AN INVESTIGATION OF ACQUIRED HUNGER DRIVE

By

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Bachelor of Science

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1961

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
Master of Science
May, 1963

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ACKNOWLEDGEMENT

The writer wishes to acknowledge his debt to all of those in the Department of Psychology at Oklahoma State University for their guidance and assistance in this investigation.

To Dr. Larry T. Brown goes the writer's sincerest appreciation for his guidance and helpful criticisms throughout the research.

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CHAPTER I

STATEMENT OF THE PROBLEM

Theoretical Orientation

On the basis of evidence presented by Miller (1948) it is well established that a neutral stimulus may acquire the capacity to arouse fear. The experimental procedure involves the paired presentation of a neutral stimulus, the conditioned stimulus (CS), and a painful or noxious stimulus. The painful stimulus fulfills the role of the unconditioned stimulus (UCS). Typically, the paired administration of the CS and UCS is said to result in the acquisition by the CS of a tendency to evoke an anticipatory emotional (fear) response. Following conditioning, tests are made to determine whether the probability, speed, or amplitude of an indicant reaction increases over a series of trials on each of which the CS is terminated immediately after the response is elicited. When learning of the reference response is demonstrated under these conditions, it is clear that the termination of the CS is reinforcing.

Mowrer (1960 p. 149) has suggested that all primary drives may be thought of as physiological death warnings. Fear, as a learned or conditioned response, is a psychological warning, not of impending death, but of impending primary drive discomfort; and being a discomfort, i.e. a secondary drive, the fear can stimulate the organism to more or less appropriate behavior while still, so to speak, one step removed from the danger of death.

Using the experimental procedures above, this investigation was designed to test whether the onset of hunger (UCS) could be used to condition a reaction to some neutral stimulus (CS), in a manner comparable to the fear conditioning that has been obtained with shock onset.

Early studies (Anderson, 1941; Calvin, Bicknell, and Sperling, 1953) appear to support the contention that hunger onset can be conditioned to an external stimulus situation. Anderson (1941) gave one group of rats training in running a multiple-unit maze for food reward while hungry. A comparable control group was given no maze training initially. Both groups were then fed until satiated and were allowed to run through a second maze but without food reward. The animals in the pre-trained group performed better in the second maze than did the controls. It was concluded that the second maze, because of its general similarity to the first, served as a stimulus to arouse a learned drive in the pre-trained animals but not in the untrained controls.

Calvin, Bicknell, and Sperling (1953) placed two groups of rats in striped boxes 30 minutes a day for 24 days. One group received this daily experience under 22 hours of deprivation; the other group received it under a one-hour deprivation period. Following this the food consumption of each group in the striped box was measured under 11½ hours of deprivation. The results indicated that the 22-hour group ate more food than the one-hour group.

Studies by Siegel (1943), Siegel and MacDonnell (1954) have not supported the acquired-hunger drive hypothesis. Siegel (1943), using a four-unit linear maze, failed to confirm Anderson's (1941) results.

Siegel's animals were given satiation trials interposed during the learning series, but neither time nor error scores on these trials exhibited the progressive decrement expected on the acquired drive hypothesis.

Siegel and MacDonnell (1954) replicated the study of Calvin et al; (1953) and did not confirm their results. Miller (1959) has reported consistent failure in establishing any conditioned elicitation of the hunger drive and cites a study by Myers and Miller (1954) as evidence that hunger cannot be readily conditioned.

One problem not treated adequately in attempting to promote learning between a neutral stimulus and hunger is that the latter arises in a gradual fashion. An animal under twenty-three hours of food deprivation has been exposed to a multitude of stimuli during the total deprivation period. It would be unusual if an association should take place between a drive state and a specific neutral stimulus which occupies only a small portion of the total stimulation occurring over the entire deprivation period.

For a clearer demonstration of an acquired hunger drive the organism must learn some new response. This criterion involves the assumption that a reduction in the drive state associated with the neutral stimulus is rewarding and that responses followed by such a reduction will be learned. The Anderson (1941) and Calvin et al (1953) studies did not satisfy this requirement.

Hypothesis

By having the neutral stimulus increase in intensity over the entire deprivation period and requiring a more stringent criterion for the presence of an acquired drive, this investigation was designed to show whether an acquired hunger drive is more substantial than the findings to date indicate. Specifically, it was predicted in the present investigations that if an increasing intensity of white noise was presented during hunger onset it would come to have motivating properties as demonstrated by a procedure which required the subjects to learn a response that terminated the white noise.

CHAPTER II

METHOD

Subjects

The Ss were 18 male and 18 female experimentally naive rats of Long Evans stock obtained from the colony maintained by the Psychology Department of Oklahoma State University. Their ages ranged from 80 to 120 days at the start of the taming procedure.

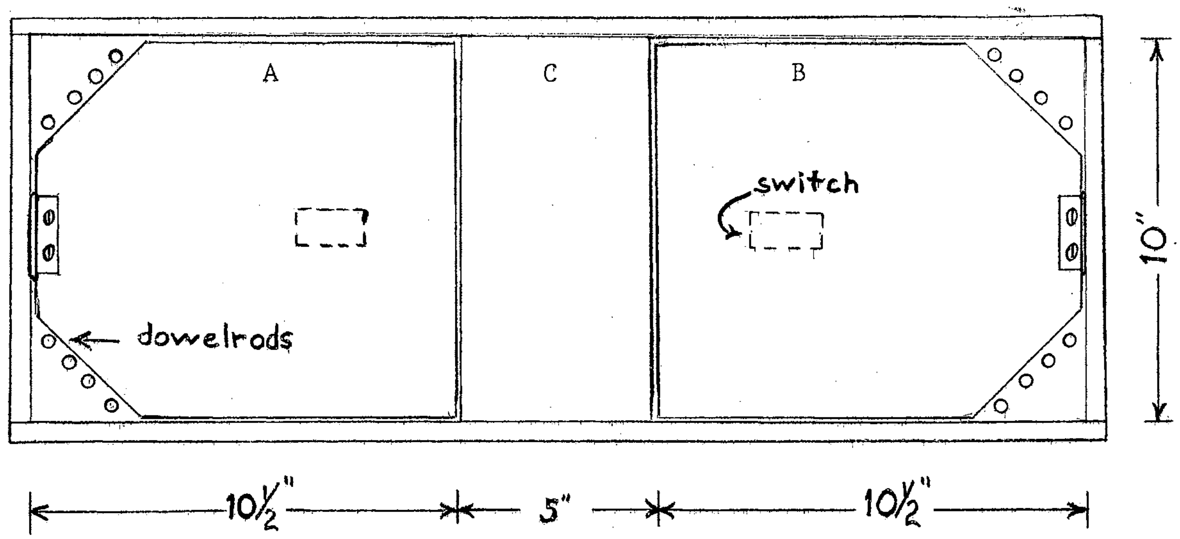
Apparatus

A model 302 white noise generator was used in the training stage. The three intensity levels were 30, 35, and 38 dbs., measured with a Heath Kit decibel meter connected across the speaker terminals. The training cages were 24 in. X 14½ in. X 14½ in. metal cages with wire mesh doors. The cages were located four feet above the floor on a 6 ft. X 4 ft. wooden table.

The testing apparatus was a 3/4-in. plywood box 27¼ in. X 10 in. and 9¼ in. deep with a ¼-in. hinged fiberglass top. A 10½ in. X 9 3/4-in. platform of ¼-in. plywood was hinged 3/4 in. above the floor at each end of the box and rested on the leaf actuator of a single-pole, double-throw microswitch. The weight required to actuate the switches was four ounces. Each corner of the box was shielded by four ¼-in. dowel rods to prevent Ss from freezing in the corners. A

Figure I

Floor plan of the two-compartment testing box



center platform 3/4 in. X 5 in. X 10 in. was installed between the two hinged platforms so as to have a level floor throughout the box. The white noise was presented through a 5-in. X 5-in. window covered with ¼-in. wore mesh centrally located in one side of the box. The entire apparatus was painted a flat grey. A detailed floor plan of the testing box is presented in Figure I. Depression of platform A closed a micro-switch, activating a solenoid relay which terminated the white noise and simultaneously started a 1/100-min. electric timer. When the platform was released the timer stopped and the white noise came on again. The speaker was located 12 inches from the window of the box during the test trials.

Procedure

Two separate experiments were conducted over a period of 36 days. In the first experiment the Ss were 18 females and in the second, 18 males.

Taming. Once a day for five days, one-half hour before feeding time, each S was placed in another cage where it was given a small food pellet. After eating the pellet S was returned to the home cage.

Conditioning. The Ss were randomly assigned to a control group (CG) and an experimental group (EG). The Ss in the EG began a 23-hour food deprivation cycle in the exposure cages and were simultaneously presented with pulsating white noise of 30 dbs. with on and off intervals of 10 seconds. The db. level was manually turned up at the end of 12 and 18 hours to 35 and 38 dbs. respectively. The db. levels were selected to be well under those found by Campbell (1954) to produce avoidance behavior. The exposure cages were counterbalanced each day to control for possible intensity differences at the different heights and positions of the cages.

Conditions for the CG were identical, except food was available in the exposure cages at all times. At the end of each 23-hour cycle the white noise was terminated and the Ss in both groups were taken out of the exposure cages and placed in smaller cages. The Ss were allowed to remain in the exposure cages for 5 minutes after the termination of white noise before being placed into the smaller cages to feed for one hour. This procedure was continued for eight days.

Adaptation. For three days following the training stage, both groups were placed on an ad lib. feeding schedule in their home cages. Each S was placed daily in the testing box without white noise for ten minutes, and the time spent in compartment A was recorded. Inspection of the data showed no difference between the two groups in mean time spent in this compartment.

Testing. Both CG and EG groups were randomly divided into two subgroups: satiated (S) and nonsatiated (N). For one hour each day immediately before testing, the CGS and EGS subgroups were given a small can of wet mash to insure satiation prior to testing. The CGN and EGN subgroups were approximately 22 to 24 hours hungry when tested. Each S was placed on platform C with the length of its body perpendicular to the longitudinal axis of the apparatus and presented with continuous 30 db. white noise. The location of platform A to the left or right of each S was randomly determined for each trial. Each S was given one ten-minute trial on two successive days. The running order for each day was randomly determined. The time spent on platform A and the number of crossings from platform C to platform A were recorded for each 10-minute trial.

Illumination was provided by a 60-watt lamp located centrally above the testing box.

CHAPTER III

RESULTS

Since inspection of the data revealed no difference between males and females, the data from the two experiments were combined for analysis. The time scores for the two days were averaged to give one score for each S. Table I summarizes the mean time spent on platform A and mean number of crossings between platform A and platform C.

A one-way classification ANOV was performed on the untransformed data. A summary of the analysis for time scores is given in Table II. It is apparent from inspection of the treatment and error mean squares that there were no significant differences among groups. A similar analysis was performed on the mean number of crossings. The results of the analysis are presented in Table III. This analysis also showed no significant differences among groups.

Table I

Mean time in minutes spent on platform A and mean number of crossings between platform A and C for two 10-minute trials

(N=36)

Groups		Mean time	Mean crossings
EG	N	4.11	9
	S	4.85	9
CG	N	5.24	8.38
	S	4.73	9.5

Table II

Analysis of variance for mean time (min.)

spent on platform A

(N=36)

Source	df	ms
Treatments	3	1.99
Error	32	3.78
Total	35	

Table III

Analysis of variance for mean number of crossings between platforms A and C (N=36)

Source	df	ms
Treatments	3	.87
Error	32	10.43
Total	35	

CHAPTER IV

CONCLUSIONS

The data obtained do not support the prediction that an originally neutral stimulus contiguous with hunger onset will come to have drive properties, as indexed by the increase in probability of a response which is followed by the termination of that stimulus. These data do support those reported by Myers and Miller (1954), Siegel (1943), and Siegel and MacDonnell (1954).

There are a number of possible explanations for the failure of this experiment to substantiate the acquired hunger drive hypothesis of Anderson (1941). First, hunger may be a slowly changing state and, therefore, cannot be so simply conditioned as phasic responses, such as fear, which can be rapidly conditioned to a stimulus complex.

Second, these results may reflect the absence of any mechanism for elicitation of components of the hunger drive in the absense of primary hunger such as has been postulated for conditioned fear (Miller, 1948). The process of satiating the animals prior to testing may have effectively prevented any physiological components of hunger from occurring.

Specific to the present investigation it is possible that during the testing trials competing responses were elicited by the testing apparatus that obscured any learned response to the white noise. For example, the Ss made numerous escape-like movements while in the apparatus. The adaptation trials offered some opportunity for the development of competing responses.

It may be that Anderson's (1941) results can be attributed to factors other than conditioned hunger. For example, Brown (1961 p. 188) states that the similarity of the two mazes may have mediated the transfer of fractional anticipatory eating responses for the experimental animals, and these responses rather than conditioned hunger may have facilitated the second learning. Finally, the experimental animals, who had been on a deprivation schedule for many more days than the controls, may not have had time to compensate for any loss in weight. If so, the laboratory operation of inducing satiation in both groups may have left a greater residual hunger drive in the experimental rats than in the controls, with resulting energizing effects. Further, with hunger stimuli still present, orienting responses possibly conditioned to them in the first maze may have been elicited in the second maze. Such orienting responses as eye movements, sniffing, etc., may have facilitated response to relevant cues.

It appears from the evidence presented that only the following conclusion is tenable at the present time: there is no convincing evidence that hunger onset, like fear, can be conditioned to a neutral stimulus. The evidence that exists is either inconclusive or can be interpreted by other hypotheses than that of a learned hunger drive.

It may develop that some oversight is responsible for failure to obtain evidence for conditioned hunger. Inasmuch as hunger does mount slowly, techniques of eliciting drives rapidly such as electrical or chemical stimulation of the brain should be explored.

Summary

It was predicted that an originally neutral stimulus contiguous with hunger onset would come to have motivation properties, as demonstrated by a procedure which required S to make a response that terminated the neutral stimulus. Eighteen female and 18 male rats, 80 to 120 days old, were given eight days of increasing intensity of white noise paired with hunger onset. Subsequent tests for an acquired hunger drive failed to support the prediction that hunger onset may be conditioned to a neutral stimulus. Techniques for eliciting drives more rapidly were suggested for further exploration.

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