experienced the 2-sec. STD condition. In line with this differentiation, it may be argued that the 2-sec. Ss who initially responded so as to produce the NS experienced a more pronounced change, in that these Ss received both a change in color as well as the maximum change in STD from familiarization to test phase. Thus, if these Ss were inclined to be perseverators, they may have found these changes sufficiently reinforcing to "stay with" the NS response button. On the other hand, the 2-sec. Ss who initially responded so as to produce the FS would presumably at first find this experience reinforcing because of the STD change alone. However, due to their familiarization experience with the same stimulus, these FS-responding Ss should rapidly become bored with the FS and shift to the alternative (NS) button. In contrast, the 1-sec. Ss who initially responded and experienced the FS, would presumably find the STD change less reinforcing; but relatedly, they would probably not be sufficiently bored (i.e., motivated) by their familiarization experience to reject the FS and shift to the alternative (NS) response button. Finally, the NS coupled with the STD change for 1-sec. Ss could have been sufficient to sustain responding on the NS button, but not to the extent of producing as strong a perseverating tendency as for the 2-sec. Ss.

The interaction of such stimulus conditions, combined with the unstructured nature of the task (i.e., "You can push whichever button you want"), could also have been conducive to the Ss responding on the basis of several superstitions. For example, S may have thought that E liked the initial color (i.e., the FS) and for that reason (assuming S wants to please E), continued to press for the FS. Or, with regard to the fact that more 1-sec. boys tended to be FS perseverators, one might view these FS responding boys as being more inclined to perceive the task as a race, the sole "purpose" of which was to see how fast they could push a button. Relevant to the sex bias of the perseverators, there is some evidence that responding in this type of task is influenced by the sex and socioeconomic status of the S.

Strain, Unikel and Adams (1969) found that lower socioeconomic males tend to pay less attention to a behavioral task and show significantly less alternation in a 2-choice response situation than do girls. With respect to socioeconomic status, it should be noted that the Ss of this study represented primarily lower socioeconomic groups.

As previously detailed, the variables contributing to the reinforcement of choice performance in the present study are those which have been isolated as controlling the SFE. In particular, the work by Cantor and his students has shown that the variables which are significant, and sometimes crucial, in producing the SFE, are the number of exposures and stimulus duration of the FS, and the degree of novelty of the NS. Significant choice responding for the NS in the present study was attributable to a combination of the 20 exposure and 2-sec. duration conditions, and as shown by the analyses excluding perseverating Ss, by the high-change condition as well. It is clear then that the most effective parameters of familiarity and novelty (or combinations of such) manipulated in this study closely parallel those parameters effective in SFE studies: i.e., 20 exposures (as compared to 18 for SFE), 2-sec. duration (as compared to 1.5 sec. for SFE), and high change (red vs. green for both this study and SFE).

It is noteworthy that the present study did not employ the typical reinforcers (e.g., M & M candy, marbles, toys, etc.) generally utilized to motivate the child's performance in an experimental task. In the present study, the sensory reinforcement employed was sufficient to direct and maintain responding at a level significantly above chance. Although the effects produced by such sensory reinforcement were small as compared with the effects typically produced by other reinforcers, the magnitude and duration of these effects closely parallel those obtained in animal studies utilizing response-contingent light-onset reinforcement. In the animal studies, response rate typically reaches a peak shortly after the sensory reinforcer becomes available to the S, and then almost immediately begins to wane (cf. Kish, 1966). In view of the nature of sensory reinforcers, such short-lived effects are to be expected, because once S has continuous access (i.e., exposure) to a novel stimulus, that stimulus ceases to be novel. Likewise, the limited magnitude and duration of the reinforcement effects of the present study may be related to the use of minimal satiation parameters, as previously detailed in the comparison between those minimal but sufficient conditions for producing the SFE and the conditions that were employed in the present study. Presumably, if longer STD intervals and/or larger numbers of exposures to the FS had been utilized, the magnitude and duration of the reinforcement effects might well have been proportionately greater. Nonetheless, the present study shows that the critical values of the exposure, duration and change variables needed to produce the SFE are virtually the same as those which produce a reinforcement of choice.

In view of the parallel results obtained in the present study and in those on SFE, it is important to consider the nature of SFE. In a recent review of the SFE literature, Cantor (1969) considers three possible explanations of the SFE. The first two explanations, the NS as "surprising" and associative interference, are quickly dismissed by Cantor as untenable. Cantor suggests that an explanation of the NS as "surprising" is untenable for two reasons: First, the heightened arousal assumed to be a concomitant of surprise should be as facilitative with respect to execution as to start speeds, but execution speeds do not show an SFE. Second, although the SFE is a durable effect usually persisting over a number of trials, it does not seem plausible that the initial "surprising" occurrence of the NS could have continued to remain so over the course of SFE testing.

Associative interference fares no better as an explanation. It is based on the assumed competition between an acquired, prolonged attending-response and the subsequently required motor response to the FS. In the Bogartz and Witte study (1966, Experiment I), Ss were required to perform the motor response throughout the familiarization as well as test phase. In this case, one might expect positive transfer to occur from the familiarization to the test phase for the FS. However, the SFE again obtained. In another successful SFE study (Witte & Cantor, 1967) Ss were instructed to respond to stimulus offset (rather than onset) in the motor task phase. An assumed prolonged attending-response to stimulus onset is not likely to interfere with a motor response required to stimulus offset.

Cantor (1969) regards the third hypothesis, habituation of an orientation reaction (OR) or attentional process, as a highly tenable explanation. The tenability of this hypothesis is suggested by the tendency for the SFE to occur in the initiation (start) component but not the execution component of the RT task. Accordingly, it is posited that the attending process or OR habituates to the FS during the familiarization phase; consequently, in the motor-task phase, Ss show greater habituation to the FS, and hence slower start-reaction speeds to the FS than to the NS. The lack of differences in the execution component of the RT task relates then to the consideration that, once the reaction is initiated, S is indeed attending to whichever stimulus (FS or NS) is present.

General support for an OR or attention-habituation hypothesis can be gleaned from numerous recent studies concerned with the physiological correlates (e.g., GSR, HR, EEG, EMG, etc.) of attention to a novel stimulus and the subsequent changes that occur in these various indices as habituation to that stimulus accrues (see Graham & Clifton, 1966). For example, Graham and Clifton conclude from the available evidence that "heart rate deceleration is a major component of orientation" when adult human or infrahuman Ss or human infants a few months old are presented with nonpainful, simple stimuli. Recently, McCall and Melson (1970) have reported for male infants 5 1/2 months old that cardiac deceleration to an NS increases monotonically as a function of the number of exposures to the FS. With specific reference to the SFE, Meyers and Joseph (1968) attempted to correlate GSR responsivity of college Ss with their performance in an SFE paradigm, but failed to obtain either an SFE or differential GSR responsivity to the FS and NS. Apparently, these investigators utilized less than the minimum number of exposures to the FS required to obtain the SFE. They did find, however, that female college Ss ranking high in GSR responsivity reacted significantly faster on the RT task than did those Ss categorized as low in GSR responsivity.

Additional evidence potentially relevant to performance on the motor-task component of the SFE is suggested by the studies of Coquery and Lacey (1966) and Lacey and Lacey (1966). These investigators have reported findings which suggest that a positive relationship exists between heart rate deceleration and the response speed of adults in various RT tasks. In addition, classical conditioning studies with animals have provided definitive evidence that stimulus pre-exposure (familiarization) prior to conditioning results in retarded learning to that stimulus as a CS (see Lubow & Moore, 1959; Parks, 1968). This finding has been interpreted as indicating that conditioning is dependent upon a strong OR to the CS and that with attenuation of the OR (as through pre-exposure to the CS) conditioning is impaired.

Application of the OR-habituation hypothesis to the SFE requires at least three assumptions. First, it is assumed that initial occurrences of the FS elicit the OR, i.e., a stimulus such as a red or green light elicits a relatively strong OR when first presented to the child. Second, with repeated exposures (apparently on the order of 18 or more, given a duration of 1.5 sec. and an ITI of 5.0 sec.), the OR habituates to that stimulus, i.e., repetitive exposure of S to a colored light leads to a gradual weakening of the OR to that stimulus. And third, speed of responding in the motor task is positively related to the strength and reliability of occurrence of the OR, i.e., the SFE reflects the differentially strong ORs elicited by the FS and the NS.

The most direct support for the three assumptions noted above would rest primarily upon a successful demonstration of appropriate variation in the relevant physiological indices of the OR in conjunction with the SFE paradigm. To this author's knowledge, only the Meyers and Joseph (1968) study has attempted such a demonstration, but was unsuccessful apparently because of methodological difficulties. Nonetheless, the OR-attention hypothesis appears to be the most tenable explanation for the SFE. General support for an OR-attention hypothesis is provided by the numerous studies showing correlations between various physiological indices of arousal, attention responses to novel stimuli, and performance in RT tasks. Furthermore, all of the research on investigatory behavior in animals may be viewed as evidence in support of the attention-producing properties of the novel stimulus in that it is the NS as opposed to the FS which produces active investigation (cf. attention) in the form of orientation, approach, sniffing, manipulation and the like.

The interpretation of the SFE is most important when considered together with the fact that the outcome of the present study paralleled that of the SFE regarding the variables (exposure, duration and change) controlling behavior in both situations. This suggests that the same process or processes underlying the SFE are also operative in a learning paradigm based on NS reinforcement. Considering that the SFE most likely involves an attention phenomenon (Cantor, 1969), then attention would also be operative in learning based on SFE-type variables. Specifically, this implies that the impact of the NS as a reinforcer is, at least in part, in producing an attentional-OR type of reaction. It is noteworthy that the generality of this position is supported by an extensive body of literature relating the reward value of stimuli to indices of arousal; in particular, these findings indicate that all of the stimulus properties that are characteristic of reward, in one way or another, also affect components of the orientation reaction (see Berlyne, 1967, 1969).

From the standpoint of reinforcement theory this consideration holds particular significance: First, as produced by the NS serving as a reinforcer, attention can be viewed as a "consummatory" response analogous to the URs occasioned by "typical" reinforcers like food and water. Second, as a UR to the NS, the attentional response should be subject to the laws of conditioning governing "typical" URs such as salivating, chewing, tongue-lapping, etc. Accordingly, attentional responses, treated as consummatory reactions to the NS, should become anticipatory, occurring in the context of those cues (e.g., position) associated with the NS as a reinforcer. In this fashion, anticipatory attention-ORs to the reinforcer may govern and motivate instrumental responses leading to that reinforcer.

The manner in which attentional reactions to the reinforcer may influence learning has been considered in other respects as well. For example, Kagan (1967) postulates that attention is operative not only to the reinforcing event, but also to the traces both from the instrumental response that led to the reinforcer and the stimulus context in which the instrumental response occurred. This interpretation may be expanded when it is considered in conjunction with the preceding comments relating to the conditioning of attentional responses to antedating cues. That is to say, the anticipatory occurrence of attentional responses can afford S the means by which it is anticipatorily attentive to the reinforcer while actually in the context of the stimuli preceding the reinforcer. The broad significance of this consideration is that S-R reinforcement theory is thus afforded a transition to cognitive theory: anticipatory attentional reactions occurring in the context of the cues that are associated with reward can mediate the effect of the reward; in effect, the organism can "know (be attentive to and aware of) what leads to what" (Fowler, 1970). So considered, the nature of reward and its mechanism of operation as an incentive for learning (i.e., through anticipatory response processes) may be expanded to encompass not only specific consummatory reactions (e.g., tongue-lapping, salivating, etc.), but also general orienting reactions (e.g., gross body adjustments, head and eye movements), as well as the more central reactions associated with both, in brief, increased arousal and attention.

6.0. SUMMARY

An extensive body of literature exists which shows that both animals and young children prefer novel as opposed to familiar stimuli. In addition, animals will learn to perform an instrumental response so as to produce the novel stimulus; however, comparably definitive data for children are lacking. One of the major difficulties has been the lack of a simple, yet adequate, instrumental paradigm for use with children in the context of learning based on novelty rewards. To resolve this difficulty, a paradigm initially developed to assess response _to_ novelty in RT tasks, i.e., the stimulus familiarization effect (SFE), was modified so as to assess response _for_ novelty in young children.

Deriving from the SFE and animal sensory-reinforcement literature, three variables were manipulated: number of exposures and stimulus duration (STD) of the to-be-familiarized stimulus (FS), and degree of change of the novel stimulus (NS) relative to the FS. Kindergarten children were presented with either 10 or 20 exposures of a red or green light (FS), with an STD of 1 or 2 sec. Following this familiarization, the _S_s were given 40 test trials where they could choose between two response buttons, one consistently producing the FS, and the other consistently producing the NS. Half the _S_s experienced a low change, i.e., a change from red or green (FS) to yellow (NS), while the remaining _S_s experienced a high change, i.e., a change from red or green (FS) to green or red (NS).

Analyses of variance, difference-score analyses, and analyses of deviations from chance (50%) were computed as they applied to: (1) novel response (NR) scores, (2) start speeds, and (3) execution speeds. The F-test results of NRs showed a stimulus duration main effect for the first half of training and a duration (D) x exposure (E) interaction throughout training. Additionally, when error variance was reduced by eliminating those Ss showing reliable response perseveration from the initial trial on, the data indicated a significant E effect; and, when error variance was reduced still further, by computing adjusted mean NR scores, based on the number of trials remaining following the first NR, a main effect for change (C) and a D x C interaction emerged as well. Analyses of variance of the differences (changes) in NR scores over the early stages of training showed significant D and C main effects for the data both with and without perseverators. In addition, the data excluding perseverators showed an E effect as well. Analyses of deviations from chance showed that all of the SFE variables (D, E, C) were effective in maintaining novel responding at a level above chance throughout the course of training. Contrasting with choice performance, start speeds increased non-differentially for all Ss over the early stages of training; however, execution speeds showed a significant rise for high-change Ss and a difference in favor of the 20 exposure Ss that was maintained over the course of training.

Collectively, these data demonstrate a reinforcement effect that was contributed to by all of the independent variables, i.e., the same variables and parameters critical in producing the SFE. Because the most plausible explanation for the SFE is one based on an attention-orientation reaction (OR), the data suggest that response to novelty (SFE) and response for novelty (learning-reinforcement) are parallel processes in which the effects of the novel stimulus are dependent upon an attentional reaction. Consequently, it was posited that attention-ORs may have general significance for reinforcement theory, specifically, that these responses constitute an integral part of the reinforcement process itself. Thus, reinforcers may elicit attention-ORs, as well as consummatory responses specific to their nature. Furthermore, in a learning situation, attention-ORs, like consummatory responses of "typical" reinforcers, may become anticipatory to function as mediating responses. Thus, through the conditioning of anticipatory attention-ORs to the stimulus context in which the organism makes the instrumental response, it can "know (be attentive to and aware of) what leads to what." In this manner, S-R reinforcement theory is expanded to include cognitive awareness.

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APPENDIX (RAW DATA)

TABLE 1

Novel Response Scores (1) over
Single Trials 1-10 for Ss of the
Various Conditions

L10-1 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	1	1	1	1	1	1	1	1	1	1
2.	M	0	0	0	0	0	0	0	0	0	0
3.	F	1	1	0	1	1	0	1	0	1	0
4.	F	1	0	0	1	0	1	0	1	0	1
5.	M	0	0	0	0	0	0	0	0	0	0
6.	M	1	1	1	1	1	0	1	0	1	0
7.	F	0	1	0	1	1	0	1	0	1	0
8.	F	0	0	0	0	0	0	0	0	0	0
9.	M	1	1	1	0	0	1	1	0	1	0
10.	M	1	0	1	1	0	0	1	0	1	1
11.	F	1	1	1	1	1	1	1	1	1	1
12.	F	0	1	1	0	1	0	1	0	0	1

L10-2 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	1	0	1	0	1	0	1	0	1	0
2.	M	0	0	0	0	0	0	0	0	0	0
3.	F	0	1	0	1	0	1	1	1	1	1
4.	F	1	1	1	1	1	1	1	1	1	1
5.	M	0	0	1	0	1	0	1	0	1	0
6.	M	0	0	0	0	0	0	0	0	0	0
7.	F	0	0	0	0	0	0	0	1	1	0
8.	F	0	1	1	0	1	0	0	0	0	0
9.	M	1	1	1	1	1	0	0	0	1	1
10.	M	0	0	0	0	0	0	0	0	0	0
11.	F	1	1	1	1	1	1	1	1	1	1
12.	F	1	0	1	1	0	0	1	1	1	0

TABLE 1 (continued)

L20-1 Condition

S	Gender	1	2	3	4	5	6	7	8	9	10
					Trials						
1.	M	1	1	1	1	1	1	0	0	1	1
2.	M	0	1	0	1	0	1	0	1	0	1
3.	F	0	1	0	1	0	1	0	1	0	1
4.	F	0	0	0	0	0	0	0	0	0	0
5.	M	1	1	1	1	0	0	1	1	1	0
6.	M	0	0	0	0	0	0	0	0	0	0
7.	F	1	1	1	0	0	0	1	0	1	0
8.	F	1	0	1	0	1	0	1	0	0	1
9.	M	0	0	0	1	0	1	0	1	1	0
10.	M	1	1	1	1	1	1	1	1	1	0
11.	F	1	0	0	1	0	1	0	1	0	0
12.	F	1	1	0	1	0	1	0	1	0	1

L20-2 Condition

S	Gender	1	2	3	4	5	6	7	8	9	10
					Trials						
1.	M	1	0	1	1	1	1	1	1	1	1
2.	M	0	0	0	0	0	0	0	0	0	0
3.	F	1	1	1	1	1	1	1	1	1	1
4.	F	0	1	1	1	1	1	0	1	0	0
5.	M	0	1	0	1	0	1	0	1	0	0
6.	M	1	0	1	1	1	1	0	1	1	1
7.	F	1	0	1	0	1	0	1	1	0	1
8.	F	0	0	1	0	1	1	0	0	0	1
9.	M	0	0	0	0	0	1	1	0	1	0
10.	M	1	1	1	0	1	0	1	0	1	1
11.	F	1	1	1	0	0	1	1	1	0	1
12.	F	1	1	1	1	1	1	1	1	1	1

TABLE 1 (continued)

H10-1 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	0	0	0	0	0	0	0	0	0	0
2.	M	1	1	1	1	1	0	1	0	1	1
3.	F	1	1	1	1	1	1	0	0	1	1
4.	F	1	1	1	1	1	1	1	1	1	1
5.	M	1	0	1	0	1	1	0	1	0	1
6.	M	0	1	0	1	1	0	1	1	0	0
7.	F	1	1	0	1	0	1	0	1	1	0
8.	F	0	0	0	0	0	0	0	0	0	1
9.	M	1	0	1	0	1	1	0	1	0	1
10.	M	0	0	0	0	0	0	0	0	0	0
11.	F	0	0	1	1	0	1	0	1	0	1
12.	F	1	0	1	0	1	0	0	1	1	0

H10-2 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	0	0	0	0	1	0	1	0	1	0
2.	M	0	0	0	0	1	1	1	1	0	1
3.	F	0	0	0	1	0	1	1	1	1	1
4.	F	0	1	1	1	1	1	1	1	1	0
5.	M	0	1	0	1	0	1	0	1	1	0
6.	M	1	0	1	0	1	0	1	0	1	0
7.	F	0	0	0	0	0	0	0	0	0	0
8.	F	1	1	0	0	1	1	1	0	1	0
9.	M	1	0	1	0	1	0	1	1	0	1
10.	M	0	0	1	0	1	0	1	0	1	0
11.	F	1	1	1	1	1	1	1	1	1	1
12.	F	1	1	1	0	1	0	1	1	0	1

TABLE 1 (continued)

H20-1 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	0	1	0	0	1	1	1	1	1	1
2.	M	0	0	0	0	0	1	1	1	0	1
3.	F	0	0	0	0	0	0	0	0	0	0
4.	F	1	1	1	1	0	1	0	1	0	1
5.	M	0	1	0	1	1	0	0	1	1	0
6.	M	0	0	0	0	1	1	1	1	1	1
7.	F	0	0	0	0	0	0	0	0	0	0
8.	F	1	1	1	1	0	1	1	1	0	1
9.	M	0	0	0	0	0	0	0	0	0	0
10.	M	0	0	0	0	0	0	1	1	0	1
11.	F	0	0	0	0	0	0	0	0	0	0
12.	F	0	0	0	0	0	0	0	0	0	0

H20-2 Condition

S	Gender	Trials 1	2	3	4	5	6	7	8	9	10
1.	M	0	0	0	0	0	1	1	0	1	1
2.	M	0	0	0	0	1	0	1	1	0	0
3.	F	1	1	1	1	1	1	1	1	1	1
4.	F	1	1	0	0	1	1	1	0	1	0
5.	M	0	1	1	0	1	0	1	1	0	0
6.	M	0	0	0	1	1	0	1	1	0	1
7.	F	1	1	1	1	1	1	1	1	1	1
8.	F	1	1	1	1	1	1	1	1	1	1
9.	M	0	1	1	0	1	0	1	0	0	1
10.	M	1	1	1	1	1	1	1	1	1	1
11.	F	0	0	0	0	0	1	1	1	0	1
12.	F	1	1	1	1	1	1	1	1	1	1

TABLE 2

Novel Response Scores in Five-Trial Blocks

for Ss of the Various Conditions

L10-1 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.*	M	FS	0	2	3	1	4	3	2	3	18
2.*	M	FS	0	0	0	0	0	0	0	0	0
3.	F	NS	4	2	2	3	2	4	2	3	22
4.	F	NS	2	3	3	2	3	2	3	2	20
5.*	M	FS	0	5	5	3	3	0	0	4	20
6.	M	NS	5	2	2	4	1	3	0	3	20
7.	F	FS	3	2	3	3	3	2	2	4	22
8.*	F	FS	0	0	0	0	3	4	5	5	17
9.	M	NS	3	3	4	4	2	3	2	4	25
10.	M	NS	3	3	2	2	3	2	3	3	21
11.*	F	FS	2	2	3	2	3	4	2	3	21
12.	F	FS	3	2	3	4	0	2	2	1	17

L10-2 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.	M	NS	3	2	2	1	4	1	3	1	17
2.*	M	NS	3	2	1	2	3	3	3	2	19
3.	F	FS	2	5	5	5	2	2	1	1	23
4.*	F	NS	5	5	5	5	5	4	5	3	37
5.	M	FS	2	2	2	1	3	1	2	2	15
6.*	M	FS	2	3	2	3	2	2	2	2	18
7.*	F	FS	0	2	5	3	5	4	4	4	27
8.	F	FS	3	0	1	1	1	4	5	5	20
9.	M	NS	5	2	2	2	3	3	2	1	20
10.*	M	NS	5	3	4	3	3	3	5	4	30
11.*	F	NS	4	3	2	3	3	4	2	4	25
12.	F	NS	3	3	2	1	3	0	0	0	12

*Asterisk indicates a perseverator as defined in the text.

TABLE 2 (continued)

L20-1 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.	M	NS	5	3	2	5	4	3	4	2	28
2.	M	FS	2	3	1	3	2	1	2	3	17
3.	F	FS	2	3	2	3	1	2	3	2	18
4.*	F	FS	0	0	0	0	0	0	0	0	0
5.	M	NS	4	3	3	2	3	3	4	1	23
6.*	M	FS	0	3	3	2	3	1	2	2	16
7.	F	NS	3	2	1	2	3	1	0	2	14
8.	F	NS	3	2	2	2	3	3	4	2	21
9.	M	FS	1	3	4	1	4	3	2	5	23
10.*	M	NS	5	4	3	4	5	4	4	3	32
11.	F	NS	2	2	3	3	2	3	1	1	17
12.	F	NS	3	3	3	2	2	3	3	3	22

L20-2 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.	M	NS	4	5	3	4	2	5	4	5	32
2.*	M	NS	5	4	1	3	0	1	0	4	18
3.*	F	NS	2	3	3	3	3	3	2	3	22
4.	F	FS	4	2	3	2	4	5	5	1	26
5.	M	FS	2	2	3	2	2	3	2	5	21
6.	M	NS	4	4	5	5	5	5	5	5	38
7.	F	NS	3	3	3	3	2	2	3	3	22
8.	F	FS	2	2	4	2	1	3	2	1	17
9.	M	FS	0	3	4	2	4	4	1	3	21
10.	M	NS	4	3	2	3	2	2	2	2	20
11.	F	NS	3	4	4	3	1	3	3	4	25
12.*	F	FS	3	2	3	2	2	2	4	3	21

TABLE 2 (continued)

H10-1 Condition

S	Gender	Initial Stimulus choice	1	2	3	4	5	6	7	8	Total novel responses
			Trial Blocks								
1.*	M	FS	0	0	0	3	3	2	3	2	13
2.	M	NS	5	3	0	2	3	2	3	2	20
3.	F	NS	5	3	3	2	2	4	4	5	28
4.*	F	NS	5	5	5	5	5	5	5	5	40
5.	M	NS	3	3	2	3	2	3	2	3	21
6.	M	FS	3	2	2	5	2	3	3	4	24
7.	F	NS	3	3	2	1	2	2	3	3	19
8.*	F	FS	0	1	3	4	0	5	4	0	17
9.	M	NS	3	3	3	2	3	3	4	2	23
10.*	M	NS	5	3	2	3	5	3	5	3	29
11.	F	FS	2	3	2	4	3	3	3	1	21
12.	F	NS	3	2	3	2	4	2	4	3	23

H10-2 Condition

S	Gender	Initial Stimulus choice	1	2	3	4	5	6	7	8	Total novel responses
			Trial Blocks								
1.	M	FS	1	2	3	3	3	4	2	1	19
2.	M	FS	1	4	3	3	3	3	3	1	21
3.	F	FS	1	5	1	1	4	2	0	5	19
4.	F	FS	4	4	4	4	5	1	5	5	32
5.	M	FS	2	3	3	3	3	2	3	3	22
6.	M	NS	3	2	2	2	3	1	1	3	17
7.*	F	FS	0	0	0	4	3	1	2	2	12
8.	F	NS	3	3	3	2	1	3	3	3	21
9.	M	NS	3	3	2	2	3	4	2	3	22
10.	M	FS	2	2	3	3	2	3	3	2	20
11.*	F	NS	5	5	2	3	2	2	3	3	25
12.	F	NS	4	3	3	2	3	3	2	4	24

TABLE 2 (continued)

H20-1 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.	M	FS	2	5	4	4	1	0	4	0	20
2.	M	FS	0	4	4	2	2	5	2	5	24
3.*	F	FS	2	3	3	1	3	2	4	1	19
4.	F	NS	4	3	2	3	4	2	4	4	26
5.	M	FS	3	2	4	3	4	4	4	4	28
6.	M	FS	1	5	5	1	5	5	5	5	32
7.*	F	NS	3	2	1	4	3	2	1	2	18
8.	F	NS	4	4	3	3	4	5	5	2	30
9.*	M	FS	0	0	0	3	3	2	3	3	14
10.	M	FS	0	3	4	5	5	3	5	4	29
11.*	F	FS	0	0	0	3	2	4	4	0	13
12.*	F	FS	0	0	2	4	2	1	1	2	12

H20-2 Condition

S	Gender	Initial Stimulus choice	Trial Blocks 1	2	3	4	5	6	7	8	Total novel responses
1.	M	FS	0	4	4	3	2	3	0	0	16
2.	M	FS	1	2	4	4	2	3	5	5	26
3.*	F	NS	3	2	2	3	2	3	2	3	20
4.	F	NS	3	3	3	3	3	3	2	4	24
5.	M	FS	3	2	4	1	3	0	0	2	15
6.	M	FS	2	3	3	2	4	4	5	3	26
7.*	F	NS	5	5	4	1	5	4	2	3	29
8.*	F	FS	1	2	4	2	3	2	2	4	20
9.	M	FS	3	2	2	4	3	3	2	3	22
10.*	M	NS	5	5	5	2	2	2	3	2	26
11.	F	FS	0	4	2	3	2	4	3	3	21
12.*	F	NS	3	3	4	4	2	2	2	1	21

TABLE 3

Median Start Speed Scores in Five-Trial Blocks for Ss of the Various Conditions

L10-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.*	M	2.38	3.33	8.33	3.33	5.00	8.33	4.55	5.00
2.*	M	.42	.14	.11	.35	.50	.59	.31	.83
3.	F	2.00	2.50	1.79	2.50	2.78	2.63	2.38	2.17
4.	F	1.72	1.72	1.43	1.79	2.22	2.27	2.22	2.22
5.*	M	1.25	1.43	1.00	1.09	1.52	1.00	1.33	1.61
6.	M	2.00	2.22	2.94	5.00	4.35	3.33	5.00	3.85
7.	F	1.67	2.22	1.89	3.12	5.00	3.33	1.11	2.17
8.*	F	1.54	2.50	2.00	1.54	2.22	2.86	1.11	2.08
9.	M	1.33	1.72	1.22	2.00	1.52	1.79	2.22	2.50
10.	M	3.12	3.12	3.12	3.33	3.33	3.33	4.00	4.17
11.*	F	1.82	1.43	2.86	2.22	2.50	3.33	1.54	1.11
12.	F	2.00	2.50	5.00	3.33	2.50	3.33	3.12	2.78

L10-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	1.05	1.43	.37	1.67	.20	.20	.50	.91
2.*	M	1.33	1.67	1.25	3.33	2.86	4.00	3.12	3.33
3.	F	.25	1.43	1.82	1.43	1.82	2.00	2.22	1.00
4.*	F	1.00	2.22	2.50	4.55	2.22	1.00	1.54	1.72
5.	M	3.85	4.55	4.17	4.55	5.00	4.17	4.35	4.55
6.*	M	.63	1.43	1.54	1.11	1.18	1.18	1.11	1.00
7.*	F	1.67	3.33	2.94	3.12	6.67	3.33	6.67	4.00
8.	F	1.33	.91	1.25	1.00	1.00	1.11	1.00	.50
9.	M	2.86	3.33	2.94	5.00	10.00	4.00	5.56	1.85
10.*	M	3.33	2.86	4.00	4.00	3.33	5.00	5.00	5.00
11.*	F	2.68	2.86	3.33	2.50	2.18	2.86	3.12	2.86
12.	F	1.91	.63	1.00	.59	.63	.83	.71	.74

*Asterisk indicates a perseverator as defined in the text.

TABLE 3 (continued)

L20-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	.91	1.11	1.00	.20	.10	.23	.17	.40
2.	M	.24	.57	.44	2.00	.65	.43	.37	.20
3.	F	4.55	8.33	2.50	3.12	2.78	1.67	3.57	5.00
4.*	F	.65	.27	.27	.35	.54	.61	.61	1.67
5.	M	2.27	4.00	4.00	5.00	5.56	4.55	4.17	5.00
6.*	M	.81	.81	.57	.65	.65	.91	.68	.81
7.	F	1.25	2.00	5.00	5.00	1.89	1.89	4.00	6.67
8.	F	2.08	2.86	3.57	2.86	2.33	2.86	2.22	2.08
9.	M	2.86	10.00	2.22	1.67	1.67	5.00	2.22	2.63
10.*	M	2.17	2.38	2.00	2.00	2.94	2.00	1.85	2.50
11.	F	1.79	1.25	1.82	2.50	3.12	2.00	1.79	3.33
12.	F	2.50	2.63	2.86	3.57	2.94	3.57	1.72	4.00

L20-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	2.22	1.82	1.82	8.33	5.00	5.00	3.33	3.33
2.*	M	1.72	2.50	2.50	1.05	2.00	1.00	4.00	2.22
3.*	F	.14	.14	.20	.13	.30	.20	.17	.10
4.	F	2.00	2.86	3.33	4.00	1.79	2.50	1.85	2.94
5.	M	2.86	2.63	2.86	2.86	3.33	3.33	4.00	4.00
6.	M	2.50	5.00	6.67	5.00	4.00	5.00	5.00	6.67
7.	F	1.82	2.00	2.00	2.22	2.50	2.22	2.08	2.50
8.	F	3.12	3.33	3.12	2.86	3.33	2.86	2.78	2.63
9.	M	1.67	1.47	1.67	1.82	2.00	1.67	1.79	1.47
10.	M	.23	.26	.29	.29	.20	.23	.24	.32
11.	F	2.00	2.00	2.17	5.00	10.00	4.00	6.67	4.55
12.*	F	2.00	1.19	1.72	2.86	1.72	2.22	1.85	6.67

TABLE 3 (continued)

H10-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.*	M	.13	.13	.20	.56	1.01	2.22	5.56	2.50
2.	M	.95	1.18	1.67	1.82	2.86	2.00	2.00	1.92
3.	F	2.00	1.47	1.67	2.86	1.82	2.00	.89	.52
4.*	F	2.08	2.63	2.27	2.27	2.86	2.63	2.22	2.27
5.	M	2.00	1.25	3.12	2.17	3.03	4.00	2.86	5.00
6.	M	1.43	1.67	1.54	1.33	1.67	1.14	1.54	1.18
7.	F	10.00	10.00	10.00	10.00	4.00	5.00	8.33	2.86
8.*	F	.87	.54	.91	1.11	2.86	3.33	4.00	2.00
9.	M	2.86	2.63	2.86	5.00	2.33	5.00	2.94	4.00
10.*	M	1.67	2.17	2.08	4.00	3.85	4.00	4.00	5.00
11.	F	2.22	2.86	10.00	2.86	5.00	1.18	2.22	2.50
12.	F	4.00	3.57	3.33	3.33	2.63	2.86	2.94	2.63

H10-2 Condition

S	Gender	Trial Blocks 1.	2	3	4	5	6	7	8
1.	M	.54	.57	.71	.71	2.00	2.86	2.86	3.33
2.	M	1.82	.91	5.00	2.86	2.27	4.00	4.55	2.63
3.	F	.91	.63	5.00	7.14	8.33	5.00	6.67	6.67
4.	F	3.33	8.33	5.00	6.25	6.67	3.33	6.67	5.88
5.	M	3.57	4.00	4.00	2.78	5.00	2.86	1.47	2.63
6.	M	.91	1.11	1.11	1.11	1.25	1.43	1.82	2.00
7.*	F	4.35	3.33	1.67	1.52	2.22	1.33	3.03	2.08
8.	F	1.43	1.82	.69	.71	.63	1.18	2.00	2.22
9.	M	1.25	.81	.91	.91	.74	.61	.77	.77
10.	M	.67	.80	.80	.69	.95	.73	.69	1.16
11.*	F	1.67	4.00	5.00	2.86	3.03	2.38	2.22	2.78
12.	F	1.43	2.00	2.70	3.12	3.70	2.00	3.57	2.70

TABLE 3 (continued)

H20-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	2.50	2.86	3.12	3.85	2.78	2.86	3.33	2.94
2.	M	.69	.61	.56	.74	.54	.61	.54	.65
3.*	F	1.54	1.54	1.18	3.33	4.00	5.00	4.00	5.00
4.	F	3.12	4.17	2.22	2.50	4.00	4.00	2.94	4.00
5.	M	1.39	2.00	1.43	1.14	.87	.59	.87	.48
6.	M	6.67	4.55	8.33	10.00	10.00	3.33	2.63	2.50
7.*	F	1.14	2.30	2.30	1.67	.57	.44	.44	1.25
8.	F	2.86	3.85	3.33	4.00	3.85	5.56	3.33	4.17
9.*	M	3.33	4.35	5.00	4.00	5.00	4.33	5.00	4.55
10.	M	1.54	2.22	1.89	3.12	3.33	1.82	3.33	3.33
11.*	F	1.67	2.22	6.67	3.33	10.00	3.57	5.00	4.00
12.*	F	1.47	2.50	1.82	3.12	2.22	2.04	2.08	1.56

H20-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	.57	.67	2.00	.83	.77	.80	.69	.83
2.	M	2.00	2.38	2.38	2.22	2.63	1.67	2.08	2.22
3.*	F	2.22	4.00	4.55	5.00	6.67	8.33	4.55	2.27
4.	F	.91	2.50	4.00	3.57	4.00	3.33	2.86	2.86
5.	M	1.52	2.08	1.43	1.61	1.11	2.86	2.22	1.82
6.	M	2.22	4.55	10.00	10.00	10.00	10.00	5.56	10.00
7.*	F	5.36	8.33	10.00	3.33	8.33	10.00	10.00	5.00
8.*	F	1.54	1.54	1.82	1.52	1.33	2.50	2.50	2.94
9.	M	1.82	1.43	1.54	1.33	1.43	1.43	1.43	1.92
10.*	M	2.50	2.86	2.50	3.00	6.67	5.36	5.36	5.00
11.	F	6.67	.91	.91	.69	.68	.74	1.28	1.18
12.*	F	.80	.65	.56	.53	.71	.63	.55	.53

TABLE 4

Median Execution Speed Scores in

Five-Trial Blocks for Ss of the

Various Conditions

L10-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.*	M	2.94	3.85	4.55	3.33	4.00	3.85	3.45	3.57
2.*	M	4.00	4.00	3.12	3.33	2.86	4.00	2.86	2.50
3.	F	3.33	3.12	2.94	3.12	2.78	2.63	2.50	2.38
4.	F	1.85	4.00	1.82	1.82	3.33	3.12	2.27	2.50
5.*	M	2.78	2.86	2.86	2.86	2.38	2.50	3.33	2.50
6.	M	1.72	2.33	2.50	2.78	2.50	1.89	2.00	1.47
7.	F	3.33	2.86	1.82	2.22	2.22	1.35	1.72	1.89
8.*	F	2.50	2.63	1.82	1.33	1.67	1.67	10.00	3.33
9.	M	2.86	2.63	3.33	2.63	2.50	2.27	2.86	2.38
10.	M	3.33	3.33	3.03	2.50	3.12	2.50	2.50	2.38
11.*	F	3.33	3.33	4.00	4.00	3.33	3.33	4.00	4.00
12.	F	2.00	3.12	2.50	1.82	1.82	1.72	1.89	2.50

L10-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	2.00	2.86	1.25	.50	.20	1.67	.71	1.82
2.*	M	2.27	2.22	2.50	2.86	2.22	2.86	2.63	2.78
3.	F	2.50	2.78	1.33	1.47	1.43	.64	.39	.59
4.*	F	1.00	4.00	3.33	4.00	3.33	2.86	1.43	1.67
5.	M	3.33	4.00	4.00	3.12	4.00	3.85	3.85	4.00
6.*	M	.61	.20	.28	.26	.35	.25	.32	.33
7.*	F	3.33	3.12	4.17	4.00	4.17	4.76	4.00	4.17
8.	F	1.43	1.11	1.14	1.00	.91	.63	1.18	1.33
9.	M	3.33	2.50	2.22	2.86	2.00	1.72	2.00	1.67
10.*	M	4.00	4.55	4.00	3.33	3.57	3.57	4.00	3.51
11.*	F	4.00	4.00	3.33	3.33	3.33	3.12	3.23	3.03
12.	F	1.33	.59	.58	.54	.58	.77	.80	.91

*Asterisk indicates a perseverator as defined in the text.

TABLE 4 (continued)

L20-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	1.25	1.67	1.00	1.54	.71	1.33	1.79	1.67
2.	M	1.54	2.17	1.54	1.54	1.43	1.43	1.79	1.52
3.	F	5.00	5.00	4.17	4.17	10.00	10.00	4.00	4.00
4.*	F	.91	1.25	1.43	2.00	1.25	1.82	4.00	2.50
5.	M	2.94	3.85	10.00	3.33	2.78	2.94	2.78	2.86
6.*	M	4.00	4.55	4.00	4.00	4.55	4.55	4.35	3.57
7.	F	5.00	8.33	6.67	8.33	8.33	5.00	5.00	8.33
8.	F	2.22	2.22	2.86	2.00	2.86	2.27	2.22	1.54
9.	M	5.00	4.00	4.00	3.33	4.00	3.33	3.57	3.12
10.*	M	3.03	3.33	3.33	2.86	2.94	3.33	2.63	2.22
11.	F	2.86	1.11	1.33	.87	1.67	1.75	1.67	1.72
12.	F	2.38	2.86	3.33	3.33	3.23	3.33	2.78	3.33

L20-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	4.00	3.33	4.00	4.17	3.33	3.33	3.12	3.57
2.*	M	1.54	1.82	1.25	1.43	1.33	.74	2.86	1.89
3.*	F	.25	.50	.69	.54	.59	1.00	.77	1.00
4.	F	5.00	5.00	3.85	3.57	4.00	3.23	3.33	3.57
5.	M	1.18	2.86	.87	1.33	2.38	1.82	1.67	1.67
6.	M	5.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00
7.	F	2.00	2.22	2.22	2.27	2.22	2.33	2.08	2.38
8.	F	3.03	4.00	6.67	4.55	3.57	4.00	3.12	6.67
9.	M	2.00	2.00	1.14	1.47	2.00	1.61	2.13	2.22
10.	M	5.00	5.00	5.00	4.00	4.00	3.12	2.94	3.03
11.	F	1.92	1.54	2.00	1.67	2.22	2.86	2.00	2.63
12.*	F	1.25	2.08	2.17	1.82	1.92	1.75	1.67	1.67

TABLE 4 (continued)

H10-1 Condition

S	Gender	1	2	3	4	5	6	7	8
1.*	M	1.43	1.54	1.82	1.67	2.38	2.00	2.00	2.17
2.	M	2.50	3.33	2.86	3.12	3.33	3.12	3.33	3.33
3.	F	1.54	1.45	1.11	2.50	1.79	2.17	.63	1.67
4.*	F	4.00	3.12	2.86	3.12	2.78	2.86	2.86	2.70
5.	M	1.54	1.33	1.61	1.82	1.54	2.22	2.50	4.00
6.	M	2.22	2.50	2.00	1.54	1.67	2.50	1.82	2.50
7.	F	3.12	2.63	3.57	2.86	3.23	3.33	3.12	3.33
8.*	F	.13	.28	.29	.28	.39	.33	.31	.32
9.	M	4.00	4.00	4.00	4.00	4.55	4.00	3.85	3.85
10.*	M	4.00	4.00	4.00	5.00	4.17	4.35	4.55	4.17
11.	F	2.22	2.50	1.43	2.22	2.17	2.50	2.27	2.22
12.	F	1.67	1.92	2.08	1.72	2.08	2.22	1.82	1.14

H10-2 Condition

S	Gender	Trial Blocks							
		1	2	3	4	5	6	7	8
1.	M	2.22	2.50	2.50	2.86	2.50	2.50	2.86	2.86
2.	M	3.12	3.33	3.33	3.57	3.33	3.33	3.33	2.86
3.	F	2.86	4.00	3.57	3.33	4.00	2.94	3.57	4.76
4.	F	4.00	4.76	4.00	4.00	4.00	2.63	3.57	4.00
5.	M	2.00	2.22	2.22	2.63	2.22	2.38	2.50	2.04
6.	M	2.50	1.33	2.22	4.00	2.86	4.00	2.50	2.86
7.*	F	1.11	2.00	1.54	1.92	1.28	1.00	1.11	1.22
8.	F	1.25	1.33	1.25	1.89	1.43	1.54	1.18	1.54
9.	M	2.00	.81	1.11	1.47	1.33	1.82	1.92	1.54
10.	M	1.54	2.00	2.22	2.08	1.67	2.08	.91	2.50
11.*	F	3.33	3.33	3.33	3.33	3.03	2.78	2.86	2.78
12.	F	3.33	4.00	3.85	3.85	3.33	3.23	3.33	3.12

TABLE 4 (continued)

H20-1 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	2.22	1.54	2.38	2.50	2.00	1.61	2.22	1.33
2.	M	3.33	3.33	6.67	3.57	3.33	4.55	2.78	4.00
3.*	F	2.50	2.50	2.38	1.89	1.61	2.00	1.32	1.92
4.	F	2.00	4.00	4.00	4.00	4.55	4.00	3.85	4.00
5.	M	1.00	1.11	1.05	.69	1.25	1.09	1.00	1.11
6.	M	3.33	2.38	2.86	8.33	1.92	2.86	2.56	2.44
7.*	F	1.54	1.54	1.61	1.61	1.92	1.61	1.79	1.54
8.	F	2.63	2.86	2.50	2.50	2.33	2.63	2.50	2.27
9.*	M	3.57	4.00	3.33	3.33	3.33	2.94	2.94	2.94
10.	M	2.86	3.33	2.86	3.33	2.38	2.63	3.23	2.86
11.*	F	5.00	5.00	5.00	5.00	5.00	4.55	4.76	4.00
12.*	F	4.00	4.00	4.00	4.00	4.00	4.55	3.23	3.33

H20-2 Condition

S	Gender	Trial Blocks 1	2	3	4	5	6	7	8
1.	M	2.50	2.86	2.86	4.00	2.63	3.33	2.86	2.50
2.	M	1.67	1.56	1.67	1.92	1.82	2.00	2.22	2.86
3.*	F	3.33	3.33	3.57	3.33	3.12	3.12	2.86	3.03
4.	F	2.86	2.86	3.33	3.12	3.33	2.63	2.13	3.12
5.	M	2.38	2.50	2.78	1.18	1.61	1.67	1.89	1.82
6.	M	4.55	4.00	4.17	5.00	4.17	6.25	5.00	6.67
7.*	F	1.33	3.57	2.50	2.50	2.50	3.33	3.12	2.50
8.*	F	2.00	2.22	2.38	2.86	1.82	1.18	1.72	2.38
9.	M	3.57	4.00	4.17	3.03	3.12	3.12	2.86	2.94
10.*	M	2.33	1.82	2.50	3.33	4.00	3.03	3.12	2.78
11.	F	1.54	1.43	1.72	1.47	1.43	1.37	1.67	1.39
12.*	F	2.08	1.82	1.82	1.67	2.50	1.43	1.82	1.92