

PHOBIAS:

PREPARED LEARNING OR SELECTIVE ATTENTION?

Alastair J. Younger

A Thesis

in the

Department of Psychology

Presented in Partial Fulfillment of the Requirements for

the Degree of Master of Arts at

Concordia University

Montreal, Quebec, Canada

1979

© Alastair J. Younger, 1979

1

ABSTRACT

PHOBIAS: PREPARED LEARNING OR SELECTIVE ATTENTION?

Alastair J. Younger

It has recently been suggested that human phobias, because of the selectivity of phobic stimuli, their high associability with aversive events and high resistance to extinction, may be instances of "prepared" fear conditioning. The present investigation represents an attempt to explain "prepared" fear conditioning in terms of physical and experiential characteristics of the CS. Four experiments were conducted utilizing the CER (conditioned suppression) paradigm as a measure of the associability of a neutral CS and an aversive UCS, using hooded rats as subjects. Examination of the physical characteristics of the CS involved manipulating auditory stimuli according to criteria sufficient to arouse approach or withdrawal in neonate vertebrates (cf. Schneirla, 1965). Manipulation of the experiential component of the CS involved presenting the unreinforced CS for 4 or 20 trials prior to conditioning. Results indicated no differences in conditioning or extinction rates between approach or withdrawal stimuli, except when preceded by a difference in orienting response and only after the fewer (4) number of pre-exposures. These findings suggest the importance of the attentional value or salience of the CS, and its interaction with the organism's experience in effect on fear conditioning. The implications of the demonstrated salience - familiarity effect toward an understanding of the "uniqueness" of phobic avoidance learning were discussed.

ACKNOWLEDGEMENTS

The author wishes to express his thanks and appreciation to Jane Ledingham and Tom Gray for their advice and encouragement concerning the designing, execution, and reporting of the results of this investigation.

CONTENTS

	Page
Introduction.....	1
"Preparedness" Theory of Phobias.....	3
Experiment 1.....	16
Method.....	16
Results.....	19
Discussion.....	22
Experiment 2.....	24
Method.....	24
Results.....	26
Discussion.....	30
Experiment 3.....	32
Method.....	35
Results.....	36
Discussion.....	40
Experiment 4.....	42
Method.....	43
Results.....	44
Discussion.....	45
General Discussion.....	48
Approach - Withdrawal Characteristics.....	49
Salience and Novelty.....	52
Relevance of Salience and Novelty to the	
Acquisition of Human Phobias.....	59
References.....	63

LIST OF FIGURES

Figure	Page
1. Mean Suppression Ratios for the High, Fast, Irregular and Low, Slow, Regular stimulus Conditions Across the Eight Trials of Extinction Sessions 2 and 3, Experiment 1.....	21
2. Mean Suppression Ratios for the Tone and Noise Stimulus Conditions Across the four Trials of the Pre-Test Session, and the Eight Trials of Conditioning Sessions 1 and 2, Experiment 2.....	27
3. Mean Suppression Ratios for the Tone and Noise Stimulus Conditions Across the Eight Trials of Extinction Sessions 2 and 3, Experiment 2.....	29
4. Mean Suppression Ratios Elicited After 4 or 20 Pre-Exposures Across the Four Trials of the First Pre-Exposure Session and Across the Eight Trials of Conditioning Sessions 1 and 2, Experiment 3.....	38
5. Mean Suppression Ratios Elicited by the Noise And Tone Stimulus Conditions after 20 Pre-Exposures, for the First Pre-exposure Session and the First Two Conditioning Sessions, Experiment 4.....	46

LIST OF TABLES

Table

Page

1. Stimuli Adequate to Arouse Approach or Withdrawal in Neonate Vertebrates.....10

INTRODUCTION

Phobic disorders have been described as "episodic, often chronic, disorders in which the predominant feature is persistent avoidance behavior, secondary to irrational fears of a specific object, activity or situation" (DSM-III, 1977, p G-1). Behavioral explanations of the acquisition and maintenance of phobic behavior have typically made use of a two-process, fear mediation model of avoidance learning. According to this approach, the pairing of a neutral stimulus with an aversive event causes that stimulus to elicit a classically conditioned fear response, which maintains an instrumental avoidance response. Successful escape from the conditioned stimulus, and consequent avoidance of the aversive event, is reinforced through the elimination of the fear response (Mowrer, 1947, 1960; Rescorla & Solomon, 1967). The applicability of this model, as a description of phobic behavior, becomes obvious if it is assumed that the presentation of the phobic stimulus, which in itself is generally unthreatening to a non-phobic individual (hence the "irrational fear"), elicits fear which typically leads to an avoidance response.

Although this model of fear and avoidance learning would appear to account for a general description of phobic behavior, it is the opinion of several authors that it serves as an incomplete analogy (De Silva, Rachman, & Seligman, 1977;

Ohman, Eriksson, & Olofsson, 1975; Ohman, Erixon, & Lofberg, 1975; Ohman, Fredrikson, Hugdahl, & Rinno, 1976; and particularly Seligman, 1970, 1971; Seligman & Hager, 1972). These authors describe three characteristics of human phobias which they maintain cannot be adequately accounted for by traditional behavioral explanations.

Serious doubt has been expressed over the assumption that any "neutral" stimulus, when paired with an aversive event, can come to elicit the fear response. Seligman (1971) believes that this assumption runs contrary to what is known about human phobias. Phobic stimuli appear to comprise a select group of "potentially" harmful stimuli (Marks, 1969; Seligman, 1971). Although stimuli such as dogs, snakes, or heights may come to elicit phobic responses, it is rare that more harmless stimuli such as chairs, plants, or lambs serve as phobic stimuli (Seligman, 1971). Thus, the selectivity of phobic stimuli would appear to run contrary to a theory of conditioning postulating stimulus equipotentiality (Ohman et al., 1976; Seligman, 1970, 1971; Seligman & Hager, 1972).

The second area of concern lies in the rate of association of a stimulus with an aversive event. Although laboratory fear conditioning is generally learned over several trials (Kamin, 1969; Seligman, 1968), phobic behavior is assumed to be the result of only one pairing of a traumatic event with the phobic stimulus (Seligman, 1971), and often this traumatic event cannot even be

recalled by the phobic individual (Marks, 1969). Thus, although one-trial learning appears to be the exception in laboratory fear conditioning, it would appear to be the rule in the acquisition of human phobias.¹

Finally, Seligman (1971) believes that the high resistance to extinction characteristic of phobias cannot be adequately explained in terms of conventional learning theory. Although laboratory avoidance responding is similarly highly resistant to extinction, forced exposure to the conditioned stimulus (CS), through prevention of the avoidance response, results in rapid extinction (Baum, 1970). However, Seligman states that although the phobic individual may come into contact with the unreinforced phobic stimulus, these presentations of the CS without the presence of the unconditioned stimulus (UCS) generally do not result in such rapid extinction, if any at all.

It appears, therefore, that the selectivity, high conditionability and resistance to extinction of human phobias distinguish them from laboratory analogues of fear and avoidance learning.

"Preparedness" Theory of Phobias

To account for these apparent distinctions between phobic learning and conventional learning theory, Seligman (1970, 1971) has argued that phobic learning may actually be learning of a different sort than laboratory conditioning. Moreover, such

¹Recent evidence has been reported (Gray, in press) indicating that one-trial learning may occur more frequently in the laboratory than previously thought, although not necessarily on the first trial.

4

distinctions do not appear to be unique to phobias. Seligman and Hager (1972) have reviewed a wide assortment of studies which reveal differential responding to different stimuli, both within and between species. In particular, the findings of the conditioned taste aversion literature reveal distinctions similar to those noted between phobic learning and laboratory fear conditioning. Researchers in this area have demonstrated that rats more easily associate taste, rather than light or noise, with nausea, but that light or noise are more easily associated, than taste, with shock (Garcia, McGowan, & Green, 1972). Such CS-UCS specificity of association has led Seligman (1970, 1971) to propose that because certain CS-UCS associations are formed more easily than others, some associations may be phylogenetically "prepared" within the species. In other words, through a process of natural selection, a predisposition to respond in certain ways to certain stimuli, or to associate certain stimuli with certain consequences, has been preprogrammed into a species.

This conceptualization of a phylogenetic preparedness of certain associations has been suggested as a possible explanation of the acquisition of human phobias (Seligman, 1971). Seligman believes that the "preparedness" approach to learning may explain the distinctions between phobic learning and conventional fear or avoidance learning. He proposes that phobias are highly prepared to be learned by humans, "and like all other highly prepared

relationships, they are selective and resistant to extinction, learned even with degraded input, and probably are non-cognitive" (Seligman, 1971, p 312).

Seligman (1971) suggests that learning can be described as prepared, unprepared, or contraprepared, depending upon the stimulus situation in which learning takes place. Laboratory fear conditioning, such as tones paired with shock, is described as involving unprepared conditioning (i.e. of no biological advantage). Associations which are extremely difficult to condition, such as tones or light paired with nausea, would involve contraprepared conditioning, whereas human phobias are purportedly examples of prepared fear conditioning. The selectivity, conditionability, and resistance to extinction of phobias are therefore interpreted by Seligman within a phylogenetic framework. Thus he has argued that most phobias are of biological significance, stating that "the great majority of phobias are about objects of natural importance to the survival of the species. It (preparedness) does not deny that other phobias are possible, it only claims that they should be less frequent since they are less prepared" (Seligman, 1971, p 460).

Such an approach, to learning in general, and to phobias in particular is intuitively appealing in that it presents what appears to be a valid account of the differential associability of various events. However, it is questionable whether this phylogenetic

explanation offered by Seligman provides a clearer understanding of the development of human phobias. There appears to be a lack of convincing support in the investigations which have attempted to test the preparedness approach to phobias. Ohman and associates (Ohman et al., 1975, 1976) have found that pictures of "prepared" phobic stimuli (spiders or snakes), compared to "unprepared" pictures (circles or triangles), and to "contraprepared" pictures (flowers or mushrooms) when paired with shock, did not produce a greater or more easily acquired conditioned emotional response (CER) in humans, as measured by galvanic skin responding, as was predicted, but did tend to produce CERs that were more resistant to extinction.

De Silva et al. (1977), in a retrospective examination of 69 phobic cases, determined that the large majority of the content of the phobias (66 of the 69 cases) could be judged as evolutionarily significant, based upon the possible dangerousness of the situation to pretechnological man. The relative degree of preparedness, however, did not appear to be related to ease of acquisition or resistance to extinction of the phobia, as measured in terms of: outcome of therapy (satisfactory vs. unsatisfactory), suddenness of onset of the disorder (gradual vs. sudden), severity of impairment (very severe vs. less severe), intensity of treatment received (intensive vs. superficial), or age of onset (before 10, 10 to 25, after 25). Thus, while results supported the prediction that

7

prepared fears should occur more frequently in clinical populations, they failed to demonstrate that prepared fears are more easily acquired and more resistant to extinction than unprepared fears.

It would appear, from the results of these investigations, that the concept of prepared phobias has not stood up to tests of its assumptions. The lack of confirmatory evidence, however, may in fact be due to the difficulties encountered in attempts to operationalize "preparedness". The original definition of prepared learning proposed by Seligman (1970) was stated in terms of conditionability, or the ease with which a CS-UCS association is formed. Seligman's original definition of the dimension of preparedness involved "the amount of input (e.g. numbers of trials, pairings, bits of information) which must occur before that output (responses, acts, repertoire etc.) which is construed as evidence of acquisition reliably occurs" (1970, p 408).

Because human phobias do appear to satisfy these criteria, Seligman has suggested that they are instances of prepared learning, and as such must serve some biological advantage to the species. This hypothesis is strengthened by the observation that many phobic stimuli involve objects or situations which could involve threat to the individual (Marks, 1969). However, since some phobias which meet the original criteria of preparedness (i.e. conditionability), do not appear to possess this quality of potential threat (e.g. insect phobias), and some stimuli or situations which definitely

possess threatening qualities do not frequently serve as phobic stimuli, Seligman (1971) has proposed that the potential threat of prepared phobic stimuli was relevant to "pretechnological man". Thus, phobias may be instances of prepared conditioning of fear which are carried over from mankind's past, and may not necessarily serve any present day biological advantage.

Such a definition of preparedness is exceedingly difficult to test, as it involves "looking back" into mankind's past to select this or that stimulus which might have been potentially threatening to his survival. It is easy to argue that present phobic stimuli are prepared to be associated with an aversive event because they may have, at some time, been critical to the survival of mankind, an argument which De Silva et al. (1977), themselves, describe as "rather slippery". The difficulties in testing this argument lie in the lack of an empirical definition of potential threat to pretechnological man beyond the present conditionability of the stimulus. If the concept of prepared learning is to be of any use in the understanding of human phobias, it is necessary to extend it beyond this circular explanation, which defines conditionability in terms of potential threat to pretechnological man, but is forced to define this potential threat in terms of conditionability.

- It is conceivable that stimuli which are easily associated with aversive events share common perceptual, experiential, or other

5

properties, and that it may be these properties, to which the organism may be more or less prepared to respond, rather than to the actual object itself. Such an explanation has been suggested by Marks (1969), who has proposed that certain perceptual qualities of stimuli may predispose these stimuli to elicit fear, or to be easily associated with fear. Examples of such stimulus qualities have been suggested by Schneirla (1965), who has differentiated classes of stimulation which arouse approach or withdrawal in neonate vertebrates. Schneirla has suggested that approach and withdrawal are elicited by different classes of stimuli which form a biphasic functional system from embryonic stages onwards. Stimulation of low intensity (described as of low magnitude, regular, gradually changing) tends to elicit approach responses, whereas stimulation of high intensity (high magnitude, irregular, abruptly changing) tends to arouse withdrawal behavior. Table 1 represents those classes which elicit approach and withdrawal described by Schneirla (1965). Schneirla has suggested that these functional conditions may be due, both phylogenetically and ontogenetically, to low intensity stimulation being more likely to be followed by beneficial results, and high intensity stimulation by noxious consequences.

Schneirla's biphasic classification of stimulus characteristics appears quite compatible with a preparedness interpretation of phobic learning. If, as suggested by Schneirla, vertebrates have been

Table 1

Stimuli Adequate to Arouse Approach or Withdrawal in Neonate Vertebrates
(adapted from Schneirla, 1965)

Types of effective stimuli	Equivalent for arousal of A-processes	Equivalent for arousal of W-processes
<u>Proximal</u>	Tactuo-proprioceptive, chemoceptive patterns of low magnitude, regular timing	Tactuo-proprioceptive, chemoceptive patterns of high magnitude, irregular timing
<u>Distance</u>		
<u>Visual</u>		
Succession	Gradual changes, regular intervals, low motion-parallax	Abrupt changes, irregular intervals, high motion parallax
Intensity	Low to low-medium, or decreasing	Medium-high to high, sharply or irregularly increasing
Contour	Rounded (e.g. a disc)	Angular, abrupt corners
Movement	Regular; low to medium rate; away from subject	Irregular; high rate; toward subject
Size	Small to medium-small	Large
<u>Auditory</u>		
Succession	Regular	Irregular
Intensity	Low to low-medium	High
Frequency	Medium-low to low; regular	Medium to high; irregular
Pattern	Simple	Complex; irregular (noisy)

phylogenetically preprogrammed to withdraw from stimulation of "high intensity", due to its high correlation with aversive consequences, then these characteristics which Schneirla describes as contributing to high intensity (abruptness, high magnitude, irregularity) may be factors which differentiate prepared from unprepared phobic events. Stimuli meeting these criteria of high intensity would therefore be expected to be readily associated with an aversive UCS, thereby facilitating fear and avoidance learning, as compared to stimuli of "low" intensity.

The explanation of differential associability of various CSs with aversive UCSs, provided by Schneirla's classification of stimulus qualities, has been partially supported by a number of studies investigating the effect of CS magnitude. According to Schneirla (1965), high magnitude stimulation can elicit withdrawal, and should therefore be easily associated with an aversive UCS. Kamin (1965) reports the results of a series of experiments investigating the effect of the magnitude of the CS (volume of white noise) on CER acquisition in rats. Using suppression of ongoing operant behavior (lever pressing) as a measure of CER (cf. Estes & Skinner, 1941), Kamin has noted that the rate of CER acquisition varies directly with CS magnitude. Moreover, Kamin has determined that the magnitude of the CS is an especially potent variable in trace conditioning. Trace conditioning consisted of presentation of the CS (49 db noise or 81 db noise) for two minutes, with one

minute of silence between the CS termination and the onset of the UCS. Results indicated that with the low volume CS (49 db), there was no hint of a CER within 10 days of training, while with the high volume CS (81 db) complete suppression was rapidly acquired. The rapid association of the high magnitude CS with the aversive UCS, in spite of a 1-min CS-UCS interval, clearly demonstrates the effect of the dimension of CS magnitude, as suggested by Schneirla. Moreover, this observed high vs. low CS magnitude effect on trace conditioning may have particular relevance to Seligman's suggestion that prepared fears may be learned "even with degraded input" (1971, p 312).

High magnitude stimuli have been demonstrated to be more readily associated with aversive UCSs than stimuli of low magnitude in a variety of conditioning situations including avoidance learning (James, Ossenkop, & Mostoway, 1973), CER conditioning (conditioned suppression) using auditory stimuli (Kamin, 1965; Tait & Suboski, 1973) and using light as the CS (Kamin, 1965), and in eyelid conditioning (Grice, Hunter, & Kohfeld, 1967). Moreover, superior avoidance responding has been demonstrated to result from an increasing change in CS magnitude, in comparison to a decreasing change (James et al., 1973).

Evidently the magnitude of a stimulus is related to its associability with an aversive event, as predicted from Schneirla's (1965) description of stimulus qualities which elicit approach or

withdrawal. It is unclear, however, whether the relationship between the magnitude of the CS and its associability with an aversive event is due to an innate tendency to associate what Schneirla describes as "high intensity" stimulation, including magnitude, with aversive consequences, or whether stimuli of high magnitude are simply more noticeable to the organism. Kamin (1965) has noted that both the low and the high magnitude CSs were clearly distinguishable from background noises, implying that the effect is due to actual CS differences and not to an inability to perceive the low volume CS. However, the actual mechanism underlying the effect is not clear. It is quite possible that the superior conditionability of a high magnitude CS could be attributed to the attentional value of that stimulus. Such an effect would be in agreement with current theories of classical conditioning (e.g. Mackintosh, 1975) which include stimulus salience (i.e. noticeability or attentional value of the CS) as one of several parameters affecting conditioning. If the attentional value of a CS affects its associability with reinforcement then differences in orienting responses produced by different CS's should predict similar differences in conditioning rate. If, however, the differences in conditioning rate produced by the high vs. low volume stimuli are caused by an innate tendency to withdraw from "high intensity" stimulation and to approach "low intensity" stimulation, then similar differences in conditioning rates should be demonstrated in comparisons of the other

approach - withdrawal dimensions, independent of differences in orienting response prior to conditioning.

The following series of experiments represent an attempt to evaluate the effects, on CER conditioning, of the dimensions of auditory stimulation which Schneirla proposes are able to elicit approach or withdrawal in neonate vertebrates. The following four experiments are comparisons of variations in the auditory dimensions of succession (regular vs. irregular), frequency (low; vs. high; regular vs. irregular), and pattern (simple vs. complex) as described by Schneirla in Table 1.

The conditioned suppression technique was used in these experiments as a measure of CER, primarily as an indicator of the associability of a CS with an aversive UCS. However, it has been proposed that this measure may be particularly appropriate as a laboratory analogue to phobic behavior, since the suppression of ongoing operant behavior upon presentation of a CS may be considered analogous to the interference, by anxiety or avoidance behaviors, of the phobic individual's daily activities, upon presentation of the phobic stimulus (Monti & Smith, 1976).

The effects of the auditory characteristics of stimuli which elicit withdrawal in neonate vertebrates, and of the attentional value of a CS, upon CER acquisition, were examined in this investigation in an attempt to define the concept of prepared learning of fear in terms of measureable perceptual characteristics of a

stimulus situation. It has been suggested, however, that the conditionability of a stimulus is not an immutable consequence of the physical characteristics of that stimulus, but may be greatly influenced by experience (Mackintosh, 1975). While the preparedness account of human phobias is described only in terms of an innate predisposition to associate fear with certain classes of stimuli, considerable evidence suggests that the conditionability of a stimulus is modified through previous experience with similar stimuli (Kalat & Rozin, 1972; Lubow, 1973; Mackintosh, 1975, 1974; Revusky & Bedarf, 1967; Wittlin & Brookshire, 1968). It may be that the relative familiarity or novelty of classes of stimuli, and their previous correlation with reinforcement may interact with any innate predisposition to associate such stimuli with reinforcing events. Indeed, Schneirla (1965) has suggested that the stimulus qualities which elicit approach or withdrawal in neonate vertebrates may be greatly modified or even reversed through experience. This possible interaction between perceptual characteristics of the stimulus and greater familiarity with the stimulus in effects on CER acquisition was investigated in the third and fourth experiments.

EXPERIMENT 1

Evidence from a variety of experiments indicates that the intensity of a stimulus, in terms of magnitude, is related to the associability of that stimulus with an aversive event (James et al., 1973; Thompson & Van Hoesen, 1967; Tait & Suboski, 1973; Kamin, 1965; Grice et al., 1967). While such findings lend support to Schneirla's (1965) proposal that high intensity stimuli are predictive of noxious consequences, Schneirla defines "high intensity" as more than merely high magnitude. The present experiment is an examination of the other auditory dimensions outlined by Schneirla. The dimensions of succession and frequency were examined, by comparing the effects of a high frequency tone, pulsed in a rapid and irregular manner, and a low frequency tone, pulsed in a slow and regular manner, upon CER (conditioned suppression) acquisition and extinction. Then stimuli were selected to represent extreme points along the approach/withdrawal dimensions described by Schneirla.

METHOD

Subjects

Subjects were 16 experimentally naive, male hooded rats, that weighed between 250 and 275 g when they were received from the supplier.

Apparatus

The apparatus consisted of eight Grason-Stadler conditioning units, individually housed in sound attenuating boxes. The

appropriate timers, relays, and counters necessary for automatic control of the units were located in an adjacent room. Reinforcers were .045g Noyes food pellets.

The low frequency, slow, regular stimulus was a 400 Hz tone, pulsed at a rate of once per second, and of .50-sec duration. The high frequency, fast, irregular stimulus was a .20-sec duration tone of 2000 Hz, pulsed in an irregular manner at an average rate of three per second. The "irregular" pulse presentation was created in the following manner. Three rats from a previous experiment were selected such that their combined rate of bar pressing, on a VI 2.5-min schedule, was an average of once per second over a three minute interval. The irregular, once per second pattern of pulses generated by these rats was superimposed upon a regular two per second background. In this way an irregular, three per second pulse pattern was created, which maintained a minimal rate of two per second at any time. This pulse pattern was then used to initiate a tone burst which was recorded on a standard cassette-type audio tape. Both stimuli were 80db sine-wave tones produced by an Eico model 377 Audio Generator. Each stimulus was played through an amplifier into each conditioning unit through a speaker mounted on one wall of each unit.

The UCS was a .50-sec, 1.0mA shock presented through the grid floor of each conditioning unit, and was produced by Grason-Stadler model E1064GS shock generators.

Procedure

Upon being received from the supplier, the animals were randomly assigned to each group. They were then reduced to 75% of their pre-experimental body weights over a period of 10 days prior to participating in the experiment, and were maintained at that weight throughout the course of the experiment. Daily weighings and feedings were scheduled for each group to coincide with the time of day when they would be run in the experiment. Water was continuously available to the animals in their home cages.

The initial day of magazine training and continuous reinforcement was followed by three, daily, 2-hr, bar press sessions on a 2.50-min VI schedule. All animals were run in complete darkness. Pre-test presentations of the CS to be used later in conditioning occurred on the fourth day of bar press training. Each group received four, 3-min, unreinforced CS presentations. Conditioning trials began on the day following the pre-test. All animals received three days of conditioning, which consisted of four daily CS-UCS pairings superimposed upon the regular, daily 2-hr bar press sessions. The 3-min duration CS was programmed to occur 18, 38, 64, and 88 minutes after the start of the 2-hr session. The .50-sec UCS (shock) presentation coincided with the termination of the CS. Extinction trials began on the day following the third conditioning session. All animals received a series of 12 unreinforced 3-min CS presentations over three days, in a manner identical

to the conditioning procedure. Throughout the course of the experiment, each group was run at the same time each day for a 2-hr period.

For the pre-test measures, the acquisition measures, and the extinction measures, CER was measured by a "suppression ratio", $D/(B+D)$, where D represents total number of bar presses during the 3-min CS presentation, and B represents the total number of bar presses during the 3-min period immediately preceding the presentation of the CS. In all cases, a ratio of .50 indicates no effect of the CS on bar pressing (i.e. no suppression) and .00 indicates complete suppression of bar pressing during the CS presentation. Ratios between .50 and .00 therefore indicate various degrees of conditioned suppression.

RESULTS

Equipment failure resulted in one animal being removed from each group. All results are therefore comparisons of two groups of seven animals each.

Pre-test Phase

During the pre-test phase of the experiment no significant differences were observed between the two groups on any of the four pre-test presentations. Both groups habituated completely to the stimuli, each exhibiting a mean suppression ratio of .49 on the last pre-test trial.

Conditioning Phase

Analyses of the conditioning effects of each stimulus were conducted separately for each conditioning session by means of a 2(Stimulus Condition) X 4(Successive Conditioning Trials) ANOVA with repeated measures across trials. For the purposes of analysis, each session was considered a separate unit of four trials because of the lack of continuity between sessions (i.e. the inter-trial interval between the last trial of one session and the first of the following session involved a 22-hr period during which the animals were returned to their home cages).

Results of the first conditioning session analysis revealed only a significant Trials effect, $F(3,36) = 3.19$, $p < .05$. On the second and third conditioning days no effects of either stimuli or trials were reliable. Both stimuli appeared to be conditioning at the same rate, and both reached a floor effect on days 2 and 3, where mean suppression ratios varied between .00 and .10.

Extinction Phase

As in the conditioning analyses, each of the extinction sessions was analyzed as a separate unit using 2(Stimulus Condition) X 4(Successive Extinction Trials) ANOVAs with repeated measures across trials. Results of the analysis of the first extinction session indicated no effects of either stimuli or trials. Analysis

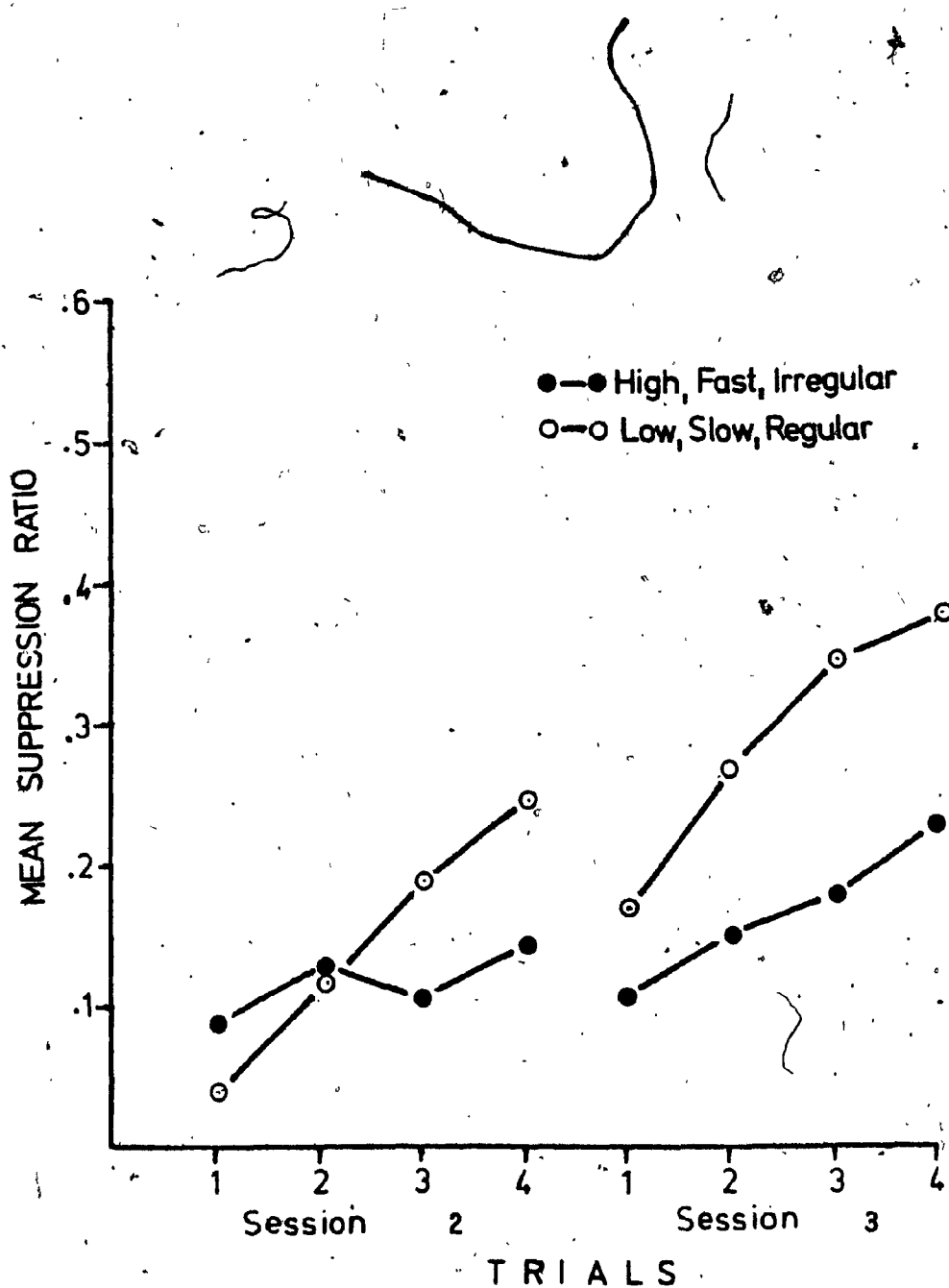


Figure 1: Mean suppression ratios for the High, Fast, Irregular and Low, Slow, Regular stimulus conditions across the eight trials of Extinction Sessions 2 and 3.

of the second extinction session revealed a significant Trials effect, $F(3,36) = 9.05$, $p < .01$, as well as a significant Trials X Stimulus interaction, $F(3,36) = 4.47$, $p < .01$. Although no significant trial-by-trial difference between the stimulus conditions was revealed, Scheffé tests revealed a significantly greater increase in suppression ratio from Trial 1 to Trial 4 of .22 under the Low, Slow, Regular condition than under the High, Fast, Irregular condition which increased only .05, $F(3,18) = 24.24$, $p < .01$ (see figure 1). Analysis of the third extinction session revealed only a significant Trials effect, $F(3,36) = 13.84$, $p < .01$.

DISCUSSION

The high frequency, irregularly and quickly pulsing stimulus, and the low frequency, slowly and regularly pulsing stimulus were chosen because they seemed to represent widely separated points in Schneirla's (1965) approach/withdrawal scheme. As such, it had been expected that clear and sharply increasing differences would have been noted between the two conditions in terms of conditioning and/or extinction effects. This obviously was not the case. Both stimuli produced almost identical conditioning curves across the eight trials of the first two conditioning sessions, and there was a lack of any maintained extinction difference between the stimuli. Such results appear to be contrary to the predictions generated from Schneirla's discussion of stimulus characteristics which are

capable of eliciting approach or withdrawal. Because differences were not found, it could always be argued that differences in the stimuli were not great enough. Yet these stimuli were clearly distinguishable, and differences between them were prima facie sufficiently different. These findings cast considerable doubt on the utility of Schneirla's stimulus classification scheme as an explanation for the selectivity or ease of conditioning of prepared fears. However, before rejecting this interpretation of prepared conditioning of fear, further investigation of the perceptual characteristics of stimuli, which are capable of eliciting withdrawal, was undertaken in the following two experiments. The first examined the dimension of Pattern, which Schneirla describes as simple vs. complex. The second experiment dealt primarily with the quality of irregular change in the frequency of a stimulus.

EXPERIMENT 2

This experiment involved a further examination of the stimulus characteristics outlined in Schneirla's (1965) biphasic scheme. Results of the preceding experiment indicated no effect on CER acquisition rate of high vs. low frequency, and of fast-irregular vs. slow-regular succession. In this experiment the dimension of succession was further investigated by increasing the rate of the fast stimulus from three per second to 10 per second. Increasing the rate of succession precluded the use of an irregular vs. regular difference as in the preceding experiment, since it was not possible to produce an irregular stimulus at this faster rate.

This experiment also involved an investigation of the auditory dimension described by Schneirla as pattern. Schneirla (1965) describes the approach or withdrawal eliciting qualities of the auditory dimension of Pattern as "simple" vs. "complex, irregular, or noisy" (see Table 1). These criteria were satisfied by representing the simple stimulus with a sine wave, pure tone of a medium frequency (1000 Hz), while a "white noise" served as the complex stimulus.

METHOD

Subjects

Subjects in this experiment were 32 experimentally naive male hooded rats that weighed between 250 and 275g when they were

received from the supplier.

Apparatus and Procedure

The apparatus used in this experiment was identical to that used in the first experiment. The only difference was in the characteristics of stimuli presented. Four CS conditions were prepared for this experiment: a fast-simple, a slow-simple, a fast-complex, and a slow-complex. Simple stimuli were 80db pure tones (sine wave) of 1000 Hz, while complex stimuli were 80db "white noise" produced by a Grason-Stadler 901B noise generator. Slow stimuli were .50-sec duration pulses delivered at a rate of one per second, while fast stimuli were .05-sec duration pulses delivered at a rate of 10 per second. Stimuli in this experiment were not taped, but were presented directly from the tone or noise generators directly into the speakers in the conditioning units.

Upon being received from the supplier, the 32 animals were randomly assigned to four groups of eight subjects, and as in the first experiment, the four groups of animals were weighed and fed daily, during the 10 day deprivation period, at the same time of day as they would be run in the experiment.

Apart from the different stimuli being used, all four groups were run in exactly the same manner as were the animals in the preceding experiment.

RESULTS

Pre-test Phase

Suppression ratios during the four pre-test presentations were analyzed by a 2(Stimulus Complexity) X 2(Rate of Pulsing) X 4(Successive Pre-test Trials) ANOVA with repeated measures across Trials. The analysis revealed a significant Trial effect, $F(3,84) = 32.28$, $p < .001$, and a significant stimulus complexity (Tone vs. Noise) by Trials interaction, $F(3,84) = 4.49$, $p < .01$. On the first Pre-test Trial, trial-by-trial comparisons of the tone and noise stimuli revealed a significantly lower mean suppression ratio of .28 for the Noise stimuli, than for the Tone stimuli which displayed a mean ratio of .56, $t(30) = 2.21$, $p < .05$. No further differences were found on Trials 2, 3, and 4 (see fig. 3).

Conditioning Phase

As in the first experiment, each of the three conditioning sessions was considered as a self-contained unit for the purpose of analysis. The first two conditioning sessions were analyzed using 2(Stimulus Complexity) X 2(Rate of Pulsing) X 4(Successive Conditioning Trials) ANOVA's with repeated measures across Trials. Results of the third conditioning session were not analyzed since all mean suppression ratios were below .10 and because of the high proportion of zero ratios in each group (i.e. some cells displayed means and standard deviations of zero).

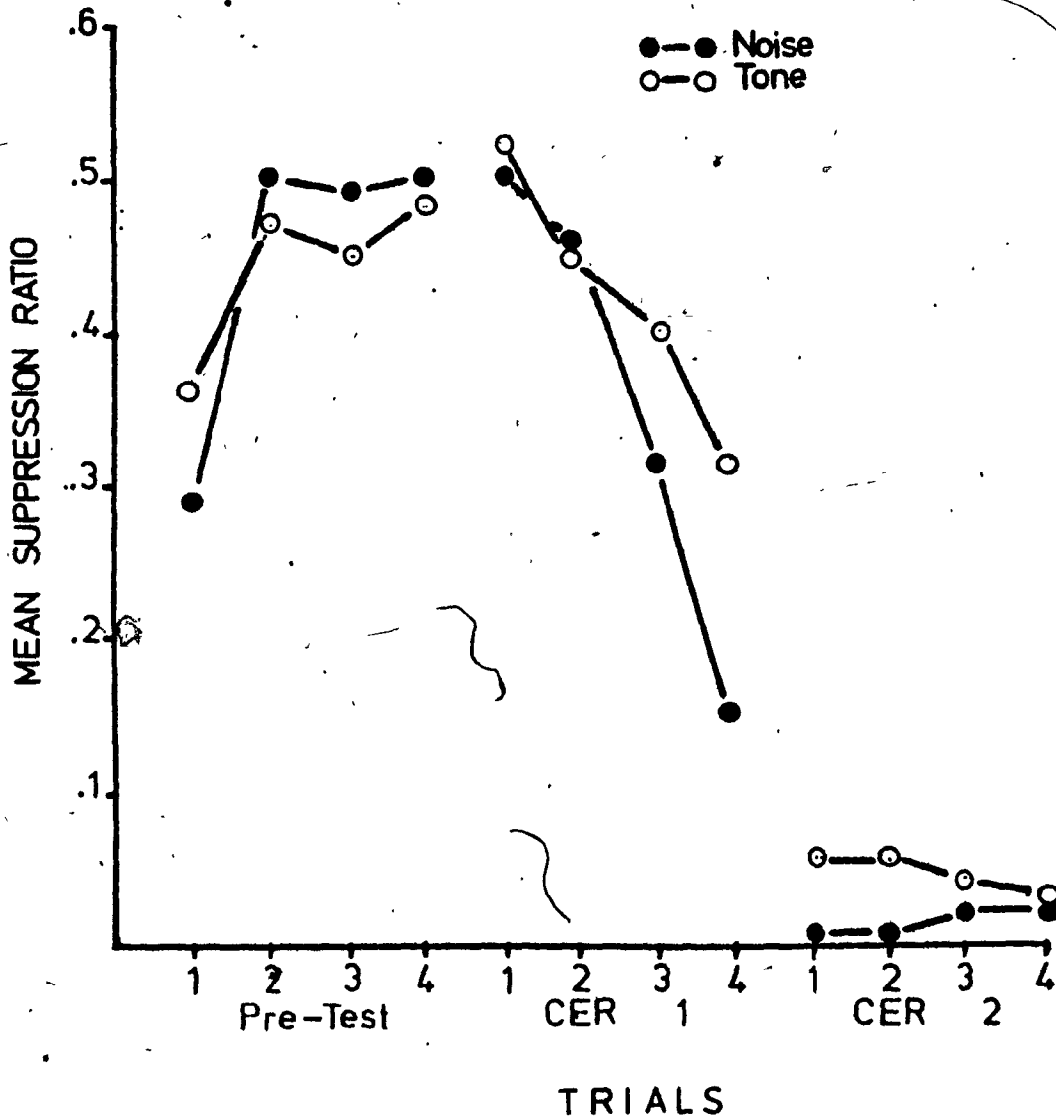


Figure 2: Mean suppression ratios for the Tone and Noise stimulus conditions across the four trials of the Pre-test session, and the eight trials of Conditioning Sessions 1 and 2, respectively.

Only within the first conditioning session were any significant between groups effects found. The session 1 analysis revealed a significant Trials effect, $F(3,84) = 38.48$, $p < .001$, and a significant stimulus complexity by Trials interaction, $F(3,84) = 2.89$, $p < .05$. Further examination of the Complexity by Trials interaction revealed an increasing difference between the Tone and the Noise across the four trials of Session 1, resulting in a significantly lower mean suppression ratio, on the fourth trial, under the Noise condition (.15), than during the Tone presentation (.30), $t(30) = 2.28$, $p < .05$ (See fig 2).

Extinction Phase

Each of the three Extinction Sessions was considered as a separate unit, and for reasons similar to the conditioning analysis (i.e. the "floor" effect produced by the high proportion of suppression ratios of zero), the results from the first session were not analyzed. Results of the second and third extinction sessions were analyzed using two 2(Stimulus Complexity) X 2 (Rate of Pulse Presentation) X 4 (Successive Extinction Trials) ANOVA's with repeated measures across Trails. Results indicated only a significant Trials effect during the second session, $F(3,84) = 42.28$, $p < .001$. Results of the third extinction session revealed a significant Trials effect, $F(3,84) = 19.37$, $p < .01$, as well as a significant Stimulus Complexity by Trials interaction $F(3,84) = 3.99$, $p < .01$. Comparisons of the effects

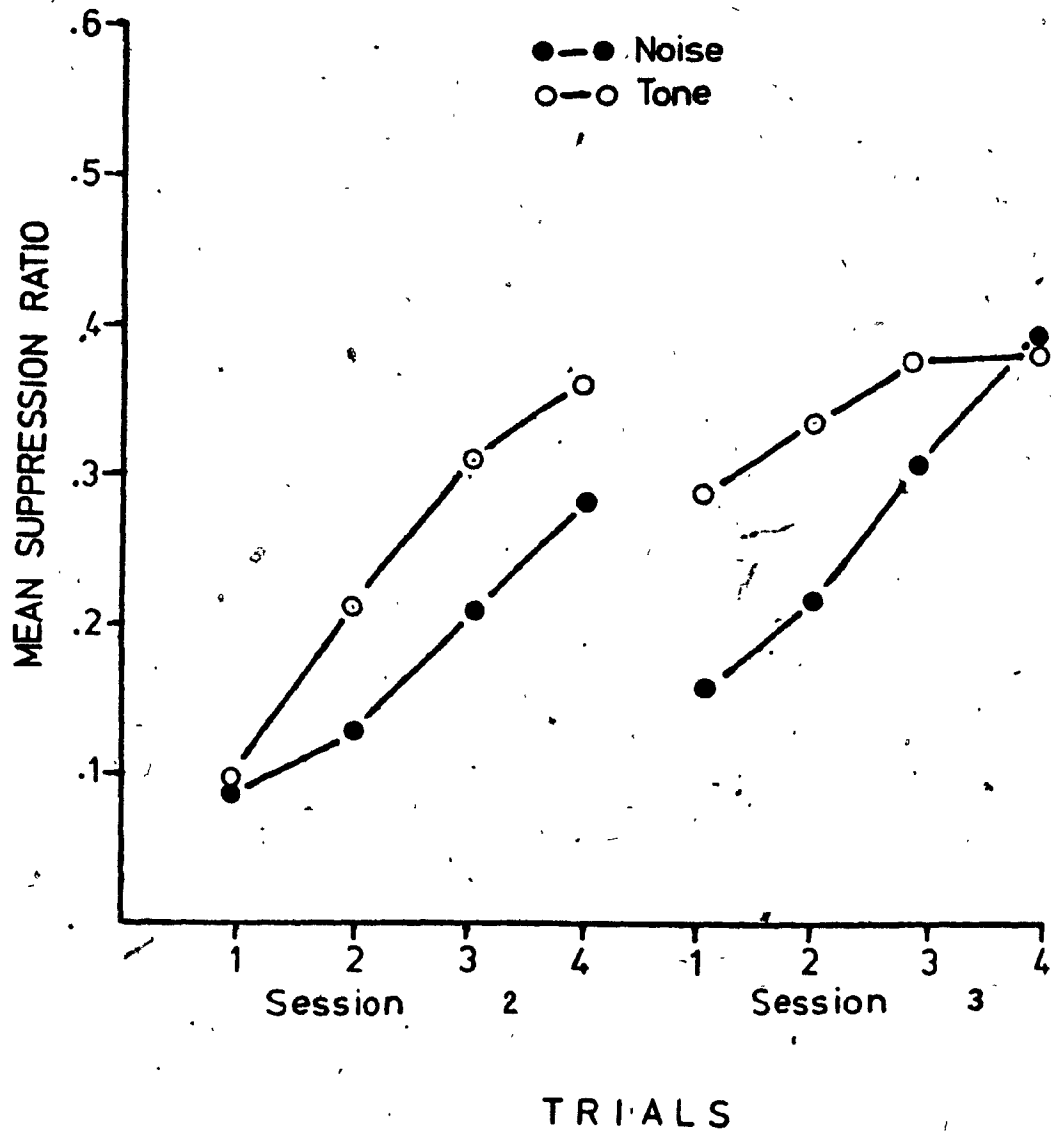


Figure 3: Mean suppression ratios for the Tone and Noise stimulus conditions across the eight trials of Extinction Sessions 2 and 3, respectively.

of the Tone and Noise stimuli on each of the four extinction trials of Session 3 revealed significantly lower suppression ratios during the Noise presentation than during the Tone presentation on Trial 1 (mean suppression ratio Noise = .16; Tone = .29), $t(30) = 2.48$, $p < .02$, and on Trial 2 (mean ratio Noise = .22; Tone = .34) $t(30) = 2.27$, $p < .05$. This initially significant difference between the stimuli decreased across the four extinction trials.

DISCUSSION

Results of this investigation provide partial support for the hypothesis developed from the approach-withdrawal stimulus classification scheme proposed by Schneirla (1965). The more rapid conditioning of the CER to the Noise than to the Tone suggests that, in agreement with Schneirla's proposals, complex stimuli should be more readily associated with aversive events than simple stimuli. It is particularly interesting that this noise vs. tone conditioning effect is also represented in the Pre-test comparison. Unconditioned suppression to the first unreinforced pre-exposure of the Noise was significantly lower than during the Tone presentation. Such a finding suggests that the salience of the stimulus, as measured by the magnitude of the unconditioned response produced by that stimulus, may contribute to the conditionability of that stimulus, and does not allow for

any innate withdrawal-eliciting effects of the complex stimulus to be assessed independently of its salience.

The increasingly different conditioning effects produced by these stimuli might lead one to believe that a similar extinction effect would be observed. Such an effect was not found. The extinction results indicated no difference in rate of extinction between any stimuli. However, the initial lower suppression ratios produced by the noise stimuli on the first two trials of the third extinction session imply a greater spontaneous recovery of the CER produced by the noise than by the tone over the 22-hr home-cage period.

EXPERIMENT 3

This experiment involved a re-examination of the dimension of frequency of an auditory stimulus. Schneirla (1965) describes frequency characteristics which elicit approach vs. withdrawal as "medium low to low; regular" vs. "medium to high; irregular". Results of the first experiment indicated no conditioning differences and minimal extinction differences between a high frequency tone pulsed in an irregular manner, and a low frequency tone pulsed in a regular manner. In this experiment the "regular" vs. "irregular" component of the dimension of frequency was examined. For the purposes of this comparison, "irregular" frequency was interpreted as meaning a tone which changes in frequency in an irregular and abrupt manner, while "regular" frequency was considered to be a tone of equal volume which was maintained at a constant frequency.

A second aim of this experiment involved an examination of the effect of the pre-test trials preceding conditioning. While previous investigations of "prepared" phobic learning have centered around the physical or symbolic characteristics of stimuli (i.e. possessing "potential threat"), Mackintosh (1975) has argued that the associability of a stimulus with reinforcement may involve more than just the physical qualities of that stimulus. The conditionability of a stimulus also depends upon the organism's previous experience with that and similar stimuli. Mackintosh explains that stimuli which have been previously correlated with

changes in reinforcement are more readily associated with future changes in reinforcement. Conversely, exposure to stimuli in the absence of correlated changes in reinforcement appears to decrease the associability of these and similar stimuli with future changes in reinforcement. Such a proposal suggests that novel stimuli would more readily be associated with changes in reinforcement than familiar ones. In fact, this suggestion has been demonstrated by various researchers. For example, it has been observed that rats learn aversions much more readily to novel, than to familiar solutions, even when the familiar solution is ingested after the novel solution (Revusky & Bedarf, 1967; Wittlin & Brookshire 1968). Moreover, Kalat and Rozin (1972) have demonstrated that even a single 20-min exposure to a solution, followed by neutral consequences, greatly interferes with the association of that solution with poisoning, even when the single pre-exposure occurred up to three weeks before the poisoning. Similar findings, demonstrating the greater effectiveness of novel than familiar stimuli as CS's have been reported in the CER literature (Lubow, 1973; Mackintosh, 1974). In fact, Gray (Note 1) has reported that even a single unreinforced pre-exposure to the CS can significantly retard CER conditioning to that CS.

It is evident, therefore, that an organism's past experience with the CS, or with similar stimuli, can greatly affect the associability of that stimulus with reinforcement. Moreover,

Gray (Note 1) has demonstrated that the novelty-familiarity dimension can interact with physical characteristics of the stimulus, in its effect on conditioning rate. Gray reported an increasingly greater retardation of conditioning coincident with an increasing number of unreinforced pre-exposures to the CS, except in the case of a stimulus (in this case a steady light) which failed to produce complete habituation. When responding to the stimulus did not completely habituate even over 24 pre-exposures, no difference in acquisition rate was observed between subjects which received a single pre-exposure and those which received 24 pre-exposures, although both pre-exposure groups conditioned more slowly than the group which received no pre-exposures. Such a finding implies that in some instances, the salience of a stimulus (i.e. its ability to attract the attention of the animal), may preclude the effects of experience.

In the preceding two experiments all stimuli were presented for four unreinforced pre-exposures prior to conditioning in order to evaluate the ability of these stimuli to elicit unconditioned suppression, and for the purposes of habituating the animals to these stimuli before conditioning began. In light of Gray's (Note 1) findings which suggest a possible salience-familiarity interaction, this experiment compared two stimuli, the tone which changed in frequency (Irregular Frequency Tone) and the tone which remained at a steady frequency (Steady.

Frequency Tone), under two pre-exposure conditions. The effects of the stimuli were examined after four pre-exposures, the condition utilized in the first two experiments, and also after 20 unreinforced pre-exposures.

METHOD

Subjects

Subject in this experiment were 32 experimentally naive, male hooded rats that weighed between 250 and 275g when they were received from the supplier.

Apparatus and Procedure

The apparatus used in this experiment was identical to that used in the first experiment, with the only difference being in the stimuli presented. The "Regular Frequency" stimulus consisted of an 80db steady tone (sine wave) of 1000Hz, while the "Irregular Frequency" stimulus was an 80db sine wave tone which was varied within a frequency range of 500Hz to 2000Hz in an irregular manner. This stimulus was created by rapidly adjusting the frequency control on the audio generator, within the frequency range previously described. Both stimuli were pre-recorded on a standard cassette tape and were played in a constant manner (i.e. not pulsed). The stimuli were presented in a manner similar to that of the first experiment.

With the exception of the addition of the 20 pre-exposure

condition, the procedure was identical to that followed in the previous two experiments. Immediately after being received from the supplier, the 32 animals were randomly assigned to four groups of eight animals, such that there were two varied frequency and two steady frequency groups. One of each of the two stimulus groups began the first of five pre-exposure sessions immediately following the four VI-2.5 min training days. The other two groups remained on the VI schedule with no CS for four more days. By utilizing this procedure, the groups which were to receive four pre-exposures began their Pre-test session on the same day as the two 20 pre-exposure groups were receiving their last session, thereby maintaining the total number of VI training days constant across all groups. Following pre-exposure, all animals underwent the same three days of conditioning and three days of extinction.

RESULTS

Pre-test Phase

Comparisons of the Irregular Frequency and the Regular Frequency groups revealed no significant between-group differences on any pre-exposure trial.

Conditioning Phase

For the reasons outlined in the first experiment, each conditioning session was analyzed as a separate unit. The first

conditioning session was analyzed by means of a 2 (Stimulus Condition) X 2 (Pre-exposure Condition) X 4 (Successive Conditioning Trials) ANOVA with repeated measures across Trials. Results revealed only a significant Trials main effect, $F(3,84) = 19.70$, $p < .001$, with the effects of the other conditions represented in F ratios less than 1 (see Table 8).

After the first conditioning session, one animal in each of the two 20 pre-exposure groups refused to bar press during both the CS presentation and during the 3-min pre-CS period, for the remainder of the experiment. Because suppression ratios could not be computed for these animals they were excluded from further analysis. Results of the second conditioning session were analyzed using a 2 (Stimulus Condition) X 2 (Pre-exposure Condition) X 4 (Successive Conditioning Trials) unweighted means ANOVA with repeated measures across Trials. The analysis revealed a significant Pre-exposure Condition effect, $F(1,26) = 11.22$, $p < .001$, a significant Trials effect, $F(3,78) = 10.18$, $p < .001$, and a significant Pre-exposure Condition by Trials interaction, $F(3,78) = 8.33$, $p < .001$. Further examination of the Pre-exposure Condition by Trials interaction revealed an initial large difference between the two conditions which decreased across the four conditioning trials, with no difference on the last trial (Trial 1, $t(28) = 4.48$, $p < .01$; Trial 2, $t(28) = 3.16$, $p < .01$; Trial 3, $t(28) = 2.29$, $p < .05$). While the 4 Pre-exposure condition showed

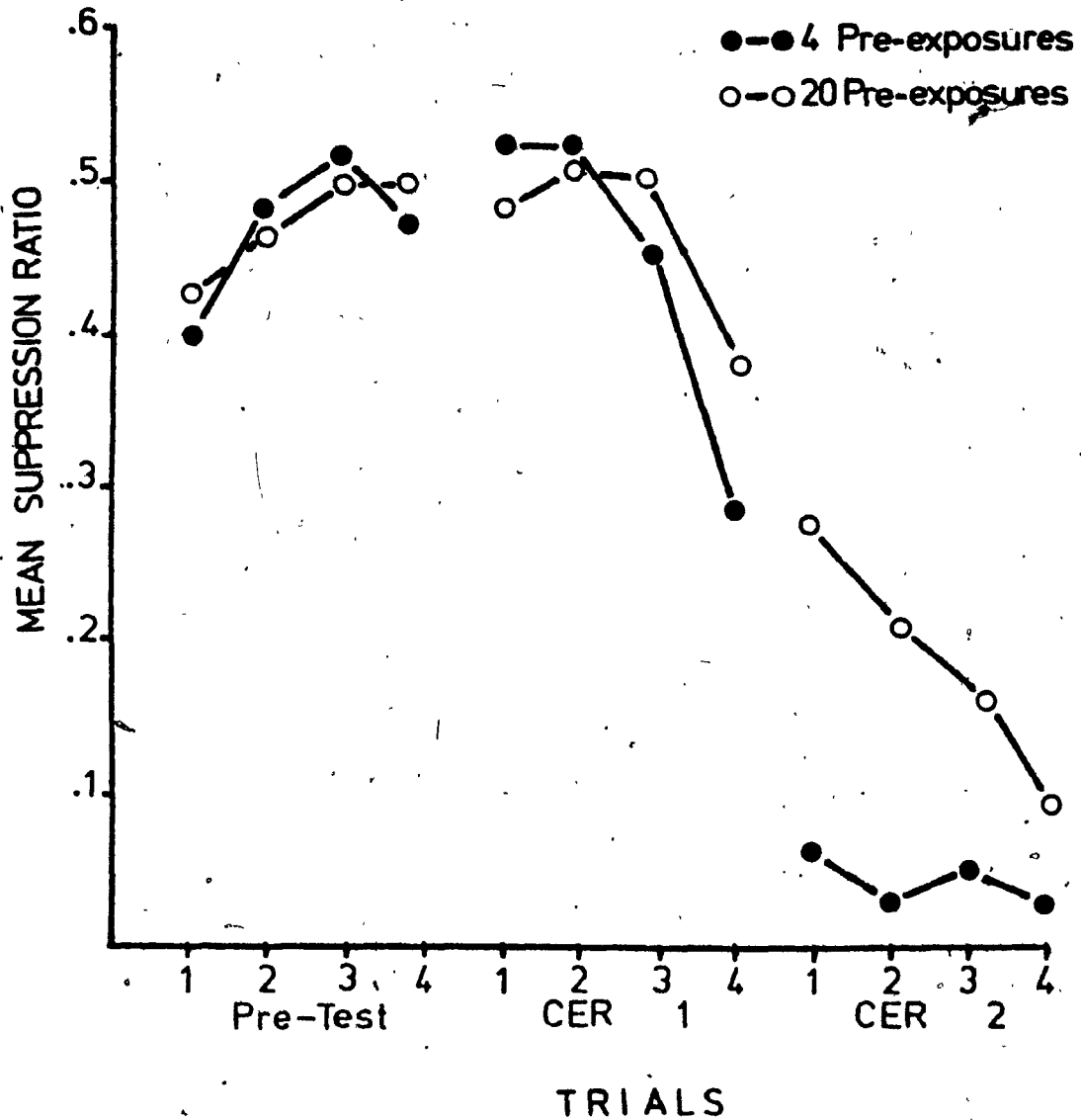


Figure 4: Mean suppression ratios elicited after 4 or 20 pre-exposures across the four trials of the first Pre-exposure session and across the eight trials of Conditioning Sessions 1 and 2, respectively.

little change across Trials 1 to 4, with mean suppression ratios of .06, .04, .06, and .05 respectively, the 20 Pre-exposure condition produced suppression ratios which, although decreasing across Trials 1 to 4, are consistently greater than those displayed under the 4 Pre-exposure condition. Mean suppression ratios under the 20 Pre-exposure condition were .28, .21, .16, and .10 respectively.

The third conditioning session produced a floor effect similar to that noted in the second experiment, with a high proportion of suppression ratios of zero within each cell. For these reasons these results were not analyzed.

Extinction Phase

As in the third conditioning session, results of the first extinction session revealed a floor effect with a high number of zero ratios within each cell. For these reasons the results of the first extinction session were not analyzed.

Results of the second and third extinction sessions were analyzed by means of two 2 (Stimulus Condition) X 2 (Pre-exposure Condition) X 4 (Successive Extinction Trials) unweighted means ANOVAs with repeated measures across Trials. Results indicated only a significant effect of Trials for each session, $F(3,78) = 8.06, p < .001$; $F(3,78) = 11.61, p < .001$, respectively.

DISCUSSION

Contrary to predictions developed from Schneirla's (1965) approach - withdrawal classification scheme, the stimulus which changed in frequency in an irregular manner, was not more readily associated with the aversive UCS than was the constant frequency stimulus. Interestingly, this lack of a conditioning and extinction difference between the irregular and regular stimuli was associated with a lack of a difference in unconditioned suppression during the initial unreinforced pre-exposure. These findings cast further doubt on the usefulness of Schneirla's scheme as an explanation of phobic learning, suggesting instead that differences in salience between CSs, as measured by differences in ability to elicit unconditioned suppression, may be better predictors of differences in conditionability.

Because the stimuli did not differ in conditioning and extinction effects, the hypothesized interaction between stimulus and pre-exposure effects could not be investigated. However, increasing the number of unreinforced pre-exposures to the CS resulted in a greater effect on CER acquisition than was observed in any previous comparison. While the 4 Pre-exposure condition showed almost complete suppression on all trials of the second conditioning session, the 20 Pre-exposure group appeared to be three trials behind, displaying less suppression than the 4 Pre-exposure group until the fourth trial of Session 2.

This powerful effect of varying the number of unreinforced pre-exposures, on conditioning, indicates that the dimension of CS novelty - familiarity may be an important factor affecting the rate of conditioning. This finding is clearly in agreement with the reports of other researchers demonstrating the retarding effect of pre-exposure on CER acquisition (e.g; Lubow, 1973; Mackintosh, 1974; Gray, Note 1), and seems to be consistent with the findings suggesting the prepotency of novel stimuli in the acquisition of conditioned taste aversions (Revusky & Bedarf, 1967; Wittlin & Brookshire, 1968; Kalat & Rozin, 1972). Although the actual mechanisms underlying the retarding effect of stimulus familiarity are the subject of some dispute, it is clear that the effect itself is quite powerful, and may have important implications in the development of human fears and phobias.

EXPERIMENT 4

In the second of this series of experiments, the Tone vs. Noise comparison, it was observed that a significant difference in terms of unconditioned suppression initially elicited by these stimuli, predicted later differences in CER acquisition. Interpreting unconditioned suppression as indicative of the orienting response, it was hypothesized that these stimuli differed in terms of salience, or ability to attract the attention of the organism, and that it was this attentional quality of the CS which was related to its conditionability. Although the stimuli compared in the first and third experiments failed to reveal any significant conditioning differences on any trial, the fact that these stimuli also failed to differ in terms of salience (as measured by the magnitude of initial unconditioned suppression elicited by these stimuli) supports the hypothesized relationship between salience and conditionability.

The preceding experiment demonstrated clearly the retarding of the conditioning effect produced by unreinforced pre-exposure to the CS. However, it was impossible to determine whether pre-exposure to the CS interacted with the effect of salience of the CS, in its effect upon CER acquisition, since initial unconditioned suppression to these two tones did not significantly differ. In order to further examine a possible salience - familiarity interaction, the tone and noise stimuli, which were demonstrated

in the second experiment to differ both in terms of salience and conditionability, were compared in effect on CER acquisition and extinction after 20 unreinforced pre-exposures.

METHOD

Subjects

Subjects in this experiment were 16 experimentally naive, male hooded rats that weighed between 250 and 275g when they were received from the supplier.

Apparatus and Procedure

The apparatus and procedure used in this experiment were identical to that used in the preceding experiments. The stimuli presented in this experiment were an 80db 1000Hz sine wave tone, and an 80db white noise. Since rate of pulsing produced no effect on conditioning or extinction in the second experiment, both stimuli were .50-sec duration pulses delivered at a rate of one per second. Stimuli in this experiment were not taped, but were presented directly from the tone or noise generators into the speakers in the conditioning units.

Upon being received from the supplier, the 16 animals were randomly assigned to two groups of eight subjects, and as in the preceding experiments, were weighed and fed daily, during the 10 day deprivation period, at the same time of day as they would be run in the experiment.

Subjects in both groups received 20 unreinforced pre-exposures to the CS, over a period of five days, in a manner similar to the 20 pre-exposure groups of the third experiment. Following pre-exposure, all animals underwent three days of conditioning and three days of extinction.

RESULTS

Pre-exposure Phase

Of the five pre-exposure sessions, only during the first was there any reliable effects of any variable. Results of the 2(Stimulus) X 4(Successive Trials) ANOVA with repeated measures across Trials for the first pre-exposure session revealed a significant Stimulus main effect, $F(1,14) = 8.03, p < .05$, a significant Trials main effect, $F(3,42) = 15.80, p < .001$, and a significant Stimulus by Trials interaction, $F(3,42) = 3.37, p < .05$. Trial-by-trial comparisons of unconditioned suppression elicited by the noise and the tone during the first pre-exposure session revealed that the Noise produced significantly greater suppression than the Tone on the first trial, $t(14) = 2.98, p < .01$, and the second trial, $t(14) = 2.19, p < .05$. No significant differences in unconditioned suppression were found between the two conditions on any of the remaining pre-exposure trials. From Figure 5 it can be seen that the animals had habituated to both stimuli by the third trial of the first pre-exposure session.

Conditioning Phase

Analysis of the effects of the tone and the noise across the four trials of the first conditioning session was undertaken using a 2(Stimulus) X 4(Successive Trials) ANOVA with repeated measures across trials. Results indicated no effects of either Stimulus or Trials, as all F values were less than 1. The same analysis performed on the results of the second conditioning session revealed only a significant effect of Trials, $F(3,42) = 4.93$, $p < .05$, while in the third conditioning session a floor effect was reached, and the high number of suppression ratios of zero precluded analysis of this session. Figure 6 reveals that conditioned suppression was acquired at equal rates under both stimulus conditions.

Extinction Phase

As in the third conditioning session, the high number of suppression ratios of zero precluded analysis of the first extinction session. Analysis of the second and third extinction sessions revealed no reliable effects of Stimulus Condition, as only the Trials main effect was significant within each session, $F(3,42) = 5.80$, $p < .01$ for Session 2; $F(3,42) = 5.62$, $p < .01$ for Session 3.

DISCUSSION

As demonstrated in the second experiment, the noise stimulus produced significantly greater unconditioned suppression during the

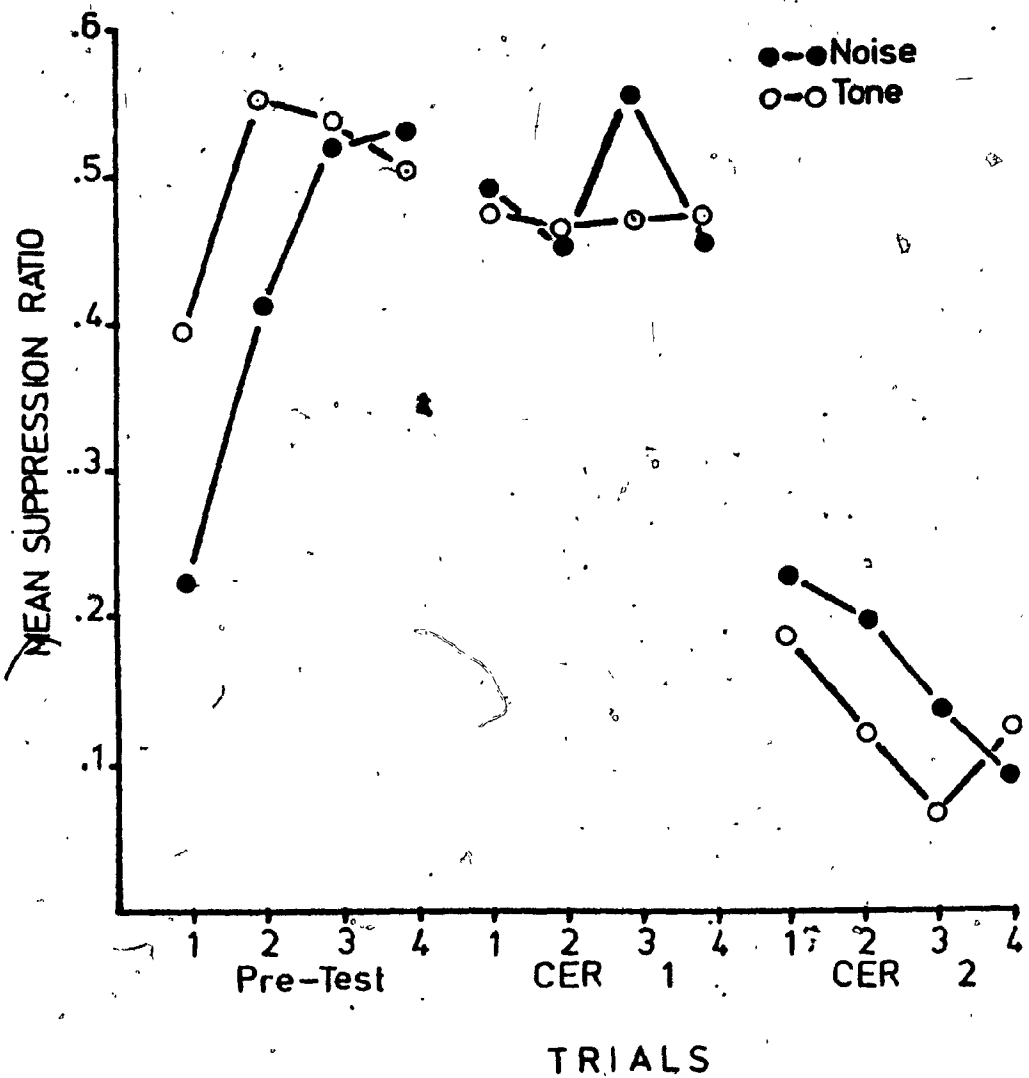


Figure 5: Mean suppression ratios elicited by the Noise and Tone stimulus conditions after 20 pre-exposures, for the first pre-exposure session and the first two conditioning sessions.

first pre-exposure session than did the tone. Unlike the second experiment, however, this difference in initial unconditioned suppression did not predict a conditioning difference between the stimuli, nor were there any extinction differences noted between the two conditions. Apparently an increase in the number of unreinforced pre-exposures produces more than merely a retarding of the conditioning effect. Increasing the familiarity of the unreinforced CS to the animals, before conditioning, also appears to have eliminated the differences in conditioning and extinction which were associated with differences in unconditioned suppression in the second experiment. Such a finding supports Mackintosh's (1975) contention that the effects of experience with a class of stimuli can interact with the effects of the physical qualities of a stimulus upon conditioning.

GENERAL DISCUSSION

The preceding series of experiments was initiated in an attempt to determine factors which facilitate the association of a CS with an aversive UCS, as a possible explanation for the selectivity, high conditionability and resistance to extinction characteristic of human phobias. Differential rates of CER acquisition were noted in the second and third experiments, demonstrating that these results do not support a notion of stimulus equipotentiality. To this extent, these results could be said to be in favor of a "preparedness" explanation of fear acquisition. Since prepared learning has been defined in terms of ease of association between events (Seligman, 1970), then it could be said that the animals in the above experiments were more prepared to associate fear with certain stimulus events than with others. Yet, none of these stimuli were inherently more threatening than the others, suggesting that although potential threat may influence the associability of the CS with an aversive UCS, it is not a necessary condition. Rather, these experiments suggest three dimensions which may influence the association of a stimulus with aversive consequences. First, Experiment 2 provided partial support for the hypothesis that stimuli meeting the "withdrawal" characteristics outlined by Schneirla (1965) should be readily associated with aversive events. Secondly, the ability of differences in orienting response produced by the CS, as indicated by differences in initial unconditioned suppression,

to predict later differences in CER acquisition rate suggest the importance of the salience of the stimulus. Finally, the retarding effects of increasing the number of unreinforced pre-exposures to the CS, and its interaction with the effects of salience, suggests that the dimension of novelty - familiarity of a stimulus event may exert an important influence upon the associability of events.

Approach - Withdrawal Characteristics

Schneirla (1965) has suggested that responding to stimuli which meet the criteria for eliciting either approach or withdrawal may have a survival function for vertebrates. This assumption is based upon his observation that stimulation which elicits withdrawal is frequently correlated with noxious events, whereas stimulation which elicits approach often predicts beneficial consequences. Because of this proposed relationship between withdrawal-eliciting stimulation and noxious consequences, it had been expected that such stimuli would have been readily associated with the aversive UCS. Examination of auditory stimuli which differed along the dimensions of Frequency, Succession, and Pattern, according to the criteria described by Schneirla in Table 1, did not fully support this hypothesis. The only reliable difference produced by withdrawal vs. approach comparisons occurred in the second experiment. The faster rate of CER acquisition in Experiment 2 during the presentation of the noise than during the tone,

supported the prediction that stimuli which are complex in pattern should be more easily associated with an aversive event than simple stimuli. This finding could be interpreted as offering some support for Schneirla's position. However, the lack of similar withdrawal vs. approach differences in conditioning, produced by the other auditory dimensions places considerable doubt upon this approach. Moreover, the noise vs. tone difference in unconditioned suppression, which actually predicted later CER differences, suggests that the observed differences in conditioning rate may be due to differences in the salience of the CS, rather than to an innate tendency of the noise to elicit withdrawal. The predictive value of initial differences in unconditioned suppression upon later conditioning rates was also demonstrated in Experiments 1 and 3, where the lack of difference between the stimuli during the pre-exposure period was reflected in a similar lack of conditioning difference.

Before rejecting Schneirla's biphasic system as a basis for prepared fear conditioning, several precautionary considerations must be taken into account. Of obvious primary concern is the use of rats in this series of experiments. Since the basic assumption of the preparedness position lies in a phylogenetic interpretation of learning, then it could be argued that results of experiments using rats as subjects have little or no relevance to the development of human phobias. A further concern lies in the argument that pairing shock with a stimulus does not produce a phobia, and it may be

possible even to say that conditioned suppression is not a measure of fear. These are important arguments, and must be considered before any analogy can be drawn between human phobic learning and CER learning in rats. Although the preparedness account of the acquisition of phobias stresses the phylogenetic relevance of phobic stimuli, this need not imply that such relevance must be species-specific. Indeed, Schneirla does not limit the effect of approach/withdrawal characteristics to any species, but generalizes their significance to neonate vertebrates. Thus, although the stimulus events to which the organism is prepared to respond may differ between species, Schneirla suggest that they share common perceptual qualities. Thus the use of rats as subjects is justified since the aim of this investigation was not to generate a list of objects feared by humans, but to examine the perceptual characteristics which may underlie the fear of these objects. It is more difficult to deal with the second argument, that pairing shock with a stimulus event does not produce a phobia, and may not even elicit fear. Such an argument is important in that it suggests the necessity of considering the UCS in terms of the actual unconditioned response which is elicited prior to conditioning. It would certainly be fallacious to assume that, because a UCS is aversive, it must elicit an unconditioned fear response. Moreover, it is not being suggested that all avoidance behavior is mediated by fear. It could be argued that shock may not actually elicit fear,

and thereby may not serve as an appropriate UCS for a laboratory analogue to the acquisition of phobias. However, other researchers who purport to be experimentally investigating the acquisition of phobias (e.g. Ohman et al. 1975, 1976) have also utilized electric shock as the UCS. The value of this procedure lies not so much in the ability to produce conditioned fear, but in the measurement of the associability of a stimulus with an aversive event. Thus, to the extent that the withdrawal characteristics described by Schneirla (1965) were not more readily associated with the aversive UCS, than were the approach characteristics, it would appear that these auditory characteristics are not factors which could account for the selectivity and high conditionability of phobic stimuli. The only exception to the above was demonstrated in the tone vs. noise comparison, where the greater associability of the noise, than of the tone, with shock was predicted by a similarly greater orienting response elicited by the noise, suggesting the importance of the salience of the CS.

Salience and Novelty

It appears, from the evidence of this investigation, that a relationship exists between the ability of a stimulus to elicit an orienting response (measured in terms of magnitude of unconditioned suppression elicited by the stimulus) and its associability with an aversive event. If the magnitude of the orienting response is

considered indicative of the ability of the stimulus to attract the attention of the organism, then the conditionability of that stimulus may be related to its attentional value or salience. Indeed, it has been demonstrated that stimuli do differ in ability to attract the organism's attention. For example, investigations of compound conditioning have shown that when an animal is presented with a compound composed of equally valid stimuli (i.e. each stimulus is correlated with reinforcement), one stimulus (often the more intense stimulus) may overshadow the other stimulus, such that conditioning to the less salient stimulus is decreased or even prevented (Hall, Mackintosh, Goodall, & Del Martello, 1977; Kamin, 1969; Mackintosh, 1971). Moreover, Kamin (1968) has demonstrated that the degree of overshadowing of one element by the other can be predicted from the rates of conditioning of the individual elements, suggesting a relationship between salience and conditionability similar to that found in the present investigation.

Although apparently exerting an important influence upon conditionability, the dimension of stimulus salience does not appear to operate independently of the effects of the relative familiarity of the stimulus. In fact, the dimension of novelty - familiarity of the CS proved to be the most important factor influencing conditioning in these experiments. Not only did increasing familiarity with the unreinforced CS before conditioning interfere with the association of the CS with reinforcement, as demonstrated

in Experiment 3, but was able to eliminate the salience-related conditioning differences between the noise and the tone.

Although the superior associability of novel stimuli with reinforcement has been repeatedly demonstrated in classical conditioning experiments (see Lubow (1973) for a comprehensive review of the effects of CS pre-exposure), the underlying mechanisms of the effect are unclear. Various theorists have suggested different functions served by the unreinforced CS. It has been suggested by a number of authors (e.g. Lubow, 1965, 1973; Lubow & Moore, 1959) that the CS acquires an inhibitory function such that it comes to predict that no reinforcement follows. Other theorists (e.g. Mackintosh, 1975) have postulated that only those stimuli which predict a change in reinforcement are attended to by the organism. Repeated unreinforced pre-exposure to a CS therefore results in a lack of attending to that CS, just as other background stimulation is ignored. Although this investigation was not intended to examine the mechanism underlying the retardation of conditioning due to CS pre-exposure, the latter explanation of selective attention is particularly interesting in that it implies a relationship between novelty and salience. Such a relationship can be seen when the results of the second and fourth experiments are examined. Although, after only four pre-exposures, the ability of the CS (noise or tone) to elicit an orienting response predicted its associability with the aversive UCS, this relationship was not

maintained after 20 pre-exposures. After 20 unreinforced pre-exposures to the CS, the rate of CER acquisition between the noise and tone no longer differed, in spite of large differences during pre-exposure. Apparently, familiarity with a CS can counteract the effects of its salience. In fact, Rescorla (1971) has attributed the retarding effect of pre-exposure to a reduction of stimulus salience. Such an interpretation is clearly supported by this investigation, which demonstrates the ability of unreinforced pre-exposure to eliminate salience-related differences in conditioning. Indirect support for Rescorla's position can also be found in the finding of Gray (Note 1). This researcher has demonstrated that a stimulus which failed to produce habituation even after 24 pre-exposures (i.e. an extremely salient CS) was relatively unaffected in associability with reinforcement by more than one pre-exposure. These findings suggest that unreinforced pre-exposure impedes the association of a stimulus and a reinforcing event through a reduction of the salience of the stimulus. If salience cannot be reduced (as in the case of stimuli to which the animal fails to habituate), then pre-exposure produces little effect.

Because of their effect on the associability of a CS with an aversive UCS, the inter-related dimensions of salience and novelty appear to be factors which could contribute to the selectivity and conditionability of phobic stimuli. However, in their investigations of "prepared" vs. "unprepared" fear conditioning, Ohman et al. (1976)

contend that salience cannot account for the demonstrated extinction differences between "phobic" and "neutral" stimuli. Defining salience in terms of magnitude of the orienting response elicited by a stimulus, these researchers compared the effects of a complex to a simple visual stimulus on CER acquisition and extinction in human subjects, as measured by conditioned GSR. Their results indicated that the complex stimulus, in spite of producing a greater orienting response than the simple stimulus, failed to produce a more extinction-resistant CER. The "phobic" stimulus, on the other hand, not only elicited a more extinction-resistant CER than the neutral stimulus but also produced a greater orienting response. On the basis of these findings, these authors have concluded that salience, as measured in terms of magnitude of the orienting response, is not a factor influencing "prepared" fear conditioning. However, because these authors define salience in terms of the magnitude of the orienting response, it must be concluded that the "phobic" and "neutral" stimuli, as well as the complex and simple stimuli, differed in terms of salience. Thus, on the basis of these comparisons it is not possible to rule out the effects of salience. Rather, it can be said that salience appears to interact with some other variable such that its effect is eliminated in the comparison of the complex and simple visual stimuli. Interestingly, although Ohman et al. informed subjects in the "phobic" vs. "neutral" comparison as to which stimulus was to be reinforced, subjects in the high vs. low salience comparison were

not so informed. By informing subjects in the first comparison, these authors have, in effect, correlated these stimuli with reinforcement to a greater degree than the stimuli in the second experiment (which also received three unreinforced pre-exposures). Thus before the experiment began the phobic and neutral stimuli were better correlated with reinforcement (or were more valid CS's) than the high or low salience stimuli. But, this is precisely the opposite of the effect of unreinforced pre-exposure, which reduces the correlation of the stimulus with reinforcement. Thus, if the action of informing subjects concerning reinforcement can be conceptualized as similar in effect to decreasing the number of unreinforced pre-exposures, then it might be expected, as was demonstrated in the present investigation, that the effects of salience could interact with the relative familiarity (i.e. validity) of the CS to reduce resistance to extinction with the complex stimulus. Clearly the evidence is insufficient to eliminate the role of salience, as these authors propose. On the contrary, as previously discussed there is considerable evidence which favors the role of salience in the association of events.

The suggested inter-relationship between the dimensions of salience and novelty has been illustrated in the definition of salience provided by Rozin and Kalat (1971). These authors define salience in terms of the "relative novelty" of the stimulus. Arguing in favor of a "familiarity generalization" explanation,

Rozin and Kalat have suggested that more salient stimuli may, in actuality, be more different from previously experienced stimuli. The appeal of this explanation lies in its extension of the novelty - familiarity effect, beyond the specific CS, to classes of stimuli which are similar to that CS. This notion of generalization from past experience to the present learning situation has been suggested by Mackintosh (1973) as a possible explanation of the phenomenon of "belongingness" or specificity of association between a stimulus and a reinforcer. Mackintosh has proposed that the interference of conditioning produced by unreinforced pre-exposure may explain why some stimuli are readily associated with certain reinforcers, and not others. Arguing that animals may learn that variations in a certain class of stimuli are unrelated to variations in a specific class of reinforcers, he has suggested that a tendency for an animal to presently associate only certain stimuli with a given reinforcer could be a consequence of a past history in which other classes of stimuli have varied without predicting variations in the reinforcer in question. Thus, as an explanation of the specificity of association noted in conditioned taste aversions, Mackintosh proposes that "tastes are now readily associated with internal changes because the adult rat has had a lifetime's experience of such changes not being correlated with changes in external stimuli (1973. p. 93).

Although purely conjectural, the value of such an interpretation lies in its suggestion of the importance of apparent CS - UCS

causality. Perhaps greater conditioning can be expected to occur if the CS, based on its physical qualities and on the past experience of the organism with stimuli possessing similar physical qualities, appears to be the cause of the UCS. In fact, the importance of apparent CS - UCS causality has been demonstrated by Testa (1975) who has shown that a covariation of the stimulus event and the reinforcing event, in terms of similarity of location and temporal patterning, greatly facilitates the association of the two events.

Relevance of Salience and Novelty to the Acquisition of Human Phobias

There appears to be considerable evidence, both in the literature and reflected in this series of experiments, suggesting that learning involves more than simply the pairing of any neutral stimulus with a reinforcing event. The observation that human phobias, too, do not fit this description need not imply that a new approach to learning is necessary to explain their acquisition. Those characteristics which appear to differentiate phobias from laboratory fear conditioning -- their selectivity, their rapid association with reinforcement, and their resistance to extinction (Seligman, 1971), are, in fact, characteristics which have been demonstrated in laboratory fear conditioning. The observation that phobic stimuli comprise a select group of potentially threatening stimuli, which are readily associated with aversive consequences, is explainable, in part, with reference to the salience and novelty of such stimuli.

Such an explanation does not deny the preparedness position, but rather suggests that the organism may be prepared to make associations when certain conditions are met, rather than to certain stimuli.

Indeed, the salience - novelty effects could easily be interpreted in terms of biological advantage. In suggesting the biological advantage associated with the phenomenon of CS - UCS "belongingness" observed in conditioned taste aversions, Rozin and Kalat (1971) have proposed that an equal ability to associate lights and sounds with gastrointestinal consequences would be unadaptive, and in fact would result in "superstitious" learning. The same could be said regarding familiar vs. novel stimuli. An equal associability between stimuli which are not correlated with change in reinforcement, and stimuli which are, would result in superstitious learning. It is clearly to the advantage of the organism to ignore familiar stimuli when a change in reinforcement occurs, and instead to associate that reinforcing event with a novel or more salient stimulus.

In the situation in which the phobia is acquired, the individual may indeed be more prepared to associate certain stimuli with the aversive event than others. As in laboratory fear conditioning where several stimuli are presented, it would be expected that the most salient stimulus would be associated with the aversive event (Kamin, 1969; Mackintosh, 1971) and that the salience of the CS may predict the strength of the association. Certain stimuli may

be more salient, and are more readily associated with the aversive event because they are similar to stimuli which have been previously associated with similar aversive consequences (Mackintosh, 1973; Rozin & Kalat, 1971), or because they are stimuli which are unfamiliar to the individual (Gray, Note 1; Kalat & Rozin, 1970; Lubow, 1973; Mackintosh, 1973, 1975; Rescorla, 1971; Revusky & Bedarf, 1967; Wittlin & Brookshire, 1968), or because they possess certain perceptual similarities to the aversive event, thereby appearing to cause the event (Testa, 1975).

Although obviously important to an understanding of the acquisition of phobias, it is not suggested that the dimensions of salience and novelty explain all. There is clear evidence throughout the animal learning literature suggesting the importance of biological factors in learning, and it would seem only logical to expect that some forms of human learning might be similarly phylogenetically prepared. It is the contention of this investigation, however, that caution must be exercised before a behavioral phenomenon is attributed to phylogeny, simply because of the difficulties encountered in its explanation in terms of current knowledge. For example, Seligman (1971) illustrates his discussion of the preparedness notion of phobias by describing the non-arbitrariness of phobic stimuli. Commenting on the characteristic of potential threat, Seligman states "only rarely, if ever, do we have pajama phobias, grass phobias, electric-outlet phobias, hamster phobias,

even though these things are likely to be associated with trauma in our world" (1971, p 312). Indeed, these things may be likely to be associated with trauma, but after how many unreinforced presentations? Moreover, would the "traumatic" UCS elicit fear, or as in the case of the hammer, merely aversion? Finally, due to their potential threat, certain stimuli may have a greater probability of occurring concurrently with reinforcement, thereby increasing the chance that they will be associated with the event. As well, certain stimuli may be predisposed, through social learning, to be associated with reinforcement. Such an increase in the validity of a CS would be expected to increase its associability with reinforcement. Evidently there remain many unanswered questions in behavioral explanations of the acquisition of phobias.

REFERENCE NOTES

1. Gray, T. CS pre-exposure and acquisition of the CER.

Paper presented at the meeting of the Canadian
Psychological Association, Ottawa, Ontario, 1978.

REFERENCES

- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. (3rd ed.) Washington, D.C., 1977.
- Baum, M. Extinction of avoidance responding through response prevention (flooding). Psychological Bulletin, 1970, 74, 276-284.
- De Silva, P., Rachman, S., & Seligman, M.E.P. Prepared phobias and obsessions: Therapeutic outcome. Behavior Research and Therapy, 1977, 15, 66-77.
- Estes, W.K., & Skinner, B.F. Some quantitative properties of anxiety. Journal of Experimental Psychology, 1941, 29, 390-400.
- Garcia, J., McGowan, B.K., & Green, K.F. Biological constraints on conditioning. In A.H.Black & W.F.Prokasky (Eds.), Classical Conditioning II: Current research and theory. New York: Appleton-Century-Crofts, 1972.
- Gray, T. Sudden, rapid acquisition of the CER (conditioned suppression) Animal Learning and Behavior, in press.
- Grice, G.R., Hunter, J.J., & Kohfeld, D.L. Order of presentation, CS intensity, and response latency. Journal of Experimental Psychology, 1967, 74, 581-585.
- Hall, G., Mackintosh, N.j., Goodall, G., & Dal Martello, M. Loss of control by a less valid or by a less salient stimulus compounded with a better predictor of reinforcement. Learning and Motivation, 1977, 8, 145-158.
- James, J.P., Ossenkop, P., & Mostoway, W.W. Avoidance learning as a function of amount and direction of change in CS intensity

without a constant background intensity. Bulletin of the Psychonomic Society, 1973, 2(1), 18-20.

Kalat, J.W., & Rozin, P. You can lead a rat to poison but you can't make him think. In M.E.P. Seligman and J.E. Hager (Eds.) Biological boundaries of learning. New York: Appleton-Century-Crofts, 1972.

Kamin, L.J. Temporal and intensity characteristics of the conditioned stimulus. In W.F. Prokasky (Ed.), Classical conditioning. New York: Appleton-Century-Crofts, 1965.

Kamin, L.J. "Attention-like" processes in classical conditioning. In M.R. Jones (Ed.), Miami symposium on the prediction of behavior. Coral Gables, Florida: University of Miami Press, 1968.

Kamin, L.J. Predictability, surprise, attention, and conditioning. In B.A. Campbell and M.R. Church (Eds.), Punishment and aversive behavior. New York: Appleton-Century-Crofts, 1969.

Lubow, R.E. Latent inhibition: Effects of frequency of non-reinforced preexposures to the CS. Journal of Comparative and Physiological Psychology, 1965, 60, 454-455.

Lubow, R.E. Latent inhibition. Psychological Bulletin, 1973, 79, 398-407.

Lubow, R.E., & Moore, A.U. Latent inhibition: The effect of non-reinforced preexposure to the conditioned stimulus. Journal of Comparative and Physiological Psychology, 1968, 66, 688-694.

- Mackintosh, N.J. An analysis of overshadowing and blocking. Quarterly Journal of Experimental Psychology, 1971, 23, 118-125.
- Mackintosh, N.J. Stimulus selection: Learning to ignore stimuli that predict no change in reinforcement. In R.A.Hinde & J. Stevenson-Hinde (Eds.), Constraints on learning. London: Academic Press, 1973.
- Mackintosh, N.J. A theory of attention: Variations in the associability of stimuli with reinforcement. Psychological Review, 1975, 82, 276-298.
- Marks, I. Fears and phobias, New York: Academic Press, 1969.
- Monti, P.M., & Smith, N.F. Residual fear of the conditioned stimulus as a function of response prevention after avoidance or classical defensive conditioning in the rat. Journal of Experimental Psychology: General, 1976, 105, 148-162.
- Mowrer, O.H. On the dual nature of learning --- a reinterpretation of "conditioning" and "problem-solving". Harvard Educational Review, 1947, 17, 102-148.
- Mowrer, O.H. Learning theory and behavior. New York: Wiley, 1960.
- Ohman, A., Eriksson, A., & Olofsson, C. One-trial learning and superior resistance to extinction of autonomic responses conditioned to potentially phobic stimuli. Journal of Comparative and Physiological Psychology, 1975, 88, 619-627.
- Ohman, A., Erixon, G., & Lofberg, I. Phobias and preparedness: Phobic versus neutral pictures as conditioned stimuli for

- human autonomic responses. Journal of Abnormal Psychology, 1975, 84, 41-45.
- Ohman, A., Frederikson, M., Hugdahl, K., & Rimmo, P.A. The premise of equipotentiality in human classical conditioning: Conditioned electropdermal responses to potentially phobic stimuli. Journal of Experimental Psychology: General, 1976, 105, 313-337.
- Rescorla, R.A. Summation and retardation tests of latent inhibition. Journal of Comparative and Physiological Psychology, 1971, 75, 77-81.
- Rescorla, R.A., & Solomon, R.L. Two process learning theory: Relations between Pavlovian conditioning and instrumental learning. Psychological Review, 1967, 74, 151-182.
- Revusky, S.H., & Bedarf, E.W. Association of illness with prior ingestion of novel foods. Science, 1967, 155, 219-220.
- Rozin, P., & Kalat, J.W. Specific hungers and poison avoidance as adaptive specialization of learning. Psychological Review, 1971, 78, 459-486.
- Schneirla, T.C. Aspects of stimulation and organization in approach/withdrawal processes underlying vertebrate behavioral development. In D.S. Lehrman, R.A. Hinde, & E. Shaw (Eds.), Advances in the study of behavior, New York: Academic Press, 1965.
- Seligman, M.E.P. Chronic fear produced by unpredictable electric shock. Journal of Comparative and Physiological Psychology, 1968, 66, 402-411.

Seligman, M.E.P. On the generality of the laws of learning.

Psychology Review, 1970, 77, 406-418.

Seligman, M.E.P. Phobias and preparedness. Behavior Therapy,

1971, 2, 307-320.

Seligman, M.E.P., & Hager, J.E. (Eds.), Biological boundaries of

learning. New York: Appleton-Century-Crofts, 1972.

Tait, R.W., & Suboski, M.D. Stimulus intensity in sensory pre-

conditioning of rats. Canadian Journal of Psychology,

1972, 26(4), 374-381.

Testa, T.J. Effects of similarity of location and temporal intensity

pattern of conditioned and unconditioned stimuli on the acquis-

ition of conditioned suppression in rats. Journal of Experimental

Psychology: Animal Behavior Processes, 1975, 104, 114-121.

Thompson, C.P., & Van Hoesen, G.W. Compound conditioning: Effects

of component intensity on acquisition and extinction. Journal

of Comparative and Physiological Psychology, 1967, 64, 128-132.

Wittlin, W.A., & Brookshire, K.H. Apomorphine-induced conditioned

aversion to a novel food. Psychonomic Science, 1968, 12,

317-218.

APPENDIX 1

ANOVA SUMMARY TABLES FOR CONDITIONING PHASE, EXPERIMENT 1

CONDITIONING SESSION 1				
SOURCE	SS	df	MS	F
Between Subjects	1190.53	13		
Stimulus	21.37	1	21.37	<1
Subjects w Groups	1169.16	12	97.43	
Within Subjects	5570.03	42		
Trials	1116.90	3	372.30	3.19*
Stimulus X Trials	251.57	3	83.86	<1
Trials X Sub w Gp	4201.56	36	116.71	

* $p < .05$

CONDITIONING SESSION 2				
SOURCE	SS	df	MS	F
Between Subjects	6546.86	13		
Stimulus	.07	1	.07	<1
Subjects w Groups	6546.79	12	545.57	
Within Subjects	1796.00	42		
Trials	190.43	3	63.48	1.44
Stimulus X Trials	18.36	3	6.12	<1
Trials X sub w Gp	1587.21	36	44.09	

APPENDIX 2

ANOVA SUMMARY TABLES FOR EXTINCTION PHASE, EXPERIMENT 1

EXTINCTION SESSION 2

SOURCE	SS	df	MS	F
Between Subjects	5991.43	13		
Stimulus	144.64	1	144.64	<1
Subjects w Groups	5846.79	12	487.23	
Within Subjects	3590.50	42		
Trials	1272.79	3	424.26	9.05**
Stimulus X Trials	629.36	3	209.79	4.47*
Trials X Sub w Gp	1688.36	36	46.90	

* $p < .05$ ** $p < .01$

EXTINCTION SESSION 3

SOURCE	SS	df	MS	F
Between Subjects	13661.31	13		
Stimulus	2137.78	1	2137.78	2.23
Subjects w Groups	11523.43	12	960.79	
Within Subjects	4185.00	42		
Trials	2118.92	3	706.31	13.84**
Stimulus X Trials	228.94	3	76.31	1.50
Trials X Sub w Gp	1837.14	36	51.03	

** $p < .01$

APPENDIX 3

ANOVA SUMMARY TABLE FOR THE PRE-TEST SESSION, EXPERIMENT 2

SOURCE	SS	df	MS	F
Between Subjects	9479.97	31		
Complexity	45.13	1	45.13	< 1
Rate	561.13	1	561.13	1.88
Complexity X Rate	520.02	1	520.02	1.74
Subjects w Groups	8353.69	28	298.35	
Within Subjects	13107.00	96		
Trials	6326.53	3	2108.84	32.28***
Complexity X Trials	853.44	3	284.48	4.49**
Rate X Trials	434.81	3	144.94	2.29
Comp1 X Rate X Trials	169.66	3	56.55	< 1
Trials X Sub w Gp	5322.56	84	63.36	

**p < .01
 ***p < .001

APPENDIX 4

ANOVA SUMMARY TABLE FOR CONDITIONING SESSION 1, EXPERIMENT 2

SOURCE	SS	df	MS	F _j
Between Subjects	15890.87	31		
Complexity	990.12	1	990.12	2.03
Rate	13.78	1	13.78	.03
Complexity X Rate	1262.53	1	1262.53	2.59
Subjects w Groups	13624.44	28	486.59	
Within Subjects	27617.00	96		
Trials	15059.56	3	5019.85	38.48***
Complexity X Trials	1129.19	3	376.40	2.89*
Rate X Trials	268.41	3	89.47	.69
Compl X Rate X Trials	203.03	3	67.68	.52
Trials X Sub w Gp	10956.81	84	130.44	

* $p < .05$
 *** $p < .001$

APPENDIX 5

ANOVA SUMMARY TABLE FOR EXTINCTION SESSION 2, EXPERIMENT 2

SOURCE	SS	df	MS	F
Between Subjects	19987.75	31		
Complexity	1682.00	1	1682.00	3.14
Rate	1891.13	1	1891.13	3.53
Complexity X Rate	1404.50	1	1404.50	2.62
Subjects w Groups	15010.12	28	536.08	
Within Subjects	17256.25	96		
Trials	9919.44	3	3306.48	42.28***
Complexity X Trials	413.69	3	137.90	1.76
Rate X Trials	263.06	3	87.69	1.12
Compl X Rate X Trials	91.43	3	30.48	1
Trials X Sub w Gp	6568.63	84	78.20	

***p < .001

APPENDIX 6

ANOVA SUMMARY TABLE FOR EXTINCTION SESSION 3, EXPERIMENT 2

SOURCE	SS	df	MS	F
Between Subjects	20283.49	31		
Complexity	1747.88	1	1747.88	2.67
Rate	10.69	1	10.69	1
Complexity X Rate	192.58	1	192.58	1
Subjects w Groups	18332.34	28	654.73	
Within Subjects	12502.00	96		
Trials	4604.83	3	1534.94	19.37**
Complexity X Trials	947.67	3	315.89	3.99**
Rate X Trials	222.28	3	74.09	1
Compl X Rate X Trials	70.94	3	23.65	1
Trials X Sub w Gp	6656.28	84	79.24	

**p < .01

APPENDIX 7

ANOVA SUMMARY TABLE FOR CONDITIONING SESSION 1, EXPERIMENT 3

SOURCE	SS	df	MS	F
Between Subjects	8817.18	31		
Stimulus	239.26	1	239.26	< 1
Pre-exposure	70.51	1	70.51	< 1
Stim X Pre-exp	35.07	1	35.07	< 1
Subjects w Groups	7929.34	28	283.19	
Within Subjects	6909.75	96		
Trials	6350.46	3	2116.82	19.70***
Stimulus X Trials	615.77	3	205.26	1.91
Pre-exp X Trials	833.15	3	277.72	2.58
Stim X Pre-exp X Trials	85.34	3	28.45	< 1
Trials X Sub w Gp	9025.03	84	107.44	

***p < .001

APPENDIX 8

ANOVA SUMMARY TABLE FOR CONDITIONING SESSION 2, EXPERIMENT 3

SOURCE	SS	df	MS	F
Between Subjects		29		
Stimulus	452.38	1	452.38	< 1
Pre-exposure	5778.27	1	5778.27	11.22***
Stim X Pre-exp	166.28	1	166.28	< 1
Subjects w Groups	13387.53	26	514.91	
Within Subjects		90		
Trials	1682.54	3	560.85	10.18***
Stim X Trials	73.36	3	24.45	< 1
Pre-exp X Trials	1377.02	3	459.01	8.33***
Stim X Pre-exp X Trials	28.17	3	9.06	< 1
Trials X Sub w Gp	4297.92	78	55.10	

***p < .001

APPENDIX 9

ANOVA SUMMARY TABLE FOR EXTINCTION SESSION 2, EXPERIMENT 3

SOURCE	SS	df	MS	F
Between Subjects		29		
Stimulus	87.77	1	87.77	< 1
Pre-exposure	69.17	1	69.17	< 1
Stim X Pre-exp	84.41	1	84.41	< 1
Subjects w Groups	10048.80	26	386.49	
Within Subjects		90		
Trials	1402.49	3	467.50	8.06***
Stim X Trials	116.08	3	38.69	< 1
Pre-exp X Trials	410.48	3	136.83	2.36
Stim X Pre-exp X Trials	129.83	3	43.28	< 1
Trials X Sub w Gp	4523.16	78	57.99	

*** $p < .001$

APPENDIX 10

ANOVA SUMMARY TABLE FOR EXTINCTION SESSION 3, EXPERIMENT 3

SOURCE	SS	df	MS	F
Between Subjects		29		
Stimulus	97.93	1	97.93	<1
Pre-exposure	83.37	1	83.37	<1
Stim X Pre-exp	171.66	1	171.66	<1
Subjects w Groups	20553.08	26	790.50	
Within Subjects		90		
Trials	2638.55	3	879.52	11.61***
Stim X Trials	93.52	3	31.17	<1
Pre-exp X Trials	255.47	3	85.16	1.12
Stim X Pre-exp X Trials	33.09	3	11.03	<1
Trials X Sub w Gp	5911.31	78	75.79	

***p < .001

APPENDIX 11

ANOVA SUMMARY TABLE FOR PRE-TEST SESSION 1, EXPERIMENT 4

SOURCE	SS	df	MS	F
Between Subjects	2387.25	15		
Stimuli	870.31	1	870.31	8.03*
Subjects w Groups	1516.94	14	108.35	
Within Subjects	10449.25	48		
Trials	4977.25	3	1659.08	15.80***
Stim X Trials	1062.44	3	354.15	3.37*
Trials X Sub w Gp	4409.56	42	104.99	

* $p < .05$ *** $p < .001$

APPENDIX 12

ANOVA SUMMARY TABLES FOR THE CONDITIONING PHASE, EXPERIMENT 4

CONDITIONING SESSION 1

SOURCE	SS	df	MS	F
Between Subjects	1753.25	15		
Stimulus	45.56	1	45.56	<1
Subjects w Groups	1707.69	14	121.98	
Within Subjects	5346.50	48		
Trials	288.13	3	96.04	<1
Stim X Trials	292.56	3	97.52	<1
Trials X Sub w Gp	4765.81	42	113.47	

CONDITIONING SESSION 2

SOURCE	SS	df	MS	F
Between Subjects	9241.00	15		
Stimulus	203.06	1	203.06	<1
Subjects w Groups	9037.94	14	645.57	
Within Subjects	5038.00	48		
Trials	1237.25	3	412.42	4.93*
Stim X Trials	288.69	3	96.23	1.15
Trials X Sub w Gp	3512.06	42	83.62	

* $p < .05$

APPENDIX 13

ANOVA SUMMARY TABLES FOR THE EXTINCTION PHASE, EXPERIMENT 4.

EXTINCTION SESSION 2

SOURCE	SS	df	MS	F
Between Subjects	7712.36	15		
Stimulus	456.89	1	458.89	<1
Subjects w Groups	7255.47	14	518.25	
Within Subjects	2404.25	48		
Trials	665.30	3	221.77	5.80**
Stimulus X Trials	133.55	3	44.52	1.16
Trials X Sub w Gp	1605.41	42	38.22	

**p < .01

EXTINCTION SESSION 3

SOURCE	SS	df	MS	F
Between Subjects	12064.69	15		
Stimulus	361.00	1	361.00	<1
Subjects W Groups	11703.69	14	835.98	
Within Subjects	2402.25	48		
Trials	643.06	3	214.35	5.62**
Stim X Trials	156.88	3	52.29	1.37
Trials X Sub w Gp	1602.31	42	38.15	

**p < .01