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Conditioned Suppression in Humans

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CONDITIONED SUPPRESSION IN HUMANS

by

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INTRODUCTION

Conditioned suppression is a reduction in ongoing behavior maintained by positive reinforcement during a short duration stimulus (CS) which terminates independently of the animal's behavior and coincidentally with an unavoidable electric shock (Estes & Skinner, 1941). This technique has been demonstrated with a variety of organisms including rats (Estes & Skinner, 1941), cats and monkeys (Brady & Conrad, 1960), dogs (Lindsley & Jetter, 1953), guinea pigs (Valenstein, 1959), goldfish (Geller, 1964; Geller, 1963), and pigeons (Lyon, 1963). The present study is an attempt to replicate the Estes-Skinner conditioned suppression procedure used in animal research with human subjects.

Conditioned suppression, conditioned "anxiety" or the conditioned emotional response (CER) is assumed to be closely related to the many forms of emotional behavior observed in humans, commonly defined as "fear" or "anxiety." "Anxiety" has been defined as an anticipatory reaction pattern that has a disruptive effect on some ongoing performance (Estes & Skinner, 1941). Indeed, clinical and even casual observation indicates that emotional stress does interfere with ongoing behavior.

Brady and Hunt (1955) have indicated several advantages of the conditioned suppression procedure in the experimental analysis of emotional behavior. First, the response may be obtained under a broad range of experimental conditions. Second, the response is very stable over time and is quite resistant to extinction procedures. Third, the technique of super-imposing this procedure on a well established baseline makes it possible to derive a quantitative measure of the degree of the emotional response. The degree to which the ongoing behavior is disrupted is assumed to represent the magnitude of the emotional response. Observation of the experimental animal indicates the presence of concommitant behaviors typical of emotional states. The reduction in the positively reinforced behavior during the pre-shock stimulus is usually accompanied by some rather primitive behavior such as crouching, freezing, defecation and other overt signs of aggitation (Brady & Conrad, 1960; Hunt & Brady, 1951). There are also physiological changes indicative of emotional stress such as an increase in cardiac rate and blood flow (Stebbins & Smith, 1964), and increases in pituitary-adrenocortical activity (Mason, Brady & Sidman, 1957). A similar correlation between ACTH secretion and emotional stress not unlike anxiety has also been observed in humans (Thorn, Jenkins & Laidlow, 1953).

One of the earliest studies to clearly demonstrate a conditioned emotional response in humans was conducted by Watson & Raynor (1920). A child of 11 months was conditioned to show "anxiety" or "fear" in the presence of a white rat by pairing the rat with the presentation of a loud sound. Prior to conditioning, the experimenters put the child through a series of emotional tests and found no general signs of "fear" in any situation. Then a white rat was presented to the child and as his hand touched the animal a loud noise was presented immediately behind his head. The child startled violently and fell forward, burying his face in the mattress of his crib. After a total of 7 trials on which the animal and sound were paired, the child cried and withdrew violently whenever the rat was presented. Emotional responses of a similar nature occurred in the presence of a white rabbit, a dog and a fur coat and to a lesser degree when a wad of cotton wool and a Santa Claus mask were presented.

A study by Kanfer (1958), which attempted to demonstrate conditioned suppression in humans using rate of verbal responding as the baseline behavior, proved to be unsuccessful. The results indicated an increase in verbal behavior during the preshock stimulus rather than typical suppression found in other studies. The possible reason for this could be that the verbal

behavior was not well defined and there were no external reinforcement contingencies operating as in the case of animal studies. The problems which arise when using a verbal behavior baseline which is not structured have been discussed by Greenspoon (1962), and Goldiamond (1962).

Of the several procedures used to study conditioned emotional behavior, the Estes-Skinner (1941) procedure is the most general. In this procedure the stimulus-shock trials are superimposed directly on the baseline to be studied. An advantage of this procedure is that it allows the experimenter to follow the development of the response and to make any necessary changes in the controlling parameters as they are needed.

Since Estes and Skinner's original experimental definition of conditioned suppression, a number of studies have demonstrated that the degree of suppression varies with reinforcement variables as well as the shock intensity (Annau & Kamin, 1961). The degree to which the behavior is suppressed during the pre-shock stimulus is determined by the reinforcement frequency (Stein, Sidman & Brady, 1958; Carlton & Didamo, 1960; Lyon, 1963), the reinforcement schedule (Lyon, 1964; Lyon & Felton, 1966a; Lyon & Felton, 1966b; Brady, 1955), as well as the reinforcement value (Geller, 1960), and the level of deprivation (Estes & Skinner, 1941).

The results reported by Lyon (1964) demonstrated that the degree of suppression on fixed ratio schedules is influenced by the relationship between the pre-shock stimulus onset and the reinforcement proximity (Lyon, 1964). This was substantiated for fixed ratio schedules of 100, 150, and 200 (Lyon, 1964; Lyon & Felton, 1966a). Generally, suppression was complete if the pre-shock stimulus occurred at or near the beginning of the ratio run. When the pre-shock stimulus occurred during the later stages of the ratio run, the animals continued responding until the reinforcement was obtained and then exhibited complete suppression.

A fixed ratio schedule was chosen as a baseline on which to investigate the conditioned emotional response for two reasons. First, stable response rates in humans may be established very rapidly. Secondly, the schedule allows for the possibility of demonstrating conditioned suppression with humans and those unique response characteristics found on this baseline with infra-human subjects.

METHOD

Subjects

The subjects were 6 male undergraduates from Western Michigan University, and 4 student nurses from Bronson Hospital, Kalamazoo, Michigan. All were paid volunteers. Data for 1 subject had to be discarded due to an equipment malfunction. Male subjects are hereafter referred to as SM and females as SF.

Apparatus

The experiment was conducted in a 10 x 10 sound attenuated room containing a table, a chair, and a console. The console (Fig. 1) was provided with a response lever which required 800 grams through an excursion of 15 inches to activate the microswitch. Reinforcements were recorded on a counter and indicated by a 4 sec. illumination of a 6 watt red light. The general illumination was provided by three 6 watt lights. A red 15 watt light served as the pre-shock stimulus. The shock was adjusted by a Variac transformer and programmed by a 1.25 sec. fixed pulse former. A system of relays and timers, located outside the experimental room, provided automatic control of all experimental conditions. The data were collected from electrical impulse counters, running timer meters, and a Gerbrands cumulative recorder.

Figure 1. Subject seated at human response console used in study of conditioned suppression in humans.

Procedure

Since this study is a first attempt to replicate the conditioned suppression procedure with humans, no fixed experimental design could be established prior to the initial conditioning sessions. The various procedures used for the subjects were changed as dictated by the data.

The subjects were seated in a dimly lighted room with the console placed on the table in front of them. Shock electrodes were applied to the inside of the left forearm approximately 4 inches apart. Electrode jelly was used on the contacts to reduce any changes in resistance as a result of perspiration. The following instructions were given to each of the subjects.

> "You are to pull the lever with your right hand. How much money you make is dependent upon the rate at which you pull the lever--the more you pull it the more money you will receive. Each time you have earned 10¢ (or 50¢) the little red light in front of you will come on for 4 seconds. The counter in front of you and one outside will count the total number of times that red light has come on and you will be paid at the end of the session. The session will last approximately 45 minutes."

With subjects SM - 1, SM - 2, SM - 3, and SM - 5, the shock was given after every pre-shock stimulus presentation. With subjects SM - 6, SF - 7, SF - 8, and SF - 9, the shock was paired with the pre-shock stimulus intermittently as follows: shock, no

shock, shock, no shock, no shock, shock, shock, no shock, shock, no shock, no shock.

The fixed ratio of reinforcement, the intensity and duration of the shock, and the reinforcement value differed for the subjects. The settings are summarized in Table 1.

Table 1. Summary of experimental procedure for each subject. Male subjects are referred to as SM and females as SF.

Table 1

Summary of Variables for Each Subject

Subject	Fixed Ratio	Shock Intensity (Volts)	Shock Duration (Sec.)	Pay-off Value
SM - 1	75	40	2.0	10¢
SM - 2	100	40	1.25	10¢
SM - 3	100	40	1.25	10¢
SM - 5	100	40	1.25	10¢
SM - 6	100	60	1.25	10¢
SF - 7	300	40	1.25	50¢
SF - 8	300	40	1.25	50¢
SF - 9	300	40	1.25	50¢
SF - 10	300	40	1.25	50¢

RESULTS

The results were recorded on a Gerbrands cumulative recorder. These data are presented in figures 2 and 3 for all but three of the ten subjects. The paper is driven through the recorder at a constant speed of 60 cm. per hour. Each response produces a 2 mm. vertical movement of the pen. The response rate may be interpreted by measuring the slope of the curve. A horizontal movement indicates a zero response rate and a perfect vertical line would indicate an extremely high response rate. Typical response rates between these two extremes are indicated on the figures.

Evidence of the degree of suppression is readily observed by inspection of the slope during the pre-shock stimulus as indicated by a downward deflection of the pen. A horizontal line indicates complete suppression and a continuation of the slope is indicative of no suppression.

Figure 2 presents the cumulative records for subjects SM - 1, SM - 2, and SF - 7. These subjects all demonstrated suppression of varying degrees. On the first trial for subject SM - 1, the subject stopped responding prior to the onset of the pre-shock stimulus so this is obviously not a function of the stimulus-shock pairings.

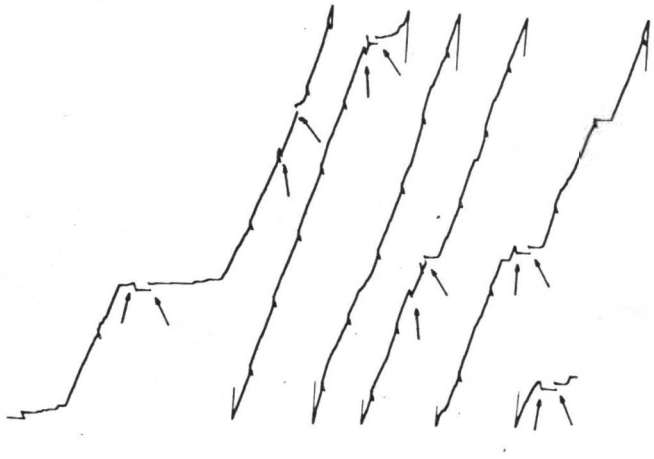
The second trial shows no suppression. On trial three the pre-shock stimulus onset occurred in the later stages of the ratio run and the subject continued to respond until the reinforcement was obtained, which was followed by complete suppression. The fourth trail shows no suppression, while complete suppression was recorded during the last 2 trials.

The record for subject SM - 2, indicates partial suppression at approximately midway through the pre-shock stimulus on trial 1. The second trial indicates complete suppression and the following trial shows no suppression. The record for subject SF - 7 indicates no suppression on trial 1, and complete suppression on the remaining 7 trials.

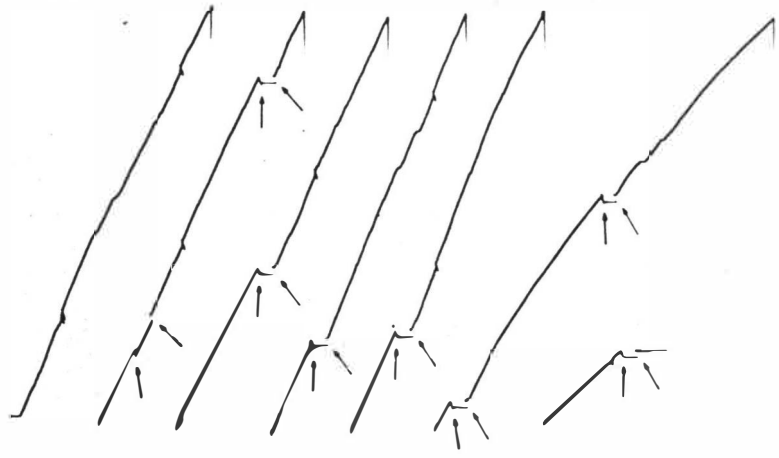
Figure 3 presents the cumulative records of 4 subjects who did not demonstrate suppression, although some slight changes in the rate are apparent during the pre-shock stimulus. The two remaining subjects quit before the experimental session was terminated. One of the subjects quit by leaving the experimental room and the other merely removed the electrodes and continued to respond.

Figure 2. Cumulative records for 3 subjects, SM - 1, SM - 2, SF - 7, illustrating suppression behavior patterns on fixed ratios of 75, 100, and 300. Each of the stimulus-shock trials is indicated by a downward displacement of the pen for 30 sec. Onset and termination of the pre-shock stimulus is indicated by the arrows. Reinforcements are indicated by a downward pip of the pen.

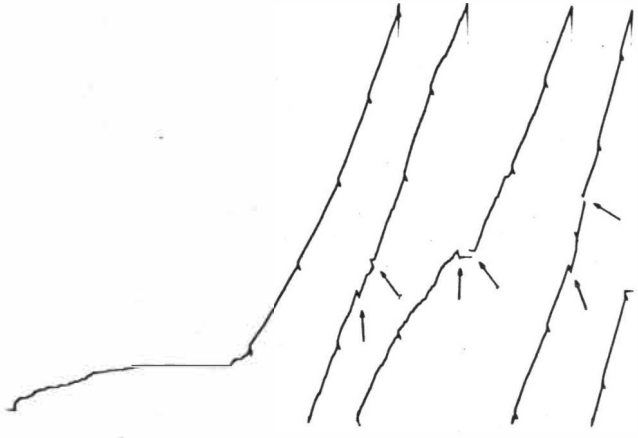
SM-1



SF-7



SM-2



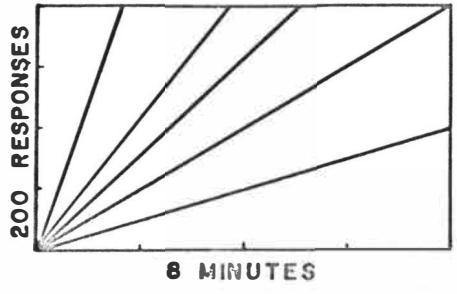
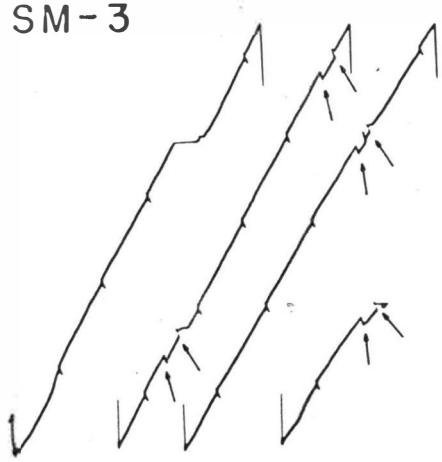
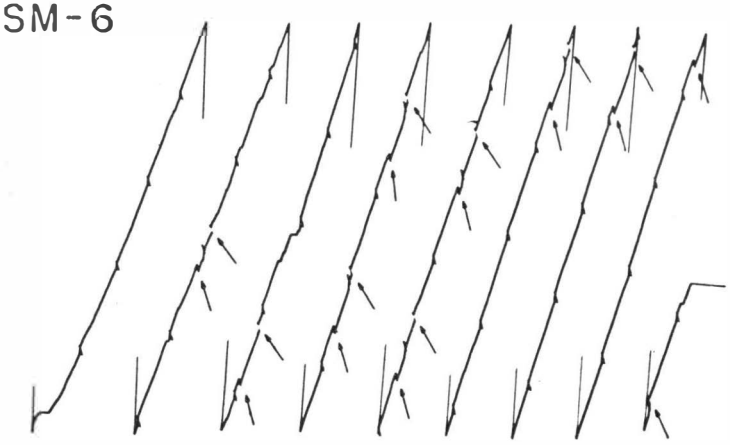


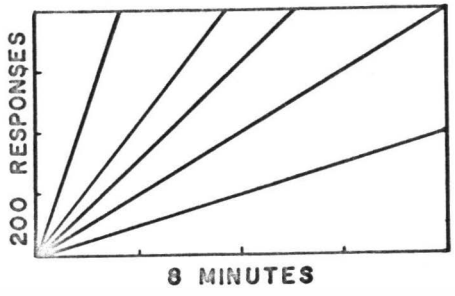
Figure 3. Cumulative records for 4 subjects, SM - 3, SM - 5, SM - 6, and SF - 9, illustrating no suppression on fixed ratios of 100 and 300. Each of the stimulus-shock trials is indicated by a downward displacement of the pen for 30 sec. Onset and termination of the pre-shock stimulus is indicated by the arrows. Reinforcements are indicated by a downward pip of the pen.

SM-3

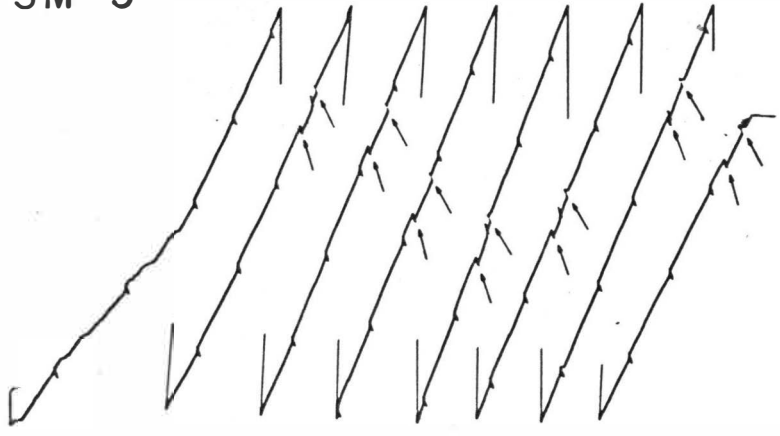


SM-6

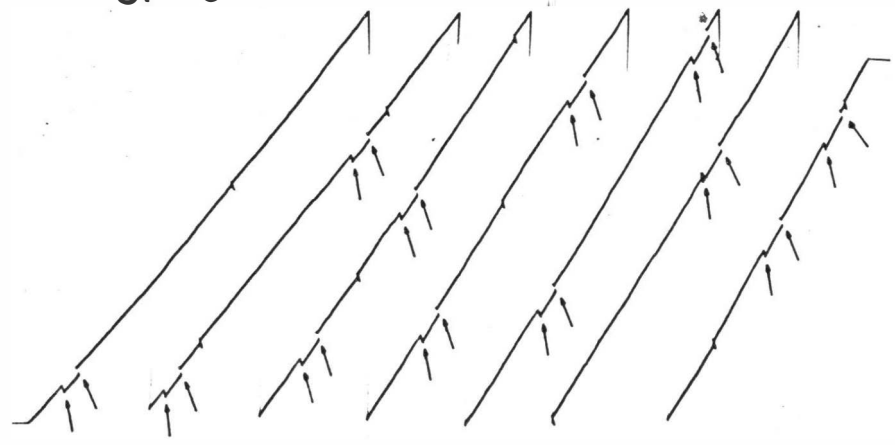




SM-5



SF-9



DISCUSSION

The results of the present study indicate that under some circumstances conditioned suppression similar to that found in animal research using the Estes & Skinner (1941) "anxiety" paradigm can be demonstrated with human subjects. A specific response characteristic similar to those found in infra-human organisms (Lyon, 1964; Lyon & Felton, 1966a) was also demonstrated. One subject in particular (SM - 1) showed complete suppression if the pre-shock stimulus onset occurred in the early stages of the ratio run. When the pre-shock stimulus occurred during the later stages of the run, the subject continued to respond until the reinforcement was obtained and then complete suppression was exhibited. The most consistent demonstration of complete suppression was on the highest ratio schedule which also concurs with previous research using infra-human organisms (Lyon & Felton, 1966a).

A difficulty encountered twice in this study was the problem of subjects voluntarily terminating the session. In one case, the subject left the experimental room and in the other the subject removed the electrodes. This problem is not unknown in animal research, for although the organism cannot leave the experimental response chamber, the animal may stop responding completely. This complete disruption of behavior usually occurs when the

shock level is too high or the baseline is not maintained by optimal reinforcement and deprivation conditions.

The fact that conditioned suppression was not demonstrated with subjects might be attributed to the fact that the experimenter had no control over the deprivation level under which the subjects were operating. Under most circumstances the level of deprivation cannot be manipulated for human subjects as it can for animal subjects. Therefore, the motivational factors with humans must be controlled through the manipulation of the reinforcement. Since monetary reinforcement is generalized, its worth cannot be specifically determined for the individual subjects. Consequently, it is difficult to arrange the necessary and sufficient conditions for demonstrating conditioned suppression when using human subjects.

An additional problem was encountered in determining the appropriate shock intensity, even though most subjects indicated that it was painful. There appears to be a wide range of thresholds at which individual subjects find electric shock to be aversive. The use of an interview technique or some psychophysical method in order to determine the relative aversiveness of the shock does not appear to be an appropriate answer to this problem. The difficulties encountered in using verbal report of the subject in

determining thresholds has been discussed by Goldiamond (1962). He has pointed out that thresholds are determined in part by other motivational variables not under the experimenters control.

One possible solution to some of these difficulties might be to establish an independent measure of reinforcement value and then use this appropriate reinforcement to maintain the conditioned suppression baseline. A progressive ratio technique as a means of evaluating the relative strength of a reinforcement without reference to rate of responding has been suggested. The technique is based on the rationale that the point at which the animal fails to respond for a fixed period of time should be a good means of measuring reinforcement strength (Hodos, 1961; Hodos & Kalman, 1963).

SUMMARY

The effects of an Estes-Skinner conditioned emotional response procedure on the rate of free operant responding were investigated using human subjects. All subjects were given monetary reinforcement on a fixed ratio schedule. A stimulus of a 30 second duration followed by an electric shock was programmed to occur at variable intervals in an attempt to demonstrate conditioned suppression.

The results indicated that conditioned suppression can be demonstrated with human subjects under certain circumstances.

The findings were discussed in terms of similarities with results obtained in animal research. Several variables were suggested which may determine the necessary and sufficient conditions under which suppression of continuous behavior may be demonstrated in humans.

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