

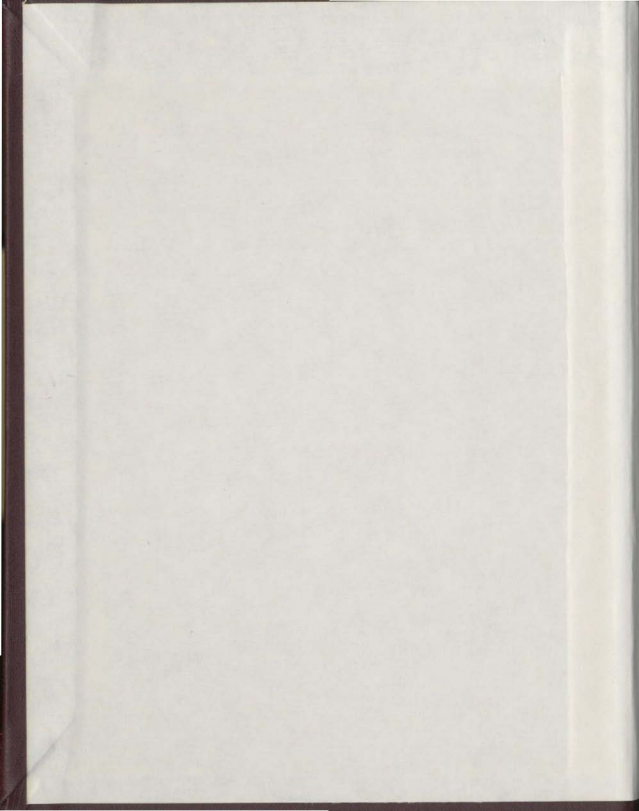
THE EFFECT OF VARYING CS
EXPOSURE DURATION ON
PARADOXICAL ENHANCEMENT
OF A CONDITIONED RESPONSE

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THE EFFECT OF VARYING CS EXPOSURE DURATION ON PARADOXICAL
ENHANCEMENT OF A CONDITIONED RESPONSE

by

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A Thesis submitted in partial fulfillment
of the requirements for the degree
Master of Science

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ABSTRACT

The present study investigated the phenomenon that under certain conditions the presentation of the conditioned stimulus (CS) alone leads to enhancement of the conditioned response (CR) rather than to extinction of the CR. It was further hypothesized that the personality dimensions of neuroticism and introversion were related to enhancement in that those persons high on these dimensions would tend to exhibit enhancement more than persons low on those dimensions.

Thirty-four male subjects were used, there being eight subjects per group in two groups, and nine subjects per group in the remaining two groups. Three groups received CS (slide presentation)-UCS (a loud burst of white noise) pairings on a 76 per cent irregular reinforcement pattern. The groups differed by the duration of the CS-alone exposure each received one minute after conditioning--either 2, 60 or 300 seconds. The fourth group served as a control and received non-contingent CS and UCS presentations. At two extinction sessions held one and two weeks after conditioning the CR strength (magnitude and latency of the GSR and change in rate of Finger Pulse) was measured. The results showed: (a) that the experimental groups exhibited

CR's on unreinforced CS presentations in the conditioning session with significantly higher GSR magnitudes than the control group ($p < .05$); (b) that there was no evidence for enhancement since neither of the groups were responding differently on GSR magnitude in the first extinction session ($p > .05$) nor were they responding differently on change in rate of Finger Pulse ($p > .05$); (c) significant main effects were found for Sessions and Trials and an interaction effect was found for Sessions x Trials on magnitude of the GSR ($p < .05$); (d) significant main effects were also found for Sessions x Trials on latency of the GSR ($p < .01$). These results reflect the well-known extinction effect rather than the desired enhancement effect. Possible explanations of why this study failed to find evidence of enhancement are proposed along with some suggestions for future research.

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INTRODUCTION

Eysenck (1967, 1968) has called attention to Napalkov's observation which he refers to as "incubation" or enhancement of anxiety and fear responses. Napalkov (1963) has very briefly described the results of his work on psychical traumatization in dogs. The conditioned stimulus (CS) used in this work was a metronome or flash of light. The unconditioned stimulus (UCS), which was applied only once, was intended to "provoke the emotions of fear and rage in the experimental dogs" (p. 64). For this purpose the dogs were stimulated by either an electric current, by flashes of light or by raising the dogs to the ceiling by the straps in which they were fastened. In each experiment the conditioned stimulus was subsequently presented alone, repeatedly at intervals of 3 to 5 minutes. Thus, the CS was presented with no reinforcement (UCS) being present. Such trials are by definition extinction trials. The results, however, showed an increase in response strength with repeated presentations of the CS. The conditioned response (CR) which was an increase in blood pressure rose from an initial application level of 30-40 mm of mercury to a final application level of 190-230 mm of mercury. This hypertensive state persisted in the

dogs for an extended period of time (5 months).

Paradoxical enhancement is defined as "an increment in CR strength occurring during a period of time when only unreinforced presentations of the CS are made; when traditionally extinction would be expected to occur" (Eysenck, 1968, p. 309). Enhancement is characterized not only by this increment in CR strength, but also by a maintenance of CR strength and a greater resistance to extinction of such enhanced responses.

Eysenck (1968) refers to such a concept as incubation. However, Rohrbaugh and Riccio (1970) use the term enhancement rather than incubation to refer to this phenomenon. This is done in order to more clearly differentiate Eysenck's usage of the word from that of McAllister and McAllister (1967) who use the term incubation to mean "a growth of fear over a time interval which follows some aversive stimulus. The increase in fear is assumed to be spontaneous in the sense that the time interval is free of further exposure to the aversive stimulus" (p. 180).

Such a concept as paradoxical enhancement may be useful in the explanation of the origin of phobic disorders and other maladaptive human behaviour. The existence of paradoxical enhancement is supported by several incidental findings and a few recent experimental studies.

Incidental Findings

Lichtenstein (1950) administered shocks to dogs while they were eating to observe the inhibition of feeding responses. He writes that the "anxiety symptoms" of the dogs "formed, increased in strength and fixated some time after shock has been discontinued" (p. 29). Other symptoms of anxiety (tics, tremors, struggle) emerged even after the shock had been discontinued. Other studies in which dogs have been used have been conducted by Dykman, Mack and Ackerman (1965), Dykman and Gantt (1958, 1960a, 1960b), and Galbrecht, Dykman and Peters (1960). Dykman et al. (1965) as a result of their work on conditioning and extinguishing specific responses in dogs conclude:

In general, extinction was more upsetting than conditioning and this finding is contrary to expectation. Apparently, to some dogs the threat is more traumatic than the presence of shock. The median number of "symptoms" during all conditioning phases was 5.0 and the median number during extinction was 13.0 (p. 222).

This finding closely resembles that of Lichtenstein (1950) and Napalkov (1963).

Solomon, Kamin and Wynne (1953) and Solomon and Wynne (1953, 1954) studied conditioned fear responses in dogs by use of avoidance learning paradigms. These studies show "partial irreversibility" of the conditioned fear response with an increment in CR strength, "indexed by decreased latency during extinction trials. These data are suggestive of an enhancement effect.

Additional evidence which supports the existence of an enhancement effect is that of Campbell, Sanderson and Lavery (1964). As this study used human subjects, it may be considered more relevant and consequently warrants being reviewed in greater detail than the studies reviewed above.

In this study a 600 hertz tone (to which subjects had previously habituated) which sounded at 70 decibels for a duration of 5 seconds was used as the CS. The UCS was a single period of temporary interruption of respiration by intravenous scoline. The CS was presented at the moment the polygraph record showed the first effects of the drug, and was terminated only when there was an indication of the return of normal respiration. Subsequent to the paralysis, subjects were given a rest period followed by 30 extinction trials. Further extinction trials were given one and three weeks after the conditioning trials.

Continuous recordings were made of galvanic skin resistance (GSR), respiration, heart activity (EKG and heart rate) and muscle tension (EMG). These response measures, rather than showing a decrease in their strength during extinction, showed a significant increase over trials.

"If both latency and amplitude are taken as indices of the strength of a CR one may conclude that the conditioned GSR response in the experimental group increases in

strength, as time passes, following a single traumatic conditioning trial" (Campbell et al., 1964, p. 637). The effect they observed was not merely due to the passage of time, however, but was also a function of successive re-exposures to the CS. This study may be viewed as an example of one trial learning in which repeated presentations of the CS-alone leads to enhancement rather than extinction.

In all the studies reviewed the primary goal of the experiments was not the study of enhancement. Their observations are noted in the context of inhibition of feeding responses (Lichtenstein, 1950), conditioning and extinction of specific and general responses in dogs (Dykman et al., 1965), avoidance learning (Solomon and Wynne, 1953, 1954) and a treatment of alcoholism (Campbell et al., 1964).

Direct Studies of Enhancement

Rohrbaugh and Riccio (1970), Rohrbaugh, Riccio and Arthur (1972) and Silvestri, Rohrbaugh and Riccio (1970) have all attempted to delineate the parameters of enhancement using rats as subjects, while Miller and Levis (1971) have observed increased avoidance behaviour of phobic subjects toward the phobic stimulus after a brief exposure to that stimulus. Rodgers (1976) has studied paradoxical enhancement of classically conditioned physiological

responses in human subjects.

As a measure of fear, Rohrbaugh and Riccio (1970) used the suppression of approach behaviour to food and/or water. Rats deprived of food and water for 48 hours received ten brief (2 second) inescapable shocks (UCS) in a square wooden box (CS). In the one hour interval following conditioning, subjects were returned to the box (CS) for 0, 1/2, 5, 15, or 50 minutes. During these extinction trials neither food nor water were available. Both food and water were available during the test situation, however, with latencies of intake used as a measure of fear (the longer the latency prior to intake, the greater the fear). The results showed a significant effect of exposure during the 15- and 50-minute groups being reliably less fearful than the 5-minute group. The difference between the other groups approached significance but the authors consider enhancement to be "suggested but not clearly demonstrated" (p. 212). A partial replication of this experiment using exposure groups of 0, 5, and 50 minutes indicated that subjects exposed to the CS for 50 minutes were less fearful than the 0 and 5 minute groups, but the 0 and 5 minute groups did not differ significantly. These results provide inconclusive evidence for enhancement using this paradigm.

In order to determine whether CS exposure might maintain fear over a retention interval which typically

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produces considerable forgetting Rohrbaugh and Riccio (1970) used a conditioned reinstatement procedure (Campbell and Jaynes, 1966) in the second experiment in this series. Discriminated classically conditioned fear was established by shocking rats in a black compartment (CS) but not in a white compartment. During a 2 week retention interval no further shocks were delivered to the experimental subjects but they were re-exposed to the discriminative stimuli three times. Four exposure groups were used of 0, 30, 60, or 300 seconds. Retention of fear was tested in a spatial avoidance situation two days after the third exposure session (i.e. amount of time spent on the safe side of the box is an indication of the amount of fear retention). The results of this experiment indicate a significant treatment effect in that the 30- and 60-second exposure groups produced significantly more avoidance of the black (fear) compartment than the 0- and 300-second conditions. Rohrbaugh and Riccio (1970) interpret these results as being evidence for enhancement and conclude that "circumstances exist in which conditioned anxiety is enhanced rather than extinguished by unreinforced exposure to fear stimuli" (p. 214).

Silvestri, Rohrbaugh and Riccio (1970) attempted to demonstrate that retention of learned fear is related curvilinearly to the duration of fear cue exposure treatment. Male albino rats were given discriminative classical

conditioning to establish a fear response to one compartment of a two compartment box, the other compartment being safe. A reinstatement procedure was used and experimental subjects received either a 5-, 60-, 300-, or 900-second presentation of the CS weekly for three weeks. Mean spatial avoidance time spent on the safe side was employed as an index of fear. A significant treatment effect was observed with the 5- and 60-second exposure conditions producing significantly greater spatial avoidance of fear cues than the 900-second group. Thus, the 5- and 60-second groups show enhancement of fear responses. In a modified replication of this study, exposure durations of 30-, 60-, or 300-seconds were used and the 30- and 60-second exposure groups showed greater avoidance than the controls. Such a result constitutes additional evidence for enhancement as the 30- and 60-second exposure groups showed enhancement of learned fear. This effect was curvilinear in that short exposures or long exposures produced less fear than exposures of intermediate duration. Silvestri et al. (1970) consequently conclude that "brief exposures to the conditioned fear cues, administered at periodic intervals following training, are an effective means of maintaining fear retention" (p. 392).

A later study by Rohrbaugh, Riccio and Arthur (1972) tried to obtain evidence of enhancement by the use of a

conditioned suppression paradigm (Hoffman and Flesher, 1961) in which fear is controlled by a discrete tonal stimulus. Rats were confined in the conditioning chamber for 12 minutes following completion of conditioning (classical pairings of tone and shock). During this period, the rats received 0-, 15-seconds or 10-minutes of exposure to the CS (tone) without further reinforcement (shock). Groups were then tested and latency to drink was used as a measure of fear retention (i.e. the longer the latency to drink, the more fearful the rat). The results showed a significant treatment effect with the 15-second group being most fearful. Again, curvilinearity was observed with short or long exposures producing less fear than exposures of intermediate durations. However, when the rats were tested a second time (8 minutes after the first test), there were no significant group differences. A second measure, the median number of licks at a water spout produced similar results to the latency measure. The 15-second group licked the water spout fewer times than the other groups on the first test, but this effect disappeared on the second test when there were no significant differences between groups.

These studies designed to investigate enhancement in rats (Rohrbaugh and Riccio, 1970; Rohrbaugh, Riccio and Arthur, 1972; and Silvestri, Rohrbaugh and Riccio, 1970) demonstrate that exposures to the CS-alone can increase the amount of fear behaviour exhibited by a rat. Under certain

conditions these animals show increased spatial avoidance or increased latency to drink during a CS-alone trial. These results also demonstrate that the enhancement effect is curvilinear as a function of duration of CS-alone exposure. With either very brief or very long CS-alone presentations subjects do not exhibit as much fear behaviour as do subjects which were exposed to presentations of intermediate durations of the CS-alone. Such results seem to indicate that amount of CS exposure is the critical variable in the study of paradoxical enhancement.

Miller and Levis (1971) observed increased avoidance behaviour in human phobic subjects as a result of varying visual exposure times to a phobic test stimulus. Forty high school girls who verbally admitted to a fear of snakes and who would not touch a live snake in the pretest, were assigned to groups of varying exposure to the snake. Consequently, after pretesting a girl would have either 0, 15, 30, or 45 minutes exposure to a live snake. Following the experimental period, a posttest avoidance test was given. The dependent variables used were: a contact measure (i.e. whether or not the girl actually touched the snake), a distance measure (i.e. how close the girl approached the snake), a latency measure (i.e. how long it took to approach the snake), and the Adjective Check List (completed at both pretest and posttest). No significant group differences were obtained with either latency

or the Adjective Check List. However, the contact and distance measures produced significant results with the girls in the 15-minute group being more fearful than the girls in the other three groups which were not significantly different from each other. Girls exposed to the phobic stimulus for 15-minutes displayed the strongest avoidance tendencies on posttesting. Miller and Levis (1971) conclude that certain exposure times to a phobic stimulus may "prevent extinction and result in the conservation of a high level of fear" (p. 20).

Although much work was done to establish the paradoxical enhancement effect in animals little work was conducted on human subjects. The conditions under which the enhancement phenomenon may occur in humans has been investigated by Rodgers (1976).

Rodgers (1976) investigated the phenomenon that under certain conditions the presentation of a conditioned stimulus (CS) may produce enhancement of the conditioned response (CR) rather than extinction. Five groups of five male undergraduates were used in this study. Three groups were experimental while the remaining two groups served as control groups. The three experimental groups each received CS (slide presentations) - UCS (0.5 second burst of white noise at an intensity level of 101 decibels) pairings on a 76 per cent irregular reinforcement schedule. Group treatments differed by the number of 2-second presentations of

the CS-alone administered immediately following conditioning, either 4, 12, or 30 presentations. The control groups received only either CS-alone trials or UCS-alone trials. At two extinction sessions, one week and two weeks after conditioning, the magnitude and latency of the Galvanic Skin Response (GSR) and change in Finger Pulse (FP) rate were recorded. The primary finding of this study was that the group with the greatest number of CS-alone presentations after conditioning (30) was significantly different from the other experimental groups on GSR magnitude. This group did not extinguish after 60 CS-alone presentations while the other experimental groups extinguished after 20 CS-alone presentations. Also, this same group had a significantly larger mean magnitude of GSR than did the other two experimental groups. Rodgers (1976) argued that his results are evidence of the enhancement phenomenon and that frequency of CS-alone presentation is an important determinant in the production of this effect.

The work of Miller and Levis (1971) and Rodgers (1976) shows some promising results in the production of paradoxical enhancement in human subjects. Miller and Levis (1971) demonstrate that exposure to a fear stimulus can increase the amount of avoidance behaviour exhibited by human subjects. Rodgers (1976) has shown that by repeatedly and frequently exposing a human to a CS-alone it is possible to produce physiological responses which

resist extinction. While the group of Miller and Levis (1971) which received an intermediate amount of exposure to the phobic stimulus exhibited enhancement of avoidance behaviour the group of Rodgers (1976) which received the most frequent presentation of the CS-alone following conditioning showed enhanced physiological responses.

Clinical Implications of Paradoxical Enhancement

Eysenck (1968) has suggested that this enhancement phenomenon has many implications for clinical research. He states that this concept may be very useful as an explanation of the origin of phobic disorders. Thus:

Occasionally, phobic patients are found in which the original traumatic event is not immediately followed by a strong conditioned fear of the CS, but where this fear seems to grow in time, so that exposure to the unreinforced CS does not seem to lead to extinction, but rather to an increase in the severity of the conditioned response. Again not all patients show spontaneous remission; a fair proportion either remain ill or even get worse with time, in spite of the fact that no further reinforcement (pairing of the CS and UCS) occurs (p. 63).

Eysenck (1968) notes that aversion therapy may be viewed as producing an experimental neurosis that is not maladaptive. He suggests that enhancement may have positive effects for aversion therapy as the experimental neurosis may be much more resistant to extinction. He reports that "incubation would seem to present us with a mechanism which would counteract extinction" (p. 316) in aversion therapy.

In regard to implosion therapy, Stampfl and Levis (1968) argue that exposure of the subject to the CS should lead to extinction quickly and efficiently. However, enhancement might occur under certain conditions and increase, rather than decrease, the fear of the subject.

Rachman (1966), in investigating the effectiveness of flooding as a technique of reducing fear, exposed spider phobic subjects to intensely disturbing imaginal stimuli for ten 2-minute presentations per session. After ten such sessions (two per week) two subjects reported no change in their fear of spiders, while one subject reported an increase in fear. Thus, provoking intense emotional experiences for short durations of time (two minutes) may actually prove detrimental to the subject. As the data of Wolpin and Raines (1966) suggest, much longer durations (10 minutes) of presentation of anxiety-provoking stimuli may be necessary to extinguish the fear response.

In desensitization therapy, there is a tendency for patients to relapse when in the course of therapy a stimulus is presented (either imaginally or in vivo) which is still too sensitive to be sufficiently counteracted by relaxation (Wolpe, 1958). There is nothing in the orthodox theory of desensitization to suggest that this should happen. Consequently, a concept such as enhancement is necessary to explain this occurrence.

Another concept with which Eysenck (1968) deals is the dimension of "neuroticism-anxiety-emotionality." This parameter should be investigated in relation to enhancement as Spence and Spence (1964) have shown that high neuroticism scores on the Maudsley Personality Inventory (MPI) are positively correlated with strength of conditioning. Since it may be presumed that enhancement is a conditioning phenomenon, it can be expected that those individuals who condition more readily than others will show greater enhancement of their conditioned responses.

Eysenck (1968) has also postulated that the personality dimension of introversion-extraversion may be related to enhancement. Franks (1956) has investigated the relationship between this personality dimension and conditionability. He found a significant negative correlation between extraversion and speed of conditioning. It may be postulated, therefore, that those persons who condition readily and strongly are more likely to exhibit the enhancement phenomenon (Eysenck, 1968) than are those persons who do not condition well.

Purpose of the Present Study

Rodgers (1976) has attempted to demonstrate directly the enhancement phenomenon in human subjects by varying the frequency of CS-alone presentation following conditioning. He found that the group receiving the most frequent CS-alone

presentations demonstrated increased response strength over time. The present study was designed to determine if enhancement could be demonstrated in human subjects by varying the duration of CS-alone exposure following conditioning as it was previously demonstrated in rats by Rohrbaugh and his associates. It is probably not the case that 30 2-second CS-alone presentations are equivalent to one 60-second presentation of the CS-alone, but as there are no other guidelines to follow this exposure duration was arbitrarily selected. Rodgers (1976) did not find any evidence to suggest that enhancement was a curvilinear function. Durations of CS-alone exposure were selected so that the group which showed enhancement in Rodgers' study would be the intermediate CS-alone exposure group in this study. In this manner, it was hoped that the concept of curvilinearity of the enhancement effect could be tested. The other durations of CS-alone exposure used were selected on a somewhat arbitrary basis.

In the present study it was decided to condition three groups to respond with autonomic changes when a particular slide was presented. Following conditioning, one group was exposed to the CS for a very brief time duration, the second for an intermediate duration and the third for a long duration. It was expected that during subsequent extinction sessions (conducted one week and two weeks

following conditioning) the second group would show increased physiological responses to the CS, while the first and third groups would show the well-known extinction effect. As the durations of CS-alone exposure were chosen arbitrarily, it was decided that enhanced responding in either the second or third group would be accepted as providing evidence for the existence of paradoxical enhancement.

Specifically, it was hypothesized that:

1. Enhancement of a CR occurs in human subjects following unreinforced presentations of the CS under certain conditions.

2. The occurrence of CR enhancement is a curvilinear function of the duration of unreinforced presentations of the CS; short or long presentations result in extinction of the CR, presentations of an intermediate duration result in an enhanced CR. Enhancement means the strength of the CR is increased or maintained during extinction trials.

3. Enhancement of the CR is a function of the personality dimensions of neuroticism or introversion with those persons high on introversion or neuroticism showing most enhancement.

METHOD

Subjects. The subjects were 34 male undergraduate students from Memorial University each of whom was paid \$8.00 for his participation in this experiment. They were recruited using signs placed at noticeable points around the University. The average age of subjects was 20.08 years, ranging from 15-28 years.

These students interested in participating in the study were given an information sheet describing the conditions which were to be fulfilled in order for them to take part in the experiment. These conditions were as follows: (a) the student could not participate if he had any electronic devices implanted in his body (eg. a heart pacemaker); (b) he could not participate if he had recently been under the care of a physician for ear trouble; (c) he had to agree to participate at the same time each week for three consecutive weeks; (d) he had to agree to complete a copy of the Eysenck Personality Inventory (Form A); (e) he had to agree that he would not be paid until the completion of his participation; (f) he would not be paid if he did not complete all three sessions of the experiment. Immediately following this all subjects completed the Eysenck Personality Inventory (EPI-Form A).

If the above conditions were met and agreed upon, the subject decided upon a convenient time to participate, and a card was given to him stating the time, date and place of the appointment.

The subjects were placed in one of the four groups by order of their arrival to take part in the study. That is, the first four subjects were placed in Groups 1-4 respectively, while the fifth was assigned to Group 1, the sixth to Group 2, the seventh to Group 3, the eighth to Group 4, and so on.

Two subjects were omitted from the study because they failed to come to their third session, while four other subjects were omitted from further study as they failed to respond to the CS or show any signs of conditioning in the first experimental session. These subjects may not have found the UCS arousing and consequently failed to condition, or the measures of physiological arousal used in the present study may not have been sufficient to measure arousal in these subjects.

Apparatus. A Beckman Type R411 Dynograph Recorder was used to record: (a) galvanic skin response; (b) finger pulse; and (c) the occurrence of a slide change signal.

The galvanic skin response (GSR) was obtained through Beckman Biopotential Skin Electrodes (area of 0.6 cm.^2 , current density 16.7 A/cm.^2) and a Beckman Type 9842 coupler.

Finger pulse was obtained by the use of a Motorola digital plethysmograph and a Beckman Type 9853A coupler. Slide change signals (previously recorded on magnetic tape) were obtained by connecting a third channel of the dynograph to a Sony Model TC-252 tape recorder.

The Sony tape recorder was connected to a Kodak Carousel Sound Synchronizer which in turn was connected to a Kodak Carousel 800 slide projector. As a result, slide changes (which were previously recorded as electronic signals on magnetic tape) were controlled by the tape recorder. This was connected to a Harmon-Kardon Model AX20 Audio Amplifier which delivered its signal to the subject by means of a set of headphones.

The conditioned stimulus (CS) which was used in this study was a slide containing two black circles (one directly above the other) of equal size presented on an all white background. The unconditioned stimulus (UCS) was a burst of white noise at an intensity level of 100 decibels (db) as measured by a General Radio sound level meter. Previous studies (eg. Prokasy and Ebel, 1964; Rodgers, 1976) have found evidence of GSR conditioning with this type of auditory stimulus. The intensity level which was used was just below the level which would be injurious to the subjects, but was sufficiently intense to arouse the subjects. This stimulus also was previously recorded on magnetic tape and was presented to the subject through the set of headphones for

an 0.5 second duration. However, the UCS and slide change signals were recorded on separate tracks of the magnetic tape, so that it was impossible for a subject to hear the electronic signal indicating a slide change. During pairings of the CS-UCS, there was an interstimulus interval of 1.5 seconds, the CS being present for 2.0 seconds with the UCS overlapping the CS for the last 0.5 seconds. The inter-trial interval (ITI) was either 30, 40, or 50 seconds (randomly ordered) with an average ITI of 40 seconds, during which a neutral pale blue slide was presented. The background noise level for all ITI's was approximately 60 decibels.

A second tape which programmed non-contingent presentations of the CS and UCS had a background noise level of 48 decibels. A third tape which was used for CS-alone presentations only, had a background noise level of 48 decibels. Programming and timing of all events was initially completed using the Psychology Department Digital Computer (Data General Corporation - 8K NOVA).

The conditioning session consisted of 40 trials using the above-mentioned ITI's. Thirty of these trials were acquisition trials (CS-UCS) while the remaining ten trials were unreinforced. The unreinforced trials were trials 12, 15, 19, 22, 25, 26, 29, 32, 35 and 38.

The CS-alone (extinction) tape had 48 trials with ITI's identical to the first tape. There were no reinforced

trials on this tape.

All sessions were run in a darkened, sound-attenuated room, 3.34 x 2.13 x 3.05 m. (see Figure 1).

Procedure. When the subject arrived for the first experimental session, he was shown into the experimental room and seated in a reclining chair. The subject's non-preferred hand was cleansed with rubbing alcohol, then rubbed briskly with a piece of fine sandpaper. A small dab of Beckman Electrode Paste was then rubbed into the palm of the hand, and any excess paste was removed with a paper towel. The two electrodes were then attached to the base of the subject's first and fourth fingers by adhesive cuffs. The finger plethysmograph was then clipped to the subject's index finger of the same hand, the lights dimmed and the subject given the instructions for the experiment. The instructions to all four groups were as follows:

Today you will be watching slides and listening to noise through the headphones. I will be monitoring your responses to these stimuli on the polygraph. There is nothing to worry about so just sit still and relax. I will inform you when the session is completed. Any questions?

Following this, any questions which did not concern the basic nature of the experiment were answered, the headphones were put over the subject's ears and the tape recorder, polygraph and slide projector were switched on. For all subjects in the first session the chart speed of the polygraph

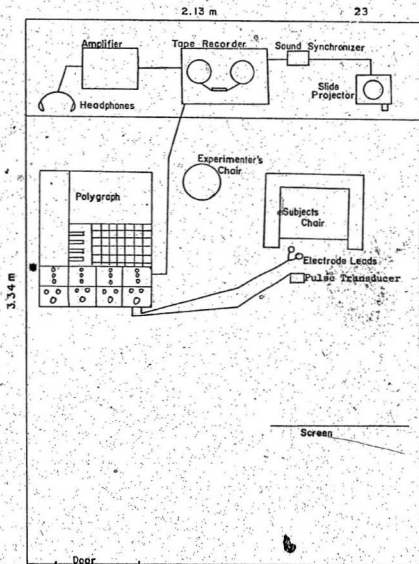


FIGURE 1. The Experimental Room.

was 5 mm./second and the pre-amplifier sensitivities were adjusted to obtain the clearest signal from each individual subject. However, before the session actually began, the subject was allowed from 1 to 5 minutes in which to relax in order to decrease any initial anxiety he may have felt related to the test situation itself. The experimenter remained in the room during the experiment to handle any possible problems which might arise with the equipment. The experimenter was seated on a chair to the right of and behind the subject.

All subjects in the three experimental groups received the same sequence of conditioning trials. Sixty seconds after the last trial on this tape Group G-2 was presented with the CS-alone for 2 seconds, Group G-60 was presented with the CS-alone for 60 seconds, and Group G-300 was presented with the CS-alone for 300 seconds. This procedure comprised the experimental manipulation.

Group G-C (control group) received 40 presentations of the CS and 30 presentations of the UCS. The number of CS and UCS presentations was the same number the three experimental groups received, however, the CS and UCS were never paired for this group.

At the termination of this session, which had a total duration of approximately 50 minutes, the subject was detached from the polygraph, then the polygraph, tape recorder and slide projector were turned off, the headphones

removed, the lights turned on, the subject thanked and reminded of his appointment for the same time the following week.

For the second and third sessions the same procedure was followed. The subjects were again instructed to try to remain still and relax. For these sessions the CS-alone tape was used for all groups, so that everyone received 30 CS-alone presentations during each of the remaining two sessions. For these, the polygraph chart speed was 2.5mm./second, and again the pre-amplifier sensitivities were adjusted for each individual subject so that the clearest signal could be obtained.

At the end of the third session, subjects were debriefed, thanked and payment for their services was made. These last two sessions lasted for approximately 30 minutes each.

For GSR, it is possible to employ measures of latency and magnitude. Latency is measured from CS onset to response onset. It is measured with a ruler in centimeters and then converted into seconds according to the chart speed of the polygraph. Magnitude is a measure of change in base which incorporates zero response (i.e. if there is no response, a score of zero is averaged with the changes recorded on other trials). This, too, is measured with a ruler in centimeters and then converted into kilohms. The frequency of response was also recorded. In

order for a response to be counted, there had to be a change of at least 100 ohms between 0.9 and 5.0 seconds after CS onset.

For Finger Pulse, a change score was employed. This change score was the difference between the number of finger pulses recorded in the 10 second interval preceding CS presentation and the number of finger pulses recorded during the 10 second interval immediately following CS presentation. These scores were then summed over blocks of five trials, and subsequent analysis performed on them.

RESULTS

Group Characteristics. The mean age of Group G-2 was 19.25 years, of Group G-60, 21.11 years, of Group G-300, 20.00 years, and of Group G-C, 19.88 years. These group differences were not significant ($F(3,30) = 0.61$, $p > .05$, see Table 1).

The mean score on the Extraversion scale of the EPI was 13.6 for Group G-2, 13.4 for Group G-60, 11.6 for Group G-300 and 12.6 for Group G-C. On the Neuroticism scale the mean score for Group G-2 was 11.0, for Group G-60, 9.5, for Group G-300, 7.5, and for Group G-C, 9.2. On the Lie scale the mean score for Group G-2 was 3.3, for Group G-60, 3.8, for Group G-300, 3.0 and for Group G-C, 3.3. The group differences on these scales were not significant yielding F ratios $(3,30) = .57$, $.49$ and $.19$, respectively (see Tables 2, 3, 4 and 5).

Evidence for Conditioning. To determine whether conditioning had taken place in the experimental groups, the magnitude of the GSR during the ten unreinforced (probe) trials of the conditioning session was compared to the magnitude of the GSR on the same trials in the control group. A transformation of this data was required so that it satisfied such assumptions as normality and homogeneity

TABLE 1
ONE-WAY ANALYSIS OF VARIANCE:
AGE OF SUBJECTS

Source	SS	df	MS	F
Between Groups	15.46	3	5.15	0.61 <u>ns</u>
Within Groups	253.28	30	8.44	
Total	268.74			

TABLE 2
ONE-WAY ANALYSIS OF VARIANCE: EXTRAVERSION-INTROVERSION
SCORES (EPI, FORM A)

Source	SS	df	MS	F
Between Groups	20.30	3	6.77	0.57 <u>ns</u>
Within Groups	351.96	30	11.73	
Total	372.26			

TABLE 3
ONE-WAY ANALYSIS OF VARIANCE: NEUROTICISM-STABILITY
SCORES (EPI, FORM A)

Source	SS	df	MS	F
Between Groups	49.66	3	16.55	0.49 ns
Within Groups	1003.78	30	33.46	
Total	1053.44			

TABLE 4
ONE-WAY ANALYSIS OF VARIANCE:
LIE SCORES (EPI, FORM A)

Source	SS	df	MS	F
Between Groups	1.94	3	0.64	0.19 ns
Within Groups	97.50	30	3.25	
Total	99.44			

TABLE 5
GROUP MEANS AND STANDARD DEVIATIONS ON EPI,
E, N AND L SCALES

Scale	Group G-2		Group G-60		Group G-300		Group G-C	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
E	13.6	2.49	13.4	3.41	11.6	3.27	12.6	4.40
N	11.0	6.04	9.5	5.25	7.5	3.71	9.2	7.46
L	3.3	2.24	3.8	0.94	3.0	1.42	3.3	2.00

of variance and minimized skew in the experimental data. This was done by means of a computer program devised by Dunlap and Duffy (1974). The program tests whether the data requires a transformation, and, if so, which transformation is appropriate so that the data best approximates a normal distribution. Here, a reciprocal transformation was required and performed with 1.000 being added to produce positive data. The means to be given of GSR magnitude are of transformed data and the smallest mean therefore reflects the greatest magnitude. The one-way analysis of variance performed upon the transformed data indicated a significant difference between the groups ($F(3,30) = 3.17$, $p < .05$, see Table 6). An F test for a priori comparisons (Ferguson, 1966) performed on the group means was also significant ($F(3,30) = 87.11$, $p < .01$) indicating a difference between the three experimental groups and the control group. The mean magnitude (in 1/kohms) of Group G-2 was .59, of Group G-60 was .51, of Group G-300 was .50 and of Group G-C was .81.

Further evidence was sought for conditioning by comparing the frequency of response of the four groups on the probe trials of the four groups of the conditioning session. A one-way analysis of variance yielded a significant difference between groups ($F(3,30) = 17.41$, $p < .01$, see Table 7). The mean frequency of response for Group G-2 was 8.88, for Group G-60, 9.00, for Group G-300, 9.38 and

TABLE 6

ONE-WAY ANALYSIS OF VARIANCE: MAGNITUDE OF GSR
(1/KOHMS) DURING PROBE TRIALS
CONDITIONING SESSION

Source	SS	df	MS	F
Between Groups	0.57	3	0.19	3.17 *
Within Groups	1.88	30	0.06	
Total	2.45			

* $p < .05$

TABLE 7

ONE-WAY ANALYSIS OF VARIANCE: FREQUENCY OF
GSR RESPONSE DURING PROBE TRIALS OF
THE CONDITIONING SESSION

Source	SS	df	MS	F
Between Groups	171.88	3	57.29	17.41 *
Within Groups	98.74	30	3.29	
Total	270.62			

* $p < .01$

for Group G-C, 4.00. Using the F test for a priori comparisons a significant difference was indicated between the experimental and control groups ($F(3,30) = 51.82$, $p < .01$, see Table 8).

A one-way analysis of variance performed upon Pulse Rate changes of the four groups on the probe trials of the conditioning session was not significant ($F(3,30) = 1.39$, $p > .05$, see Table 9). An a priori F test performed upon the means of the experimental and control groups was also non-significant ($F(3,30) = 1.08$, $p > .05$) indicating that there were no differences in the mean Pulse Rate change of the four groups. The mean Pulse Rate change for Group G-2 was -1.37, for Group G-60, .77, for Group G-300, .75, and for Group G-C, -1.11.

Evidence of Enhancement. It was predicted that during CS-alone presentations in sessions two and three, Group G-60 which received 60 seconds of CS-alone presentation after conditioning would show increased strength of response, while Group G-2 which received 2 seconds CS-alone exposure after conditioning, and Group G-300 which received 300 seconds CS-alone exposure after conditioning would show decreased strength of response.

Evidence for enhancement was sought by comparing GSR magnitudes on the first block of five extinction trials in session two. As above, this data was transformed by the

TABLE 8

A PRIORI F TEST FOR MEAN GSR RESPONSE FREQUENCY
ON PROBE TRIALS

	<u>Group G-2</u>	<u>Group G-60</u>	<u>Group G-300</u>	<u>Group G-C</u>
Means	8.88	9.00	9.38	4.00
<u>Comparison</u>				<u>F</u>
G-2 vs G-60				0.179
G-2 vs G-300				0.304
G-2 vs G-C				30.526 *
G-60 vs G-300				0.185
G-60 vs G-C				34.200 *
G-300 vs G-C				37.108 *
G-2, G-60, G-300 vs G-C				51.820 *

* $p < .01$

TABLE 9

ONE-WAY ANALYSIS OF VARIANCE: CHANGE IN PULSE RATE
DURING PROBE TRIALS IN THE CONDITIONING SESSION

Source	SS	df	MS	F
Between Groups	34.29	3	11.43	1.39 <u>ns</u>
Within Groups	245.83	30	8.19	
Total	280.12			

reciprocal transformation (Dunlap and Duffy, 1974). The group differences were not significant ($F(3,30) = 2.44$, $p > .05$, see Table 10). However, an a priori F test revealed that the three experimental groups were still responding with significantly greater magnitude of GSR than the control group ($F(3,30) = 4.86$, $p < .01$) but the three experimental groups were not significantly different from each other. Multiple comparisons performed upon these group means using the F test (Winer, 1962) indicated only that there was a significant difference between Group G-300 and Group G-C ($F(1,30) = 6.74$, $p < .05$). The other comparisons performed upon these group means did not even approach significance. Again, the significant difference between the mean GSR magnitude of Group G-300 and Group G-C may be attributed to conditioning. The mean GSR magnitude (in 1/kohms units) for Group G-2 was .342, for Group G-60, .305, for Group G-300, .190, and for Group G-C, .447.

A similar one-way analysis of variance was conducted on the Finger Pulse scores. This analysis did not yield any significant differences between groups ($F(3,30) = .935$, $p > .05$, see Table 11). An a priori F test revealed only that the experimental groups were not responding differently than the control group ($F(3,30) = .027$, $p > .05$). The mean change in beats per minute in Finger

TABLE 10

ONE-WAY ANALYSIS OF VARIANCE: MAGNITUDE OF GSR
(1/KOHMS) DURING FIRST BLOCK OF FIVE
TRIALS (SESSION TWO)

Source	SS	df	MS	F	
Between Groups	0.285	3	0.095	2.436	<u>ns</u>
Within Groups	1.157	30	0.039		
Total	2.442				

TABLE 11

ONE-WAY ANALYSIS OF VARIANCE: FINGER PULSE DURING
FIRST BLOCK OF FIVE TRIALS (SESSION TWO)

Source	SS	df	MS	F	
Between Groups	8.969	3	2.990	0.935	<u>ns</u>
Within Groups	95.972	30	3.199		
Total	104.941				

Pulse rate for Group G-2 was $-.125$, for Group G-60, $-.333$, for Group G-300, $-.875$, and for Group G-C, $.556$.

In order to further investigate the characteristics of responding during the two extinction sessions, comparisons were made for GSR magnitude between groups in each extinction session and between means of each block of five trials (a Group (4) x Sessions (2) x Trial Blocks (6) analysis of variance, see Table 12). This and subsequent analyses of variance were performed on an IBM 360 computer using the Balanova 5 (1968) computer program. A similar analysis was carried out for Finger Pulse data (see Table 13).

The expected main effect (Groups) was not significant, however, significant main effects were found for Sessions and Trials and an interaction effect was found for Sessions x Trials on magnitude of the GSR. The magnitude decreased over sessions and also across the six trial blocks (see Figure 2). These results seem to be evidence of the extinction effect where, "a response that has been classically conditioned gradually diminishes in strength if reinforcement, the unconditioned stimulus in this case, is removed" (Deese and Hulse, 1967, p. 112).

The interaction reflects that the difference in the change in GSR magnitude over trials is different in session two from that in session three. In session two

TABLE 12

SUMMARY OF ANALYSIS OF VARIANCE: MAGNITUDE OF GSR
(1/KOHMS), GROUPS X SESSIONS X TRIAL BLOCKS

Source	SS	df	MS	F
Sessions (S)	2.231	1	2.232	22.27 **
S x Groups (G)	0.423	3	0.141	1.41
S x Subjects	3.006	30	0.100	
Trials (T)	3.997	5	0.799	19.35 **
T x G	0.390	15	0.026	0.63
T x Subjects	6.197	150	0.041	
G	2.490	3	0.830	2.16
Subjects	11.505	30	0.383	
S x T	0.460	5	0.092	2.46 *
S x T x G	0.773	15	0.052	1.38
S x T x Subjects	5.604	150	0.037	

* $p < .05$

** $p < .01$

TABLE 13
SUMMARY OF ANALYSIS OF VARIANCE: CHANGE IN FINGER
PULSE, GROUPS X SESSIONS X TRIAL BLOCKS

Source	SS	df	MS	F
Sessions (S)	0.010	1	0.010	0.002
S x Groups (G)	50.604	3	16.868	4.28 *
S x Subjects	118.219	30	3.941	
Trials (T)	17.971	5	3.594	1.05
T x G	24.559	15	1.637	0.48
T x Subjects	512.616	150	3.417	
G	9.562	3	3.187	0.37
Subjects	256.181	30	8.539	
S x T	4.755	5	0.951	0.28
S x T X G	80.729	15	5.382	1.59
S x T x Subjects	508.653	150	3.391	

* $p < .05$

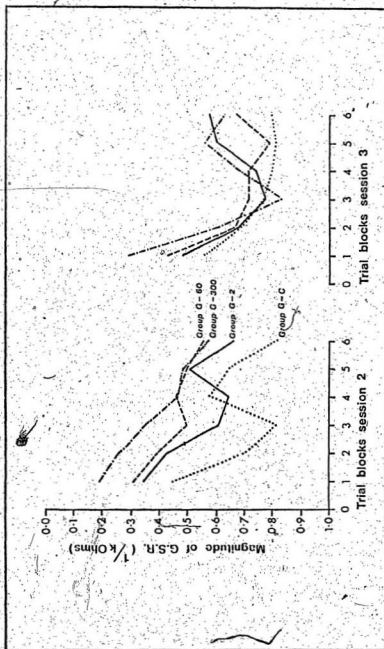


Figure 2. Magnitude (transformed) of GSR for groups during trial blocks of Sessions 2 and 3.

the magnitude of the GSR across trials initially decreases, then increases slightly and decreases again on the final trial block. However, in session three the magnitude of the GSR across trials initially decreases, then continues to increase slightly from the third to the final trial block (see Figure 3).

For Finger Pulse there were no main effects found, however, a significant interaction effect was found for Sessions x Groups. This interaction reflects the fact that the change in rate of Finger Pulse decreases from session two to session three for Groups G-2 and G-C, while it increases from session two to session three for Groups G-60 and G-300.

Latency

It was expected that if enhancement were to occur, the latency of the GSR would decrease over time. This data was also tested to determine whether any transformation was required. It was found that no transformation of the data was necessary. Analysis of this variable using a Group (4) x Sessions (2) x Trial Blocks (6) analysis of variance yielded significant main effects for Sessions and Trial Blocks, although the expected main effect for Groups was not found (see Table 14). The latency of the GSR increased over sessions and across trial blocks (see Figure 4). Such increases tend to support an extinction effect as

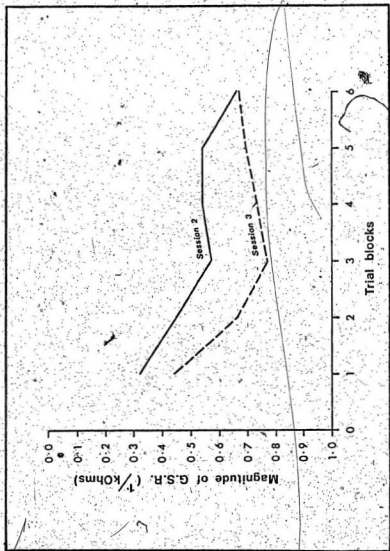


Figure 3. Magnitude (transformed) of GSR, Sessions X Trial Blocks of Interaction.

TABLE 14

SUMMARY OF ANALYSIS OF VARIANCE: LATENCY OF GSR
(SECONDS), GROUPS X SESSIONS X TRIAL BLOCKS

Source	SS	df	MS	F
Sessions (S)	27.617	1	27.617	12.95 **
S x Groups (G)	13.638	3	4.546	2.13
S x Subjects	64.002	30	2.133	
Trials (T)	10.550	5	2.110	2.23 **
T x G	6.294	15	0.420	0.64
T x Subjects	98.111	150	0.654	
G	8.301	3	2.767	0.54
Subjects	153.380	30	5.113	
S x T	3.086	5	0.617	0.93
S x T x G	10.766	15	0.718	1.08
S x T x Subjects	99.680	150	0.665	

** $p < .01$

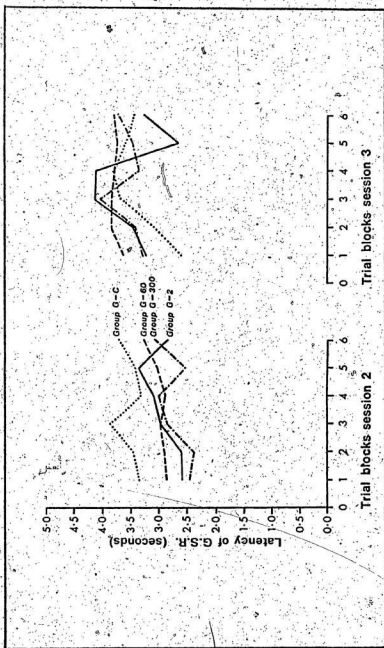


Figure 4. Latency of G.S.R. (seconds) for groups during trial blocks of Sessions 2 and 3.

was found for magnitude of the GSR.

Neuroticism and Introversion

It was predicted that those subjects high on neuroticism or introversion would show the most enhancement. There was no evidence of enhancement found in this study. The subjects were consequently divided into groups of high neuroticism or low neuroticism and high introversion or low introversion. A subject classified as high on one of these dimensions had a score which fell above the median score, while a subject classified as low on one of these dimensions had a score which fell below the median score. Subsequently, high neuroticism and high introversion subjects were compared with low neuroticism and high extraversion subjects to determine whether there were any differences between these groups on conditioning or extinction.

During conditioning, the mean GSR magnitude for the low neuroticism group was .588, while the mean GSR magnitude for the high neuroticism group was .611. These means were not significantly different ($t(32) = .328, p > .05$) indicating that the high neuroticism group did not show greater strength of response than the low neuroticism group during conditioning.

The mean GSR magnitude for the high introversion group was .588, while the mean GSR magnitude for the high extraversion group was .631 during conditioning. These

group means were not significantly different ($t(32) = .614$, $p > .05$) indicating that the introverts did not respond with greater response strength during conditioning than did the extraverts.

During the two extinction sessions the mean GSR magnitude for the low neuroticism group was .581, while for the high neuroticism group the mean GSR magnitude was .592. Again, these group means were not significantly different ($t(32) = .175$, $p > .05$) indicating that the responses of the high neuroticism group were not different from those of the low neuroticism group during the two extinction sessions.

The mean GSR magnitude for the high introversion group was .584 during the two extinction sessions and the mean GSR magnitude was .595 for the high extraversion group during the same two sessions. There was no significant difference between these two group means ($t(32) = .175$, $p > .05$) indicating that the responses of the high introversion group were not different from those of the high extraversion group during the two extinction sessions.

DISCUSSION

It was predicted that Group G-60 which received an intermediate duration of the CS-alone following conditioning would exhibit CR enhancement, while Group G-2 which received a short CS-alone duration following conditioning and Group G-300 which received a long CS-alone duration following conditioning would exhibit CR extinction. In fact, neither the dependent variables of magnitude nor latency of the GSR nor the change in rate of Finger Pulse provided any evidence to support this hypothesis.

During the conditioning session, when the loud burst of white noise (UCS) was presented the obtained response included a GSR and a change in rate of Finger Pulse. Also, clear evidence of GSR conditioning in the experimental groups was obtained, however, there was no evidence of any conditioning on the variable of change in rate of Finger Pulse. As was previously mentioned, it was expected that upon testing on the extinction trials Group G-60 would exhibit increased strength of response (enhancement) while Groups G-2 and G-300 would exhibit decreased strength of response (extinction). These predictions were not confirmed as this study failed to find the expected group differences in the rate of extinction. Such results do not reflect the desired paradoxical enhancement effect but rather the well-known

extinction effect.

No evidence for conditioning was found for the variable of change in rate of Finger Pulse. Subsequently, when the responses occurring during the extinction trials were analyzed no group differences were found for this dependent variable.

It is clear that Group G-60 neither maintained nor increased its strength of response over time after removal of the UCS. In fact, all of the experimental groups showed the well-known extinction effect.

Although the method of Rodgers (1976) was replicated, the results obtained in this study did not replicate those obtained in his study. Rodgers found evidence for the existence of the paradoxical enhancement effect by varying the frequency of CS-alone exposure after conditioning. No such evidence was found when the duration of CS-alone exposure after conditioning was varied.

Research conducted by Rohrbaugh and his associates provides evidence that duration of CS-alone exposure following conditioning is the critical variable in CR enhancement. Rohrbaugh and Riccio (1970) obtained results suggestive of, but not clearly demonstrative of, paradoxical enhancement by presenting the CS-alone only once following conditioning for varying time durations. This procedure is similar to that used in the present study. However, when groups which received varying durations of CS-alone exposure

were presented with the CS-alone repeatedly after conditioning clear evidence for an enhancement effect emerged in a test situation. Napalkov (1963), Rohrbaugh and Riccio (1970), Silvestri et al. (1970) and Rodgers (1976) have all obtained evidence for enhancement by repeatedly presenting the CS-alone after conditioning. Such results suggest that varying either the duration of CS-alone exposure after conditioning or frequency of CS-alone exposure following conditioning may not be the best approach to the phenomenon of paradoxical enhancement. Although the frequency variable has been shown to be effective in producing enhancement the variable of duration has usually been held constant in these studies. Paradoxical enhancement may not be a function of either frequency or duration alone but it may well be that it occurs only when these two variables are combined in a certain manner to produce an optimum enhancement effect. A factorial design varying both duration and frequency of CS-alone exposure following conditioning may be the best way to obtain evidence of enhancement and to determine under which conditions it will best be demonstrated. The present study, although failing to produce evidence of enhancement, may well have produced such evidence in one of the three experimental groups if the CS-alone was presented a number of times after conditioning rather than just once. That is, if rather than studying only the effect of duration of CS-alone exposure following

conditioning both the variables of frequency and duration of CS-alone exposure had been studied, evidence of paradoxical enhancement may well have been produced by this study.

There are several additional possibilities to suggest why the present study did not support the enhancement effect. Studies which obtained such an effect, particularly that of Napalkov (1963) and Campbell et al. (1964) involved a single presentation of a very traumatic unconditioned stimulus. The loud burst of white noise used in this study was not considered traumatic by the subjects involved.

Eysenck (1968) suggests a theory which he believes can account for the phenomenon of paradoxical enhancement, however, he uses the term incubation to refer to the enhanced CR. Thus:

The presentation of a CS unaccompanied by a UCS always provokes a decrement in CR strength, but that for reasons to be explained it also provokes an increment in CR strength, so that the observed CR is the resultant of two opposing tendencies; extinction will be observed if the decremending tendencies are greater than the incrementing ones, while incubation will be observed if the incrementing tendencies are greater than the decremending ones (p. 312).

Using Eysenck's theory the results obtained in this study can be accounted for by the fact that the conditioned response was not strong enough to overcome the decrement produced by the process of extinction. It may be important, therefore, in order to obtain enhancement, to use a traumatic or at least very arousing unconditioned stimulus. As the

UCS in this study was a burst of white noise presented at an intensity of 100 decibels it would be harmful to the subject to increase the intensity to make the stimulus more arousing. In order to overcome problems such as this it would be possible to use a UCS which has an emotional response already associated with it, such as electric shock.

The dependent variables employed in this study (GSR and Finger Pulse) may not have been sufficient to measure arousal in all of the subjects. As Lacey and Lacey (1958) have noted humans differ in their physiological correlates of arousal. Hence, additional measures of responsiveness, such as muscle tension and respiration, may be needed in order to adequately measure physiological responses in human subjects.

The change in rate of Finger Pulse did not yield any data which would be indicative of increased response strength. The manner in which this variable was measured, that is, the change in rate 10-seconds pre-CS to 10-seconds post-CS, may have been too gross a measure to yield any precise results. It is suggested that heart rate be used as an indicator of physiological arousal and it be measured using beat-to-beat intervals.

The durations of CS-alone exposure used in this study were 2 seconds, 60 seconds and 300 seconds. These durations may not have been close to the critical durations

of CS-alone exposure needed to produce enhancement in human subjects. Indeed, the range of time of CS-alone exposure needed could well have been missed altogether, especially if a duration of more than 300 seconds is necessary to produce enhancement. That researchers (Rohrbaugh and his associates) found enhancement in animals with the durations of 60 and 300 seconds is not a reliable indicator that such durations also produce enhancement in human subjects. Rodgers (1976) found evidence of enhancement in the group receiving the most frequent CS-alone presentations where it was not expected judging by the experimental literature. This group received 30 2-second CS-alone presentations. Consequently, a 60-second CS-alone exposure group was included in the present study to determine if only one presentation of the CS-alone would produce similar evidence of an enhancement effect. Even though it is probably not the case that 30 2-second presentations are equivalent to one 60-second CS-alone exposure, this latter group was arbitrarily selected for study as there were few guidelines to follow in selecting CS-alone exposure durations. Using a phobic test stimulus (of which subjects verbally admitted their fear) Miller and Levis (1971) found that a 15 minute exposure period to the phobic stimulus produced an increase in fear in that group of their human subjects. There are as yet no guidelines to suggest the durations of CS-alone exposure which will produce enhancement in humans. As

previously suggested, a factorially designed experiment may well deal effectively with this problem. One drawback of such an experiment would be the large number of subjects needed and the enormous amount of physiological data which would have to be analyzed.

Another area of investigation for future research involves the period of time elapsing between conditioning and CS-alone re-exposure. It should be determined if there is a critical period of time after conditioning in which enhancement will occur and before or after which extinction will occur. One useful line of research would be to re-expose groups of subjects to the CS-alone after periods of 1 minute, 10 minutes, 30 minutes, 1 hour or 1 day after conditioning to determine which group, if any, shows any evidence of enhancement.

As the results of this study clearly demonstrate the extinction effect, they can be regarded as supporting such behavioural treatments as implosion therapy and flooding. That is, if the subject is repeatedly presented with the CS-alone either in imagination or in vivo such a procedure may well lead to extinction quickly and efficiently. Although this study does not support the results of Rachman (1966) his results should be kept in mind when using such procedures. In his study, the dangers inherent in such a procedure as flooding are apparent as one of his subjects

exhibited increased fear of spiders as a result of this procedure.

Another line of investigation in this study dealt with the personality variables of the subjects involved. It was predicted that those persons high on neuroticism and introversion would tend to show enhancement more than persons low on those dimensions. As no evidence of enhancement was found in this study, the above prediction can neither be supported nor rejected at this time. However, it was found that those persons high on neuroticism and those high on introversion did not show any difference from those persons low on such dimensions on the magnitude of their GSR in either the conditioning sessions or the extinction sessions. These results do not lend any support to those of other researchers (Franks, 1956) who found a relationship between the personality dimensions of the MPI and conditionability.

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