THE EFFECTS OF THREE REWARD MAGNITUDE SHIFTS ON INSTRUMENTAL PERFORMANCE IN THE RAT

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THE EFFECTS OF THREE REWARD MAGNITUDE SHIFTS ON INSTRUMENTAL PERFORMANCE IN THE RAT

An Abstract

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in Psychology

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by

Eugene Francis Heitz

August 1976

ABSTRACT

A five-phase experiment consisting of acquisition, three incentive shifts, and extinction was performed to ascertain the effects of multiple shifts in reinforcement on instrumental performance of the rat. During acquisition 30 animals received small reward, while an equal number received large reward. These initial small-and large-reward groups were each divided into three matched subsquads at the completion of acquisition. The three shift conditions followed acquisition. The results indicated that the performance of the shifted animals (large-to small-reward, small-to large-reward) changed to approximate that of the appropriate control group. Few significant contrast effects were observed. During extinction, which immediately followed the last shift phase, all groups extinguished at relatively the same rate. Of particular interest was the performance of the large and small reward control groups. These groups displayed significant reward magnitude differences in the start and run measures throughout the entire experiment. An expectancy model is proposed to account for these results.

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by

Eugene Francis Heitz

August 1976

To the Graduate Council:

I am submitting herewith a Thesis written by Eugene Francis Heitz entitled "The Effects of Three Reward Magnitude Shifts on Instrumental Performance in the Rat". I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Stephen F. Davis
Major Professor

We have read this thesis and recommend its acceptance:

Thomas T. Jackson
Second Committee Member

Garland E. Blair
Third Committee Member

Accepted for the Council:

Wayne E. Stamper
Dean of the Graduate School

TABLE OF CONTENTS

	Page
LIST OF FIGURES	vi
LIST OF TABLES	vii
CHAPTER	
I. INTRODUCTION	1
II. METHOD	9
Subjects	9
Apparatus	9
Procedure	10
III. RESULTS	14
IV. DISCUSSION	19
BIBLIOGRAPHY	25
APPENDIX A: FIGURES	29
APPENDIX B: TABLES	36

LIST OF FIGURES

Figure		Page
1.	Mean Start Speeds (meters per second) during the Five Experimental Phases.......	31
2.	Mean Run Speeds (meters per second) during the Five Experimental Phases.......	33
3.	Mean Goal Speeds (meters per second) during the Five Experimental Phases.......	35

LIST OF TABLES

Table page

1. Experimental Design........................ 37

CHAPTER I

INTRODUCTION

Both rate of learning and level of performance in the instrumental learning situation have been attributed to a number of variables, such as severity of deprivation, and number of training trials. One factor which has received considerable attention has been reward magnitude, i.e., the amount of reinforcing stimulus given the subject upon correct completion of the assigned task.

One of the first studies to systmatically deal with quantitative variation of reinforcement magnitude was reported by Grindley in 1929. He trained chicks to run down a runway to either 0, 1, 2, 4, or 6 grains of boiled rice. He reported a negatively accelerating curve when plotting reciprocal running times as a function of reward magnitude. Wolfe and Kaplon (1941) also used chicks, and reported that for three groups receiving either four quarter grains, one full grain, or one quarter grain of popcorn, those that received the four quarter grains ran fastest, those that received one full grain ran next fastest, and those that received only one quarter grain ran the slowest. Zeaman (1949), using rats in the straight runway apparatus, also reported a positive relationship between reward magnitude and terminal level of performance. Early studies by Lawrence and Miller (1947), Metzger, Cotton, and Lewis (1957), and Spence (1956), using rats in the runway situation, have corroborated the runway data reported by Zeaman (1949). More recently, a series of studies by Marrero, Davis, and Seago (1973), Davis, Harper, and Seago (1975), and Davis, Prytula, and Seago (1975) have also reported similar results. Thus, on the basis of these studies one might be tempted to accept the hypothesis that a positive relationship exists between reward magnitude and performance, and further, that this relationship is relatively stable.

However, a recent series of studies reported by McCain and his associates has seriously questioned the generality of this proposed relationship. For example, McCain (1970) reported two studies in which rats received either large reward (one 500 mg pellet) or small reward (one 45 mg pellet). The results of these studies indicate that in early stages of training the large reward subjects had significantly shorter running times than did the small reward subjects. Later in training, however, the differences between the groups decreased and performance between the two groups became indistinguishable. Similarly, McCain, Dyleski, and McElvain (1971) reported a series of seven studies in which a total of 232 rats were trained to run to either large or small reward in a straight alley. Expected magnitude difference were found in the early stages of acquisition, but no significant differences were found after 54, 60, 70, 78, 90, 116, or 135 trials, respectively. During extinction, the large reward subjects were less resistant than the small reward subjects after 24-90 trials, but not after 116 or 135 trials. Thus it would appear that the influence of reward magnitude is not as powerful, certainly not as long lasting, as once thought. Reward magnitude may indeed have an effect on performance early in acquisition of the instrumental response, but if the data reported by McCain are to be believed, this effect is transitory.

Capitalizing upon the notion that reward magnitude effects may by transitory, McCain and Cooney (1975) reported a study involving multiple shifts in reward magnitude. Basically, they were investigating the stability of positive contrast effects (PCE) exhibited by groups shifted from small to large reward and, negative contrast effects (NCE) exhibited by groups shifted from large reward to small reward. By definition, a PCE is obtained when the performance of a group abruptly shifted from small- to large-reward magnitude exceeds that of a large reward control group. A NCE is obtained when the performance of a group abruptly shifted from large- to small-reward is depressed below that of a small reward control group. A seminal study in the area of contrast effects was reported by Crespi (1942) in which both a NCE and a PCE were reported. Similar findings were also reported by Zeaman (1949).

Of the two contrast effects, the NCE has been obtained more often, and, until quite recently, was thought to be the more "genuine" of the two. Hence, numerous studies have been conducted to ascertain the parameters controlling NCE. For example, three studies reported by Davis and North (1967, 1968, 1969) are representative of this line of research. Their studies dealt with the effects of: (a) varied reward magnitude acquisition training upon behavior during incentive reduction (1967), (b) number of large reward preshift trials (1968), and (c) number of large reward preacquisition goalbox placements (1969). The 1967 study involved giving three groups of rats 50 acquisition trials with large, varied, and small reward. After acquisition all subjects received 12 small reward trials. For subjects initially trained under large and varied reward, these trials constituted an incentive reduction phase. The results showed a large perofrmance decrement for subjects trained under large reward while subjects trained under varied reward exhibited only a slight reduction in performance level. The 1968 study used three groups of rats receiving either 18 large reward trials, 108 large reward trials, or 108 small reward trials during acquisition. Acquisition was followed by 63 small-reward trials. The 63 small reward trials constituted an incentive reduction phase for the groups initially receiving the 108 or 18 large reward trials. The results showed a greater reduction in performance level for the group that initially received 108 large reward trials. In the 1969 study, two groups of rats were given either 92 preacquisition rewarded direct goal placements, or 92 preacquisition handling trials. This was followed by 24 large reward trials for both groups. In a third phase (incentive reduction) both groups received 16 small reward trials. The results showed the greatest disruption of performance with the group receiving the preacquisition placements. Thus, the Davis and North studies (1967, 1968, 1969) demonstrate the relative consistency of NCE, and the relative ease of duplicating the phenomenon.

On the other hand, research on PCE has been aimed more in the direction of simply obtaining the phenomenon, as opposed to delineating the factors that control it. The early studies which reported PCEs, e.g., Crespi, 1942; and Zeaman, 1949, were criticized for the small number of acquisition trials employed prior to shift. If a small number of trials is employed it is reasonable to question whether the large reward control subjects have, in fact, reached an asymptotic performance level. If the asymptote has not been achieved then PCEs may well be observed, but limited to the preasymptotic level of training. However, if a maximum asymptotic performance level has been achieved by the large reward control subjects, the PCE would be prohibited from ocurring because the performance of the upshifted subjects could acheive the asymptote but not over shoot it. This "ceiling" effect has been overcome by: (a) use of a moderate level of large reward (Schrier, 1967), (b) use of a lower level of motivation (Marx, 1969; Shanab & Ferrell, 1970), and (c) use of delayed reinforcement prior to the shift phase (Mellgren, 1972). The first two methods have provided some evidence of the PCE, but appear to be less affective due to the reduced motivational level of the subjects. The delayed reward procedure has consistently yielded PCEs, and appears to be a viable technique for producing PCEs. A fourth procedure was employed in the McCain and Cooney (1975) study. In this study three shifts in reinforcement magnitude were employed following initial training under large (L) or small (S) reward. Significant PCEs were observed on the second and third shifts to L (i.e., subjects receiving training and three shifts in the sequence SLSL showed a PCE on the last shift to L, whereas subjects receiving the sequence LSLS for training and the first two shifts showed a PCE on the second shift). Thus, the procedure for employing multiple shifts would appear to be a reliable method of obtaining PCEs. It does offer the advantage of avoiding confounding due to delay (delay by its very nature introduces confounding stimuli), lowered motivational level, and the use of less than optimal levels of large reward magnitude.

The present study was designed to investigate the effects of giving partial reinforcement training prior to multiple shifts in reinforcement. It was felt that the discrepancy between partial reinforcement training under small reward and receipt of large reward (also on a partial reinforcement schedule) might serve to heighten observed PCEs. Of course, if the converse would hold true for subjects shifted from partial large reinforcement to partial small reinforcement. In this case one might expect NCEs to be more pronounced. As in the McCain and Cooney (1975) study, a total of three shift phases were surrounded by acquisition and extinction phases. Thru the use of three shift phases it was hoped that some information concerning the stability of PCEs and NCEs under partial reinforcement conditions would be obtained.

CHAPTER II

METHOD

Subjects

The subjects were 60 male albino rats, approximately 90 days old at the time of beginning the experiment, purchased from the Holtzman Co., Madison, Wis. Upon receipt from the shipper subjects were housed individually. The subjects were maintained on ad lib water throughout their residence in the laboratory while a restricted feeding schedule was initiated five days prior to acquisition. During all experimental conditions subjects received supplemental feedings of Purina Lab Chow in the home cages. These feedings equalized the difference in grams (g) between that amount received by the subjects on rewarded trials and 13g. Thus, regardless of the reinforcement condition, the total amount received by a subject per day was restricted to 13g.

Apparatus

The apparatus was a single straight runway consisting of a start box (10.16cm x 25.40cm x 10.16cm), a run section (10.16cm x 81.28cm x 10.16cm), and a goalbox (10.16cm x 15.24cm x 10.16cm) all made of wood. The startbox was painted grey. The run section and goalbox were painted black. Hinged screened lids covered the entire length of the apparatus. A goal cup was mounted 2.54cm above the floor and recessed into the back wall of the goal-box. Guillotine doors separated the startbox from the run section and the run section from the goalbox. Raising the start door activated a timer which stopped when the rat broke a photobeam located 15.24cm beyond the start door. Two other timers measured running times for the next 60.96cm and 30.48cm respectively. Start, run, and goal times were recorded for each subject for each trial.

Procedure

The experiment was divided into six phases: handling, pellet habituation, and runway exploration; acquisition; three reward magnitude shifts; and, extinction. Handling, pellet habituation, and food deprivation were begun 10 days prior to the first day of acquisition. On Day 6 each subject was given three minutes free access to the runway with all equipment in operation. Free exploration continued for five days.

Following Day 10 subjects were randomly assigned to 10 squads of six subjects each, and run for two trials on the first day, four trials the second day, and six trials each day thereafter. Within each squad three subjects were on a large reward schedule (eleven 45mg Noyes pellets) and three subjects were on a small reward schedule (one 45mg Noyes pellet); thus subjects in the large reward group received 11.50g of supplemental feeding in the home cage, while subjects in the small reward group received 12.90g. The supplemental feeding for a particular squad was given after the next squad had finished all trials. Thus, Squad 1 was given the supplemental feeding in their home cages when Squad 2 had finished all training trials. The order in which subjects were run varied between squads. Squad 1 was run on a LSSLSL order through 42 acquisition trials per animal. The other orders were: Squad 2, SLLSLS; Squad 3, SSLLSL; Squad 4, LLSSLS; Squad 5, SSSLLL; Squad 6, LLLSSS; Squad 7, SSLSLL; Squad 8, LLSLSS; Squad 9, SLSLSL; and Squad 10, LSLSLS.

A 50% reinforcement condition was maintained as a constant condition throughout the experiment prior to extinction. The sequences of rewarded (R) and nonrewarded (N) trials were randomly selected. For Day 1 the sequence was NR, and for Day 2 the sequence was NRNR. The sequences for the next six days were: RNNRRN, RNRNRN, RRNRNN, NRRNRN, RNNRNR, NRNRNR. These sequences were then repeated in the same order for the remainder of the experiment.

On the eighth and last day of acquisition all 60 subjects were matched on the basis of run time by rank ordering according to speed. From this ranking three groups of ten small reward animals were selected in such a way that the group run times were equated. The same process was then repeated for the large reward animals. With the completion of these procedures the acquisition phase was terminated and on the following day the experimental condition was instituted.

The experimental condition of interest consisted of shifting the magnitude of reward, large to small or small to large, through three phases of four days per shift. The large reward control group and small reward control group were never shifted. Thus, three shift conditions were run as shown in Table 1.

Each trial began by removing a subject from his home cage and placing him in the startbox where he was confined for a 5 sec. delay prior to initiating the trial. A trial would be initiated by raising both the start and goalbox doors. Upon breaking the first photobeam the start door would be lowered, and when the subject broke the goalbox photobeam the goalbox door would be lowered. On nonrewarded trials a 10 sec. goalbox confinement was required, while on rewarded trials the subjects were left in the goalbox until all reward was consumed, then removed immediately and returned to the home cage. An ITI of approximately 6 min. was maintained by running each subject in a squad for a single trial in rotation. Thus, each subject of a squad was run once until all six had run one trial; then each subject was run on a second trial, etc. After every six runs the alley was swabbed with a pine-scented cleaning solvent to remove any food debris and odor.

Following the completion of the third shift, extinction was instituted. During the extinction phase subjects were confined in the goalbox for 10 sec. Extinction lasted five days with six trials per day.

CHAPTER III

RESULTS

Group mean speeds (meters per sec.) during the five experimental phases for the start, run, and goal measures are shown in Figures 1-3. A separate analysis of variance was performed on the data for each phase for these three measures. The significant results of these analyses will be presented separately for each phase. As the respective shift groups were formed at the completion of Phase 1, these groups were not included in the Phase 1 analyses. For purposes of graphic clarity they are shown in Phase 1 of Figures 1-3.

Phase 1 - Acquisition

Start Measure. Start measure analyses yielded a significant, $F(1, 58) = 8.93$, $p < .01$, Reward Magnitude effect, and a significant, $F(6, 348) = 3.41$, $p < .01$, Days effect.

Run Measure. Both a significant, $F(1, 58) = 7.74$, $p < .01$, Reward Magnitude effect, and a significant, $F(6, 348) = 3.01$, $p < .01$, Days effect were found with the Run measure analysis.

Goal Measure. Similarly, the goal measure analysis indicated that both the Reward Magnitude factor, $F(1, 58) =$

5.66, $p < .05$, and the Days factor, $F(6, 348) = 4.19$, $p < .01$, were significant.

Phase 2 - Shift 1

Start Measure. Both the Groups, $F(5, 54) = 2.51$, $p < .05$, and Groups by Days interaction, $F(15,162) = 2.17$, $p < .05$, were found to be significant. Simple main effects analyses were used to probe the significant interaction. The results of these analyses yielded significance ($p < .05$) on each of the four days of Phase 2. Subsequent Newman-Keuls tests indicated that Groups SSSS, SLLS, and SLSL started significantly ($p < .05$) slower than Groups LLLL, LSSL, and LSLS on Days 1 and 2. On Days 3 and 4, Group SSSS started significantly ($p < .05$) slower than all other groups.

Run Measure. As in the start measure, both the Groups, $F(5, 54) = 2.63$, $p < .05$, and Groups by Days interaction, $F(15, 162) = 1.84$, $p < .05$, were found to be significant. Simple main effects analyses yielded significance ($p < .05$) on all four days. Newman-Keuls tests indicated that Groups SSSS, SLLS, and SLSL ran significantly ($p < .05$) slower than Groups LLLL, LSSL, and LSLS on Day 1, and that Group SSSS continued to run significantly ($p < .05$) slower than all other groups on Days 2-3.

Goal Measure. Again, both the Groups $F(5, 54) = 2.47$, $p < .05$, and Groups by Days interaction, $F(15, 162) = 1.77$, $p < .05$, were found to be significant. However, simple main effects yielded significance ($p < .05$) only on Days 1 and 2. Newman-Keuls tests indicated that Groups SSSS, SLLS, SLSL, and LSLS were approaching the goal significantly ($p < .05$) slower on Day 1, and that Group SSSS was approaching the goal significantly ($p < .05$) slower on Day 2.

Phase 3 - Shift 2

Start Measure. Significant Groups, $F(5, 54) = 2.71$, $p < .05$, and Groups by Days, $F(15, 162) = 1.97$, $p < .05$, effects were found. Simple main effects analyses yielded significance ($p < .05$) on all four days. Newman-Keuls tests indicated that Group SSSS was starting significantly ($p < .05$) slower than all other groups on Days 1 and 2, and that Groups SSSS and LSSL were starting significantly ($p < .05$) slower than all other groups on Days 3 and 4.

Run Measure. Only the Groups factor achieved significance, $F(5, 54) = 2.53$, $p < .05$, in the run measure. Newman-Keuls tests indicated that Groups SSSS and LSSL ran significantly ($p < .05$) slower than all other groups.

Goal Measure. A significant, $F(15, 162) = 2.08$,

$p < .05$, Groups by Days interaction was shown in the goal measure. Subsequent simple main effects analyses achieved significance ($p < .05$) on Days 1, 2, and 4. Newman-Keuls tests indicated that Groups SSSS and LSSL were approaching the goal significantly ($p < .05$) slower than Group SLLS on Day 1, and that Group LSSL was approaching the goal significantly ($p < .05$) slower than Group SLLS on Day 2, and significantly ($p < .05$) slower than all other groups on Day 4.

Phase 4 - Shift 3

Start Measure. Both a significant, $F(5, 54) = 3.29$, $p < .05$, Groups effect and Groups by Days interaction, $F(15, 162) = 1.83$, $p < .05$, were found. Simple main effects analyses achieved significance ($p < .05$) on all four days. Subsequent Newman-Keuls tests indicated that Group SSSS continued to start significantly ($p < .05$) slower than all other groups on all four days. Additionally, Group LSSL started significantly ($p < .05$) slower than Group SLLS on Day 1.

Goal Measure. No significant effects were obtained.

Phase 5 - Extinction

Start Measure. Both significant Groups, $F(5, 54) = 3.21$, $p < .05$, and Days, $F(3, 162) = 4.27$, $p < .01$, effects were shown. Subsequent Newman-Keuls tests indicated that

Group SSSS remained significantly ($p < .05$) below all other groups during extinction.

<u>Run Measure</u>. As in the start measure, both the Groups, $F(5, 54) = 2.59$, $p < .05$, and Days, $F(3, 162) = 4.31$, $p < .01$, factors were found to be significant. Additional Newman-Keuls tests indicated that Group SSSS remained significantly ($p < .05$) below all other groups.

<u>Goal Measure</u>. Only the Days factor achieved significance, $F(3, 162) = 3.07$, $p < .05$, in the goal measure.

CHAPTER IV

DISCUSSION

As can be seen in Figures 1, 2, and 3 the effect of reinforcement magnitude was quite pronounced during Phase 1 with small reward subjects showing significantly slower speeds in all three measures than the large reward subjects. This result would be anticipated by both those favoring the traditional (long-term) view of the effectiveness of reward magnitude, and by McCain who would predict such differences early in training. However, a comparison of the unshifted control groups (i.e., Groups SSSS and LLLL) presents some complications for both points of view.

Considering the start and run measures during Phases 2-4 (see Figs. 1 and 2), it can be seen that significant differences between the two groups persisted throughout the course of the 114 trials that were administered. Were these the only measures recorded, one would appear to have strong support for the traditional view, and contradiction for the position advocated by McCain. Examination of the goal measure (see Fig. 3) presents a different picture, and some complications. Here it can be seen that the reward magnitude effect that was so pronounced during Phase 1 dissipates and is virtually nonexistent by the end of Phase 2. In fact, at that point subjects in Group SSSS are running slightly faster than subjects in Group LLLL! This finding would appear to lend support for McCain's view that reward magnitude effects may be seen early in training, but eventually wash out. Thus, in the same experiment one is confronted with support for both positions, and an explanation for neither. Interestingly, similar findings were recently reported by Davis, Prytula, and Seago (1975). However, these investigators reported significant reward magnitude effects that persisted in the goal measure throughout the course of 56 trials. On the other hand, no effects were found in the run measure, and a transitory effect was shown in the start measure. There were several procedural differences between the two studies which might account for the observed differences. For example, the present study employed partial reinforcement, while continuous reinforcement was used in the Davis et al. (1975) study. Also, in the present study six trials were administered each day, while only two daily trials were administered in the Davis et al. (1975) study. These procedural differences may explain the differences in the pattern of results between these two studies. However, the fact that both studies did, in fact, obtain significant, long-lasting, reward magnitude effects in some measures and not in others cannot be denied. This suggests that: (a) considerable additional research is needed in the area of reward magnitude effects to delineate the factors involved, and (b) that experimenters must be cautious in reporting global measures such as total time or speed which could obscure significant effects in specific components.

Unfortunately, one encounters a rather bleak picture when the question of the occurrence of NCEs and PCEs in the present study is addressed. As can be seen from Figures 1-3, the effect of upshifting and downshifting the reward magnitude of the various groups did, in fact, generally produce predicted effects. A downshift typically resulted in slower speeds. There is one exception to this generalization, however. During Phase 4, the performance of Group SLLS which was shifted from large reward to small reward remained quite high, and was, surprisingly enough, superior to that of the large reward control group. On the other hand, an upshift from small to large reward typically resulted in an increase in speed on the part of the shifted subjects. As can be seen from Figures 1-3, this is especially pronounced during Phase 2 (first shift) on the part of Groups SLLS and SLSL. A significant contrast effect, NCE, was obtained at only one point. This occurred in the goal measure during Phase 3 when Group LSSL fell significantly below Group SSSS on the last day of that phase (see Fig. 3). A similar effect involving these two groups is suggested in the run measure during Phase 3 (see Fig. 2). However, significance was not acheived in this instance. In short, the effects of the various reward magnitude shifts can be summarized as follows; (a) appropriate adjustments to new reward values were typically observed, and (b) except for one instance, no significant contrast effects were observed. The almost total absense of contrast effects poses definite interpretation problems, especially in light of the data reported by McCain and Cooney (1975). It will be recalled that these investigators reported finding significant PCEs using the multiple-shift procedure. Why the discrepency between the two studies? The only apparent procedural differences that can be really detected is the use of continuous reinforcement in the McCain and Cooney (1975) study, and the use of partial reinforcement in the present study. Due to the fact that only 42 trials were administered during acquisition (Phase 1) in the present study, the subjects effectively received only 21 rewarded trials before the first shift (Phase 2). In contrast, the subjects in the McCain and Cooney (1975) study received a total of 46 rewarded trials prior to the first shift. If one adopts an expectancy model such as that recently proposed by Capaldi (1975) to account for contrast effects, then the number of preshift trials becomes an exceedingly important variable. According to Capaldi (1975) a reward expectancy, against which shifts in reward magnitude, and hence contrast effects, are evaluated, develops as a function of the number of rewarded trials. Thus, it could be argued that the minimum number of large number of rewarded trials required to produce a stable expectancy was not employed in the present study. Unfortunately, this explanation leaves the problem of the significant NCE observed in Phase 3. This would not be predicted to occur if the expectancy hypothesis is correct. With regard to this NCE, it should be noted that it is accentuated by the rapid improvement of performance shown by the small reward control group (Group SSSS). Thus, it may not be a true "contrast" effect. Viewed in this light, the expectancy hypothesis still appears tenable. Certainly, the number of rewarded trials administered prior to reward shift, especially when partial reinforcement is used, could appear to be a prime candidate for further research.

Concerning the extinction phase (Phase 5), Figures 1-3 indicate that the removal of the reward resulted in a decrease in performance in all groups. Interestingly, the effects of prior shifts in reinforcement appear to have little or no discernable influence upon extinction performance. The most influencial factor, judging from Figures 1-3, appeared to be the level of performance acheived at the end of Phase 4.

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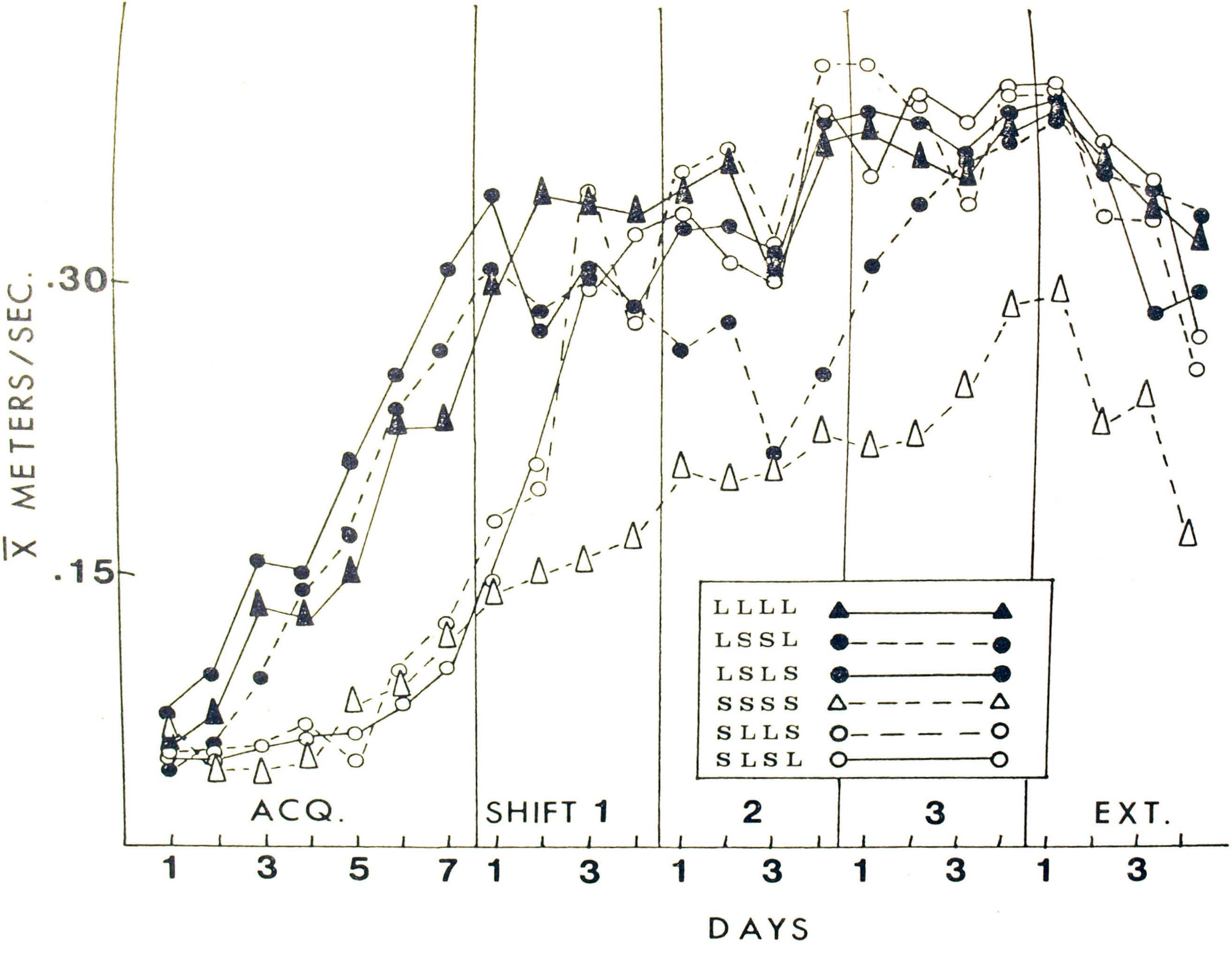
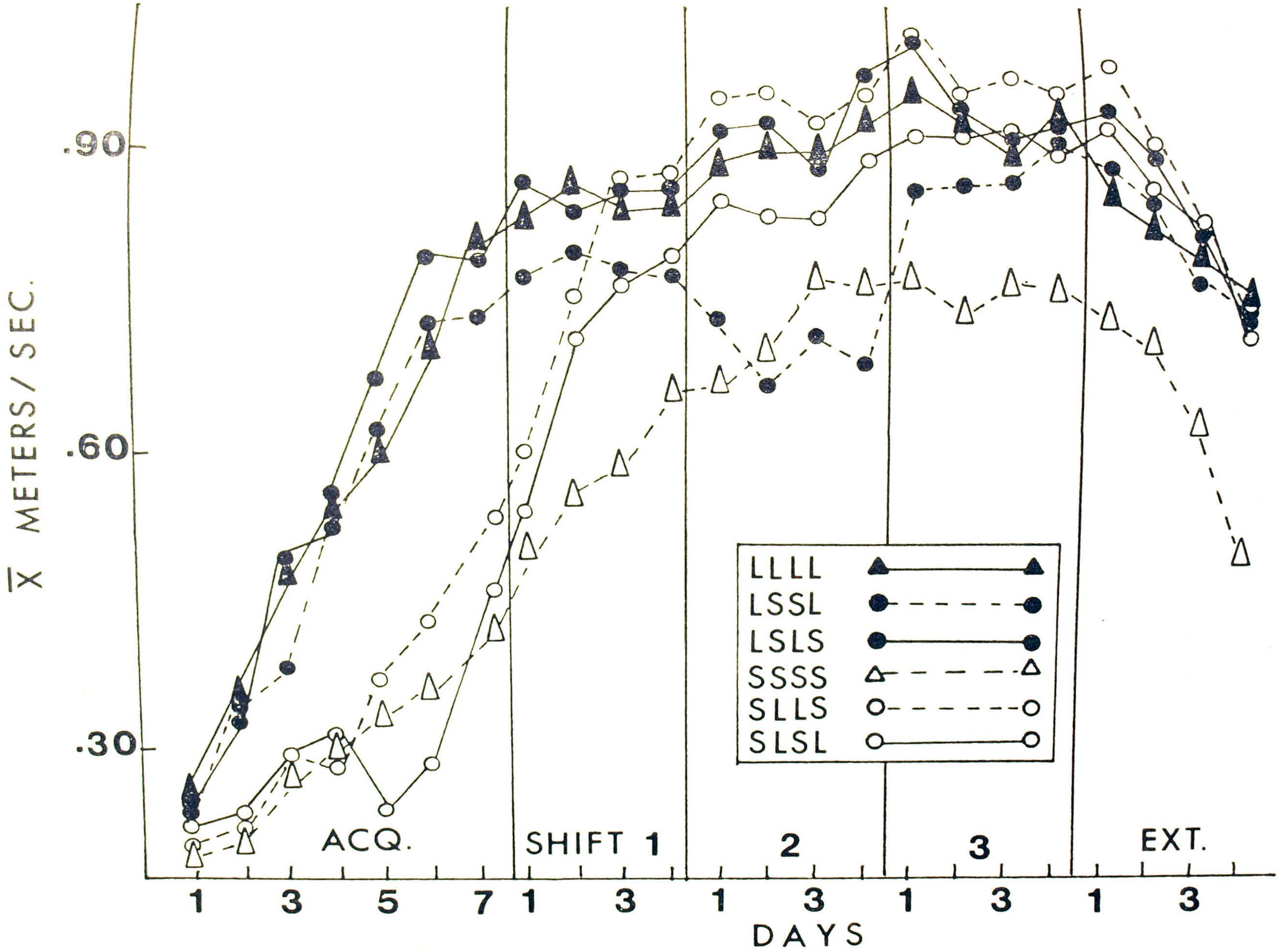
APPENDIX A: FIGURES

Fig. 1 - Mean Start Speeds (meters per second)
during the Five Experimental Phases



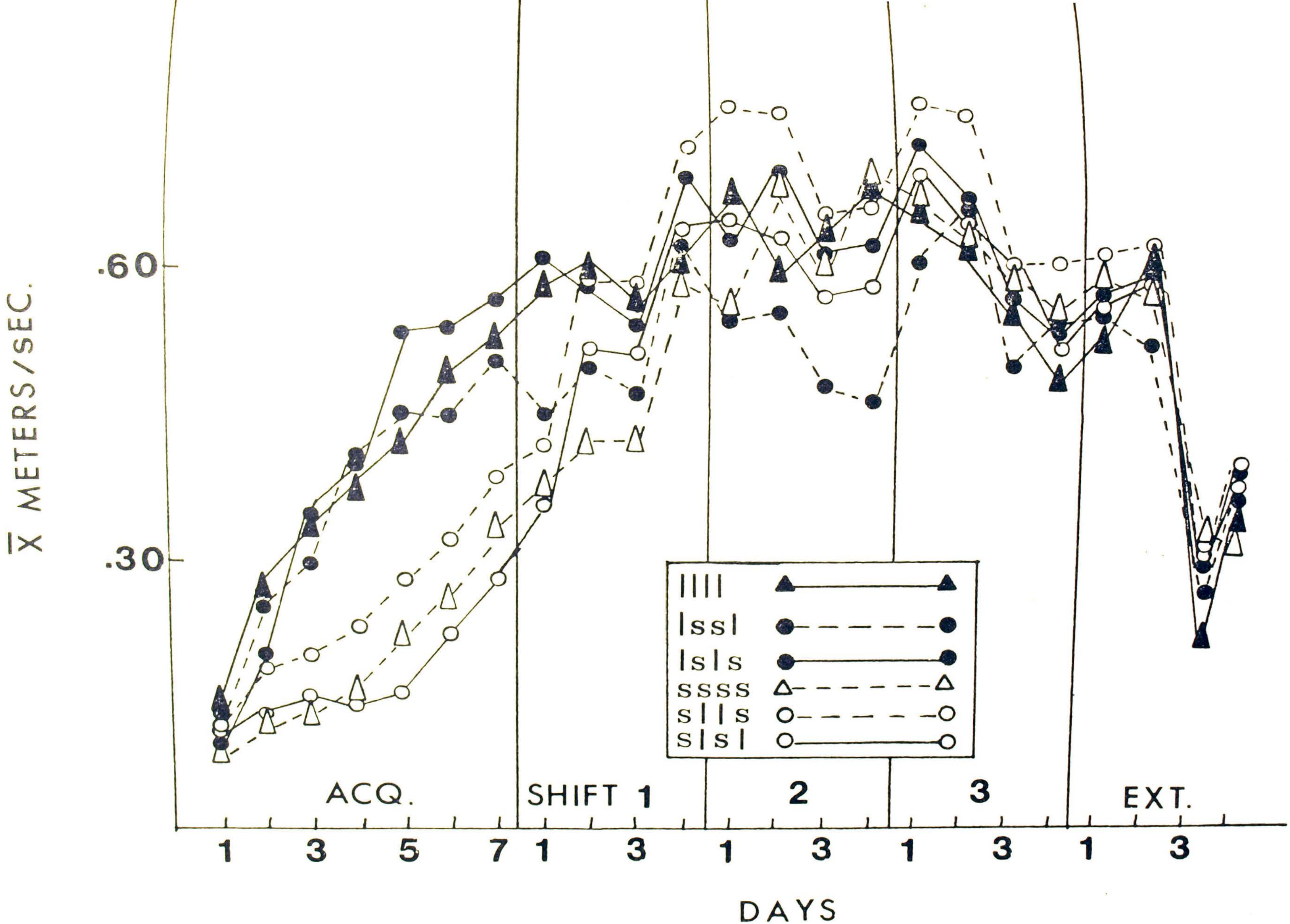
$\overline{X}$ METERS/SEC.
.30
.15
ACQ.
SHIFT 1
2
3
EXT.
1
3
5
7
1
3
1
3
1
3
1
3
DAYS
LLLL
LSSL
LSLS
SSSS
SLLS
SLSL

Fig. 2 - Mean Run Speeds (meters per second)
during the Five Experimental Phases



.90
.60
.30
$\overline{X}$ METERS / SEC.
ACQ.
SHIFT 1
2
3
EXT.
1
3
5
7
DAYS
LLLL
LSSL
LSLS
SSSS
SLLS
SLSL

Fig. 3 - Mean Goal Speeds (meters per second)
during the Five Experimental Phases



X̄ METERS/SEC.
.60
.30
ACQ.
SHIFT 1
2
3
EXT.
1
3
5
7
1
3
1
3
1
3
1
3
DAYS
IIII
IssI
IsIs
ssss
sIIs
sIsI

APPENDIX B: TABLE

GROUPS / Condition of reward	Acquisition 42 trials	1st Shift 24 trials	2nd Shift 24 trials	3rd Shift 24 trials	Extinction 24 trials
	Large (L)	Large (LL)	Large (LLL)	Large (LLLL)	x
	Large (L)	Small (LS)	Small (LSS)	Large (LSSL)	x
	Large (L)	Small (LS)	Large (LSL)	Small (LSLS)	x
	Small (S)	Small (SS)	Small (SSS)	Small (SSSS)	x
	Small (S)	Large (SL)	Large (SLL)	Small (SLLS)	
	Small (S)	Large (SL)	Small (SLS)	Large (SLSL)	x

TABLE 1

Experimental Design