THE EFFECT OF TIME OF DAY ON APPROACH-AVOIDANCE CONFLICT BEHAVIOR

by

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A.B., Morehead State University, 1968

ABSTRACT OF THESIS

Submitted in partial fulfillment of the requirements for the degree of Master of Arts in Psychology in the Graduate School of Morehead State University
May, 1970

Approved Francis Stone

Date May 22, 1970

The purpose of the present experiment was to provide empricial evidence for an interactive effect of time of day on approach and approach-avoidance behavior using a FR-3 schedule in an operant chamber as a simulated alleyway. Time of day has been shown to affect an operant response, however no study has assessed this effect on approach and approach-avoidance behavior.

Subjects were 56 naive, male, albino rats that were maintained at 80% of their normal body weight. All Ss were randomly assigned to one of four groups with each group undergoing experimental treatment at one of 4 times of day (1 a.m., 7 a.m., 1 p.m., 7 p.m.). After 2 days of bar press training in which each bar press was rewarded with one 45 mg Noyes pellet, Ss were put on a FR-3 schedule for 1 day of approach training. The purpose of the approach training was to eliminate any possible warm up effects that may have occurred. For the next 2 days the total number of bar presses was recorded in 2 ten minute sessions. To establish an approach-avoidance conflict situation on the next 2 days, a shock was administered along with a pellet of food at the termination of the 3rd bar press and the total number of bar presses was recorded.

Performance was measured by a suppression ratio using the equation B-A/B+A. The results indicated that time of day does have an interactive effect on approach and approach-avoidance conflict behavior. The effect of time of day was statistically significant on conflict behavior at 7 a.m., 1 p.m. and 7 p.m. but not at 1 a.m. Two striking differences were noted: 7 p.m. represented the time of the most bar pressing during

approach and also the least amount of bar pressing during approach-avoidance conflict behavior; 1 p.m. represented the least amount of bar pressing during approach and the least amount of suppressing during approach-avoidance conflict behavior. No differential effect was noted for a time of day effect on either approach or approach-avoidance conflict behavior.

The results were generally attributed to the rats daily diurnal cycle. Another contributing factor could be that a 2.4 watt house light was on in the experimental chamber during all phases of the experiment and this effect could be determined by running 2 separate groups: 1 with the lights on and 1 with the lights off.

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

Director of Thesis

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ACKNOWLEDGMENTS

I should like to express my gratitude to Dr. F.H. Osborne who directed this study, especially for his invaluable advice and counsel pertaining to the formulation of the problem, assistance in statistical matters, and criticism of the manuscript. I should like to extend my thankfulness to Dr. J.E. Gotsick for his patient encouragement, and to B.J. Young for assistance in the laboratory. I am also indebted to Miss C.J. Allen who typed the manuscript.

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CHAPTER I

INTRODUCTION

Various positions have been taken in regard to the factors that affect the approach and approach-avoidance gradients. Miller (1959) has assumed that the excitatory potential of the approach response can affect performance in a non-conflict situation. The variables that give rise to this excitatory potential in an approach situation are: (1) the number of reinforced trials, (2) the strength of drive motivation the approach response, (3) the delay of reward and (4) the amount of reward. The variables are assumed to be independent and not to have an affect on the avoidance gradient.

Brown, Anderson, and Brown (1966) have varied time of deprivation during approach and avoidance training in conflict tests. During approach training Ss were 1 and 44 hours deprived and 1, 14 and 44 hours deprived during shock-induced avoidance trials. The length of deprivation affected approach training but not conflict measures of avoidance training deprivation. The study previously cited (Brown, et al., 1966) assumed changes in motivation, such as time of deprivation, exerted a differential effect on these tendencies, altering the approach gradient but not the avoidance gradient. They also assumed that variations in punishment levels affected the avoidance gradient without in turn altering the a-proach gradient. Bower and Miller (1960) found that both

varying the amount of food reward, and slowly or rapidly increasing shock could affect both the approach and avoidance gradients. Increasing amounts of food produced stronger approach tendencies. Increasing shock intensities decreased approach tendencies and increased avoidance tendencies of animals.

Hearst (1967) has studied oscillation (amount of time before goal is approached) during approach-avoidance conflict in which subjects could either terminate shock or initiate food reward on a VI schedule, (VI, a reward after a varying amount of time). Termination and initiation of those conditions (i.e. oscillation) occurred most often at intermediate frequencies of food and shock. This termination and initiation at intermediate frequencies supports one of the assumptions of Miller (1960), that as two gradients approach equality, more oscillation occurs. Other investigators have used a runway to test the effect of other variables in an approach-avoidance conflict situation; Terris and Wechkin (1967) have studied the effect of prior shock in two studies. They have assessed the effects of mild shock or airblast while learning an approach response. They found that Ss with mild shock were less sensitive to subsequent shock and Ss receiving approach with mild shock were less sensitive to subsequent novel aversive stimuli.

All of the above studies used some form of an alleyway which animals had to traverse in order to receive food. Subjects were required either to discriminate paths, open a door, or operate a lever on a VI schedule after making the correct discrimination. Performance

could have been affected by the anticipatory cues and stimulus generalization as a function of running down the alleyway.

Several studies have been carried out involving approach-avoidance conflict behavior in an operant chamber which eliminates these cues. Richardson and Donahoe (1967) have used an operant chamber to test the independence of the approach and avoidance gradients. Three groups of animals were placed on a FR-10 schedule: Group 1 received food on fifty percent of the FR trials; Group 2 received food and shock positively correlated; and Group 3 received food and shock negatively correlated. Equality of approach was achieved for all groups. They found the variations in the shock-food correlation affected the conflict gradient and indicated that the suppressive effect of an aversive stimulus may be reduced if that stimulus is paired with food. This difference, however, in the shock-food correlation condition did not differentially affect the shapes of the approach and avoidance gradients and indicated that they may be independent.

Donahoe and Schulte (1967) used an operant chamber and a FR-20 schedule to test the effects of stimulus intensity on approach-avoidance conflict behavior. For half of the subjects, the intensity of a light over the response bar increased as a function of responding and for the other half the intensity decreased as a function of responding. Their findings suggest a stimulus intensity instead of a discriminative origin to account for the inequalities in the approach and the avoidance gradients. Walters and Rogers (1963) have tested the effect of pre-shock on approach-avoidance behavior using bar pressing as the operant

task. Group 1 was given a series of unavoidable shocks while Group 2 received the same treatment except for shock. One year after the original treatment all Ss were placed on a 23 hour deprivation and trained to press a lever for food. After this training Ss received punishment in the form of shock and a pellet of food each time the bar was pressed. Those Ss with prior shock exhibited a much lower rate of bar pressing than the non-shock group. Williams and Barry (1966) have also used a bar press task in an operant chamber to test the effects of counter conditioning in an approach-avoidance conflict situation.

The length of illumination has been found to effect the physiological actions of rats. Glantz (1967) has shown the effect of changing illumination on the physiological functions of urine excretion, water intake, and the antidiuretic hormone. His findings demonstrated that there may be a direct behavioral effect on rats during apperformance of a task as a function of changing the light conditions and whether the task is performed during the day or in the night time. Keller (1942) has demonstrated the effect of illumination on bar pressing. Animals consistently pressed more for a reward of darkness than for a partial decrease of light.

Since rats are nocturnal animals it may be that the time of day when the animals are run could have a significant effect of both the approach and avoidance gradients. Recent evidence for this line of thought has been demonstrated by Osborne (1970) in a series of experiments assessing the effect of time of day on aversion threshold, fear

conditioning, and avoidance responses. In the threshold experiment, the animals were found to have a significantly different level of shock aversiveness as a function of time of day (those animals run during the day had a higher threshold than those run at night). Similar results were found in the fear conditioning experiment. The results of the avoidance experiment were equivocal. Harlington (1970) has studied the startle response and motor activity of rats as a function of age and time of day. He found that the acoustic startle response magnitude in rats exhibited an age-related circadian rhythm beginning at sexual maturity and rising to a peak between 70 and 100 days followed by a decrease. At 90 days the night startle response magnitude was over 90 percent greater than during the day. Startle response magnitude did not correlate with motor activity, although he offers indirect evidence that immature females increase their activity 5-10 fold at night over their activity during the day.

The majority of investigations studying approach and approach-avoidance conflict behavior gradients asserted that these gradients are independent. Manipulation of one or more variables, either appetitive (food) or aversive (shock), have generally supported the independence of the approach and avoidance gradients. Since these studies have not specifically studied the circadian rhythm of the rats as a variable, it would be of interest to assess this effect. Specifically the purpose of this experiment was to give empirical evidence for the effect of time of day on approach-avoidance conflict behavior.

CHAPTER II

METHOD

Subjects. Fifty-nine Wistar rats raised in the animal colony at Morehead State University served as Ss. Subjects were 70-100 days old at the start of the experiment and housed in individual cages. Twenty four hours before each session, each squad of 4 Ss was placed in a separate cubicle. Illumination in the cubicles was controlled with light going on at 9 a.m. and off at 9 p.m. (EST). Prior to the experiment all Ss were given food and water ad lib.

Apparatus. The apparatus consisted of a Grason-Stadler (Model 1111) operant chamber with a single food cup and a bar. The chamber was housed in a Grason-Stadler (Model 1110) sound resistant chest with an exhaust fan to provide a constant background noise. Shock was supplied by a Grason-Stadler (Model 1064-s) shock generator and scrambler. The apparatus was automated and programmed to deliver food reward, shock and termination of each session. A 2.4 watt house light provided the only illumination for the interior of the chamber.

Design and Procedure. Subjects were randomly assigned to one of four groups, each group undergoing experimental treatment at one of four times of day (1 a.m., 7 a.m., 1 p.m., 7 p.m.). Throughout the experiment all Ss were maintained at 80%$\pm$3% of their normal body weight

with the deprivation schedule starting two weeks prior for each group. According to Stolurow (1951) there is no difference in learning an operant task (paper barrier penetration) regardless of when the deprivation is instituted if percent body weight is used as the measure of deprivation.

Sixteen Ss were run each day, 4 at each time of day and run consecutively for 7 days at the same time of day. This procedure was repeated 4 times. However, the last replication consisted of only 8 Ss, 2 at each time of day, because insufficient Noyes pellets were available to run 16 Ss. Approximately 2 to 3 days elapsed between each experimental session. Temperature records showed a range of 77±2°F for the entire experimental period.

Bar press training. Bar press training using the method of successive approximations was administered for two days at the specified time of day with 4 Ss at each time. During bar press training, 45 mg Noyes pellets were used as reinforcement. Subjects who pressed the bar a maximum of two hundred times in a total of 2 hours (1 hour each day) were continued in the experiment.[1] All Ss received approximately 7 grams of food during each session.

Approach training. Approach training was given on the third day with a criterion of a maximum of 210 bar presses in a 1 hour period. Approach measures were taken for 2 days with 10 minute sessions per S. All Ss were on a FR-3 schedule (i.e., every third bar press rewarded) during approach training.

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[1]There were 3 Ss who did not meet this criterion and were replaced by random assignment. Two Ss in Group 2 and one S in Group 3 were replaced on the 1st day when no bar presses were made in the 1st 30 minutes. For Group 2 a S was replaced at 1 a.m. and 7 a.m., and for Group 3, S was replaced at 7 p.m.

Approach-avoidance conflict situation. The approach-avoidance situation (conflict) consisted of 10 minute sessions for 2 days on a FR-3 schedule. During this procedure a 1 second .1 ma shock was delivered in conjunction with the pellet of food at the termination of the third bar press. The 10 minute session for the approach and conflict situations began after the first bar press. All Ss approached and pressed the bar within 30 minutes. Performance was measured by a suppression ratio using the equation B-A/B+A. The symbol B represented the mean number of bar presses for both 10 minute sessions calculated separately during the conflict situation. The symbol A represented the mean number of bar presses for both 10 minute sessions during approach training. The range for the suppression ratios was on a scale of -1.00 to +1.00. A minus ratio of -1.00 represented total and complete suppression of bar pressing. A plus ratio of +1.00 represented facilitation of bar pressing. A ratio of 0.00 represented no change in bar pressing during approach and conflict.

CHAPTER III

RESULTS

Figure 1 shows the means for approach and conflict taken during the 4 days of testing. The approach gradient indicated a sharp decrease in bar pressing as a function of time of day at 1 p.m. when compared to 1 a.m., 7 a.m. and 7 p.m. The percent decrease in bar pressing during conflict for the 4 times of day were: 1 a.m. 22% decrease, 7 a.m. 48% decrease, 1 p.m. 24% decrease and 7 p.m. a 54% decrease. For the conflict measures, 1 a.m. and 1 p.m. appeared to be the times of the most bar pressing while 7 a.m. and 7 p.m. were approximately equivalent.

A two-factor mixed design analysis of variance with repeated measures on one factor was computed using the 4 times of day as the between factor and the 2 trials (approach and conflict) as the within factor, Bruning and Kintz (1968, pp. 54-61). The results as shown by Table 1 indicated that trials were significant (F=43.70, df 1/52, p .01), however the time of day by trials interaction (F=3.12, df 3/52, p .05) was also significant. To test the time of day effect, separate treatment-by-subjects analysis of variance, Bruning and Kintz (1968, pp. 43-47) were computed on the approach and conflict bar presses and indicated no significant difference as a function of time of day as seen in Appendix B.

MEAN BAR PRESSES PER MINUTE
FOR APPROACH AND CONFLICT

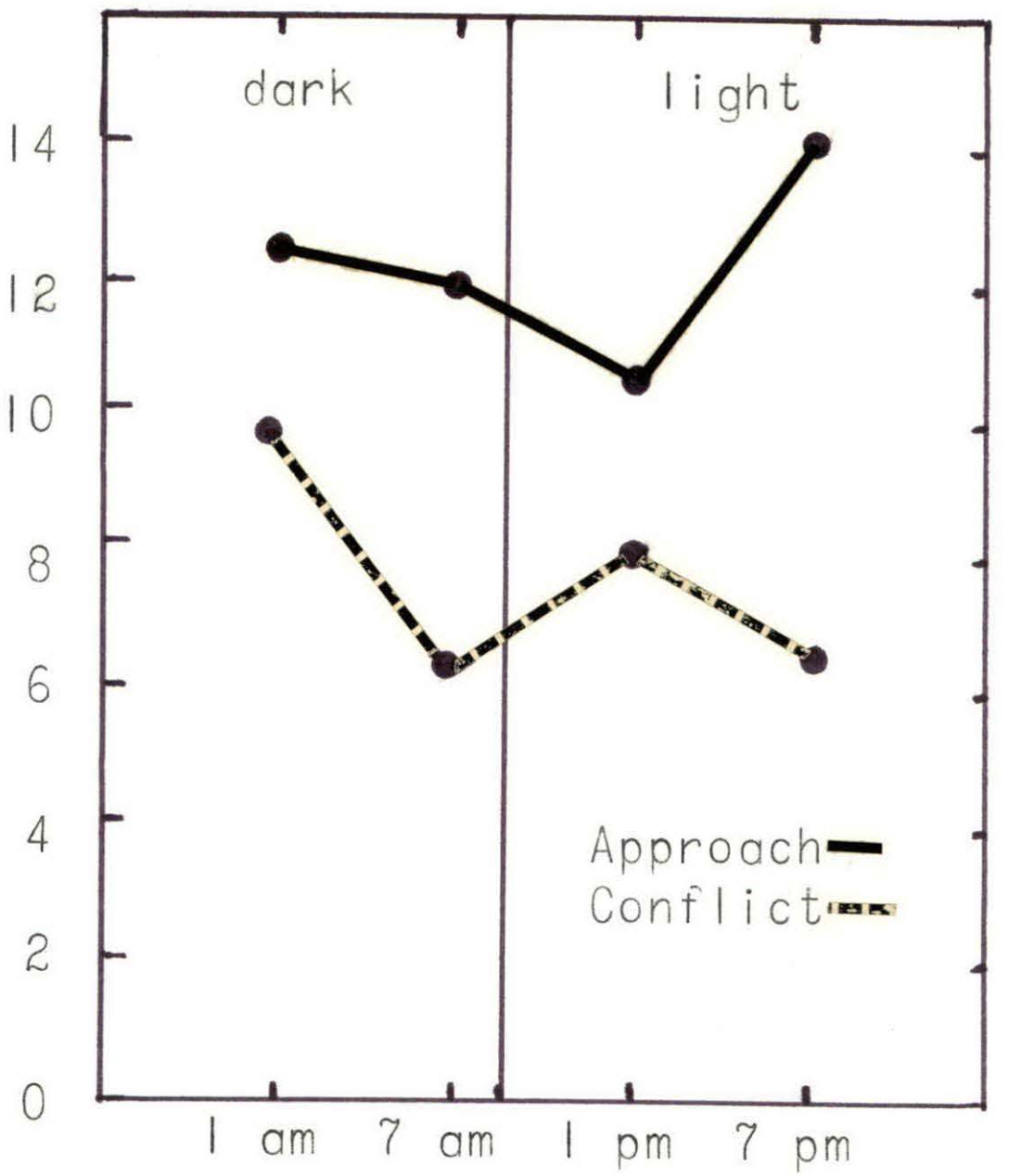

Figure 1. Mean bar presses for approach-avoidance conflict as a function of time of day (EST).

TABLE I

SUMMARY OF ANALYSIS OF VARIANCE
FOR MEAN BAR PRESSES DURING
APPROACH AND CONFLICT

Source	df	MS	F
Between Ss	55		
Time of Day (TOD)	3	1989.33	.75
Ss/TOD[a]	52	3798.12	
Within Ss	56		
Trials (T)	1	59,916.87	43.70**
TOD x T	3	4274.29	3.12*
Ss x T x TOD[b]	52	1371.25	

* $p < .05$

** $p < .01$

a. Error term for TOD

b. Error term for Within Ss

Since the time of day by trials interaction was significant, treatment-by-subjects analyses of variance were computed for each time of day. Table 2 summarizes these analyses and indicates that at 1 a.m. the approach and conflict bar pressing did not differ significantly (F=3.62, df 1/13, p .05, p .10). However, there was an effect at the other 3 times of day, 7 a.m. (F=22.05, df 1/13, p .01), 1 p.m. (F=12.89, df 1/13, p .01) and 7 p.m. (F=21.67, df 1/13, p .01). These results suggest that at the 1 a.m. time there was no effect on the approach or conflict bar pressing, but there was an effect at the other 3 times of day.

Figure 2 gives the mean suppression ratios for the 2 days of conflict bar pressing. A two-factor mixed design analysis of variance with repeated measure on one factor was computed using the 4 times of day as the between factor and the suppression ratios for 2 days of conflict bar pressing as the within factor. The results of this anlaysis presented in Table 3 indicated that time of day had a significant effect on these ratios, (F=3.04, df 3/52, p .05). No significant effect was found for trials, (F 1.00) or for a time of day by trials interaction, (F=1.39, df 3/52, p .05).

Since time of day did have a significant effect, a Duncans Multiple Range test was employed to determine which means were significantly different from each other, Bruning and Kintz (1968, pp. 115-117). The results (Appendix D) indicated that the suppression ratios for the 7 p.m. time were significantly different (p .05) from the 1 p.m. and

TABLE 2

SUMMARY OF ANALYSES OF VARIANCE OF BAR PRESSING FOR APPROACH AND CONFLICT AT EACH TIME OF DAY

Source	df	1 AM MS	1 AM F	7 AM MS	7 AM F	1 PM MS	1 PM F	7 PM MS	7 PM F
Subjects (S)	13								
Time of Day (TOD)	1	4862.93	3.62	23838.89	22.05**	4400.04	12.89**	39637.94	21.02**
S x TOD[a]	13	1343.72		1080.97		341.48		1872.61	

** $p < .01$

a. Error term for S x T

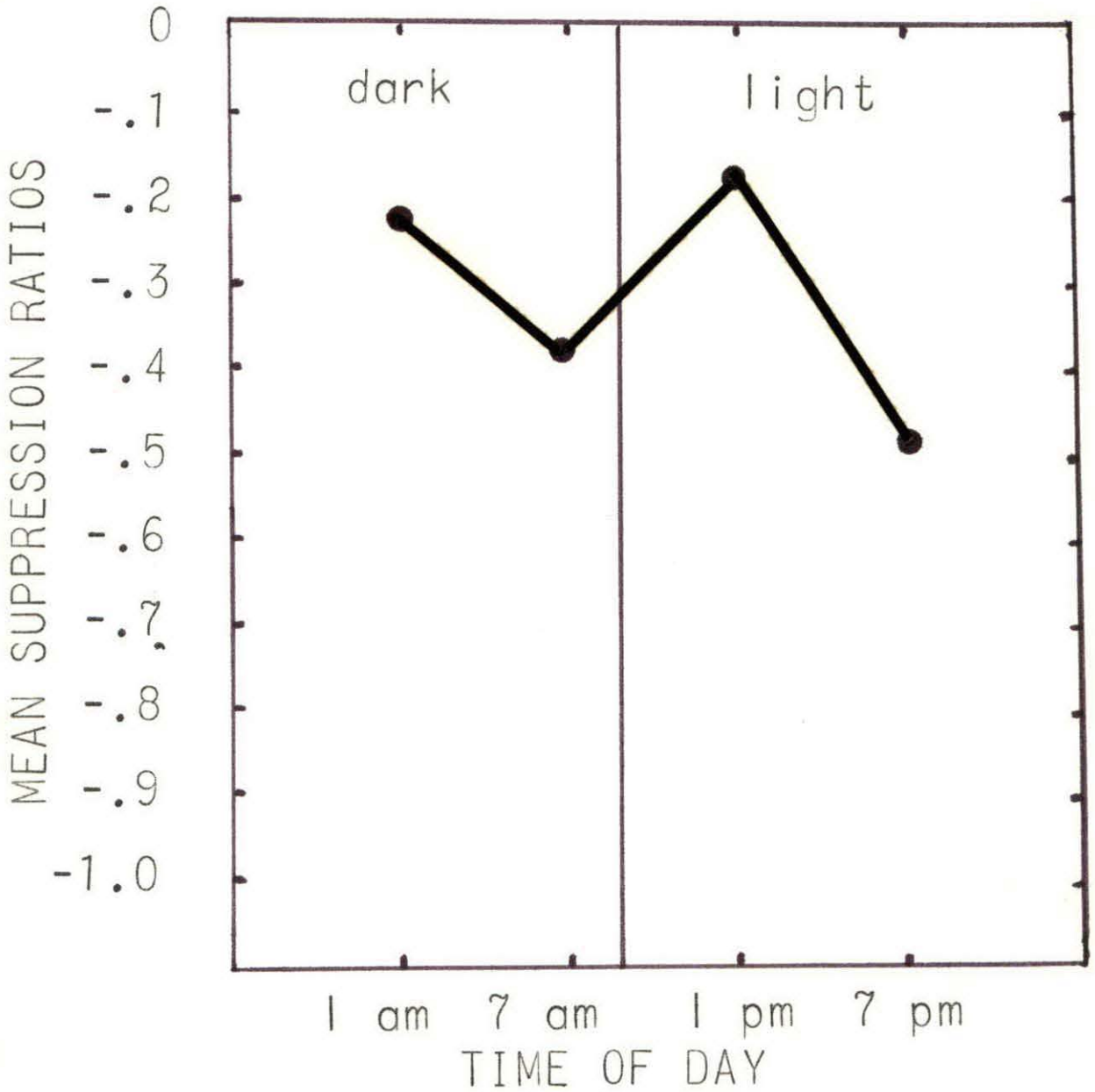

Figure 2. Mean suppression ratios during conflict as a function of time of day (EST).

TABLE 3

SUMMARY OF ANALYSIS OF VARIANCE FOR SUPPRESSION RATIOS ON APPROACH AND CONFLICT BAR PRESSING

Source	df	MS	F
Between Ss	55		
Time of Day (TOD)	3	.54	3.00*
S/TOD[a]	52	.18	
Within Ss	56		
Trials (T)	1	.01	1.00
TOD x T	3	.02	2.00
Ss x T x TOD[b]	52	.01	

* $p < .05$

a. Error term for TOD

b. Error term for Within Ss terms

1 a.m. times. The suppression ratios were not significantly different for the 1 p.m., 1 a.m. and 7 a.m. time. Suppression was the greatest at 7 p.m. and had the least effect at the 1 a.m. time.

CHAPTER IV

DISCUSSION

The purpose of this experiment was to assess, in a bar press situation, the effect of time of day on approach and conflict behavior. The variables that can affect this behavior as previously cited, (Miller, 1959) were under experimental control. (1) The number of reinforced trials were the same for all Ss, (a total of 200 in 2 days). (2) The strength of drive motivating the approach response was the same for all Ss, (± 80% of normal body weight). (3) The delay of reward was approximately equal for all Ss. (4) The amount of reward was equivalent for all Ss (a 45 mg pellet of food).

Although the delay of reward of the presentation of the pellet was the same for all Ss, some possible variations did occur which possibly affected the amount of reward. For instance, some Ss did not eat the pellets in the food cup until 2 or 3 pellets had accumulated. This situation could produce variations in the delay of reward and possibly increase the Ss incentive. However, the work-reward ratio was constant for all Ss, (i.e. 3 bar presses per 45 mg pellet).

The results indicated that the shock level used (.1 ma) was enough to induce suppression in almost all Ss and agrees with the results of other investigators who have used this same intensity to induce suppression in

a conflict situation (Richardson & Donahoe, 1967 and Terris & Enzie, 1967). According to a study by Osborne (1970), this level of shock is above threshold for rats run at all times of day.

Although there were no significant differences in approach and conflict as a function of time of day, the wide variations that were evident in approach bar pressing could contribute to the differential decrease in bar pressing that occurred during conflict. The lowest rate of bar pressing during approach occurred during the 1 p.m. time period, which corresponds approximately to the middle of the rat's light cycle. The 1 p.m. time period also represented the least amount of suppression during conflict. Since these Ss were receiving less food and subsequently fewer shocks, anticipation, or fear of future shocks, was not as great as was evidenced by the greater suppression at the other times of day. This should be tested by holding the number of reinforcements constant for each session rather than holding session time constant. Presumably if the number of exposures was responsible for this difference in suppression, then holding reinforcements constant should eliminate the difference.

The time period of 7 p.m. represented the most striking changes that occurred both during approach and conflict. For all periods, 7 p.m. represented the time of the most bar pressing during approach. Again, this period approximates the start of the rat's food gathering and activity. Suppression at this time was the greatest (54%) and may be attributed to the fact that they were receiving the greatest number of shocks.

If the effect of "least suppression" can be attributed to fewer bar presses and fewer shocks, then the greater the amount of bar pressing during approach, the greater should be the amount of suppression of bar pressing during conflict. Evidence for this effect was demonstrated during the Ss run at 7 p.m. and 7 a.m., and possibly at 1 a.m. The opposite effect, fewer bar presses and fewer shocks, was demonstrated during the 1 p.m. time when Ss exhibited the least amount of bar pressing during approach and the least amount of suppression during conflict.

The 1 a.m. and 7 a.m. times were approximately equivalent for bar pressing during approach, however the rate of suppression was the greatest at 7 a.m. This time period approximates the end of the rat's activity cycle, and perhaps is influenced by (1) fatigue and the need for sleep and (2) decreased need for food. The decrease of bar pressing during conflict at 1 a.m. was not significant although it represented a 22% decrease. Apparently this time period corresponds to the middle of the rat's food gathering cycle.

In a study previously mentioned, (Terris & Wechkin, 1967), it was found that rats can become accustomed to subsequent increasing intensities of shock. Although this effect was not directly in this experiment, performance was the same on each of the 2 conflict days, indicating that the changes observed in conflict were not due to changing approach rates.

Time of day did exert a differential interactive effect on conflict bar pressing. The results of separate analyses of variance computed

at each of the 4 times of day indicated a difference between approach and conflict at 7 a.m., 1 a.m. and 7 p.m. but not at 1 p.m. These results would appear to indicate that the time of day effect becomes an important variable that should be examined more closely and put under experimental control. For example, Brown, Anderson, and Brown (1966) assumed a 5 hour interval between groups during avoidance testing was not significant, however the evidence presented here suggests that the 5 hour interval could have a significant effect. A number of studies using rats do not report the time of day, or do not control for its possible effects. It would appear that for studies conducted during the day, a possibility exists that bar pressing is at a minimal level, both for the appetitive and aversive case.

Overall, it appears that the effect of time of day is an important source of variability that should be accounted for in experiments with animals, especially in a task that involves bar pressing.

CHAPTER V

SUMMARY

The purpose of the present experiment was to provide empirical evidence for an interactive effect of time of day on approach and approach-avoidance behavior using an FR-3 schedule in an operant chamber as a simulated alleyway. Time of day has been shown to affect an operant response, however no study has assessed this effect on approach and approach-avoidance behavior.

Subjects were 56 naive, amle, albino rats that were maintained at 80%± of their normal body weight. All Ss were randomly assigned to one of four groups with each group undergoing experimental treatment at one of 4 times of day (1 a.m., 7 a.m., 1 p.m., 7 p.m.). After 2 days of bar press training in which each bar press was rewarded with one 45 mg Noyes pellet, Ss were put on a FR-3 schedule for 1 day of approach training. The purpose of the approach training was to eliminate any possible warm up effects that may have occurred. For the next 2 days the total number of bar presses was recorded in 2 ten minute sessions. To establish an approach-avoidance conflict situation on the next 2 days, a shock was administered along with a pellet of food at the termination of the 3rd bar press and the total number of bar presses was recorded.

Performance was measured by a suppression ratio using the equation B-A/B+A. The results indicated that time of day does have an interactive effect on approach and approach-avoidance conflict behavior. The

effect of time of day was statistically significant on conflict behavior at 7 a.m., 1 p.m. and 7 p.m. but not at 1 a.m. Two striking differences were noted: 7 p.m. represented the time of the most bar pressing during approach and also the least amount of bar pressing during approach-avoidance conflict behavior; 1 p.m. represented the least amount of bar pressing during approach and the least amount of suppressing during approach-avoidance conflict behavior. No differential effect was noted for a time of day effect on either approach or approach-avoidance conflict behavior.

The results were generally attributed to the rats daily diurnal cycle. Another contributing factor could be that a 2.4 watt house light was on in the experimental chamber during all phases of the experiment and this effect could be determined by running 2 separate groups: 1 with the lights on and 1 with the lights off.

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APPENDIX A

POST EXPERIMENTAL WEIGHT AND PERCENT OF PRE-EXPERIMENTAL WEIGHT

TABLE 4

POST WEIGHT AND PERCENT OF PRE-EXPERIMENTAL WEIGHT

	1 AM		7 AM	
	Post Weight	Percent of Pre-Experimental Weight	Post Weight	Percent of Pre-Experimental Weight
Subjects				
1	287.4	79.1	311.7	79.2
2	333.1	80.0	333.6	79.8
3	354.9	81.0	321.1	81.8
4	302.1	78.9	410.4	80.0
5	227.0	80.8	179.8	77.1
6	196.4	79.1	184.4	77.5
7	198.8	81.0	196.6	81.1
8	221.7	79.9	204.9	80.7
9	189.4	78.7	245.0	82.8
10	196.7	79.9	173.9	77.1
11	210.8	81.6	227.5	82.5
12	180.1	78.5	212.7	79.8
13	226.6	78.2	213.7	79.7
14	225.5	77.1	274.1	83.3
Mean:	239.32	79.56	249.72	80.24
Standard Deviation:	56.34	1.27	70.85	2.03

TABLE 4 - Continued.

	1 PM		7 PM	
	Post Weight	Percent of Pre-Experimental Weight	Post Weight	Percent of Pre-Experimental Weight
Subjects				
1	332.7	79.2	323.0	80.1
2	327.2	79.4	280.2	78.5
3	328.9	78.5	315.0	80.0
4	352.1	79.2	377.6	79.7
5	193.6	78.9	219.1	80.0
6	206.4	77.9	190.8	77.7
7	203.7	77.1	188.8	79.8
8	193.6	80.7	220.4	79.1
9	204.6	82.2	244.6	80.9
10	216.6	83.4	248.9	82.2
11	199.1	79.3	212.6	79.1
12	238.8	82.1	208.2	80.2
13	195.6	81.7	207.3	79.9
14	204.0	80.9	193.1	80.4
Mean:	242.64	80.04	244.98	79.89
Standard Deviation:	62.06	1.83	57.98	1.10

APPENDIX B

BAR PRESSES DURING APPROACH AND CONFLICT

TABLE 5

BAR PRESSES FOR APPROACH AND CONFLICT

	Approach 1 AM		Conflict		Approach 7 AM		Conflict	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Subjects								
1	76	102	13	7	152	159	12	6
2	113	123	11	8	94	103	9	8
3	153	171	186	238	120	138	88	135
4	63	75	54	54	101	123	41	8
5	94	102	111	79	143	145	99	111
6	167	139	76	72	115	127	42	51
7	106	108	56	108	186	192	87	45
8	89	99	39	63	118	130	43	60
9	143	129	194	213	132	90	48	40
10	217	176	155	222	172	103	120	218
11	108	144	127	183	140	123	117	126
12	88	243	56	104	121	62	43	40
13	80	86	38	53	75	60	39	45
14	111	111	64	94	84	64	36	21
Mean:	114.86	129.14	84.29	107.00	125.21	115.64	58.86	65.29
Standard Deviation:	41.86	44.04	60.49	76.99	31.82	38.36	36.37.	60.97

TABLE 5 - Continued.

	Approach 1 PM		Conflict		Approach 7 PM		Conflict	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Subjects								
1	108	76	127	93	97	103	53	116
2	98	130	67	117	167	191	80	44
3	58	80	12	12	119	109	18	7
4	99	69	47	50	101	153	117	80
5	71	107	42	13	141	155	81	99
6	62	58	32	33	179	131	83	183
7	90	86	82	75	167	234	18	26
8	74	83	52	41	53	177	19	23
9	185	168	123	129	109	140	13	9
10	213	230	216	215	203	186	205	276
11	78	84	48	55	90	129	92	90
12	170	176	111	131	170	96	18	6
13	59	86	99	90	210	132	21	33
14	58	85	63	64	122	68	8	7
Mean:	101.64	108.48	80.07	79.86	137.71	143.14	59.00	71.36
Standard Deviation:	50.90	49.70	52.34	55.13	46.28	43.76	55.55	78.73

APPENDIX C

SUMMARY OF ANALYSIS OF VARIANCE FOR APPROACH AND AVOIDANCE

TABLE 6

SUMMARY OF ANALYSIS OF VARIANCE FOR TWO DAYS OF APPROACH AND TWO DAYS OF CONFLICT

Source	df	Approach		Conflict	
		MS	F	MS	F
Subjects (S)	55				
Time of Day (TOD)	3	2939.37	1.96	3324.25	.96
Ss/TOD	52	1496.44		3461.39	

APPENDIX D

DUNCANS MULTIPLE RANGE TEST ON SUPPRESSION RATIOS AT EACH TIME OF DAY

TABLE 7

DUNCANS MULTIPLE RANGE TEST FOR SUPPRESSION RATIOS AT EACH TIME OF DAY

Time of Day		1 PM	1 AM	7 AM	7 PM
	Means	.192	.218	.389	.480
1 PM	.192	-	.026	.198	.287*
11 AM	.218		-	.171	.261**
7 AM	.389			-	.089
7 PM	.480				-

* p .05

** p .01