POSITIVE CONTRAST EFFECT AS A FUNCTION OF NEGATIVE CONTRAST EFFECT IN A DRIVE LEVEL SITUATION

By

EDWARD E. GOLDENBERG

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Southern Illinois University

Carbonadale, Illinois

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Thesis Approved:

Kenneth D. Sandvold
Thesis Adviser

Robert F. Stanners

[illegible]

D. D. Durham
Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Increase of running speed based on incentive has been an interesting problem to many experimentalists. With a large reward the behavior of the animal will change as shown in increased running speeds. Similarly, with decreased reward, the behavior of the animal will show a decrement in performance.

Over the years a number of studies have examined reward magnitude as a function of running speeds in rats. Recent studies have revealed some departures from the original findings of Crespi (1942) and Zeaman (1949). For this reason only those studies directly related to Crespi and Zeaman will be discussed in the introduction. Those studies which are not as closely related are found in the review of literature (Appendix A).

Crespi (1942) reported two related experiments; in one rats received 19 acquisition trials with 16 and 64 food pellets as reward in a runway, followed by a shift to 16 pellets for all Ss. In a second experiment, Ss were given 19 acquisition trials with either 1 or 4 pellets, followed by a shift to 16 pellets for all Ss. Crespi's results indicated that Ss which were shifted downward to 16 pellets from a larger reward performed more poorly for 16 pellets than did Ss which had been consistently trained with that magnitude of reward. While the Ss shifted to 16 pellets from a smaller reward tended to "overshoot" the pre-shift performance of the original 16 pellet group. The performance resulting from low to high magnitudes of reward and from high to low magnitudes of reward Crespi called "elation" and "depression" effect, respectively. The terminology has changed and the elation effect is now called Positive Contrast Effect (PCE) and depression effect is referred to as a Negative Contrast Effect (NCE). The contrast effects or CE in the reward magnitude studies often refer to both PCE and NCE occurring in the same experiment. Zeaman (1949) replicated Crespi's study, but used grams of cheese as the magnitude of reward and found similar results.

The only studies to indicate any evidence of a positive contrast effect other than Crespi (1942) and Zeaman (1949) were the studies by Ehrenfreund and Badia (1962) and Shanab, Sanders, and Premack (1969). Ehrenfreund and Badia's study found both NCE and PCE. Essentially, Ehrenfreund and Badia used the same type of apparatus as many other reward magnitude studies, which was an alley runway with appropriate timers. However, the _Ss_ body weight as a measure of drive had not been controlled in previous reward magnitude studies. Drive was operationally defined in terms of a percentage of _S_'s body weight. This condition was maintained precluding any long period of deprivation. All of the _Ss_ lived in special weight control apparatus. The _Ss_ were divided up into high drive (85%) and low drive (95%) groups. Each group received a large and small magnitude of reward according to the pre- and post-shift phases of the experiment. Ninety trials of acquisition were carried out for both high and low drive groups with 25 post-shift trials. Ehrenfreund and Badia found that the high drive animals exhibited PCE and NCE and that the low drive animals showed neither.

During the post-shift phase, the change in running speeds was much greater for the high drive than low drive group. Ehrenfreund and Badia attributed the difference in running speed after post-shift to the high drive group based on percentage of body weight (85%) and incentive magnitude. The shift data was interpreted in terms of r_e (fractional anticipatory emotional response) and its response produced cues (r_e-S_e). Basically r_e occurs in the goal box, and generalizes to the rest of the runway. Also r_e tends to elicit through its response produced cues (r_e-S_e), overt responses, some of which may be incompatible with the running response. The combination of r_e with high drive will increase the response strength of those particular Ss under that treatment condition. Ehrenfreund and Badia hypothesized that such incompatible responses were more likely to occur in high drive (pre-shift phase) animals with a low magnitude of reward. Accordingly, in the post-shift phase the increments of reward were seen as functions of the drive level of the high drive Ss. The low drive (95% percentage of body weight) Ss also had incompatible responses; however, because these Ss had a lower drive level, any increment in reward in the post-shift phase was not seen as vital contribution to their drive state. Consequently, the high drive (85% percentage of body weight) Ss performance in the post-shift phase was seen as elation effect and the low drive Ss performance in the post-shift phase was a depression effect. Most of Ehrenfreund and Badia's ideas on drive level came from the work of Spence (1956) and Reynolds and Pavlik (1960) study which found running speed increased with levels of deprivation as reward increased.

Shanab, Sanders, and Premack (1969) found a positive contrast effect with the use of delay of reward. The Ss were divided into three groups according to reward magnitude (1, 4 and 22 pellets). The Ss were trained one trial a day in a standard long runway. After six days of adaptation to the runway, all Ss were given 41 trials (41 days) in the runway during which time runnings speeds had stabilized.

During the second phase of training, a delay of reward was introduced in the magnitude of reward, to determine whether the effect of delay would be the same for all groups. After eleven delay trials, reacquisition (no delay) was given for all Ss for 35 more trials to restabilize their performance.

Based on running speeds from the last five trials, the one and four pellet groups were divided into two matched subgroups making four subgroups with equal N. One subgroup from each of the two main groups (one pellet and four pellet) was then shifted from its training magnitude to 22 pellets; the two remaining subgroups of the one pellet and four pellet groups were then shifted to four pellets. The Ss originally on 22 pellets were maintained throughout on this magnitude of reward schedule. After the appropriate division into subgroups, the 30-second delay was introduced and each subject was then given 21 trials with delay. Shanab, Sanders and Premack's (1969) results showed that an introduction of delay accompanying a shift in magnitude of reward produced a decrement in the running speed of all groups. However, the decrement was not equal and was proportional to the reward-magnitude on which the group had been trained prior to the shift. Consequently, the greatest decrement was shown by the original training group maintained on 22 pellets throughout the experiment and the least decrement was shown by the group which was shifted from one pellet to 22 pellets. This least amount of decrement was looked upon as more of an increment in performance, thus a positive contrast effect.

Summary and Conclusion

As shown in the introduction, relatively few studies have shown any substantial evidence for positive contrast effect. Some rather broad generalizations may be drawn from the information available: (1) Positive contrast effect has occurred under conditions of controlled drive level (Ehrenfreund and Badia, 1962) and delay of reward (Shanab, Sanders, and Premack, 1969); (2) Positive contrast effect was evidenced in a magnitude of reward shift, from low to high magnitudes, (Crespi, 1942, and Zeaman, 1949). Questions regarding PCE such as satiation prior to post-shift, experience in a runway prior to post-shift, and physiological factors which effect the running speed of the animal, can be answered only hesitantly based on limited information on the positive contrast effect phenomenon.

Because of the infrequency in finding PCE based on the above studies, the question was raised if PCE could be replicated from one of the above results. It seems reasonable that with modifications of the Ehrenfreund and Badia study some evidence should be shown for a positive contrast effect. It is this question which provided the basis for the design of this study.

CHAPTER II

STATEMENT OF THE PROBLEM

Ehrenfreund and Badia's (1962) study demonstrated that some type of PCE occurs in an animal on a varied magnitude of reward schedule. Their conclusion concerning positive contrast effect was that it occurs as a function of drive in pre- and post-shift magnitude of rewards. There has been no reported attempt to explore experimentally the implications of this positive contrast effect in a drive state in recent studies.

It was, therefore, the purpose of this study to investigate the possibility that the positive contrast effect phenomenon does exist in incentive magnitude situations with pre- and post-shift trials. This study was a modification of the Ehrenfreund and Badia experiment. It is possible that positive contrast effects are not seen due to the response measure (asymptote after shift) but confounded with other unknown variables. A possible way of teasing out a "hidden" positive contrast effect is to run a third phase. In the third phase, a reduction in magnitude for the high drive subjects might produce a lower NCE, which is really a "hidden" PCE. If the high drive subjects could show a PCE (lower NCE) in the third phase, this would show up better than a control group showing no PCE during this phase. If a positive contrast effect exists, it would appear in the depression effect of one group of high drive (hi reward) subjects in the third phase. This high drive, hi reward group would be compared to a high drive, low reward group, which has a similar depression effect in the third phase. The existence of a PCE for the hi reward group would be determined by a lower running speed relative to the low reward group in the third phase.

Hypotheses

Three outcomes of this experiment were possible: (1) Ss on a high drive level (82-87% of body weight), when in Phase III on a hi-hi-low magnitude of reward schedule, might reach a lower asymptote than those Ss on a low-hi-low magnitude of reward schedule; (2) Ss on high drive level in Phase III for both low-hi-low and hi-hi-low Ss might show no differences in the asymptote of the curves in Phase III, giving no evidence of PCE; (3) Low-hi-low Ss on high drive might have a lower asymptote in Phase III than the squad on hi-hi-low magnitude of reward schedule; no evidence of PCE would be apparent. The first outcome formed the main hypothesis of this experiment.

Subjects on low drive level (92-97% of body weight) should not exhibit any evidence of decrement or increment in performance. Their performance throughout all three phases should be constant.

CHAPTER III

METHOD

Subjects

The subjects (Ss) were thirty-two albino rats of Holtzman strain, approximately 100 days old, equally divided among four squads; high drive-low reward; high drive-high reward; low drive-low reward; low drive-high reward.

Drive was operationally defined as a percentage of S's normal weight. Normal weight was the average daily weight maintained under *ad lib* feeding for a seven day period. During the experiment, all S's weights were taken each day by the experimenter on a gram weight scale. Essentially each S was maintained as close as possible to a specified weight. Loss of weight by Ss was gained back by appropriate feedings of Noyes pellets to Ss and then the Ss were weighed by the experimenter. For the purposes of this study the high-drive Ss were maintained at a range between 82-87% of *ad lib* or starting weight, and the low-drive Ss at a range of 92-97% of *ad lib* weight.

Experimental Design

Independent variables: There were three independent variables: (1) drive level for each Ss; (2) phases which were, Phases I, II and III; and (3) magnitude of reward (LHL, and HHL) which reflected the reward schedule from Phase I.

Dependent variable was running speed measured in .01 seconds by three clocks. The clocks were placed at the starting box, midpoint and goal box entry of the runway.

The experimental model was a three factor analysis of variance on running speed. Three factors were considered, drive (D), magnitude (HHL and LHL) during Phase I (M), and phases (P). Phase II and Phase III were used and were repeated measures factors. Phase I did not qualify as a repeated measure, because it was not relevant to the hypothesis question. Although the primary statistical analysis was based on three factorial designs, supplementary evaluations included (1) two factor repeated measure analysis of variance with high drive Ss on Clock 2; (2) two factor repeated measure analysis of variance with low drive Ss on Clock 2.

Apparatus

The testing apparatus was a runway with plywood on the sides and bottom. The top was clear plastic covered with two thicknesses of fine wire screen. The runway was five feet long, 2 1/2 inches wide, and four inches high. Five time clocks measured the speed of the Ss in .01 second units. A total of five pairs of photocells were used which started the clock when the animal interrupted the beam. One clock was located at the starting box, one at the goal box and the other three placed at even distances along the five foot runway. The clocks were reset after each trial. The runway was illuminated by four 7 1/2 watt bulbs. Guillotine type plywood doors, 15 inches from each end of the runway, created a start box and goal box.

Procedure

The Ss were placed in individual cages where they remained for ten days prior to the beginning of the pre-acquisition phase. Within this ten day period all Ss were prehandled for two minutes per day for a ten day duration. During pre-acquisition, the Ss were placed in the runway to become acclimated to their surroundings, but not allowed into the goal box. The experimenter then weighed each S on a gram scale to measure the percentage of body weight and to see if it was maintained or a loss had been incurred. Weighing the Ss took place eight hours prior to running. If a loss occurred, the Ss were fed the appropriate Noyes pellets to bring the body weight back to within normal range of the specified weight. The experiment was divided into three phases: acquisition phase; first-shift phase; and second-shift phase.

Acquisition Phase (Phase I)

The total sample was thirty-two Ss, with sixteen Ss in each drive condition. The magnitude groups were defined as Group LHL, L = low magnitude in Phase I, H = high magnitude in Phase II, and L = low magnitude in Phase III and Group HHL. On each trial, the squads which belonged to low-reward groups LHL received 45 mg Noyes pellets, and the high-reward HHL squads 260 mg Noyes pellets.

Phase I began with the random assignment of each of the high drive and low drive Ss to either Group LHL or Group HHL, designated in the experimental design. The Ss were prehandled for two minutes by the experimenter with gloves. This was done prior to the S being placed in the runway. The S was post-handled for two minutes after each trial in the acquisition phase.

The Ss were run in squads, eight Ss to a squad. Numbers were given to each S in each squad. These squads were: Squad 1 (Ss 1-8); Squad 2 (Ss 9-16); Squad 3 (Ss 17-24); and Squad 4 (Ss 25-32). The high drive Ss who belonged to Group LHL magnitude of reward schedule were assigned to Squad 1. Ss that belonged to Group HHL magnitude of reward were assigned to Squad 2. Ss which belonged to the low drive group (92-97% body weight) likewise had assigned numbers. Low drive Ss placed in Group LHL, (low-hi-low), were assigned to Squad 3; and low drive Ss in Group HHL were assigned to Squad 4.

Four Ss were randomly picked, one from each squad. These four Ss were run through all phases of the experiment in eight consecutive days of training. Each S was given 15 trials per day for six days in the acquisition phase, a total of 90 trials in six days. The order of running of the four Ss was always in a repetitive sequence. For example, randomly picked numbers from each of the four squads could be 3, 10, 20, and 28. After the completion of running in the order of 3, 10, 20, and 28, the experimenter always began with 3 and continued with the same sequence. A 15-20 second interval was maintained between running each S. At the completion of eight days of training, another randomly picked group of four Ss was chosen. On each trial the squads which belonged to the low reward groups received a 45 mg Noyes pellet. The high reward Ss received a 260 mg pellet. After the acquisition phase was completed, the Ss were returned and twelve hours later were weighed to see whether the percentage of weight gain or loss was within the assigned drive level of the Ss.

During a run the S was placed in the start box and when the S faced the vertical door of the start box, it was raised to allow the S to run down the alley. Just before the S reached the goal box door, the experimenter pulled up the door. The S entered the goal box and was kept there long enough to consume the pellet(s). The start box door had been closed to prevent the S from re-entering, and the goal box was closed after the animal entered the goal box. If the S did not run to the goal box within two minutes, the experimenter pushed the S (by hand) in the direction of the goal box. These times were not ignored. The Ss continued the ascribed pattern for 90 trials over the six days of acquisition training (Phase I).

First-Shift Phase (Phase II)

On days seven and eight, Ss assigned to Group LHL were shifted from a low to high magnitude of reward schedule. Each S was given 25 trials of re-acquisition (i.e., 45 mg) and then were shifted to 20 trials with a 260 mg magnitude of reward schedule. Group HHL Ss did not shift magnitude of reward. During Phase II the subject order of the acquisition phase was maintained with a 15-20 second interval between each S. Thus during this phase, all Ss assigned to Groups LHL and HHL ran on the same high magnitude of reward schedule. The Ss were weighed twelve hours after completion of running. Weighing measured any percentage of weight lost or maintained according to the drive level of the Ss.

Second-Shift Phase (Phase III)

On days nine and ten or trial 135, a second shift was made for Ss assigned to Group LHL, and Group HHL made its first shift of magnitude of reward. Groups LHL and HHL ran 20 trials per S on first-shift phase (Phase II) which was 260 mg, then both Groups LHL and HHL shifted to 25 trials per S on magnitude of reward of 45 mg. Again, all subjects were on the same magnitude of reward schedule in the second-shift phase. The exact same running procedure was used as in the acquisition and first-shift phases. The Ss were weighed after completion of the running. Weighing measured any percentage of weight lost or maintained according to hi or low groups.

CHAPTER IV

RESULTS

A three factor analysis of variance was computed on Clocks 1, 2 and 3. Three factors were considered, drive (D), magnitude (M) of both the hi group (HHL) and low group (LHL) from Phase I, and finally phases (P).

The results for the analysis of Clock 1 are presented in Table I. The main effects of drive and phases were significant at $p < .01$ level. Only the interaction of drive by magnitude was significant at the $p < .01$ level. Simple effects analysis on drive x magnitude interaction showed the following: (1) There were significant differences in performance between high drive and low drive Ss at magnitude reward schedules LHL and HHL in Phases II and III (see Table II); (2) The high drive Ss increased their running speed relative to the low drive Ss who showed a decrease in their speed.

The results of the analysis of Clock 2 are shown in Table III. The main effects of drive magnitude and phases were significant at the $p < .01$ level. Significant interactions were drive by magnitude, phase by drive and phases by drive by magnitude, all significant at $p < .01$ level. Simple effects analysis of drive x magnitude showed the following: (1) There were significant differences in performance between high drive Ss and low drive Ss at magnitude reward schedules LHL and HHL in Phases II and III, see Table II. The F test for high and low

TABLE I

THREE FACTOR ANALYSIS OF VARIANCE ON PHASE II AND III, CLOCK 1, WITH REPEATED MEASURES

Source	df	Sum of Squares	Mean Square	F Value
Between Subjects				
Drive (D)	1	86.304	86.304	*327.405
Magnitude (M) (Hi and Low - Phase I)	1	.2700	.2700	1.03
DM	1	11.3840	11.3840	*43.186
Subjects Within Groups	28	7.381	.2636	
Within Subjects				
Phases (P)	1	7.478	7.478	*28.007
PD	1	.036	.036	.13483
PM	1	.250	.250	.9363
PDM	1	.1880	.1880	.70411
P x Subjects Within Groups	28	7.478	.26707	
TOTAL	63	120.769		

*$p < 0.01$.

TABLE II

SIMPLE EFFECTS TEST FOR D X M F-TESTS ON CLOCKS 1, 2, 3 IN PHASES II AND III

	Phase II	Phase III	
	D_2M_1-D_1M_1	D_2M_2-D_1M_2	Key:
Clock 1	*66.3642	*304.2530	D_2 = Hi drive D_1 = Low drive M_1 = L reward - Phase I M_2 = H reward - Phase I
Clock 2	*19.0941	* 49.8924	
Clock 3	*40.0929	*449.7022	

*$p < .01$.

TABLE III

THREE FACTOR ANALYSIS OF VARIANCE ON PHASE II AND III, CLOCK 2, WITH REPEATED MEASURES

Source	df	Sum of Squares	Mean Square	F Value
Between Subjects				
Drive (D)	1	23.875	23.875	*65.3572
Magnitude (M) (Hi and Low - Phase I)	1	51.033	51.033	*139.701
DM	1	1.3254	1.3254	*3.6282
Subjects Within Groups	28	10.230	.3653	
Within Subjects				
Phases (P)	1	3.7587	3.7587	*11.1899
PD	1	6.6243	6.6243	*19.7210
PM	1	1.0021	1.0021	2.9833
PDM	1	4.8129	4.8129	*14.3283
P x Subjects Within Groups	28	9.406	.3359	
TOTAL	63	112.068		

*$p < 0.01$.

drive Ss at magnitude reward schedule LHL were $F_{1,28} = 19.0941$ and for magnitude reward schedule HHL the $F_{1,28} = 49.8924$. Both F tests were significant at .01 level. (2) Both high and low drive Ss increased their performance; however, high drive goup maintained a higher performance level than low drive group. Phase by drive interaction showed the following simple effects analysis: (1) There were significant differences in performance between high drive and low drive Ss at Phase II ($F_{1,28} = 9.5215$; $p < .01$) but no difference in performance between high and low drive groups at Phase III ($F_{1,28} = .91513$, not significant). (2) High drive Ss decreased their running speed from Phase II to Phase III; however, their speed did not go below the low drive Ss. The low drive Ss increased their performance from Phase II to Phase III, but this increase was below the performance of the high drive Ss.

Two more analysis of variance were computed on Clock 2 as shown in Tables IV and V. The results for the high drive Ss on Clock 2 are presented in Table IV. The main effect of magnitude was significant at $p < .01$ level. The interaction of magnitude x phase was significant at $p < .01$ level. Figure 1 (Appendix B) showed simple effects analysis of high drive and low drive Ss on Clock 2. Pertaining to the high drive Ss the analysis represented: (1) Both phases were significant at the $p < .01$ level in regard to performance. Phase II was ($F_{1,7} = 149.548$ and Phase III was $F_{1,7} = 29.503$). (2) Low magnitude (LHL) increased in performance between Phases II and III. High magnitude decreased in performance from Phase II to Phase III; however, their speed was above the low magnitude group.

The results for the low drive Ss on Clock 2 are presented in Table V. The main effects of magnitude were significant at the $p < .01$

TABLE IV

TWO FACTOR REPEATED MEASURES ANALYSIS OF VARIANCE DURING PHASES II AND III WITH HIGH DRIVE SUBJECTS ON CLOCK 2

Source	df	Sum of Squares	Mean Square	F Value
Between Subjects				
Magnitude (M) (Hi and Low - Phase I)	1	34.40352	34.40352	*171.1873
Subjects Within Groups	14	2.81358	.20097	
Within Subjects				
Phases (P)	1	.20159	.20159	.83874
M x P	1	4.10404	5.10404	*21.2361
P x Subjects Within Groups	14	3.36487	.24034	
TOTAL	31	45.8814		

*$p < 0.01$.

TABLE V

TWO FACTOR REPEATED MEASURES ANALYSIS OF VARIANCE DURING PHASES II AND III WITH LOW DRIVE SUBJECTS ON CLOCK 2

Source	df	Sum of Squares	Mean Square	F Value
Between Subjects				
Magnitude (M) (Hi and Low - Phase I)	1	17.96603	17.95503	*33.89276
Subjects Within Groups	14	7.41677	.52976	
Within Subjects				
Phases (P)	1	10.18133	10.18133	*23.5930
M x P	1	.71102	.71102	1.64763
P x Subjects Within Groups	14	6.0416	.431542	
TOTAL	31	42.3057		

*$p < 0.01$.

level. No interaction was significant; the M x P is represented in Figure 1 (Appendix B).

The results of the analysis on Clock 3 are shown in Table VI. The main effects of drive and phases were significant at $p < .01$ level. The interaction of drive x magnitude was significant at $p < .01$ level. Simple effects analysis on drive x magnitude showed: (1) There were significant differences in performance between high drive and low drive Ss at magnitude of reward schedules HHL and LHL in Phases II and III, see Table II. Both F tests were significant at $p < .01$ level. (2) High drive Ss increased their running speed relative to the low drive Ss which showed a decrease in speed.

Low and high drive Ss performance for all three phases on Clock 1 are shown in Appendix C and D (see Appendix C and D). The LHL group's running speeds were somewhat higher than the HHL group's performance for Phases II and III (see Appendix C). The HHL group's running speeds were higher than the LHL group for Phases II and III (see Appendix D). Analyses for Appendices C and D are presented in Table I.

Low and high drive Ss performance for all three phases on Clock 2 are shown in Appendix E and F (see Appendix E and F). The HHL group had a higher running speed than the LHL group in Phase II, and rapidly increased in speed in Phase III more so than the LHL group (see Appendix E). The HHL group's performance was much faster than LHL group in Phase II; however, a decrease in speed for the HHL group was observed at the beginning of the 21st trialblock. Phase III showed the HHL group's performance still higher than those of the LHL group (see Appendix F). The data presented in Appendices E and F are shown in Table III.

Low and high drive Ss performance for all three phases on Clock 3

TABLE VI

THREE FACTOR ANALYSIS OF VARIANCE ON PHASE II AND III, CLOCK 3, WITH REPEATED MEASURES

Source	df	Sum of Squares	Mean Square	F Value
Between Subjects				
Drive (D)	1	99.95	99.95	*252.017
Magnitude (M) (Hi and Low - Phase I)	1	2.016	2.016	5.0832
DM	1	29.1604	29.1604	*73.5259
Subjects Within Groups	28	11.1061	.3966	
Within Subjects				
Phases (P)	1	5.8564	5.8564	*18.5153
PD	1	.1296	.1296	.4097
PM	1	1.1722	1.1722	3.7059
PDM	1	.2181	.2181	.6895
P x Subjects Within Groups	28	8.8576	.3163	
TOTAL	63	158.4664		

*$p < 0.01$.

are shown in Appendices G and H (see Appendices G and H). The LHL group was performing higher in Phase II and III than the HHL group (see Appendix G). The HHL group sharply increased its performance in the beginning of Phase II over the LHL group. This increase was maintained over LHL group into Phase III (see Appendix H). Analyses for the data presented in Appendices G and H are shown in Table VI.

CHAPTER V

DISCUSSION

In this investigation an attempt was made to determine if Ss on a high drive level with a hi-hi-low magnitude of reward schedule from Phase I, would reach a lower asymptote in running speed in Phase III than those Ss on the same drive level but on a different magnitude of reward schedule from Phase I which was low-high-low. The results on all three clocks did not support this hypothesis.

However, the most relevant questions to ask from the available data, seem to be: Is the Phase I magnitude by Phase II and III interaction significant for the high drive animals? Is the same interaction significant for low drive animals? If the interaction is significant for high drive but not low dirve what does this mean?

The only data that followed the pattern indicated by the questions were from clock 2 (see Tables III, IV, and Figure 1). The results from Figure 1 suggested the following for high drive Ss: (1) The high drive Ss decrease in performance on hi magnitude (HHL) indicated a negative contrast effect. (2) The increase in performance of the high drive Ss on low magnitude (LHL) from Phase II to Phase III cannot be explained by any available theory. (3) The significance of Phase II can be explained in terms that hi magnitude (HHL) from Phase I Ss are performing faster than those Ss on low magnitude (LHL) from Phase I. Crespi and Zeaman both agreed in their findings that animals on a larger magnitude of reward will perform better than animals on a smaller magnitude of reward. But this would be a persisting effect of magnitude. The differentiation in magnitude, in the present study, was based on Phase I. (4) The significance in Phase III cannot be explained.

Interpretation of the high drive Ss hi-magnitude (HHL) performance on Figure 1 can be explained in terms of Spence, Gonzalez, Gleitman and Bitterman (1962). The high drive Ss on hi magnitude did decrease in performance from Phase II to Phase III, but not enough to warrant any evidence that might support the hypothesis for the present study. There are indications of a negative contrast effect. Spence's theoretical explanation can support this indication of NCE. Spence believed NCE results from the frustration response (rf-sf) based on reduction in reward magnitude. Interfering responses (sf-R_I) occur in the goal box and generalize to the runway on the next trial. The speed of the animal is reduced considerably. The frustration response produces a variety of internal stimuli which elicit overt responses which compete with the instrumental response, thus resulting in an initial depression in performance. From the decrease in performance of the hi magnitude-high drive Ss, Spence's theoretical explanation lends support to their performances (see Figure 1). Gonzalez, Gleitman and Bitterman in their work with negative contrast effect found that abrupt decrements in reward produced a significant decrement in performance. Once again this can support the performance of the high drive-hi magnitude group in Figure 1.

In summary, the hypothesis was not supported. A three factor interaction of phase x drive x magnitude was significant at Clock 2 (prior to the middle of the runway) in Phase II. Further analysis of Clock 2 suggested that high drive Ss on hi magnitude of reward performance might indicate a negative contrast effect. Those, high drive Ss on low magnitude, their performance on Clock 2 could not be explained. Likewise the significance of Phase III for the high drive Ss on Clock 2 could not be explained.

CHAPTER VI

SUMMARY

This study represents an attempt to investigate the relationship that positive contrast effect phenomenon does exist in incentive magnitude situations with pre- and post-shift trials. Three hypotheses were offered: (1) Ss on a high drive level (82-87% of body weight), when in Phase III on a hi-hi-low magnitude of reward schedule - Phase I, would reach a lower asymptote than those Ss on a low-hi-low magnitude of reward schedule - Phase I. (2) Ss on high drive (82-87% of body weight) in Phase III for both low-hi-low and hi-hi-low Ss would show no differences in the slopes of the curves in Phase III, giving no evidence of PCE. (3) Low-hi-low Ss on high drive would have a lower asymptote in Phase III than the Ss on hi-hi-low magnitude of reward schedule. No evidence of PCE would be apparent. Of these three outcomes the first formed the hypothesis in this experiment.

Thirty-two 100 day old male albino rats were equally divided among four squads: high drive-low reward, high drive-high reward, low drive-low reward, low drive-high reward. During the experiment, all S's weights were taken each day by the experimenter on a gram weight scale. There were three phases of the experiment. Phase I (Acquisition) both high and low drive Ss were on two magnitude of reward schedules (high and low) and were shifted after the 90th trial. Phase II (First-Shift) both high and low drive groups were on high magnitude of reward and were shifted after the 135^{th} trial. Finally, Phase III (Second-Shift) both high and low drive groups were on low reward schedule.

The hypothesis was not supported by the results. It was shown that a significant three factor interaction at Clock 2 appeared in Phase II. Further analysis on Clock 2 showed significance in Phase II and III for the high drive Ss at hi magnitude and low magnitude, respectively. High drive-hi magnitude Ss performance was attributed to frustration and indications of a negative contrast effect. High drive-low magnitude Ss performance could not be explained. Phase III significance at Clock 2 for high drive Ss could not be explained.

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APPENDIX A

Contrast effects can be investigated in experiments in which Ss are initially trained with one level of magnitude of reward and subsequently shifted to a different magnitude of reward in the same task. This is referred to as successive contrast effects which was discussed in the introduction and the concern of this thesis. Simultaneous contrast effects are investigated in situations in which S receives two or more magnitudes of rewards in some intermixed order throughout training. For instance, two straight alleys (A_1 and A_2) may have a differential reward in each alley. If the S runs to Alley A_1 and receives a small reward then in Alley A_2 (large reward), the performance is effected by the magnitude of reward. Spence and Goldstein (1963), using two alleys (white and black), found that simultaneous contrast effects occurred when the white alley had a smaller magnitude of reward than the black alley. The speed of the Ss was determined by the magnitude of the reward.

Spence (1956) disagreed with Crespi's and Zeaman's findings of the elation effect, or PCE. In discussing the data Spence noted that the number of pre-shift trials employed by Crespi and Zeaman was relatively small (19 trials), and he believed that this did not insure that the Ss had attained their performance asymptotes prior to post-shift. Spence thought if this were the case, the positive contrast effect or PCE (elation effect) could simply have been the result of improvement with further practice of those Ss which were shifted upward and whose performance was compared with the pre-shift performance of Ss given their pre-shift trials with a large magnitude of reward. Spence tested this hypothesis by running rats in a straight alley with .05 and 1.0 grams of food as reward for four, following which the magnitude of rewards were reversed for ten additional trials. A significant negative contrast was obtained. There was no positive contrast effect, or PCE. Czeh (1954), who replicated a similar experiment by Spence also found NCE but no PCE.

Additional evidence of NCE was provided by DiLollo and Beez (1966) who reported that NCE did occur and that its magnitude was a direct function of the difference between pre- and post-shift magnitude of rewards. Further, DiLollo (1964) reported NCE in a runway situation which persisted not only through an initial post-shift test phase, but through subsequent extinction and relearning phases as well. Once again there was no evidence of PCE. Some factors which seem to contribute to NCE have been suggested by Gonzalez, Gleitman and Bitterman (1962). In their study, they concluded that abrupt decrements in amount of reward produced a significant decrement in performance. The larger the decrement in reward, the larger the decrement in performance. Any gradual decrement in amount of reward had no significant effect on performance. Gonzalez, Gleitman and Bitterman (1962) thought that animals react to perceived discrepancies between any prevailing and previously encountered reward situation. Interestingly enough, Gragg and Black (1967) reported that when reversals in large and small rewards were coupled with major reductions in drive, no NCE occurred.

A theoretical explanation of the phenomena of NCE and PCE is best understood by Spence's concept of frustration response. A possible reason that successive negative contrast effect (NCE) occurs is the result of the frustration response (rf-sf) due to the reduction in reward magnitude. While in the goal box, interfering responses (rf-sf) generalize to the runway on the next trial and the speed is reduced considerably. The frustration response produces a variety of internal stimuli which tend to elicit overt responses which compete with the instrumental response, thus resulting in an initial depression in performance. The absence of a PCE is also explained in the frustration response. There is decrease or absence in the frustration response when the Ss are shifted from small to large magnitude of rewards. Because this decrease in frustration response does increase the drive level, there is no PCE.

Black (1968), modifying Spence's formula of $\overline{E} = E - I$, explains why PCE does not occur. Briefly Spence's formula "excitation" (E) minus "inhibition" (I) equals "effective excitatory potential ($\overline{E}$) for discrimination learning and related learning situations. Spence assumed that an increment in E occurred when a response occurred in the presence of a particular stimulus which was reinforced. Conversely, the nonreinforced occurrence of a response resulted in an increment in (I). The strength of a particular S-R association is then assumed to be directly related to the difference between E and I or $\overline{E}$. Black assumed that during the pre-shift phase, in straight runway experiments, neither group (large to small magnitude or small to large magnitude) develops any (I); and the level of excitatory potential that is developed depends solely on their respective, pre-shift reward magnitudes. Ss should perform at a higher level with large rather than small reward magnitudes. Following a reversal in magnitudes, (I) will occur for downward shifting Ss due to the creation of frustration (rf-sf). This will reduce $\overline{E}$, thereby, depressing performance of these Ss compared with those consistently trained on small magnitude of reward. The excitatory potential of the Ss shifting from small magnitudes of reward to larger magnitudes will rise to the asymptotic level of Ss trained with larger rewards (Black, 1968). No PCE occurred since there were no mechanisms like that of frustration to produce it.

APPENDIX B

$$F_{Phase_{II}} \text{ Hi Drive } \underline{Ss} = \frac{MS_{Magnitude} \text{ at } P_{II}}{\text{MS Within Cell}}$$

$$= \frac{33.005}{.22066} = {}^{*}149.5488$$

$$F_{Phase_{III}} \text{ Hi Drive } \underline{Ss} = \frac{MS_{Magnitude} \text{ at } P_{III}}{\text{MS Within Cell}}$$

$$= \frac{6.5}{.22066} = {}^{*}29.503$$

$^{*}p(1,7) < .01$

Key:

M_1 = Low Mag (LHL) From Phase I

M_2 = Hi Mag (HHL) From Phase I

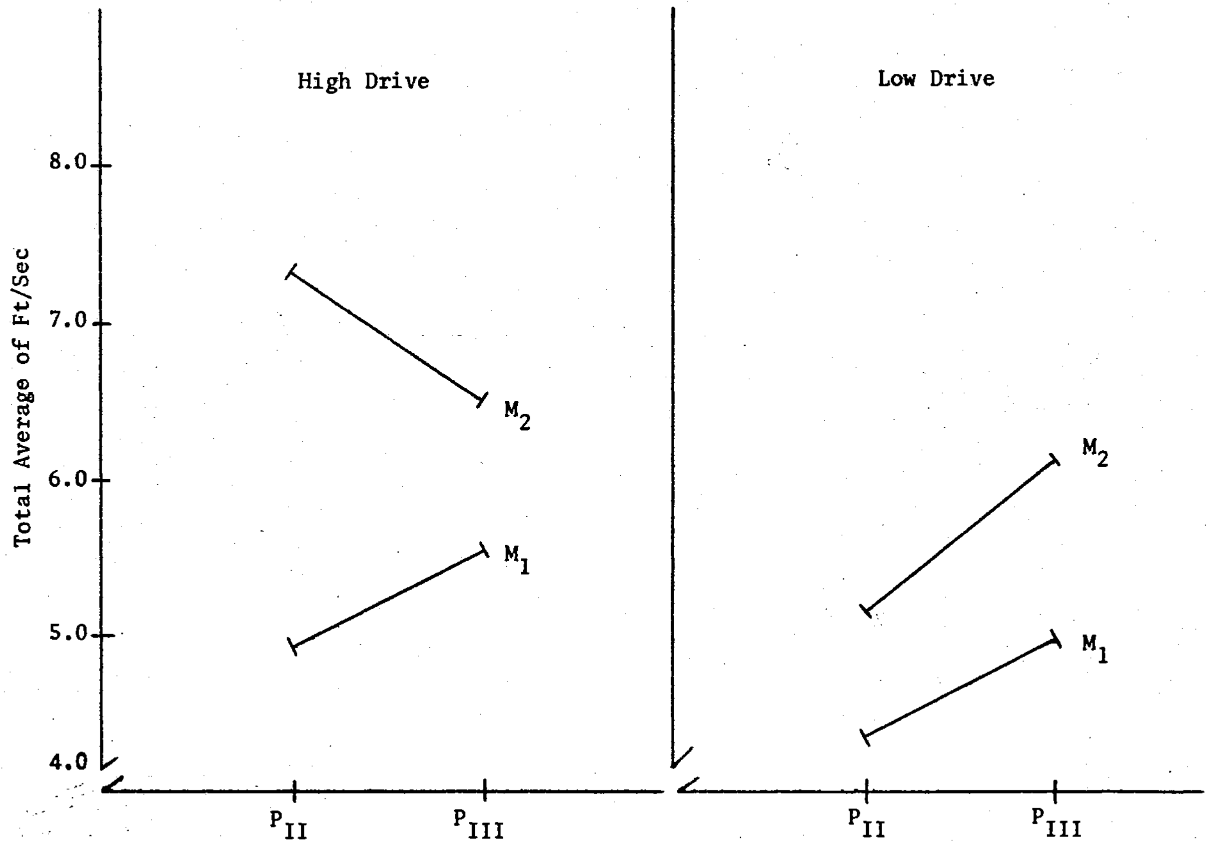

Figure 1. Simple Effects of Magnitude X Phase on Clock 2 for High and Low Subjects During Phases II and III

APPENDIX C

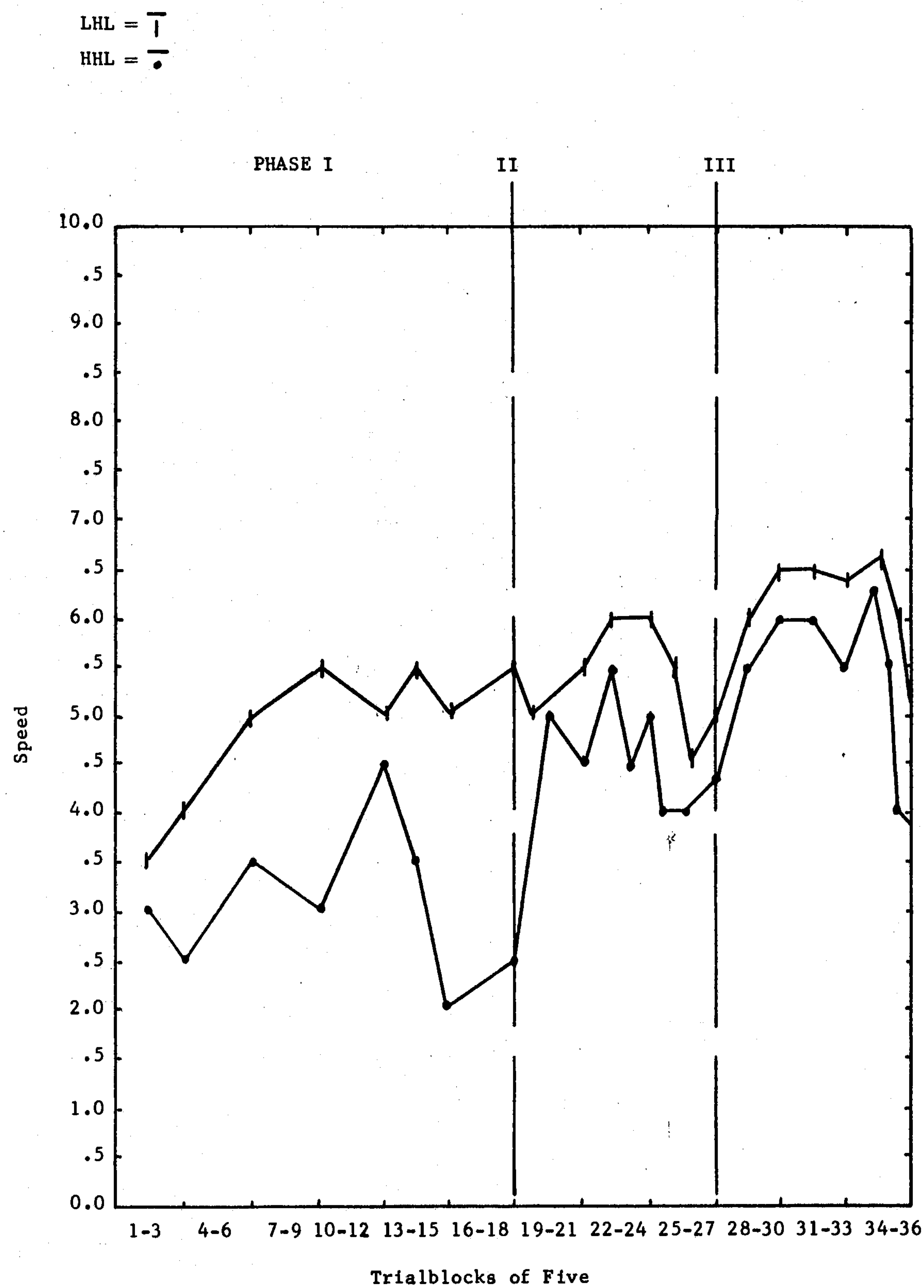

Figure 2. Low Drive Subjects on Clock 1 During Phases I-III

APPENDIX D

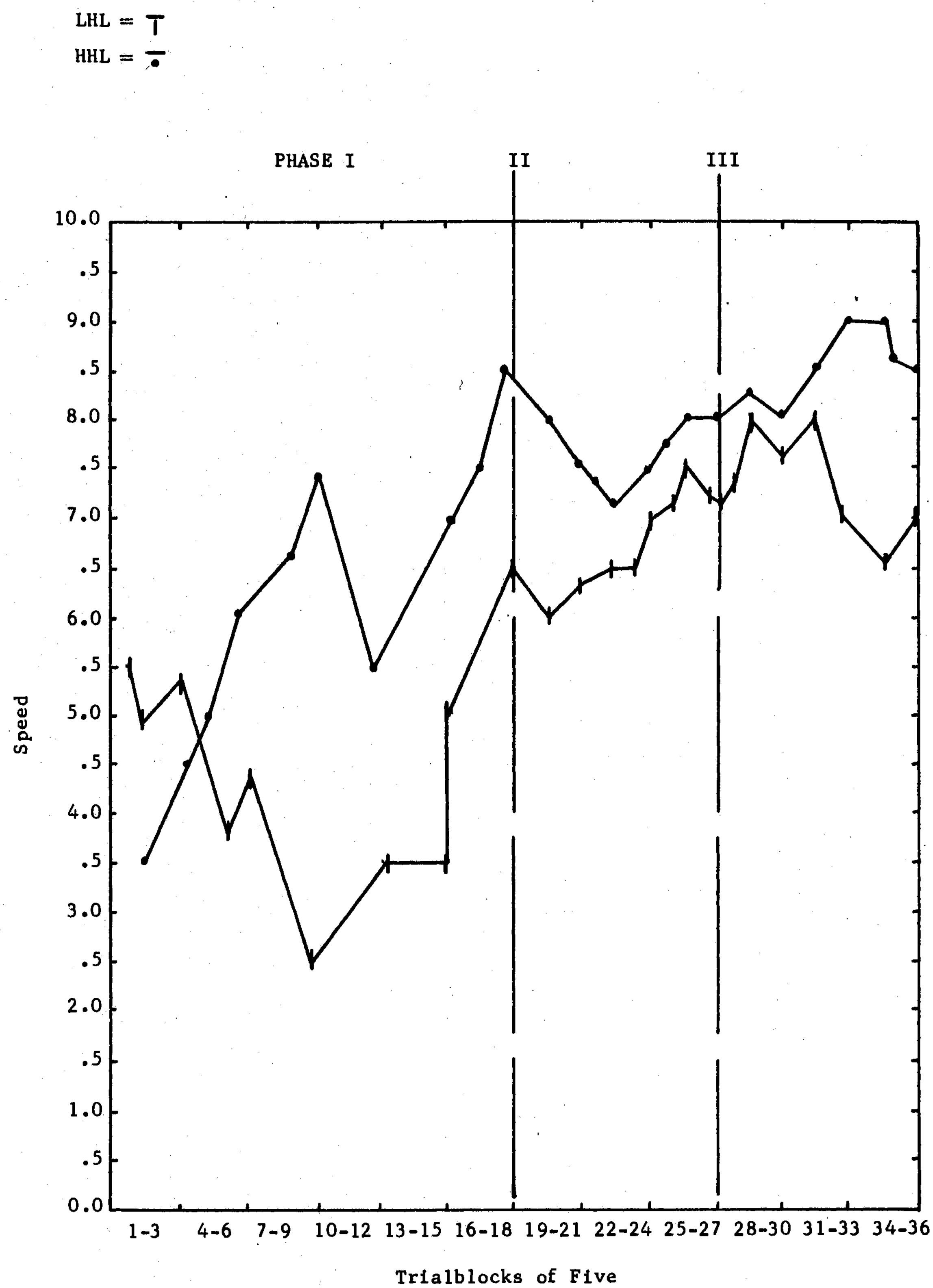

Figure 3. High Drive Subjects on Clock 1 During Phases I-III

APPENDIX E

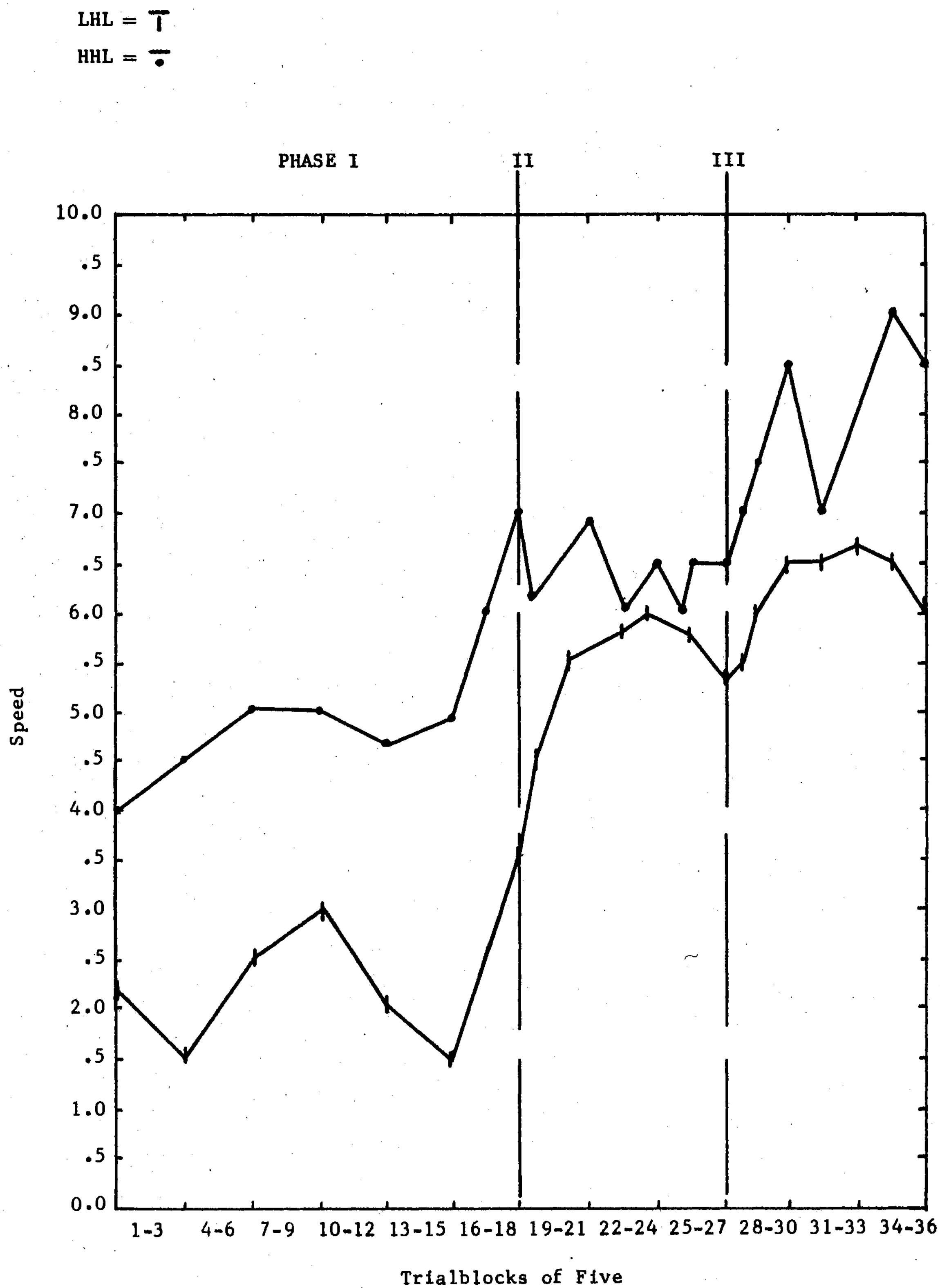

Figure 4. Low Drive Subjects on Clock 2 During Phases I-III

APPENDIX F

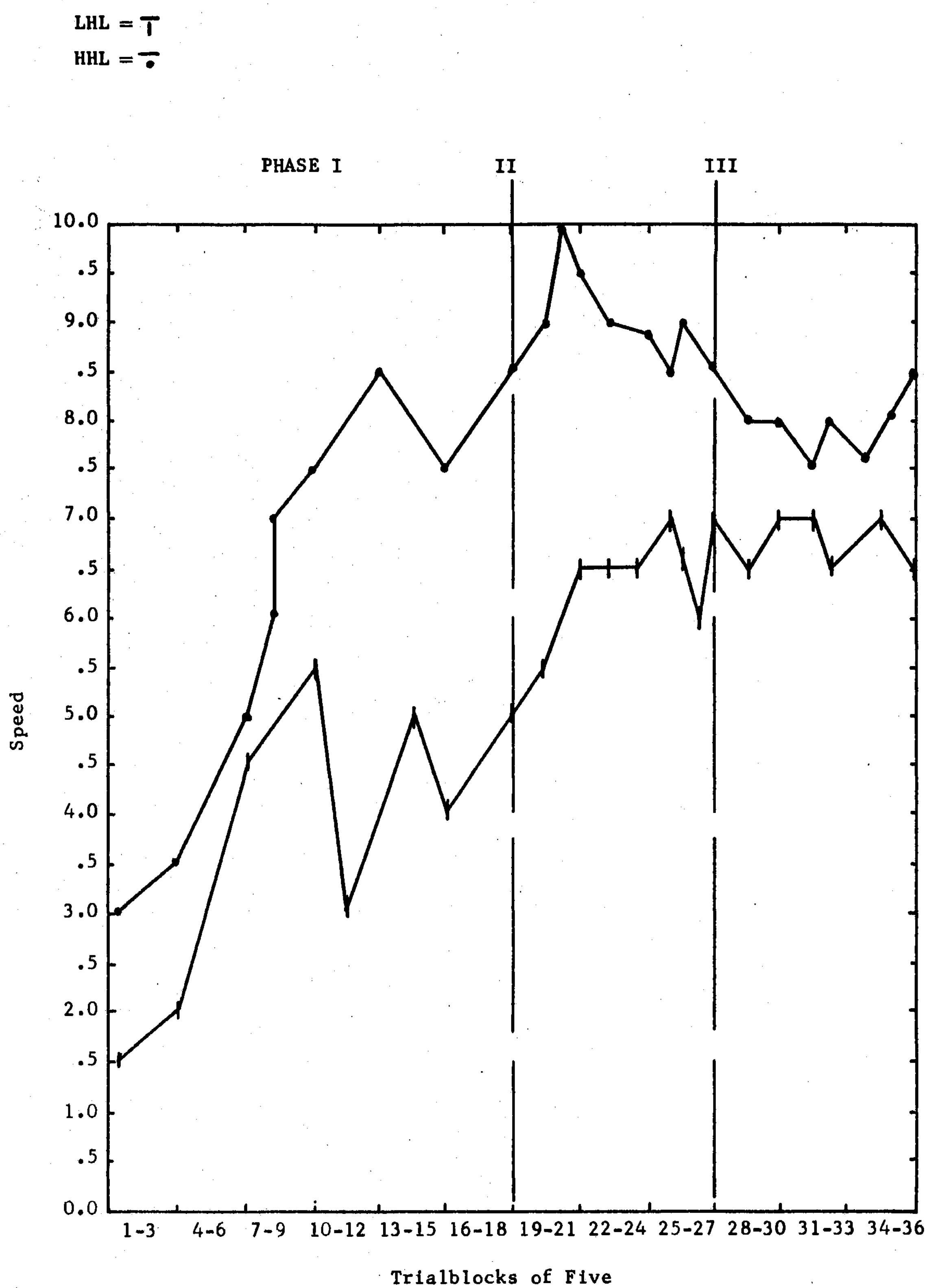

Figure 5. High Drive Subjects on Clock 2 During Phases I-III

APPENDIX G

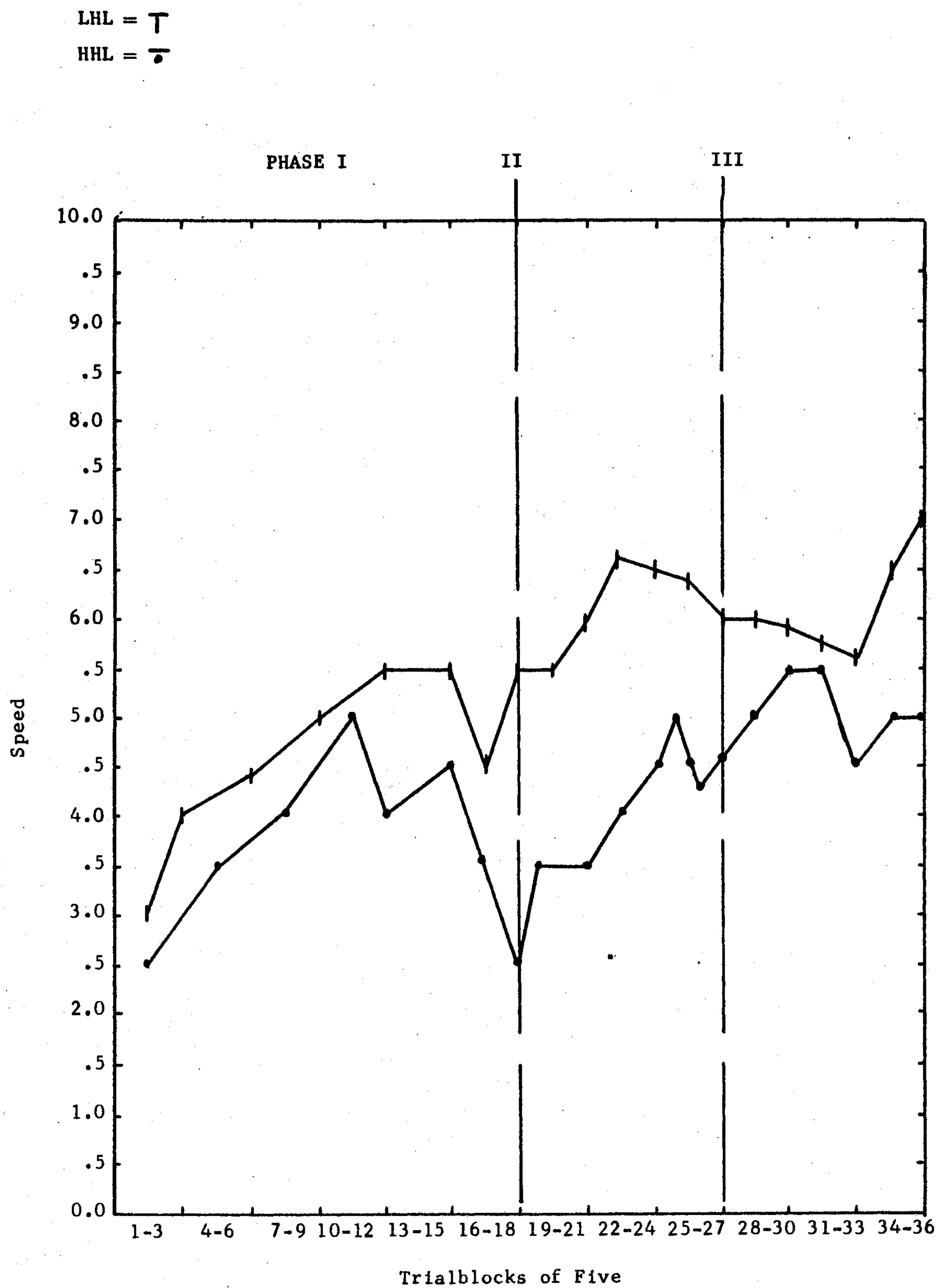

Figure 6. Low Drive Subjects on Clock 3 During Phases I-III

APPENDIX H

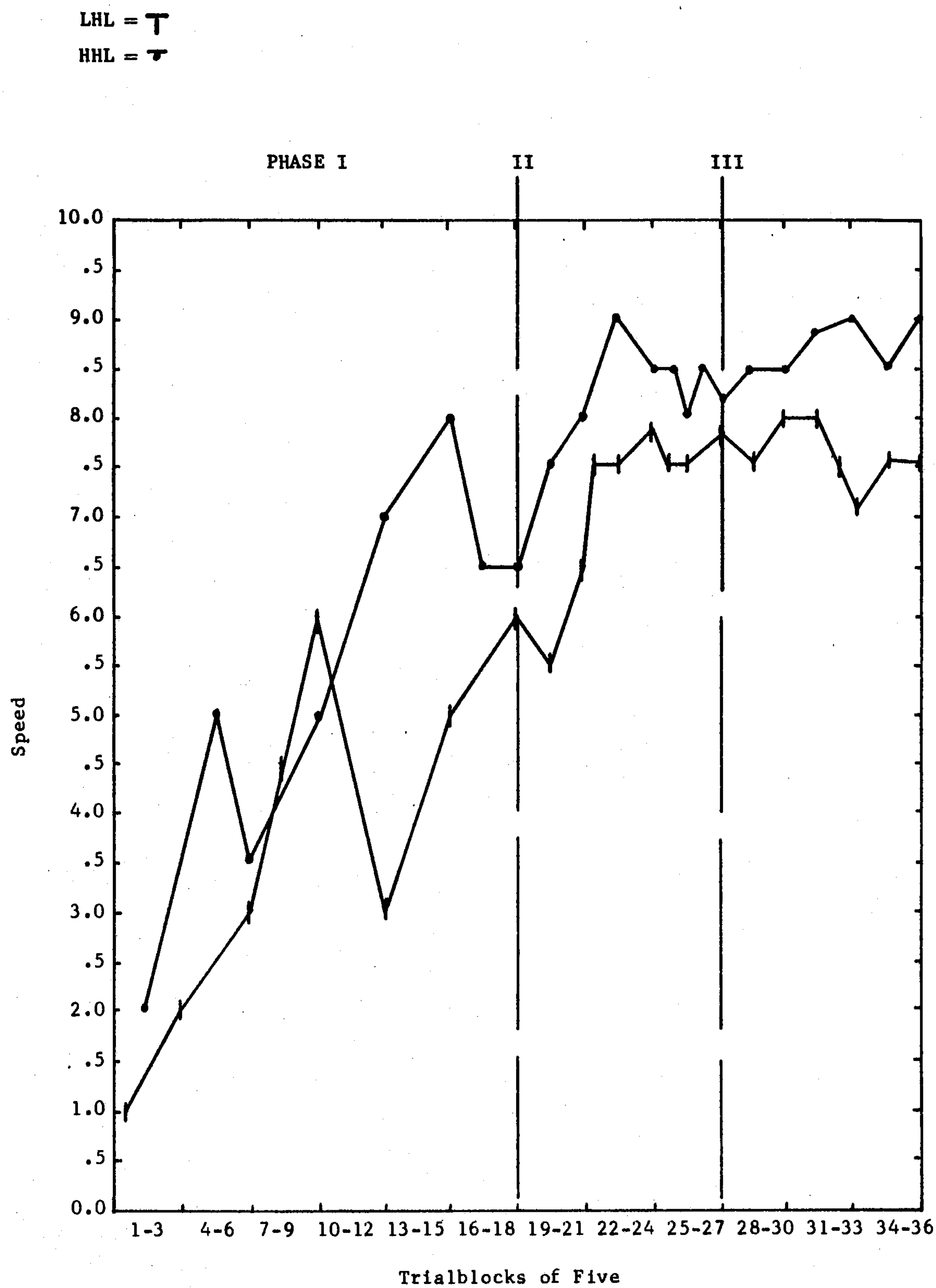

Figure 7. High Drive Subjects on Clock 3 During Phases I-III

VITA

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Edward Elliott Goldenberg

Candidate for Degree of

Master of Science

Thesis: POSITIVE CONTRAST EFFECT AS A FUNCTION OF NEGATIVE CONTRAST EFFECT IN A DRIVE LEVEL SITUATION

Major Field: Psychology

Biographical:

Personal Data: Born in Chicago, Illinois, March 31, 1945, the son of Mr. and Mrs. Jacob Goldenberg.

Education: Graduate from New Trier Township High School, Winnetka, Illinois in June, 1963; attended Denver University 1963 through 1965; received the Bachelor of Arts degree from Southern Illinois University in 1967 with a major in psychology. Completed requirements for a Master of Science degree at Oklahoma State University in May, 1971.

Professional Experience: Research assistant on Brain Research Foundation Grant connected with University of Illinois Medical School, Summer 1965; Activity therapist at Anna State Hospital, Anna State Hospital, Anna, Illinois, Summer, 1968; Research assistant to Dr. D. K. Fromme on Agriculture Extension Grant in Group Dynamics, Summer 1969; graduate teaching assistant in Psychological Mental Testing 5153, 1968-69 and Psychodiagnostics I (5713) and II (5753), 1969-70. Practicum experience at Payne County Guidance Center at Stillwater, Oklahoma, September, 1969 to August, 1970. Practicum experience at Oklahoma State University Student Counseling Center, January, 1970 to May, 1970. Psychological associate at the Psychology Guidance Center at Oklahoma State University, September, 1969 to August, 1970. National Insititute of Mental Health Clinical Trainee Fellow at Oklahoma State University, October, 1970 to October, 1971.