THE PARAMETERS INVOLVED IN THE ACQUISITION AND EXTINCTION PROCESSES OF A DECLINED RUNWAY UPON THE BEHAVIOR OF THE RAT

A Thesis

Presented to

the Faculty of the Graduate School

of the University of Houston

In Partial Fulfillment

of the Requirements for the Degree,

Master of Arts

by

Robert E. Prytula

August, 1966

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AN ABSTRACT

This study was designed to investigate the parameters involved in a declined runway situation.

The subjects were eighteen female and twelve male Holtzman rats.

The procedure involved varying factorially the decline of a runway during extinction as a function of the acquisition training. The declines used were 45°, 15°, and 0°.

The results of the acquisition process show that there is a significant difference between the various decline levels.

The results of the extinction phase show that there is no significant difference among the factorially varied decline conditions as a function of acquisition training.

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CHAPTER I

RELEVANT LITERATURE

Since the independent variable (runway decline) has not received any attention in the literature and the concern in this study was with the acquisition and extinction processes, the experiments to be discussed will mainly center upon these processes and their theoretical implications.

Acquisition

First of all, under the topic of acquisition a distinction must be made between learning and performance. The separation of these factors is extremely difficult because the criteria is hard to define -- the most accepted criteria for learning is any relatively permanent change in behavior which occurs as a result of reinforced practice. Performance criteria are changes which occur without practice (Kimble 1961). In other words, an effect which is observed to carry over from acquisition to extinction will be called a learning variable; an effect which does not show permanence from acquisition to extinction will be called a performance variable.

The most common method used to separate these two variables is a factorial design. It should be pointed out that there are some limitations with this procedure; the main limitation is that any change in the conditions of the experiment also changes performance.

Extinction Theories

The next topic to be discussed will be the variety of extinction theories and their consequences. First, it should be mentioned that the omission of reinforcement has some of the following consequences: 1) inhibition or adaptation of response, 2) elicitation of interfering responses, 3) generalized decrement, 4) frustration, (Kimble 1961). These consequences parallel to some extent the important theories of extinction.

Inhibition Theory

The first theory is the Inhibition Theory of Hull (1943). Basically every response the organism elicits, whether reinforced or not, leaves an increment of reactive inhibition (I_R) which is a primary negative drive state and is a function of the number of responses and the effortfulness of the response. It is similar to fatigue in that it produces a cessation of response. Theoretically then, the greater the number of responses or the more effort involved -- the faster I_R should build up. I_R builds up in a linear function where as S^ER (behavior potential) increases in a negatively accelerating manner, at some point the effects of I_R will overcome the behavior potential leading to cessation of the response. In a later revision, Hull added a second concept S^IR (conditioned inhibition) which is I_R conditioned to the stimuli in the learning situation. I_R and S^IR combine in an additive fashion to subtract from S^ER. It should be stated that during extinction

$_S H_R$ (habit strength) is no longer being built up where as both I_R and $_S I_R$ continue to build up.

Generalization Decrement

The Generalization Decrement (Kimble 1961) stresses the fact that all extinction procedures involve a change in the proprioceptive consequences due to the omission of reinforcement. If the conditioned response is under the control of the proprioceptive stimuli due to reward and the stimuli due to the situation, it should lose strength as a result of changes. The greater the changes from acquisition to extinction -- the more prominent the proprioceptive consequences and easier detection of the difference by the organism. In other words, if the conditions of acquisition and extinction are highly similar the less detected difference between the two processes. A study of drinking behavior by Fink and Patton (1953) illustrates this process. In this study, they found that drinking behavior decreased as a function of the familiar cues removed from the situation. Other evidence comes from studies done by Weinstock and Wilson (1954), V. F. Sheffield (1950) and others.

Frustration

The next theory to be discussed is that concerning frustration. It appears that the omission of reward is frustrating and during this period of non-reward there is a higher probability of conditioning interfering responses to the learning situation.

Under the frustration hypothesis there are a variety of theories from men such as: Brown-Farber (1951), Amsel (1951), Spence (1960), and others.

The Brown-Farber theory (1951) was basically derived from a Hullian framework, frustration resulting from the interference with an ongoing motivated behavior by either an inhibitory tendency (produced by non-reinforcement) or by a competing response.

Amsel's theory (1951, 1958, 1962) primarily agrees with the two-factor explanation of Brown-Farber (1951); but, adds a third factor namely the "fractional anticipatory frustration mechanism" which becomes classically conditioned and acts as an inhibitory function. Both Amsel (1958) and Brown-Farber (1951) agree that frustration energizes and adds directional cues.

Spence's (1960) position is in many ways similar because he defines frustration operationally as the omission of reward. The anticipation of non-reward is frustrating; this frustration has stimulus consequences which can be generalized and also elicit competing responses incompatible with the instrumental response. Spence's (1960) frustration mechanism (rf-sf) becomes classically conditioned in a manner similar to the fractional anticipatory goal response (rg-sg).

Most frustration theorists stress the fact that frustration in some manner energizes behavior, provides directional cues, and allows for interfering responses to be elicited.

Discrimination Hypothesis

The Discrimination Hypothesis of Mowrer and Jones (1954) stresses the fact that extinction is retarded by any procedures which make it difficult for the organism to tell the difference between acquisition and extinction processes. Conditions which make it easy for the organism to detect a difference between the two processes are continuous reinforcement, regular patterns, and alterations in the stimulus conditions at the beginning of extinction. Literally, the organism develops an expectancy during acquisition concerning the reward and the stimulus conditions. All that is needed to produce extinction is a disconfirmation of the acquired expectancy.

Dissonance Theory

An experiment reported by Lawrence and Festinger (1962) showed that increasing the effortfulness, by varying runway slope, of trained response led to an increase in resistance to extinction of the resulting habit. Lawrence and Festinger (1962) also factorially varied effortfulness with partial reinforcement, and delay of reward.

Dissonance Theory states that the information an organism has concerning the expenditure of energy and effort, given a fixed reinforcement level, is dissonant with continuing to engage in the action. Hence, the greater the effort required, the greater would be the magnitude of dissonance and the greater the development of extra attraction for something in the situation in order to reduce dissonance. So, the greater the effort, the more dissonance created -- the more the organism seeks to reduce the dissonance, hence more resistant to extinction. Lawrence and Festinger (1962) used an inclined runway with three conditions: 1) level, 2) 45°, and 3) a mixed group which received a number of trials at level and the same number of trials at 45°. The level group was least resistant to extinction; the 45° was next, and the mixed group was most resistant to extinction. It was speculated by Festinger (1962) that the mixed group had a comparison of information which created more dissonance.

Grusec and Bower (1965) compared response effort (dissonance theory) and the frustration hypothesis. They ran rats in a double runway, the standard test situation for the frustration effect while manipulating the effort in this runway situation. They found that high response effort did not enhance the frustration effect produced by non-reward. Thus, it appears that frustration theory can not account for the effect of effort on resistance to extinction.

CHAPTER II

PURPOSE

This study was undertaken to identify some of the various parameters involved in a declined runway situation. The specific parameters of concern are the effects of varied proprioceptive acquisition training upon the extinction process. The effect to be tested is whether extinction represents an isolate process not dependent upon prior acquisition training or whether it is a compound effect of both acquisition and extinction conditions in reference to the manipulated variable -- runway decline. In other words, if the proprioceptive acquisition process exhibits some carry over effects into extinction it represents a learning variable. If the acquisition process has no effect upon extinction it represents a performance variable.

CHAPTER III

METHODS AND PROCEDURE

Subjects

Eighteen female and twelve male Holtzman rats approximately 120 days old served as subjects.

Apparatus

A wooden U shaped, enclosed runway was used. The runway was five-feet long, six-inches high, and four-inches wide. The bottom floor was covered with $\frac{1}{4}$ inch standard hardware cloth and the top was covered with clear plexi-glass hinged doors. The goal area was twelve-inches long and contained a guillotine door operated by a clutch-type motor which was activated by breaking the photoelectric beam in goal area. The alley was painted a flat gray both inside and out. The alley contained four photoelectric cells which were connected to four standard timers. The goal area contained a food cup painted the same color as runway. Beneath the hardware cloth floor was a slotted panel which was inserted so as to eliminate depth cues from the varying angles.

At both ends of the alley were bolts with wing-nuts, and two slotted - adjustable stands which allowed for the various decline positions. The positions were marked on stands by means of a float level. The levels of decline used were 45°, 15°, and 0° or level.

Procedure and Design

Pre-experimental treatment consisted of placing subjects upon a two week deprivation schedule which consisted of ten grams of standard laboratory chow with free access to water. This ten gram diet was maintained throughout the course of the study with daily feedings occurring fifteen minutes after last subject had been run.

Each subject was handled and received two placements in goal box area per day for three days prior to experimental treatment. All placements were at 0°.

The subjects were randomly assigned to one of the three acquisition groups keeping an equal number of males and females in each group. The acquisition groups were differentiated by the decline of the runway. The three decline conditions were 45°, 15°, and 0° with ten subjects in each group. The acquisition phase consisted of five trials per day per subject for eight days, a total of 40 acquisition trials. During the last day of acquisition training, the slowest subject from each group was dropped leaving a total of 27 subjects.

The acquisition groups were run on a counter balanced schedule and within each acquisition group the intertrial interval was randomly varied by placing the subject in home cage after each trial. During the last day of acquisition, subjects from each acquisition group were matched on their various latencies and designated to one of three extinction conditions contingent upon acquisition training. Each extinction condition, nine in all, contained a fast, medium, and slow subject.

During the acquisition phase subjects were allowed twenty seconds in goal box area where continuous reward was available.

Prior to each days experimental treatment subjects were placed in the experimental room for a fifteen minute adaptation period.

The extinction phase represents a factorially designed study whereby three acquisition groups are designated to nine extinction conditions with three subjects in each condition. The subjects were run under the various extinction conditions. The conditions used were 45°, 15°, and 0° contingent upon original acquisition condition. Each subject received five trials per day for five days a total of 25 extinction trials.

The extinction phase represents an experimental treatment where reward is omitted; the food cup was thoroughly washed following the last day of acquisition and was present during extinction procedure.

Total latency and the latency for each segment were recorded. The total median latency from a block of five trials was the experimental measure used.

TABLE 1

SCHEMATIC ILLUSTRATION OF FACTORIAL DESIGN

40 Trials Acquisition	25 Trials Extinction
	3Ss - 0°
10Ss - 0°	3Ss - 15°
	3Ss - 45°
	3Ss - 0°
10Ss - 15°	3Ss - 15°
	3Ss - 45°
	3Ss - 0°
10Ss - 45°	3Ss - 15°
	3Ss - 45°
30Ss	27Ss

CHAPTER IV

ANALYSIS AND RESULTS

Acquisition

Figure 1 and Tables 2 and 3 present data for the three acquisition groups. The mean of the medians (latency) was used to plot data and an analysis of variance (Lindquist 1953, Simple Randomized Design) was performed upon the last day of acquisition. The F ratio computed shows that there is a significant difference at the .05 level. The critical difference test (Lindquist 1953) shows that the difference lies between 45° and 15°. The other two comparisons are non-significant.

Figure 1 shows that the 15° condition had the fastest latency ($\bar{X} = 1.75$); 0° condition the next fastest ($\bar{X} = 2.32$), and 45° the slowest ($\bar{X} = 3.35$).

Extinction

Figures 2 through 5 and Tables 4 and 5 present data for the various extinction conditions. The F ratios (Lindquist 1953, Type III and Treatments x Levels Designs) show that there is no significant differences among the factorially varied extinction conditions except the significance reported for days. This significance shows that subjects were extinguishing over days.

Figure 2 represents overall extinction time irrespective of acquisition training and shows that 0° decline condition was most resistant to extinction; the 15° condition was next, and the 45° condition was least resistant to extinction.

Figure 3 represents the three acquisition groups at 15° extinction condition. It shows that 15° was most resistant with 45° next, and 0° least resistant.

Figure 4 represents the three acquisition conditions at 0° extinction. The 0° group is most resistant to extinction followed by 15°, and 45° the least resistant.

Figure 5 represents the three acquisition conditions at 45° extinction. The graph shows that 15° is most resistant; 45° is next, with 0° being least resistant to extinction.

Table 4 represents a "Post-Hoc" comparison of day one during the extinction phase. It was thought that there might be evidence of a post-shift effect (Spence 1953). Basically this technique is concerned with the portion of data which is analyzed. If the data is analyzed early during the experimental situation, it will most likely show the variable to be a compound effect of learning and performance. If the last portion of data is selected the variable will be mainly influenced by performance. It appears from the non-significant ratios that there is an immediate disruptive effect starting with the first day of extinction.

FIGURE 1

TOTAL RUNWAY TIME PLOTTED FROM MEANS
OF MEDIANS FOR EACH ACQUISITION GROUP

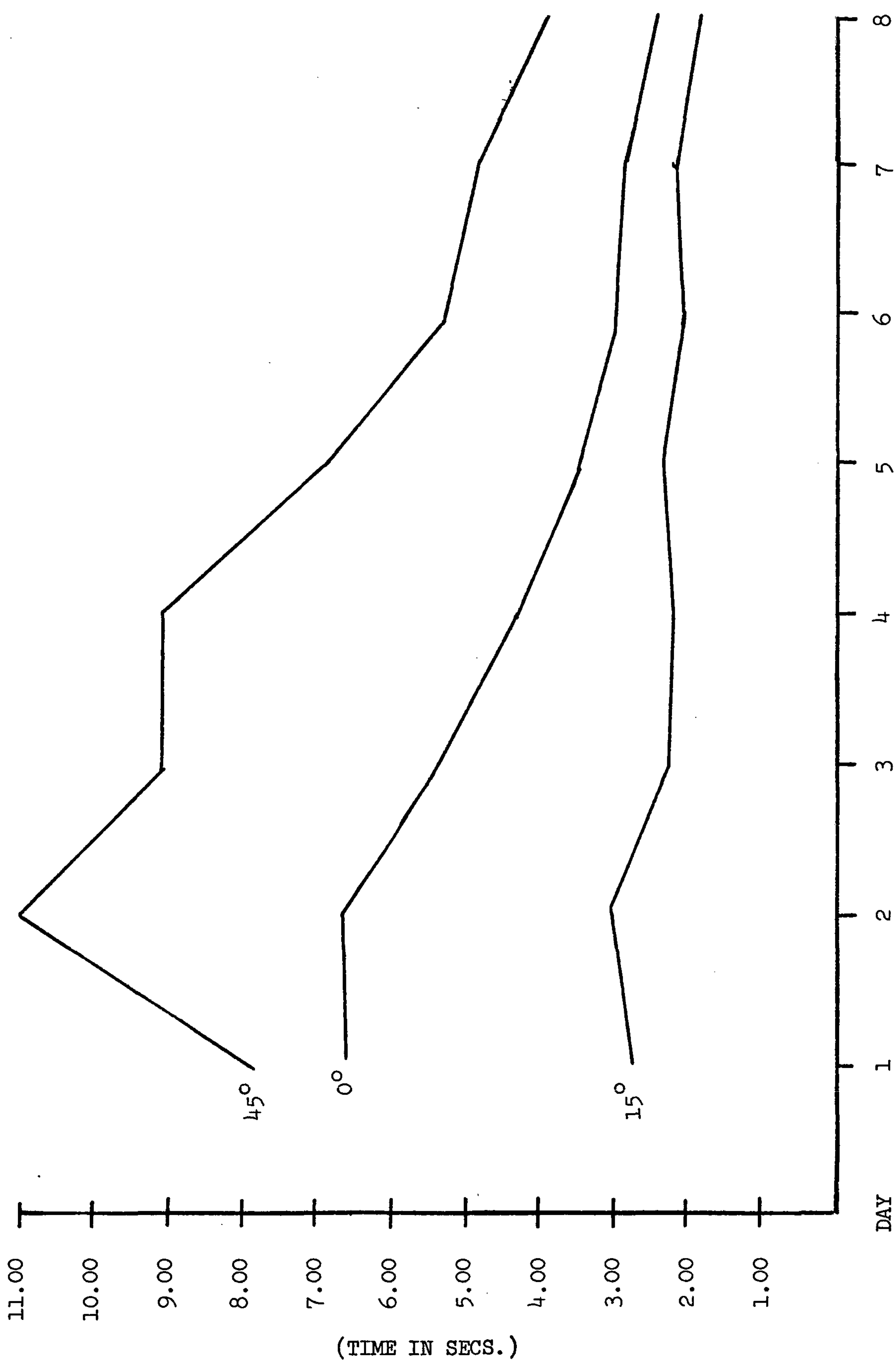

TABLE 2

ANALYSIS OF VARIANCE PERFORMED UPON
THE LAST DAY OF ACQUISITION

(Simple Randomized Design)

Source of Variance	SS	df	MS	F
Between Acquisition	12.39	2	6.195	4.11 *
Within Acquisition	36.19	24	1.507	
Total	48.58	26		

* significant at .05 level.

TABLE 3

CRITICAL DIFFERENCE TEST
A COMPARISON AMONG ACQUISITION MEANS

$\overline{X}_{15}(1.75) - \overline{X}_{45}(3.35) = 1.60$ *

$\overline{X}_{15}(1.75) - \overline{X}_{0}(2.32) = .57$ N.S.

$\overline{X}_{0}(2.32) - \overline{X}_{45}(3.35) = 1.03$ N.S.

Critical difference value at .05 level is 1.04

* significant at .05 level.

FIGURE 2

OVERALL EXTINCTION OF DECLINE LEVELS IRRESPECTIVE OF ACQUISITION TRAINING: PLOTTED BY USING MEAN OF THE MEDIANS

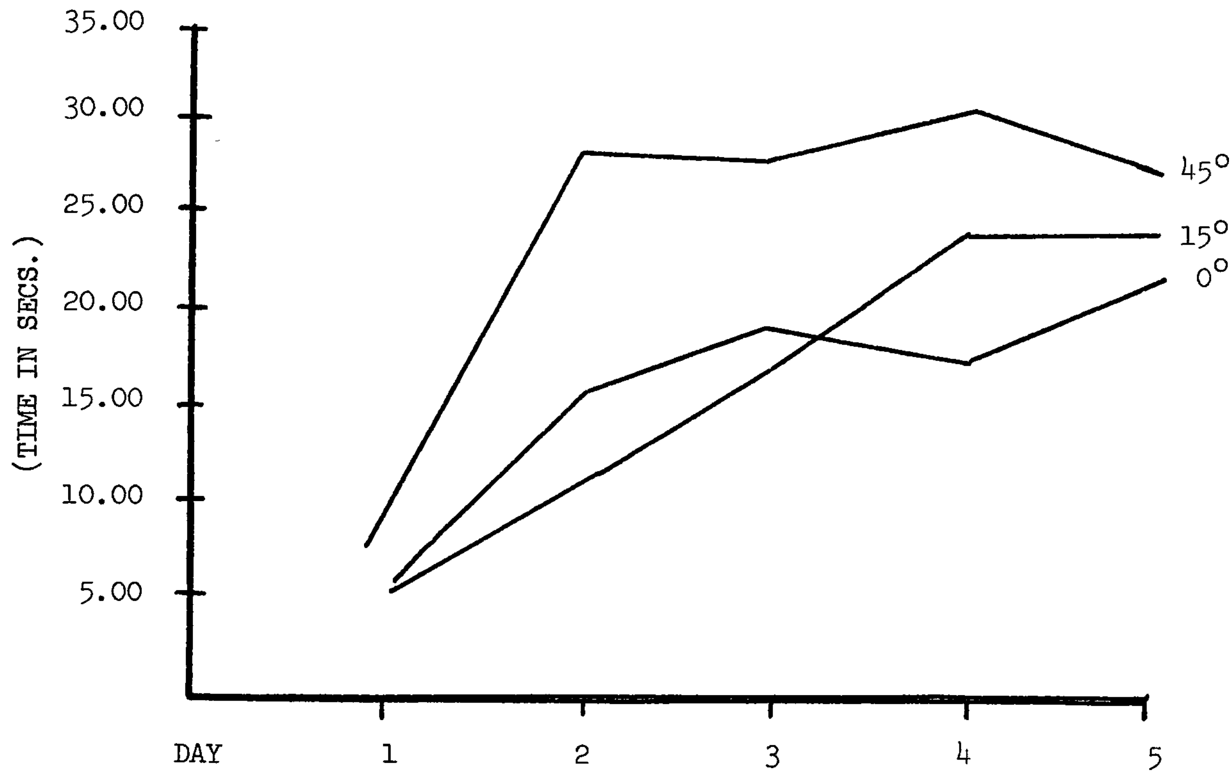

FIGURE 3

THE THREE ACQUISITION CONDITION AT 15° EXTINCTION:
PLOTTED BY USING MEAN OF MEDIANS

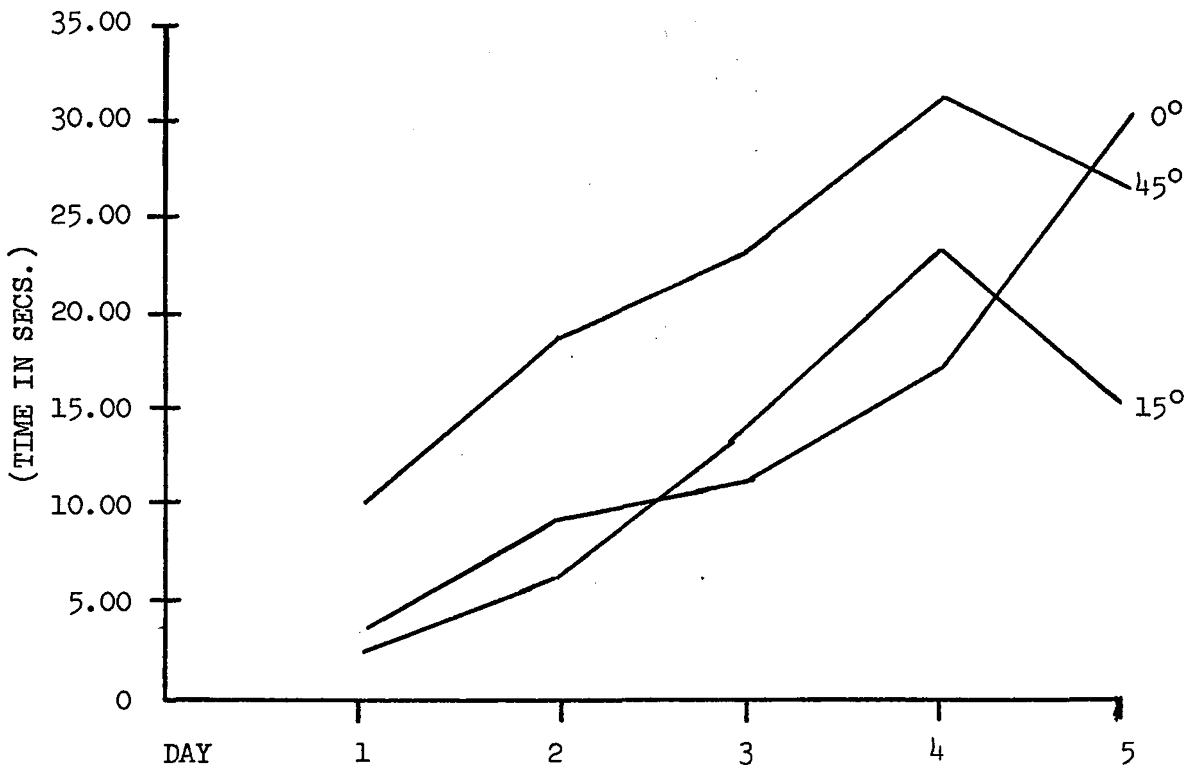

FIGURE 4

THE THREE ACQUISITION CONDITIONS AT 0° EXTINCTION:
PLOTTED BY USING MEAN OF MEDIANS

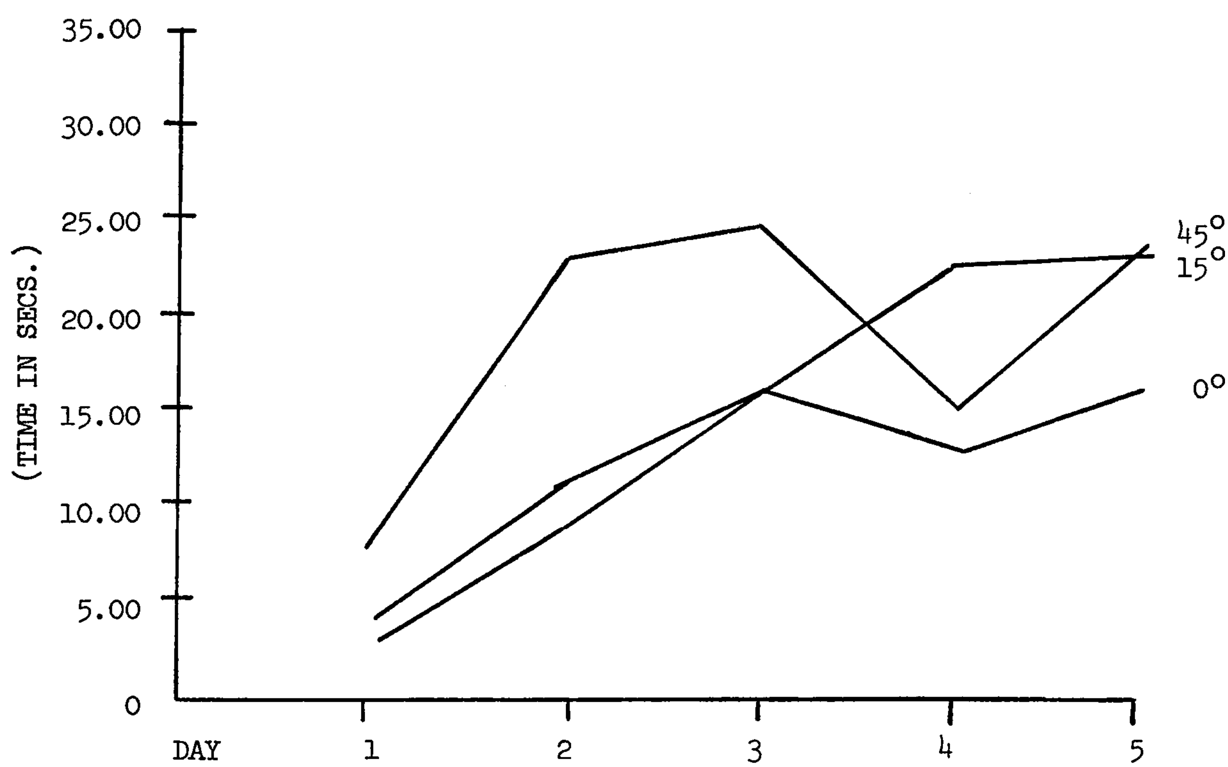

FIGURE 5

THE THREE ACQUISITION CONDITIONS AT 45° EXTINCTION:
PLOTTED BY USING MEAN OF MEDIANS

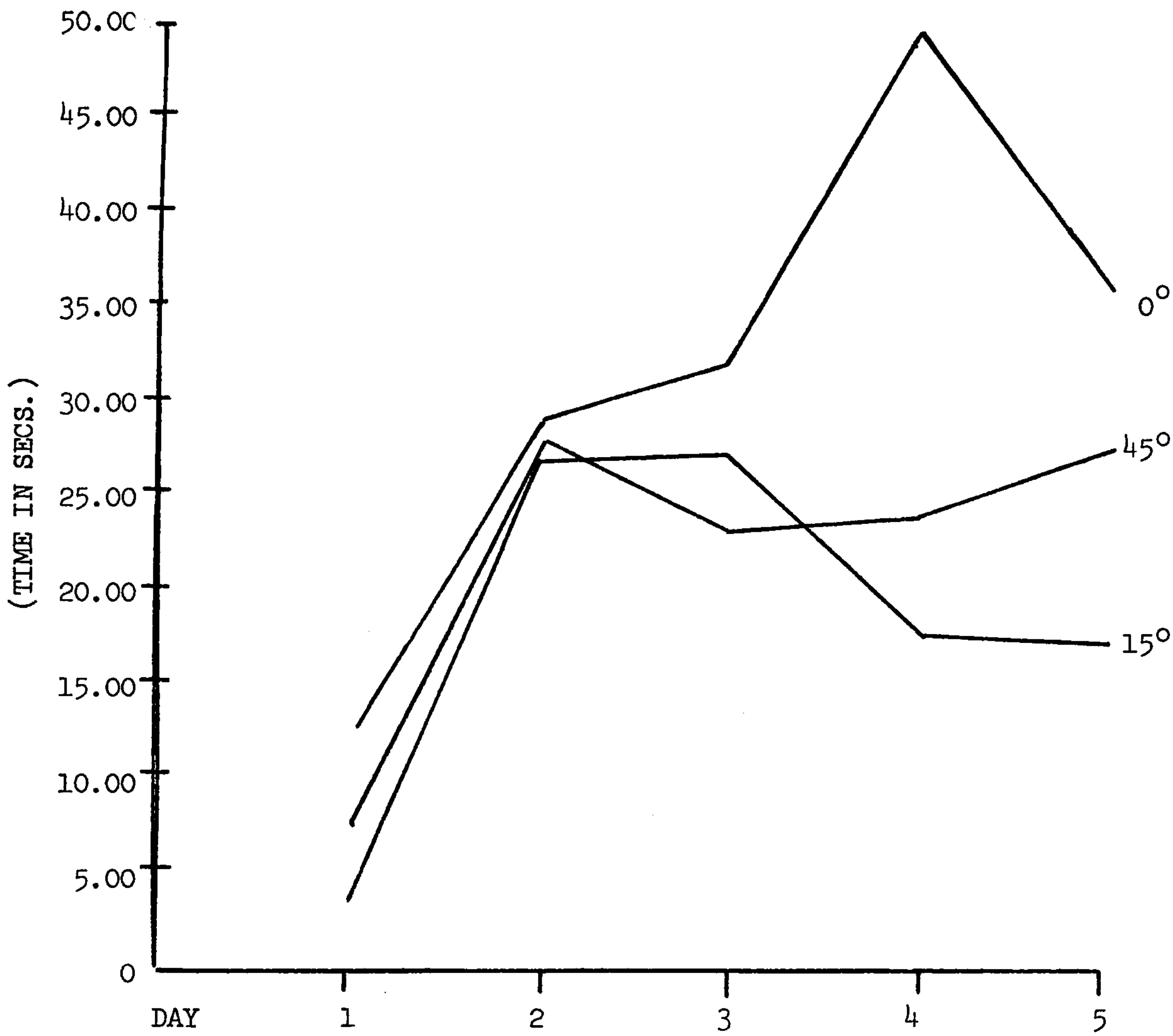

TABLE 4

ANALYSIS OF VARIANCE OF THE FACTORIALLY VARIED EXTINCTION CONDITIONS CONTINGENT UPON ACQUISITION TRAINING (Type III)

Source of Variance	SS	df	MS	F
Between	26124.21	26		
Acq.	698.81	2	349.40	.29 N.S.
Ext.	2185.64	2	1092.82	.92 N.S.
AXE	1866.82	4	466.70	.39 N.S.
error (b)	21372.94	18	1187.39	
Within	18307.55	108		
Days	5817.07	4	1454.26	10.66 *
DXA	470.81	8	58.85	.43 N.S.
DXE	847.20	8	105.90	.77 N.S.
DXAXE	1353.10	16	84.56	.62 N.S.
error (w)	9819.37	72	136.38	
Total	44431.76	134		

* significant at .05 level.

TABLE 5

ANALYSIS OF VARIANCE OF THE FACTORIALLY
VARIED EXTINCTION CONDITIONS
CONTINGENT UPON ACQUISITION TRAINING
DAY 1 ONLY
(Treatments x Levels)

Source of Variance	SS	df	MS	F
Between				
Acq.	55.32	2	27.66	1.503 N.S.
Ext.	103.31	2	51.65	2.807 N.S.
AXE.	130.05	4	32.51	1.766 N.S.
error	331.25	18	18.40	
Total	619.93	26		

CHAPTER V

DISCUSSION AND SUMMARY

Discussion

The results of acquisition show that the 15° group is the fastest ($\overline{X} = 1.75$); the 0° group next fastest ($\overline{X} = 2.32$), and the 45° group the slowest ($\overline{X} = 3.35$). An interesting effect emerges in that the 15° group almost from the first day of acquisition ran at an asymptotic level below that of the other groups. From these results it appears that the 15° decline condition may represent an optimal acquisition condition. This variable along with other decline acquisition variables deserves further study.

It was hypothesized that the various decline levels used during acquisition had a differing proprioceptive effect for the various groups. The results (Tables 2 and 3) show that there was a difference in the acquisition phase; this difference may be due to the proprioceptive effects conditioned during acquisition.

The results of extinction (Tables 4 and 5) show that the effect of acquisition immediately dissappears. The post-hoc analysis of day one (Table 5) shows that the disruptive effect is present during the first few extinction trials. These results point to the fact that the variable under study (decline runway) represents a performance variable rather than a permanent learning variable. In other words, the acquisition process did not have any significant effect upon the extinction process. These two processes were independent of one another.

The Generalization Decrement stresses the fact that similar proprioceptive consequences between acquisition and extinction retards extinction. The non-significant results obtained in this study make this theory of extinction improbable as an explanatory device for these data.

The Discrimination Theory (1954) stresses the fact that any conditions which make it easy for the organism to detect a difference between acquisition and extinction processes hastens extinction. This theory along with other major theories of extinction does not lend itself to theoretical interpretation of the data in the present study.

In summary, the variable under study represents a performance variable with differing temporary effects upon the acquisition and extinction processes. The acquisition process does not have any significant effect upon the extinction phase.

Summary

The results show that during acquisition there is a significant difference between the 45° decline group and the 15° group. The other two comparisons are non-significant.

The extinction results show that there is no detectable significance except days. The post-hoc analysis of day one shows that there is an immediate disruptive effect.

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