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The Effects of Non-Contingent Stimuli on Rate of Lever Pressing Using Human Subjects

Dan V. Lebenta
Western Michigan University

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THE EFFECTS OF NON-CONTINGENT STIMULI ON RATE OF LEVER PRESSING USING HUMAN SUBJECTS

by

Dan V. Lebenta

A Thesis
Submitted to the
Faculty of the School of Graduate Studies in partial fulfillment of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
December, 1969
ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Dr. D. O. Lyon for his assistance throughout the course of this study. The constructive criticisms offered by Dr. C. Koronakos and Dr. P. Mountjoy were also greatly appreciated. This research was supported by PHS Grant 16089-01 awarded to Dr. D. O. Lyon.

In addition I wish to express more than gratitude to my wife, Marianne, since her assistance made graduate study and thus, the preparation of this thesis possible.

Dan V. Lebenta
MASTER'S THESIS

LEBENTA, Dan Victor
THE EFFECTS OF NON-CONTINGENT STIMULI ON RATE OF LEVER PRESSING USING HUMAN SUBJECTS.

Western Michigan University, M.A., 1969
Psychology, experimental

University Microfilms, Inc., Ann Arbor, Michigan
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Figure 11  Suppression ratios for individual subjects in Group F-20 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.

Figure 12  Suppression ratios for Subjects F-40-1 through F-40-6 in Group F-40 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
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**Table I**
Experimental procedures for Experiment I showing number of subjects per group, events occurring during the three experimental phases, the CS and UCS duration for each group, and the nature of the UCS for each group.

**Table II**
Experimental procedures for Experiment II showing assignment of subjects to groups, number of subjects per group completing the experiment, reinforcers used, CS duration and shock intensity in volts.

**Table III**
Reasons for experimental termination for eleven males and five females from Experiment II showing group assignment of the subject, the session of termination, and the reason for termination when it was known. When shock severity was the reason for termination, the subject would knock on the door and report to the experimenter that he did not wish to continue either because the shock hurt or he could not stand anticipating when he would receive the next shock.
In the present study the effects of introducing non-contingent stimuli on an operant baseline maintained by a schedule of positive reinforcement were investigated using human subjects. The two paradigms traditionally used in experiments of this type are similar since both require that a neutral stimulus precede the delivery of the non-contingent stimulus. The paradigms differ with respect to the nature of the non-contingent stimulus. In one paradigm the non-contingent stimulus is aversive, e.g., electric shock, and in the other, the non-contingent stimulus is a positive reinforcer, e.g., food. Both paradigms were used in the present study.

In the prototype of this procedure, Estes and Skinner (1941) trained rats to bar press for food which became available on an intermittent schedule of reinforcement. When the rate of bar pressing stabilized, response-independent electric shock (UCS) signaled by a tone (CS) was introduced. After several pairings of the tone and shock, the rate of lever pressing decreased during the pre-shock tone. This phenomenon has since been called conditioned suppression, conditioned anxiety, conditioned fear, or the conditioned emotional response (CER) to describe the behavioral effect produced by a signaled aversive event.

Lyon (1968) indicates that the defining characteristics of the conditioned suppression procedure are 1) two stimulus conditions, the CS and shock, presented independently of behavior; and 2) an operant baseline maintained by a schedule of positive reinforcement.
The first requirement distinguishes the procedure from conditioned punishment (Azrin and Holz, 1966) and satisfies the operational definition of classical conditioning (Gormezano, 1966.) The second defining characteristic distinguishes the procedure from techniques in which no behavioral repertoire is maintained or in which the CS-shock pairings are presented on a baseline maintained by shock avoidance. Both classical and operant conditioning variables consequently combine to determine the rate of acquisition and degree of conditioned-suppression. The classical conditioning variables include intensity and duration of the CS and UCS (Kamin, 1965; Annau and Kamin, 1961) and the temporal relationship between these stimuli (Kamin, 1965). The operant conditioning variables include the type (Geller, 1960; Brady and Conrad, 1960), schedule (Lyon, 1964; Lyon and Felton, 1966b; Brady, 1955), and frequency (Lyon, 1963) of reinforcement. Furthermore the deprivation schedule (Estes and Skinner, 1941) and response rates affect conditioned suppression.

Several investigators have extended the conditioned suppression paradigm to study the behavioral effect produced by a signaled positively reinforcing stimulus. Since this procedure is the antithesis of the conditioned suppression paradigm, it is often stated to produce "joy" or "elation" effects (Millenson, 1967). Herrnstein and Morse (1957) trained pigeons to key peck for food reinforcements on a differential reinforcement of low rates baseline (DRL). When DRL performance had stabilized, an independent light stimulus (CS) signaling non-contingent food was introduced. After several conditioning trials the birds showed acceleration during the CS. Brady
(1961), using brain stimulation as the non-contingent stimulus and a food maintained variable-interval (VI) baseline, similarly reported an increase in response rate during the CS.

A recent study by Azrin and Hake (1969), using rats maintained on a VI schedule of positive appetitive reinforcement, reported suppression during a CS (clicker) which preceded the delivery of non-contingent food, water, or brain stimulation. Similar findings were reported by Pliskoff (1963) using a multiple VI-VI schedule. In this study suppression occurred during a stimulus which preceded a change from a period of low density reinforcement to a period of high density reinforcement.

The conditioned suppression phenomenon has been demonstrated in a wide variety of infrahuman organisms, including fish, mice, guinea pigs, cats, dogs, pigeons, monkeys, and, of course, rats. Attempts to replicate the conditioned suppression phenomenon with humans have been less successful. The only clear demonstration of a conditioned emotional response was reported by Watson and Raynor (1920) in which a young child was conditioned to "fear" a white rat by pairing the stimulus animal (CS) with a loud sound (UCS). Although this study does not fall within the strict definition of conditioned suppression, the general behavior patterns of the child - withdrawal and agitation - are similar to those observed in infrahuman organisms under similar circumstances (Lyon, 1968).

In a more recent attempt, Kanfer (1958a, 1958b) reported acceleration during a pre-shock stimulus which was superimposed on a verbal baseline. This study was criticized by Lyon (1968)
on the grounds that the verbal baseline was neither structured nor maintained by extrinsic reinforcement contingencies. Sachs and May (1967) failed to find conditioned suppression in a study using four human subjects. In this study, signaled electric shocks were superimposed on a lever-pressing performance maintained by a VI schedule for point reinforcements. The lack of suppression was attributed to the directive nature of the instructions, the population of subjects, and the insensitivity of the operant response.

A recent experiment by Mulder, Lyon, and Pott (1967), using a lever-pressing task maintained by money reinforcements, indicated some success. That is, clear suppression of lever pressing was noted in four subjects; no effect was observed in others, although emotional behaviors such as cursing and bizarre arm raising were reported during the CS. The failure to achieve suppression with all subjects was attributed to insufficient shock intensities for some subjects and to escape behaviors on the part of others. The escape behaviors had two forms. Subjects exhibiting the first form simply terminated the experiment. Most of the subjects stated that either the shock was too severe or they could not bear the anticipation of the shock. In the second type of escape behavior the subjects appeared to respond only to terminate the session. Since subjects were told that the experiment would end after a fixed number of reinforcements were received, i.e., $10.00, it may be speculated that these subjects responded as rapidly as possible solely to escape the situation and receive the money. Therefore
the behavior of these subjects may have been insensitive to the immediate effects of the suppression procedure.

Lyon (1968) discusses two interpretations of conditioned suppression data which emphasize each of the major procedures used in the general experimental paradigm. The "interference" hypothesis stresses that conditioned suppression results from various types of conditioned respondents which interfere with an organism's ongoing performance. The "punishment" hypothesis places less emphasis on the conditioning of respondents. Instead, the disruption of the ongoing behavior is interpreted as the result of punishment, although the contingency between the behavior and the punishment is an adventitious one.

An alternate explanation is offered by Azrin and Hake (1969) to predict suppression with aversive as well as non-aversive stimuli. This hypothesis stresses that the decrease in rate results from a general preparatory or emotional state conditioned during the presentation of a stimulus that is paired with any strong reinforcer or punisher.

The present study was designed to demonstrate conditioned suppression with humans engaged in a lever-pressing task. In Experiment I the effects of introducing signaled non-contingent positive stimuli were investigated. From Azrin and Hake's (1969) findings with infrahumans, it was predicted that suppression would be obtained during a CS which preceded a strong non-contingent reinforcer (UCS). With this procedure the problem of escape behavior encountered by Mulder, et al. (1967) with aversive stimuli could
be eliminated. In addition, since instructions seemed a factor in
the failure of Sachs and May (1967) to obtain suppression, non-
directive instructions were used which allowed the behavior of
subjects to be shaped and maintained only by the immediate contin-
gencies for responding. To bring the procedure closer to the infra-
human paradigm, immediately retrievable reinforcers were used. In
this case, slides of nude women were used which are fairly powerful
conditioned reinforcers for males. For the non-contingent UCS a
reinforcer of potentially greater magnitude was used - a silent movie
of a woman disrobing. The Estes and Skinner paradigm was followed
in all other respects.

In Experiment II the effects of superimposing signaled non-
contingent aversive stimuli (electric shock) on the lever-pressing
baseline were investigated. As in Experiment I non-directive
instructions were used, and similar reinforcers maintained responding
for men. The behavior of female subjects was maintained by money
reinforcements signaled by "general" slides, i.e., landscapes, etc.
The Estes-Skinner paradigm was followed in all other respects.

METHOD

Experiment I

Subjects

Fourteen male college students ranging in age from eighteen to
forty-one years, were paid at a rate of $3.00 per hour to par-
ticipate in a series of three sessions. All subjects were naive
in the sense that they had never participated in psychological experiments or taken courses in psychology. The experimenter initially contacted each subject by telephone and explained that the experience would be non-harmful; that the length of each session would be approximately one hour; and that the sessions must be on consecutive days and at the same time each day.

**Apparatus**

The experiment was conducted in a 6.25 x 4 x 8.42 foot sound-attenuated room which was carpeted and ventilated by means of an overhead air duct and a 20 inch floor fan. The floor fan also served to provide masking noise. The room contained a chair, a response console mounted on a 37 x 25 inch table, and, on an overhead shelf located 7 feet from the floor above the door, a Kodak model 850 slide projector and a Bolex 8 mm movie projector. The room was dimly illuminated by a blue 25 watt bulb and a white 1½ watt bulb, both situated on the overhead shelf to provide a system of indirect lighting.

The response console, constructed with a sloped front chassis, had an 18 inch response lever mounted on the right side requiring 5.25 pounds of force to operate through an excursion of 20 inches. Two 6 watt indicator lamps, one red and one yellow, and an electrical impulse counter were mounted in a horizontal row on the front of the console. A 6 watt white indicator lamp was situated below the impulse counter. On the front right underside of the table, facing the subject, a green push-button was mounted on a metal bracket.
A correct response on the lever was indicated by a brief flash of the yellow indicator lamp. A reinforcement was indicated by the simultaneous occurrence of a point on the counter, a brief flash of the white indicator lamp, and the presentation of a 35 mm color slide on a screen situated on the wall in front of the subject. The non-contingent stimuli were provided by the red indicator lamp, the conditioned stimulus (CS), and by the presentation of segments of a movie, the unconditioned stimulus (UCS). The movie onset occurred simultaneously with the red light termination.

A total of 80 different slides of nude and semi-nude attractive women were used as reinforcers. Two different 8 mm movies of women disrobing were used as the UCS. The first was a 25 foot, black and white film presented in 8 second segments at a speed of five frames per second. The second film, a 200 foot color movie, was shown in 20 second segments at 18 frames per second. The slides and movies were of professional quality and were purchased from photographic supply houses.

The procedure was programmed by appropriate electromechanical circuitry in an adjacent room. The data were recorded from electrical impulse counters, running time meters, and a Gerbrand's cumulative recorder.

Procedure

At the appointed time for the first session, each subject was met by the experimenter in an anteroom and the following conditions controlling subject participation were explained: 1) No information can be given about the nature of the research nor are you to discuss
your participation with anyone. 2) You will earn $3.00 per hour, but you will earn nothing if you do nothing, i.e., sleep for the session. 3) You must come at the same time for each of three successive days. A progressive fine will be instituted for missing sessions without informing me. That is, for missing one session, you will be fined $1.00; for missing two sessions, you will be fined $2.00, etc. 4) Watches, pencils, papers, books, and wallets are not allowed in the experimental room. 5) You will be paid only after you have completed the last session (Kaufman, 1964; Scobie and Kaufman, 1969).

Following consent to these conditions, the subject was seated in the experimental room and the following instructions were read:

You will be required to remain in this room for approximately one hour. You can do anything you like for this hour with the following restrictions. While you sit on the chair place your feet only on the floor, on the table base, or on the chair foot support. If you stand, stand only on the floor. You may manipulate this apparatus (point to apparatus), but please do not dismantle anything, unplug anything, remove screws, or lift covers. During the hour this door will be closed (point to door) and a room light turned on. If you must leave the room before the end of the hour, knock on the door and it will be opened. The session will begin when I close the door. Do you have any questions?

Upon leaving the experimental room, the lever was depressed slightly by the experimenter and allowed to return to the up position. No other instructions were given to the subject. Any questions were answered by references to the instructions. The instructions were reread to the subject at the beginning of each subsequent session.
The subjects were divided into two groups based on the order in which they were contacted and the amenability of their schedules. A summary of the experimental design is presented in Table I. Nine subjects were assigned to Group I and five to Group II. The procedure for the groups differed only in terms of CS duration, UCS duration, and the qualitative nature of the UCS. Thus, for Group I, the CS consisted of an 8 second presentation of the red light; while the UCS was an 8 second presentation of the black and white movie. For Group II the CS was a 10 second presentation of the red light and the UCS consisted of a 20 second segment of the color movie.

The experiment was conducted in three phases, each approximately an hour in length and each instituted on successive days. During Phase I, day 1, lever pressing was shaped by presenting slides for a five second duration on a continuous reinforcement schedule for lever presses. After the subject had received four or five reinforcements, the schedule was changed to a VI 30 second schedule. The balance of Phase I consisted of allowing lever pressing to establish a stable rate.

On day 2, Phase II was initiated. When approximately five minutes of the session had elapsed, CS-alone presentations were begun consisting of the onset of the red lamp for the appropriate duration. Approximately 20 CS's were presented with an average inter-CS interval of three minutes. Each CS was presented irrespectively of the subject's behavior or the availability of reinforcement. No reinforcements were lost during CS periods.
### Table 1

Experimental Procedures for Experiment 1

<table>
<thead>
<tr>
<th>Group in Group</th>
<th>Procedures during Experiment Phases</th>
<th>CS Duration (Sec)</th>
<th>UCS Duration (Sec)</th>
<th>Nature of UCS</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Phase I Day 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Shaping lever pressing</td>
<td></td>
<td></td>
<td>Black &amp; White Movie</td>
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<tr>
<td>11</td>
<td>same</td>
<td></td>
<td></td>
<td>Color Movie</td>
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<tr>
<td>11</td>
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<td>11</td>
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Note: Group 1 and Group 11 are the same group, with Group 11 being a replication.
Responses during the CS were recorded and compared to the baseline rates to determine if the CS-alone had a differential effect on rate of response.

Phase III was initiated during the third session. CS-movie presentations were begun after approximately five minutes of lever pressing. The CS-movie pairings were presented on the average of every three minutes irrespectively of the subject's behavior or the availability of reinforcement. During this phase a reinforcement could be received during the CS but not during the movie. Any reinforcement which accumulated during the movie was held until the first lever press following the termination of the movie. After approximately 20 CS-UCS pairings, the movie was discontinued and the CS was presented alone for three or four extinction trials. At the end of the third session each subject completed a questionnaire which consisted of statements such as, "Did you do anything to make the slides come on?" and "Did you like the slides or the movie better?"

RESULTS

Experiment I

The effects of the non-contingent stimuli on lever pressing were evaluated by comparing the mean rate of response during the CS to the mean baseline rate of response. These comparisons, averaged for 6 subjects in Group I and 3 subjects in Group II, are presented respectively in Figures 1 and 2. The data for Subject 1, and
Fig. 1. Comparisons of mean responses per minute per session for baseline, CS-alone trials, CS-movie trials, and CS-extinction trials as a function of the experimental sessions for six subjects in Group I. The data for Subjects 3, and 5 through 9 were averaged for each experimental manipulation to provide a group mean for that manipulation. All histogram bars grouped around the session number on the abscissa are included in that session.
**EXPERIMENTAL BASELINE**

- **CS-ALONE**
- **CS-MOVIE**
- **CS-EXTINCTION**

**MEAN RESPONSES / MIN.**

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<td>8</td>
</tr>
<tr>
<td><strong>CS-MOVIE</strong></td>
<td>11</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td><strong>CS-EXTINCTION</strong></td>
<td>10</td>
<td>9</td>
<td>6</td>
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</tbody>
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Fig. 2. Comparisons of mean responses per minute per session for baseline, CS-alone trials, CS-movie trials, and CS-extinction trials as a function of the experimental sessions for three subjects in Group II. The data for Subjects 10, 12, and 14 were averaged for each experimental manipulation to provide a mean for that manipulation. The data for Subjects 11 and 13 of Group II are presented in Figures 3 and 4 respectively. All histogram bars grouped around the session number on the abscissa are included in that session.
Subjects 2 and 4 in Group I were eliminated because of equipment failure during session 3, and instruction violations respectively. The data for two subjects, Subject 11 and Subject 13 of Group II, are not shown in Figure 2. The rate comparisons for these subjects are presented separately since their response patterns during CS-movie pairings were unique.

From the data in Figures 1 and 2 it is noted that the procedure had similar effects on both groups. All subjects responded on the lever to see the slides. Thus, the slides maintained the operant response of lever pressing and can be considered as reinforcers. Response rates during day 2 differ from the day 1 rates in both groups. This can be attributed to individual rate adjustments as responding stabilized. The mean response rates during CS-alone presentations on day 2 were slightly below the baseline rates for that day. These differences, although not great, might be attributed to the differential effects of the "novel" CS. During the first few CS-alone presentations, all subjects showed suppression. This effect disappeared, however, as adaptation to the CS occurred with continued CS presentations.

The baseline rates for day 3 were almost identical to the day 2 rates indicating rate stabilization. It is noted that the response rates during the CS-movie pairings were considerably below any baseline rates or the day 2 CS-alone rates. This phenomenon was true for all subjects in Figures 1 and 2. It appears, then, the effect of the CS-movie pairings was to suppress lever pressing during the CS. The response rate during CS-alone extinction trials for Group I
recovered to almost baseline rate, and was approximately five responses per minute above the CS-movie rate. The Group II extinction rate showed little recovery to the pre-movie rate.

The results for Subject II are presented in Figure 3. As previously mentioned Subject II had a unique pattern of responding during CS-movie pairings. During the first 10 CS-UCS trials, the response rate was higher than the CS-alone rate. In the last 10 CS-UCS trials, however, the rate declined below any baseline rate or the CS-alone rate. The pattern of responding was, then, acceleration followed by suppression. During extinction trials the CS response rate recovered to the CS-alone rate.

The record for Subject 13 is presented in Figure 4. This subject failed to show suppression during the CS-movie pairings. The actual rates suggest that acceleration occurred. However, problems arise in interpreting the data and assessing the experimental effects because of the extremely low baseline rates of response and short CS. Since Subject 13 only made a total of 10 responses during the 20 CS-movie trials, it is dubious to conclude that the rate during this interval is indicative of a real effect. A better interpretation is "no effect."

The record for Subject 6 is presented in Figure 5. The pattern of responding by Subject 6 is representative of the typical subject shown in Figures 1 and 2.

In examining the post-session questionnaires, it was noted that several subjects had utilized combinations of lever presses and green button presses to make the slides appear more rapidly. Since the
Fig. 3. Comparisons of mean responses per minute per session for baseline, CS-alone trials, first 10 CS-movie trials, last 10 CS-movie trials, and CS-extinction trials as a function of the experimental sessions for Subject 11 of Group II. The data for each manipulation were averaged to provide a mean for that manipulation. All histogram bars grouped around the session number on the abscissa are included in that session.
Fig. 4. Comparisons of mean responses per minute per session for baseline, CS-alone trials, CS-movie trials, and CS-extinction trials as a function of the experimental sessions for Subject 13 of Group II. The data for each experimental manipulation were averaged to provide a mean for that manipulation. All histogram bars grouped around the session number on the abscissa are included in that session.
Fig. 5. Comparisons of mean responses per minute per session for baseline, CS-alone trials, CS-movie trials, and CS-extinction trials as a function of the experimental session for Subject 6 of Group 1. The data for Subject 6 are typical of the data for the subjects in Figures 1 and 2. The data for Subject 6 are included in the Group 1 mean data prescribed in Figure 1. All histogram bars grouped around the session number on the abscissa are included in that session.
The green button was just extraneous equipment, serving no function; it appeared that possibly this behavior was being maintained by adventitious reinforcement. To determine the rate of this behavior, responses for Group II were recorded. During days 1 and 2, Subjects 10, 11, and 12 showed medium to low response rates on the green button. However, these response rates dropped to 0.0 about halfway into the third session. Subject 13 continued to respond on the green button at a low rate throughout all sessions. Subject 14 made only 2 superstitious responses, both on day 2.

The responses of subjects on the post-session questionnaires were valuable for several reasons. The responses conveyed:

1) a subjective evaluation of the reinforcing potential of the movie versus the slides - All but one subject reported that "the movie was better";
2) an indication of the strategy employed during lever pressing;
3) feedback on the relationship between the CS and the availability of the baseline reinforcement - No relationship was seen;
4) feedback on the relationship between the CS and the movie - The movie followed the CS; and,
5) feedback on the relationship between responding and the appearance of the movie - Nothing was done to make the movie appear. These responses from the questionnaire tended to support the empirical findings and indicated that the experimental manipulations were having the intended effect.
METHOD

Experiment II

Subjects

Twenty-six males and twenty-three females served as subjects. Twenty-three males and seventeen females were students at Western Michigan University; the remaining males and females were employed by Borgess Hospital as orderlies and nurse aides respectively.

The subjects were contacted by telephone after indicating an interest in participation by signing a list, which explained that the experiment would involve non-harmful electric shock and remuneration of about $10.00 for two sessions of approximately one hour in length. Care was taken to select only individuals who had not taken courses in psychology. Students currently enrolled in Introductory Psychology were allowed only if they were able to schedule the two sessions before they had completed the third week of the course.

During the telephone contact the experimenter explained that the two sessions must be on consecutive days and at the same time each day; that no information about the nature of the research could be conveyed until the completion of the last session; and re-emphasized that the shock was non-harmful. No other information was given.

Subjects were identified as M for males and F for females.

Apparatus

The apparatus was identical to that used in Experiment I except for the addition of the shock source, a new black and white movie, and a set of 80 "general" purpose color slides, i.e., street scenes,
classroom scenes, etc.

The aversive stimulus was provided by an AC shock source programmed through a pulse former to two silver electrodes. The electrodes were mounted 1½ inches apart on a non-conductive surface, and were attached to the inside of the left forearm of the subject with an elastic bandage. A 57 inch cord connected the electrodes to the response console allowing the subject free arm movement. Before the electrodes were attached, the area on the forearm was cleansed with alcohol, and electrode jelly was applied. In addition, an ohm meter was connected in series with the shock source and served as a monitor to insure that the subject did not remove the electrodes and that the shock source was functioning. The shock duration was approximately .5 sec. Voltage was controlled by an exterior rehostat; amperage varied slightly depending on skin resistance.

The new black and white movie was 200 feet in length and showed two nude women in activities such as sunbathing and swimming. The 25 foot black and white movie used in Experiment I was subsequently eliminated.

Procedure

Each subject was met by the experimenter in a anteroom and the following conditions were explained: 1) No information can be given about the nature of the research nor are you to discuss your participation with anyone. 2) You will earn approximately $5.00 per hour, but you will earn nothing if you do nothing, i.e., sleep for the session. 3) You must come at the same time for tomorrow's session. A progressive fine will be imposed for missing the session without
informing me. That is, for missing the second session once, you will be fined $1.00; for missing it twice, you will be fined $2.00, etc.

4) Watches, pencils, papers, books, and wallets (purses) are not allowed in the experimental room. 5) You will be paid only after you have completed the last session (Kaufman, 1964; Scobie and Kaufman, 1969). Following agreement to these conditions, the subject signed a consent statement.

Upon being seated in the experimental room, the electrodes were strapped to the subject's arm and the following instructions were read:

Instructions for men: As you were told when you signed up to participate in the study, you will receive some mild electric shocks. The shock will be delivered through this bracelet. If the bracelet is moved or removed, this will invalidate the procedure and you will not be paid. After receiving each shock, press this green button once.

During the hour that you will be in the room, you may do anything you like with these restrictions. While you sit on the chair, place your feet only on the floor, on the chair foot support, or on the table foot support. If you stand up, stand only on the floor. You may manipulate this apparatus, but do not dismantle anything, unplug anything, or lift covers.

During the session, the door will be closed and a room light turned on. If you must leave the room before the end of the hour, knock on the door and it will be opened. The session will begin when I close the door.

Again, let me emphasize that you are not to move the shock bracelet from its present position. Do you understand the instructions?

Instructions for women: As you were told when you signed up to participate in the study, you will receive some mild electric shocks. The
shock will be delivered through this bracelet. While you are in the room, you must wear the bracelet in the position in which I have placed it. If the bracelet is moved or removed, this will invalidate the procedure and you will not be paid. After receiving a shock, press this green button once.

You are here to earn money. You will know when you have earned five cents when you see a slide appear on the screen in front of you. Each time a slide appears, you will have earned another five cents. You must do something to earn money. If you do nothing, you will earn nothing. Thus, the amount of money you earn depends on you.

During the hour that you will be in the room, you may do anything you like with these restrictions. While you sit on the chair, place your feet only on the chair foot support, table support, or on the floor. If you stand up, stand only on the floor. You may manipulate this apparatus, but please do not dismantle anything, unplug anything, or lift covers.

During the session, the door will be closed and a room light turned on. If you must leave the room before the end of the hour, knock on the door and it will be opened. The sessions will begin when I close the door.

Again, let me emphasize that you are not to move the shock bracelet from its present position. Do you understand the instructions? If these instructions are violated, you will lose money.

Upon leaving the experimental room, the lever was depressed by the experimenter so that a slide or movie appeared on the screen. No other instructions were given to the subject. Any questions were answered by references to the instructions. The instructions were reread to the subject at the beginning of the subsequent session.

The subjects were divided into major groups based on sex and each of these groups were further subdivided into three additional
groups based on CS duration. The assignment of a subject was based on the order of contact, the amenability of their schedules, and the premature termination of assigned subjects. A summary of the experimental design is presented in Table II.

As stated in Table II different reinforcers were used for men and women and among groups of men. Initially it was planned to use the color slides of nudes on day 1 for all male groups. However, because the rates of response were low with the slide contingency, showing a substantial increase on day 2 under the movie contingency, it was decided to substitute a movie for the slides. The day 1 rates for Groups M-20 and M-40 were markedly increased with this procedure. Since it was doubtful if women would respond for these sexual stimuli, reinforcements of money signaled by one of the general purpose slides were provided. Each time a slide appeared, the female subject earned five cents. The total number of slides seen were accumulated to calculate her earnings. The amount earned by the women for both sessions was usually in excess of $10.00. The men received a total of $10.00 for the two sessions.

The procedure for all groups was conducted in two phases, each instituted on successive days. During Phase I, day 1, lever pressing was shaped by presenting slides or movies for a five second duration on a continuous reinforcement schedule for lever presses. After the subject had received several reinforcements, the schedule was changed to a VI 30 second schedule. When approximately five minutes of the session had elapsed, CS-alone presentations consisting of the onset of the red lamp for the
Table II  
Experimental Procedures for Experiment II

Male

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Group Completing Experiment</th>
<th>Reinforcer Day 1</th>
<th>Reinforcer Day 2</th>
<th>CS-Duration (Sec)</th>
<th>Shock Intensity (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-10</td>
<td>5</td>
<td>Slides (Nudes)</td>
<td>Movie (Color)</td>
<td>10</td>
<td>30-35</td>
</tr>
<tr>
<td>M-20</td>
<td>6</td>
<td>Movie (B &amp; W)</td>
<td>Movie (Color)</td>
<td>20</td>
<td>30-35</td>
</tr>
<tr>
<td>M-40</td>
<td>5</td>
<td>Movie (B &amp; W)</td>
<td>Movie (Color)</td>
<td>40</td>
<td>30-35</td>
</tr>
<tr>
<td>M-L</td>
<td>0</td>
<td>Slides for money (General Purpose)</td>
<td>Slides for money (General Purpose)</td>
<td>Alternating between 20 and 40 seconds</td>
<td>30-35</td>
</tr>
</tbody>
</table>

Female

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Group Completing Experiment</th>
<th>Reinforcer Day 1</th>
<th>Reinforcer Day 2</th>
<th>CS-Duration (Sec)</th>
<th>Shock Intensity (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-10</td>
<td>5</td>
<td>Slides for money (General Purpose)</td>
<td>Slides for money (General Purpose)</td>
<td>10</td>
<td>30-35</td>
</tr>
<tr>
<td>F-20</td>
<td>5</td>
<td>Slides for money (General Purpose)</td>
<td>Slides for money (General Purpose)</td>
<td>20</td>
<td>28-33</td>
</tr>
<tr>
<td>F-40</td>
<td>7</td>
<td>Slides for money (General Purpose)</td>
<td>Slides for money (General Purpose)</td>
<td>40</td>
<td>30-35</td>
</tr>
</tbody>
</table>
appropriate duration, were begun. Approximately 20 CS-alone presentations were programmed with a mean inter-CS interval of three minutes. Each CS was presented irrespectively of the subject's behavior or the availability of reinforcement. No reinforcements were lost during CS periods. Responses during the CS were recorded and compared to the baseline rate to determine if the CS-alone had a differential effect on rate of response.

Phase II was initiated on the second day. After approximately three minutes of the session, one to three CS-alone adaptation trials were given. The shock source was then connected and CS-shock pairings were presented at an average inter-shock interval of three minutes. All CS-shock pairings were programmed to occur irrespectively of the subject's behavior or the availability of reinforcement. After approximately 20 CS-shock trials, the shock was disconnected and the CS was presented alone for three to five extinction trials. At the termination of the session, each subject completed a questionnaire which consisted of statements such as, "Was the shock painful?" and "Did you do anything to avoid the shock?"

As the experiment progressed, an additional group of subjects was added when failure to produce suppression in all subjects was noted. It was hypothesized that by running subjects for more than two sessions, it would be possible to better determine those variables controlling suppression. The three males who began in this group, however, all terminated before the end of the experiment: one terminated after the first day of shock; one before the first day of shock; and the remaining subject who had previously been
through the two day procedure, after five days of shock. The lever pulling behavior of this group was maintained by money reinforcements of three cents per slide or about $3.00 per session. This group received the same instructions as the female group. The procedure for the long term group consisted of shaping lever pressing on day 1; the presentation of six CS-alone trials at 10 minute intervals on days 2 and 3; and on day 4 the introduction of CS-shock trials at 10 minute intervals.

RESULTS

Experiment II

To evaluate the effects of the non-contingent stimuli on lever pressing, the rate of response during every CS was compared to baseline rate of response for the five minute segment during which the CS occurred. The rate comparisons were made in the form of the ratio:

\[
\frac{\text{CS Rate of Response Per Minute}}{\text{Baseline Rate of Response Per Minute}} + \frac{\text{Baseline Rate of Response Per Minute}}{\text{Baseline Rate of Response Per Minute}}
\]

Using this ratio, complete suppression during the CS would be indicated by a value of 1; no suppression would be indicated by a ratio of 2; acceleration would be shown by a ratio value greater than 2; and complete suppression of baseline and CS responding would be indicated by a ratio of 0.

Of the 49 subjects who began the experiment only 16 males and 17 females completed both sessions. The reasons for subject
termination are presented in Table III. Except for the subjects listed as unknown; the subject who violated the procedure, and the subject who failed to respond, the reasons given for termination are those reported by the subjects. It was difficult to determine if the procedure had any effect on those subjects who received shock before termination. In a sense an effect was produced since the subjects escaped from a presumably aversive situation.

For the subjects completing the experiment, ratios for every CS for both sessions were computed. Figures 6 through 8 and 10 through 12 present this data as a function of CS number. Day 1 and 2 ratios have been plotted on a common set of axes to facilitate rate comparisons. To determine if suppression occurred, a criterion of consistent patterns of ratio values less than 1.9 during CS-shock trials was adopted.

The data for Group M-10 are presented in Figure 6. Subject M-10-5 clearly showed suppression beginning with CS-shock trial 7 and continuing through trial 20. During extinction trials 1 and 2, the response rate recovered to pre-shock levels but again dropped during trials 3 and 4. The response rates of Subjects M-10-2 and M-10-4 were extremely variable during the CS-shock trials. Subject M-10-2 suppressed for 11 shock trials. However, it is doubtful if this effect was the result of CS-shock pairings since the response rates on day 1 during CS-alone trials follow similar suppression patterns. In addition, on day 2 the greatest number of consecutive suppression trials were three. The same interpretation may be applied to the data of Subject M-10-4, although this subject did
Table III
Reasons For Experimental Termination
For 11 Males and 5 Females

<table>
<thead>
<tr>
<th>Sex of Subject</th>
<th>Group</th>
<th>Session of Termination</th>
<th>Reason for Termination</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>M-10</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>M</td>
<td>M-20</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>M</td>
<td>M-20</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>M</td>
<td>M-40</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>F</td>
<td>F-40</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>F</td>
<td>F-10</td>
<td>2</td>
<td>Shock severity</td>
</tr>
<tr>
<td>M</td>
<td>M-40</td>
<td>1</td>
<td>Personal</td>
</tr>
<tr>
<td>M</td>
<td>M-20</td>
<td>1</td>
<td>Failure to respond</td>
</tr>
<tr>
<td>M</td>
<td>M-20</td>
<td>2</td>
<td>Procedure violation</td>
</tr>
<tr>
<td>M</td>
<td>M-20</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>F</td>
<td>F-10</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>F</td>
<td>F-40</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>F</td>
<td>F-40</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>M</td>
<td>M-L</td>
<td>5</td>
<td>Shock severity</td>
</tr>
<tr>
<td>M</td>
<td>M-L</td>
<td>4</td>
<td>Unknown</td>
</tr>
<tr>
<td>M</td>
<td>M-L</td>
<td>5</td>
<td>Shock severity</td>
</tr>
</tbody>
</table>

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Fig. 6. Suppression ratios for individual subjects in Group M-10 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
appear to finally show consistent suppression beginning with shock trial 15 and recovery during extinction.

In examining the record of Subject M-10-3, it is noted that complete suppression occurred during 14 CS-shock trials, 9 of these being consecutive. In addition, complete suppression of baseline responding began during the last shock trial and continued until the end of the session. As with Subjects M-10-2 and M-10-4, it is doubtful if this suppression may be attributed to the effects of the CS-shock pairings since suppression occurred during 19 CS-alone trials on day 1. The data for Subject M-10-1 follow a similar pattern. The records show suppression during 17 CS-alone trials on day 1 and suppression during all CS-shock trials. Again it is dubious if the suppression was the effect of CS-shock pairings since almost complete suppression occurred on day 1 during CS-alone trials.

The data for Group M-20 are presented in Figure 7. Three subjects, M-20-1, M-20-3, and M-20-5, clearly showed suppression during the CS-shock trials. Subjects M-20-1 and M-20-5 not only suppressed during CS-shock, but in latter portions of the session stopped responding altogether. During the extinction trials, the rates for all three subjects remained at CS-shock levels. Subject M-20-4 showed suppression during 14 CS-shock trials. However, his rate recovered to pre-shock levels during the last three CS-shock presentations. An equipment malfunction after 60 minutes of the session prevented the delivery of the 20th shock trial and the extinction trials for this subject. The records for Subject M-20-2 and M-20-6 indicated
Fig. 7. Suppression ratios for individual subjects in Group M-20 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
that the procedure had no effect.

The response patterns during early CS-shock trials for the subjects showing suppression are similar to the patterns of Subject M-10-5. Initially, the subjects attempted to escape the shock by trying various combinations of rapid responding and no responding. After discovering that shock was inescapable, however, suppression occurred. Subject M-20-1 exhibited particularly interesting behavior during CS. He reported during the post-session questioning that when CS onset occurred, "I turned away from the apparatus, crouched down with my head between my knees, doubled up my fists, closed my eyes, and gritted my teeth." This reaction is analogous in many respects to the crouching behavior observed in infrahuman organisms during the CS period.

For all subjects of Group M-20, the day 1 ratios indicate extreme rate fluctuations during the CS. This may have been due to the effects of introducing a "novel" stimulus. Moreover, it appears that there was incomplete adaptation to the "novel" CS since the fluctuation in CS-alone rates continued throughout the session.

The data for Group M-40 are presented in Figure 8. Subjects M-40-2 and M-40-4 exhibited suppression during CS-shock presentations. During extinction trials, the rates for both returned to pre-shock levels. Subject M-40-3 suppressed for nine shock trials but recovered on trials 10 through 20 to pre-shock rates. The data for Subjects M-40-1 and M-40-5 indicate no effect.
Fig. 8. Suppression ratios for individual subjects in Group M-40 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
Portions of the day 2 cumulative record for Subject M-40-4 are presented in Figure 9. The response patterns of this subject clearly show the acquisition, suppression, and extinction processes. Suppression began after shock presentation 4 and continued through the second extinction trials. On the third extinction trial the rate recovered to the pre-shock level and remained stable during extinction trial 4.

The response patterns of Subject M-40-1 indicate that acceleration occurred during the CS. However, it is doubtful if this effect was the result of the CS-shock presentations. Rather, the responses of the subject on the post-session questionnaire indicate that the CS became a discriminative stimulus for reinforcement. Subject M-40-1 indicated that he was reinforced more frequently during the CS. By noting the response patterns of this subject, it is possible to see the occurrence of this effect through adventitious reinforcement. For an unknown reason, the baseline rate of Subject M-40-1 declined after the first 15 minutes of session 1 to a mean rate of about 2 responses per minute. These low rates, combined with the use of an unlimited hold VI schedule, increased the probability of receiving at least one reinforcement during the 40 second CS to 1.0. During the last 30 minutes of session 1 only 10 reinforcements were received. Five reinforcements (50%) occurred during the CS periods that constituted only 22% of the total remaining session time. This high density of reinforcement during CS trials was probably sufficient for conditioning to occur.
Fig. 9. Portions of the cumulative record from session 2 for Subject F-40-4 showing acquisition trials, suppression trials, and extinction trials. Reinforcements are indicated by a downward blip of the pen. The CS is shown by off-setting the reinforcement pen as indicated by the letters "B" and "B" which denote the first CS. CS-shock acquisition trials are denoted by the letter "C". CS-shock suppression trials are denoted by the letter "D". CS-alone extinction trials are denoted by the letter "F".
The data for Group F-10 are presented in Figure 10. Subjects F-10-1, F-10-3, and F-10-4 suppressed during the CS-shock trials. During extinction trials the rates of F-10-1 and F-10-4 recovered to pre-shock levels but the rates for F-10-3 exhibited little recovery. The data for F-10-2 and F-10-5 indicate no effect. The day 1 rates for F-10-1 and particularly for F-10-4 indicate suppression during the CS-alone trials. Adaptation to the CS-alone appears to have occurred, however, by the pre-shock CS-alone trials on day 2.

The data for Group F-20 are presented in Figure 11. One subject, F-20-3, showed suppression, but little recovery during extinction trials. The CS-shock presentations had no consistent effect on the response rates of the remaining subjects. The rates for Subject F-20-1 and F-20-4 were extremely variable during shock presentations, showing acceleration and suppression with approximately equal frequency.

The data for Group F-40 are presented in Figure 12. The results for Subject F-40-7 have been omitted from the figure since her response patterns are similar to those of F-40-5. Subject F-40-1 showed suppression during CS-shock trials and little recovery during the extinction phase. The data for the remaining subjects indicate no effect. The day 1 rates for Subject F-40-1 indicate extreme suppression during CS-alone trials. Adaptation to the CS appears to have occurred towards the end of the first session, but the suppression effect is reinstated on the first C- alone trial of day 2. Consequently, it is not clear if the suppression during CS-shock trials is the result of the CS-shock pairings or merely
Fig. 10. Suppression ratios for individual subjects in Group F-10 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
Fig. 11. Suppression ratios for individual subjects in Group F-20 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
Fig. 12. Suppression ratios for Subjects F-40-1 through F-40-6 in Group F-40 as a function of CS number on days 1 and 2 of the experimental procedure. The broken lines indicate the day 1 ratios. The solid lines indicate the day 2 ratios.
the effects of the CS. Subject F-40-6, although not exhibiting suppression, showed interesting behavior during the sessions. The experimenter observed that the subject was singing during session 1 and at the beginning of session 2. This behavior dropped out after the first five shock trials. On latter conditioning trials, the subject was observed to "shriek" immediately following shock.

In summary, suppression was clearly observed in a total of ten subjects during CS-UCS trials. Suppression, with recovery from suppression during latter shock trials, was noted with two subjects. Five subjects who showed suppression during CS-shock trials also showed such extreme suppression to the CS-alone that it is difficult to determine whether suppression during CS-shock trials was the effect of the shock pairings or merely the CS. Males showed the highest incidence of some form of suppression during CS-shock trials (12 males); only five females exhibited this effect. In general, the subjects with the highest baseline rates of response showed the least suppression. This was particularly true with the female subjects. However, some high rate subjects did suppress.

The responses of subjects on the post-session questionnaire were valuable in conveying a subjective evaluation of the shock severity. Of the subjects showing some form of suppression, five males and three females indicated that the shock was not painful; five males and two females stated that the shock was mildly to extremely painful during all CS shock trials; and two males indicated that the shock was only painful initially, the first 3 or 4 trials. The post-session questionnaire also provided an indication of: 1) the
behavior during the CS, e.g., "I clenched my fist"; "I looked away from the red light"; "I held my breath"; and "I kept busy (by lever pressing)"; and 2) the strategy for lever pressing, e.g., "I just kept pulling the lever" and "I pulled the lever every 10 or 15 seconds."

DISCUSSION

The data from both experiments clearly demonstrate suppression of lever pressing during the conditioned stimulus. In Experiment I suppression occurred during a stimulus which preceded a positively reinforcing stimulus. In Experiment II suppression occurred during a stimulus which preceded electric shock.

The findings from Experiment I are particularly interesting since 10 of 11 subjects suppressed. The effect seemed to be independent of: age and marital status of the subjects, e.g., two subjects were married; the baseline rates of response since the rates were as low as 1.5 responses per minute and as high as 24.9 responses per minute; the suppressive effects of the CS-alone, since the rates during CS-alone trials were approximately equal to baseline rates. Further, the results lend support to Azrin's "preparatory state" notion that suppression during a pre-UCS stimulus is an instance of a general state of emotional preparedness for a strong unconditioned stimulus. The findings are also contradictory to the studies that report acceleration during a stimulus preceding non-contingent reinforcement.
Although neither the slides nor the movies can be considered unconditioned stimuli by a strict definition of the term, the history of most males insures that photographs of nude women become extremely powerful conditioned stimuli and reinforcers. Studies by Rachman (1966) and Rachman and Hodgson (1968) provide empirical support for this general effect. Using male college students, Rachman successfully demonstrated the classical conditioning of a sexual response by pairing color slides of female boots (CS) with color slides of nude women (UCS). Since no physiological data were recorded in the present study, it is impossible to determine if classical conditioning occurred during CS-UCS trials. The fact that the slides maintained the operant in the present situation, however, is also an indication of the reinforcing potential.

Azrin and Hake (1969) indicate that an important variable determining the suppression effect is the comparative reinforcing value of the UCS to the reinforcements maintaining the operant. There are two reasons to assume that the UCS in the present study was "more" reinforcing than the reinforcements maintaining the lever-pressing response. First, the post-session questionnaires provided subjective feedback. All subjects reported that the "movie was better." Second, since the movie was used to maintain the operant in Experiment II, it should be possible to determine the more "reinforcing" stimulus by comparing response rates under slide and movie contingencies. With few exceptions, the rates under the movie contingencies were higher than the rates under the slide contingencies.
Several problems were encountered in Experiment I. These were:

1) relatively low rates of response for the slide contingency. This was particularly apparent after the subject had seen the slides a number of times.

2) lack of specific controls to prevent the CS from acquiring the functions of either a discriminative stimulus for the presence of reinforcement or for the absence of reinforcement. Indications that neither occurred can be inferred from the post-session questionnaires and from the CS-alone rates of day 2.

3) lack of control over the motivational state and activity of the subjects between sessions.

The data from Experiment II provide a successful demonstration of the conditioned suppression phenomenon with human subjects. More than 50% of the subjects (17 subjects) showed some form of suppression during CS-shock trials.

There are several probable reasons for the failure to obtain suppression with all subjects. These include:

1) insufficiently intense shock. Seven subjects reported that "the shock was not painful."

2) responding as a form of escape behavior. This effect was noted in one subject. When questioned about the CS, the subject reported, "I kept busy" (on the lever).

3) failure to observe contingency between CS and shock. One subject reported that there was no relationship between the CS and shock. It may be that the subject closed her eyes during the CS although this behavior was not reported.

4) the availability of escape by premature termination. The shock intensity was purposely held between 30 and 35 volts to discourage termination. This level, although not sufficiently intense to produce conditioning in all subjects, was sufficiently severe to induce the escape response of termination. According to Lyon (1968), the availability of premature termination represents not only a problem,
but a major fallacy in the procedure. The most pertinent aspects of the conditioned suppression procedure as programmed with infrahuman subjects is that a brief unavoidable shock is presented independently of the organism's behavior.

The degree of suppression in Experiment II seemed to be dependent on the rate of response. That is, the lower rate subjects showed the highest incidence of suppression. It is impossible to determine if sex is related to the degree of suppression since the reinforcement variables confound this analysis. However, an analysis based on CS duration indicates that a greater number of female subjects suppressed during short CS intervals than during long intervals. An analysis of the male subjects along this dimension is inconclusive.

An additional problem encountered with the procedure was the high incidence of suppression during CS-alone trials. This suppression continued throughout most of the day 1 periods and, in some instances, prevented the delineation of suppression to the CS-shock pairings from suppression to the CS-alone. Since the subjects expected shock on day 1, and since the CS was the only stimulus change other than the movie or the slides during the session, it is possible to understand the resiliency of suppression to the CS-alone. The subjects may have simply expected shock if they lever pressed during the CS. Possibly the only conditions necessary to produce conditioned suppression in humans is the threat of severe shock.

The difficulty of demonstrating the conditioned suppression phenomenon with humans is clearly documented in this study. The history of the human organism almost dictates an encounter with
electric shock before any participation in an experiment. Consequently, any study is biased before it begins. This combined with ethical restrictions is enough to render a detailed analysis of the phenomenon virtually impossible.
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