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Extinction of an Instrumentally Conditioned Avoidance Response in High and Low Anxiety Subjects

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EXTINCTION OF AN INSTRUMENTALLY CONDITIONED AVOIDANCE RESPONSE IN HIGH AND LOW ANXIETY SUBJECTS

by

Anthony Paul Gillette

A Thesis Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Arts

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CHAPTER I

INTRODUCTION

The last 20 years have seen the publication of a vast amount of research literature on "anxiety". Much of the literature has been devoted to defining anxiety in a concrete, operational way and to specifying the parameters of the concept. A smaller amount of research has been aimed at exploring such practical questions as the relationship of anxiety to certain psychopathologies. The present state of the art in psychology would seem to suggest that there is still a large need for research into the nature of anxiety before more applied problems can be explored.

The present project was an attempt to further validate and specify the nature of anxiety from a particular theoretical viewpoint. The research itself was suggested by the work of Janet Taylor, Kenneth Spence, and others. These authors were originally interested in validating some of Clark Hull's theories concerning drive by using manifest anxiety as one particular drive state. More or less tangentially to their studies, a good deal of research was generated concerning the nature of anxiety itself. The present research project was in the Taylor, Spence, et. al. tradition and derived its theoretical framework largely from Clark Hull.

Hull's system was basically a drive stimulus reduction system as Hilgard (1956) pointed out. It would be unnecessary to give a complete synopsis of it here. However, a few of the major theoretical hypotheses which are crucial for the purposes of this project will be touched on.
Basically Hull (1943) held that behavior is a multiplicative function of two hypothetical constructs: habit strength and drive strength. More explicitly, his Seventh Postulate stated that any effective habit strength \((sH_r)\) is sensitized into reaction potential \((sE_r)\) by all primary drives active within an organism at a given time. The magnitude of this potential is a product obtained by multiplying an increasing function of habit strength by an increasing function of drive strength. Drives themselves are generated by specific needs that arise within the organism. Needs in turn are a function of certain antecedent conditions such as environmental deficiencies, noxious stimulation, etc. The only systematic influence on habit strength is the number of reinforced trials.

In any particular situation where drive is operative the total effective drive strength is assumed to be determined by two factors. The first is the relevant need involved, that is, the one which is reduced by the response under consideration. The second is the aggregate strength of the irrelevant needs or all other primary and secondary needs operative at the moment.

Hull said concerning extinction that when a reaction is evoked repeatedly without a closely associated reduction in drive, the power of the stimulus-motivational combinations to evoke that reaction gradually diminishes. That the extinction of a response does not concern merely habit strength alone is shown by the fact that an increase in drive alone will serve to reinstate the power of stimuli to evoke a reaction which has been extinguished to zero.
Two of Hull's original hypotheses bear directly on the main hypotheses to be tested in the present research. Corollary IX to Postulate seven (Hull, 1943) states: the number of reinforcements being constant, the stronger the relevant drive, the greater will be the number of unreinforced evocations which will be required to reduce the reaction potential to a given level. Corollary X to Postulate seven states: the number of reinforcements being constant, the stronger an allied but irrelevant drive active at the time of extinction, the greater will be the number of unreinforced evocations required to reduce the reaction potential to a given level, though this number will be materially less than would be required under the same intensity of the relevant drive.

Purpose of this Investigation

Manifest anxiety is taken to be one type of drive. It follows that high and low anxiety subjects should provide different conditioning and extinction rates in a stress situation in line with Hull's hypotheses concerning drive. If differences are obtained in the predicted direction, then this result supports the validity of our initial assumption about the nature of anxiety, namely that it acts as a drive.

More specifically, there should be a difference in the extinction rates of high and low anxiety subjects with an instrumentally conditioned avoidance response. According to Hull's theories we should predict high anxiety subjects to extinguish slower than low anxiety subjects. But conflicting experimental results by previous researchers have forced us to be more careful and refrain from predicting the direction of the extinction
data. A difference here could have considerable practical significance. It might be found that anxiety subjects perseverate in conditioned responses after the cessation of the noxious stimulus. Perhaps then this same mechanism could be used to explain the repetitive behavior of high anxiety obsessive-compulsive neurotics.

Secondly, high anxiety subjects should condition more rapidly to a noxious stimulus than low anxiety subjects. Therefore we predict that high anxiety subjects will condition more readily to an avoidance response. This is due to the higher levels of drive present in high anxiety subjects which makes them particularly aversive to noxious stimuli.

Finally low anxiety subjects should score higher than high anxiety subjects on a complex problem-solving task such as anagrams. A body of experimental data, to be reviewed later, shows that high anxiety subjects score better on simple problem-solving tasks and low anxiety subjects better on complex problem-solving tasks. The theoretical reasons for this are disputed and unclear, as we shall see.

Hypotheses

1. High anxiety subjects will condition more readily to an avoidance response than low anxiety subjects.
   a. In terms of the percentage of subjects who meet the conditioning criterion.
   b. In terms of the number of trials until the conditioning criterion is met.
2. There will be a significant difference in extinction rates between high and low anxiety subjects in a instrumentally conditioned avoidance response to a noxious stimulus.

   a. There will be a significant difference in the percentage of high and low anxiety subjects who extinguish and who perseverate in conditioned response (CR's) up to a predetermined standard (200 trials, including the conditioning trials).

   b. There will be a significant difference between high and low anxiety subjects in the number of CR's made after the avoidance response has been conditioned and the extinction procedure has been begun.

3. There will be a significant difference in the number of anagrams solved during the experiment in the following direction: low anxiety subjects will solve more anagrams per minute than high anxiety subjects.
CHAPTER II

REVIEW OF THE RELATED LITERATURE

A considerable amount of research and theoretical literature has been devoted to anxiety as drive. Farber (1954) set out to show that anxiety could be legitimately considered to be a drive. He stated that a given variable has the characteristics of a drive if it fulfilled one or both of two conditions. First, if the elimination or reduction in the magnitude of the variable is reinforcing; secondly, if the presence of the variable energizes or intensifies whatever reaction tendencies exist in the given situation. Furthermore, Farber felt that there are at least two types of operationally defined anxiety. The first is that produced by cues that have been paired under appropriate environmental conditions with a noxious stimulus. Secondly, that defined in terms of responses to a questionnaire, such as the Manifest Anxiety Scale (MAS) of Taylor, or the Walker-Nicolay Personal Reaction Schedule (PRS). Since the second type of anxiety cannot be directly manipulated in quite the same way as can environmental conditions, the demonstration of the drive properties of manifest anxiety in terms of the reinforcing effects of its reduction presents considerable difficulty. In Farber's estimation it has never been done. However, a large number of studies have shown that the relations between MAS scores and specified behavior variables (e.g. conditioning, learning, extinction, etc.) are such as would be predicted on the assumption that these scores reflect a state having the energizing properties of a drive. There is a serious question as to
whether behavior with anxiety is due to the drive properties of anxiety per se or to the response tendencies associated with anxiety. These response tendencies have never been systematically explored. Later research has provided at least a partial answer to this question.

Likewise, a large amount of literature has been devoted to understanding the mechanisms of avoidance conditioning and anxiety's place in it. Schoenfeld (1950) caused a stir with his behavioral definition of anxiety as the relation of the conditioned stimulus (CS) to certain behaviors, namely the conditioned response (CR). Schoenfeld attacked Mowrer and Hull's concepts of drive, need, and anxiety reduction to explain avoidance conditioning as being fuzzy, nonoperational, and unnecessary. Avoidance conditioning is a form of escape conditioning, according to Schoenfeld, where the CS and/or tactile and proprioceptive stimuli which have secondary avoidance reinforcing properties are escaped. Continued CS pairing with a noxious unconditioned stimulus (UCS) gives the CS secondary noxious reinforcing power. The CS, acting as a secondary negative reinforcement, is then terminated by the CR. Not only is the CS terminated by the CR but also the other proprioceptive and tactile stimuli associated with the CS having secondary negative reinforcing properties. Extinction can be explained as being due to the absence of the UCS which leads to a gradual dissipation of the aversive strength of the CS and the proprioceptive and tactile stimuli from which the subject is escaping.

Solomon and Brush (1956) reviewed much of the previous literature on the nature of avoidance conditioning. They mentioned Mowrer's interesting
hypothesis that in avoidance conditioning Pavlovian laws of reinforcement apply to the responding members of the skeletal nervous system. Unfortunately Mowrer's hypothesis has not been supported experimentally. Solomon and Wynne (1954) have presented a two process anxiety conservation theory. This theory rejects Mowrer's ANS-CNS topology. It retains Mowrer's and Miller's conception of anxiety as an acquired drive state and anxiety reduction as the reinforcing state of affairs for strengthening instrumental avoidance responses. For Schoenfeld the avoidance response is an escape response removing the subject from the presence of secondary noxious stimuli. Likewise, for Solomon and Wynne the avoidance response is also an escape response, but in this case it removes the subject from a state of anxiety.

At first anxiety is conditioned classically to the CS. Removal of the subject from the CS is therefore reinforcing (anxiety reducing). Finally the subject's conditioned responses remove him from the source of anxiety so quickly that anxiety (autonomic nervous system reaction) is not built up or felt. But this is no longer reinforcing and extinction sets in. The longer response latencies of the CR with extinction then allow the conserved anxiety to be felt. This once again reinforces the CR when the anxiety is reduced and the cycle starts again.

Black (1956) provided experimental trouble for Solomon and Wynne's theory. He found that heart rate (a good index of autonomic anxiety) increased after the CR in avoidance experiments. This would mean that anxiety is not conserved in the manner Solomon and Wynne thought. Solomon has proposed to defend his theory in the face of Black's findings. He says
that stimuli from the viscera function as drives early in aversive learning but that Schoenfeld's avoidance of the CS becomes important later as responses quicken and anxiety conservation occurs.

In making his reply to Black, Solomon leaned heavily on the findings of Kamin (1957). Kamin's outstanding finding, using animals and a factorial design, was that evidently both the cognitive theorists and the S-R theorists were right in explaining avoidance conditioning. Kamin's data shows that response termination of the CS is important during early trials of training as S-R theorists predict. But in later trials of training, the avoidance of the UCS becomes the significant factor as cognitive set theorists predict.

Spence (1966) used college students and a cover assignment in a carefully designed study to determine whether high drive leads to perseveration of a conditioned response during extinction procedures. Having classically conditioned an eyelid avoidance response to an air puff, his design called for three procedures during the extinction trials: 1) no UCS on half of the trials, and the UCS alone without the CS on the other half; 2) no UCS on half of the trials, and neither the CS or UCS on the other half; 3) the CS followed by the UCS but at an extended length which has been found to not be conducive to human conditioning. Spence found that procedures one and three above were significantly more resistant to extinction than procedure two. Spence explained his results as being due to maintained drive level. Procedure one avoids the criticism leveled at procedure three that the extended CS-UCS connection was still reinforcing the CR.
Cobb et. al. (1967) expanded on Spence's work above and examined the rate of extinction for a conditioned eyelid response as a function of maintained drive level during extinction and the amount of stimulus change in acquisition and extinction. Under massed practice during acquisition cognitive theorists maintain that subjects learn a CS-UCS set. The cognitive theorists follow in the tradition of Tolman and his expectancy theory whereby a subject learns to anticipate a noxious event and responds by avoiding it. During extinction after massed acquisition, both a delayed CS-UCS interval and omitting the UCS altogether should result in equal extinction rates since the cognitive set has been broken. Under distributed practice during acquisition, subjects never learn whether the UCS will follow the CS or not. Subjects trained under distributed practice should take longer to extinguish than those trained under massed practice. Secondly, under distributed practice during acquisition, a delayed CS-UCS interval during extinction should extinguish more slowly than when the UCS is omitted. This is because distributed practice allows for the operation of maintained high drive level according to the S-R theorists. An alternate interpretation to that of the cognitive theorists above is S-R theory. It states that the delayed CS-UCS interval will result in slower extinction rates than omission of the UCS under both massed and distributed acquisition. This is due to the drive level being maintained by the extended CS-UCS interval. Cobb et. al. used 50 subjects and a factorial design to test the above opposing theories. The results failed to confirm either theory and were unexplained. Thus their results did not agree with those of Spence (1966).
Literature Related to Hypothesis I

The amount of literature devoted to exploring the relationship between drive and conditioning is vast. Since these relationships have been demonstrated time and again, and since these relationships concern only a secondary hypothesis in the present project, only a sampling of the related literature will be reviewed. The studies dealing with anxiety directly will be emphasized.

Spence and Taylor (1951) studied the effects of anxiety levels and UCS intensity on conditioning. One hundred students divided into high and low anxious on the basis of the MAS were used. They were sophisticated subjects in that they knew the purpose of the experiment. Strong and weak air puffs to the eye were used as the UCS with the hypothesis being that the stronger air puff would produce more conditioning as would higher anxiety levels. Results showed that the high anxious subjects were consistently superior to the low anxious in amount of conditioning as predicted. The high anxious subjects gave a larger number of CR's for the strong puff than did the low anxious subjects but the difference was not significant. Spence and Taylor speculated that perhaps the reason why the intensity of the UCS did not make a difference was because extreme ends of the MAS were employed in picking subjects. This difference in emotional levels might blunt the effects of the UCS intensity. Spence and Taylor admitted that on the basis of this experiment it would be impossible to tell whether the difference between the high and low anxious subjects was due to a difference in the development of habit strength or drive or both.
Hilgard et. al. (1951) found a positive but non-significant correlation between anxiety scores on the MAS for 46 college students and an eyelid conditioning measure. The basic conjecture was that anxious people are more likely to see many situations as threatening. These same situations would be viewed as neutral and non-threatening by low anxious people. Anxious people lose their discriminative ability due to stronger reactions to their own apprehensions. Hilgard et. al. used illumination in two windows as their CS. One was followed by an air puff to the eye and the other was not. They found correlations approaching significance between anxiety scores and two measures of lack of discrimination.

Prokasy and Truax (1959) investigated the relationship of both conditioning and startle eyeblink rates to anxiety levels. They hypothesized a positive relationship for both. Sixty-nine students were rated high, medium, and low on the MAS. An eyeblink response was conditioned to an air puff using a change in brightness in a milk-glass screen as a CS. No significant differences were found in conditioning between anxiety groups. Nor was there a significant difference when only the ten most extreme scores at either end of the MAS were compared. These results do not corroborate Spence and Taylor's findings. There was a significant difference in the startle eyeblink rates: low anxious subjects were higher than either the medium or high anxious subjects. These last results are opposite from those predicted. Prokasy and Truax had no explanation for their findings.

Maietta (1955) found that startle responses to the CS do not contribute significantly to eyelid conditioning. Using an air puff as UCS, a 1,000 cps tone at 40 decibels as CS, and 54 adult subjects with normal hearing, he
found a significant difference between the conditioned eyelid response to the air puff and startle responses to the tone alone. He also found that varying the intensity and frequency of the CS did not affect the extinction rates of the conditioned eyelid response.

Runquist and Ross (1959) developed a further refinement of Hullian theory. They hypothesized that drive level is a function of a persisting emotional response. This persisting emotional response is determined by two factors combined: the intensity of the noxious UCS, and individual differences in emotionality as measured by the MAS, etc. In their design Runquist and Ross gave 90 students 15 medium air puffs alone. On the last 10 of these 15 air puffs measures of pulse rate and skin conductance changes (GSR) were obtained. The subjects were then given 80 conditioning trials. MAS scores were obtained for all subjects. Emotional reactivity was then assessed in two ways: high and low reactive groups were picked on the basis of combined pulse rate and GSR scores; furthermore, high reactivity was also determined independently by high scores on either pulse rate or GSR. Using the combined scores, the high and low groups approached a significant difference in conditioning in the direction predicted by Spence: high anxiety subjects conditioning more readily than the low anxiety subjects. A significant difference was obtained between high reactives selected for being high on either measure and low reactives selected for being low on the combined measures. The correlation between the combined physiological measures of emotionality and MAS scores was significant at the .05 level. Runquist and Ross felt that they had again demonstrated the validity of Hull's hypotheses, but this time
with different criterion of emotional reactivity. In addition, there was some evidence that people of high emotional reactivity activate different response systems in the face of threat. This evidence came from the finding that the correlations between the two physiological measures of emotionality and between each measure of emotionality and a measure of conditioning were different.

Willett (1960) reported on five studies using male subjects and testing hypothesized relationships between Eysenck's Neuroticism and Extraversion scales and measures of eyeblink conditioning. The prediction was that there would be a negative correlation between the eyeblink measure and Extraversion scores and a positive correlation between eyeblink measures and Neuroticism scores. Neuroticism scale scores are closely related to MAS scores, with which they correlate very highly. Of the five studies, only one significant correlation was found between eyeblink conditioning and the Extraversion scale and it was in the expected direction (Franks, 1957). One of the studies also found a nonsignificant correlation between eyeblink conditioning and MAS scores (Franks, 1954). This last study fails to validate Hull's hypotheses in a direct way and the others fail to validate them at least indirectly. The other three studies failed to yield significant results (Das, 1957; O'Connor, 1959; Willett, 1960).

Sweetbaum (1963) further tested Eysenck's hypotheses. Eysenck thought that introverts (as measured by his scale) were more anxious and developed stronger excitatory potentials, thereby conditioning faster. Extraverts, on the other hand, develop weak excitatory potentials. Sweetbaum conditioned an
eyeblink to an air puff in 50 Veterans Administration male patients. All subjects were rated on Eysenck's Extraversion scale. Anxiety levels were defined in terms of whether a subject was going into major surgery (high anxiety) or had come out successfully from major surgery (low anxiety). All possible combinations of introversion/extraversion and high/low anxiety were studied. The results showed a significant difference between anxiety levels in conditioning, with high anxiety subjects conditioning more readily than low anxiety subjects. There were no significant differences between introverts and extraverts on conditioning. There was no significant interaction between anxiety levels and introversion/extraversion. The results fail to confirm Eysenck's hypotheses but do confirm those of Spence.

Spence (1964) himself reviewed all the studies to date on the relationship of eyelid conditioning to anxiety levels, using MAS scores. In 21 out of 25 independent studies the results were in the direction of high anxiety subjects being superior to low anxiety subjects in conditioning. The probability of obtaining that high a percentage of differences in the same direction by chance is less than .01. Thirteen out of 25 resulted in significant differences. When the subject population was greater than 36, eleven out of seventeen studies obtained significant differences in the expected direction. When the subject population numbered less than 36, only two out of eight of the studies obtained significant results in the expected direction. Spence listed two major reasons why he felt not all of the research results confirmed his hypotheses. In the first place a number of the studies used too small a subject sample. This throws off the results
because the variance in eyelid conditioning is very large. Secondly, Spence felt that the uncontrolled presence of "voluntary form" responders in some samples threw off the results. These subjects respond voluntarily to the CS whether the UCS follows or not. Although Spence does not mention it, one possible explanation for the high percentage of positive results he reported is experimenter effect due to the fact that at least 12 out of the 25 studies reported on were done in Spence's own Iowa laboratory. There is also the fact that studies which fail to find significant differences (and would therefore not support Spence) seldom find their way into being published.

Dorn (1965) studied the effect of social desirability on avoidance conditioning in high and low anxious subjects. Dorn used 120 male undergraduate students who were divided into high and low anxious on the basis of the MAS. The avoidance behavior with a painful electric shock was described in the instructions as either socially acceptable, neutral, or socially undesirable. As a group the high anxiety subjects engaged in significantly more avoidance behavior than did low anxiety subjects. Only under neutral instructions did low anxiety subjects engage in slightly more (but statistically non-significant) avoidance behavior than did high anxiety subjects. The findings under socially desirable and socially undesirable conditions on the one hand confirm Spence's hypotheses since both conditions can be construed as increasing drive level. On the other hand the atmosphere of the usual laboratory setting would make responding to the conditioning paradigm a socially desirable behavior. Therefore the social desirability factor and its effects may be accounting for some of the variance in these experiments.
In a very interesting factorial experiment, Elias (1965) studied the effects of classical vs. instrumental avoidance conditioning, different levels of anxiety, and strong vs. weak UCS. One hundred and twenty male students were used with a tone as CS and an electric shock to the finger used as the UCS. High, medium, and low levels of anxiety were assessed by the MAS. In the first experiment that Elias performed, an analysis of variance revealed two main effects and two interaction effects. Instrumental avoidance conditioning was superior to classical conditioning in terms of reaching the conditioning criterion more quickly. Strong shock levels resulted in conditioning superior to weak shock levels. The two interaction effects were that with a strong shock as UCS, the high anxiety subjects conditioned more poorly than either medium or low anxiety subjects. With a weak shock high anxiety subjects conditioned more readily than did the other two groups.

In his second experiment, Elias found that high anxiety subjects conditioned more readily with instrumental avoidance conditioning and least readily in classical conditioning, regardless of shock strength. Elias explained his results in the second experiment in terms of some of Spence's theories. He found that classical conditioning led to many more irrelevant responses than did instrumental conditioning. These irrelevant responses, if they had a high probability of occurring, would be energized by the high anxiety level and explain the results of the second experiment. Of the results in the first experiment, only the main effect due to shock is congruent with Spence's hypotheses. The two interaction effects contradict Spence's hypotheses. Elias attempted to partially explain the results from
the first experiment as a failure to weed out voluntary responders, who increase their voluntary responding as the shock level becomes stronger. This can explain why high anxiety subjects conditioned less readily than the medium and low anxiety groups with strong shock in avoidance conditioning. It does not explain the same behavior from high anxiety subjects with classical conditioning. This is because with classical conditioning, voluntary responding drops off since it is not rewarded by the avoidance of the UCS. To explain these latter results, Elias fell back on the same explanation used to explain the results of the second experiment. He stated that classical conditioning led to more irrelevant responses which were energized by the high anxiety level. This resulted in high anxiety subjects conditioning less readily with strong shock in classical conditioning. Of the six significant results from Elias' two experiments, only the one, that high shock levels resulted in more conditioning than low shock levels, confirm Spence's hypotheses. The other five results contradict Spence even though Elias used essentially Spence's ideas to explain them.

China (1967) also failed to confirm Spence's hypotheses on conditioning. China used Sarason's Test Anxiety Questionnaire (TAQ) to divide subjects into high and low anxiety groups. The subjects were female college students. The conditioning task was an instrumental avoidance learning situation where the subjects had to depress a key after the CS, a light, appeared in order to avoid an electric shock. Introducing another variable, shock was given either directly to the subject or indirectly to a co-subject. China predicted high anxiety subjects would condition more readily with direct
punishment and low anxiety subjects better with indirect punishment. An analysis of variance did not show the predicted interaction between anxiety levels and direct/indirect punishment. Nor was there a significant difference between anxiety levels on conditioning. The only significant difference obtained was between direct and indirect punishment. The findings do not support Spence's hypotheses.

Literature Related to Hypothesis II

An early experiment exploring the relationship of anxiety to perseveration of an avoidance response was conducted by Janet Taylor (1951). Taylor used college students scoring in the upper twelve and lower nine percentiles of the score distribution on the Manifest Anxiety Scale (MAS). This scale consists of items from the Minnesota Multiphasic Personality Inventory which were selected by clinicians as indicative of manifest anxiety. In addition Taylor used differential instructions designed to be anxiety producing or anxiety relieving. The CS was a lighted disc, the UCS an air puff to the eye, and the CR was an eyeblink. Fourteen high and fourteen low anxious subjects were used to assess resistance to extinction after the eyeblink response had been established. The high anxiety subjects conditioned to the avoidance response more rapidly than the low anxiety subjects, as predicted. The data on resistance to extinction showed the anxious group to be higher in both the mean number of responses and the mean number of trials to the extinction criterion. However, t tests computed for the two measures failed to reach significance at the .05 level. Taylor felt that the failure to reach significance could be due to the small number of subjects used.
Spence and Farber (1953) followed up Taylor's suggestion for more research in the area with a more extensive study of extinction as a function of anxiety. They used 64 male and female subjects scoring above the eightieth and below the twenty-first percentile on the MAS. The CS was a combined visual and auditory signal. The UCS was again an air puff delivered to the eye. There were 60 conditioning trials and 40 extinction trials in which the CS-UCS interval was increased to one which had been shown to be non-conducive to human eyelid conditioning (2,500 msec.). Results showed a significant difference at the .05 level between high and low anxiety subjects in terms of the mean number of CR's made during conditioning and extinction. The high anxiety subjects made a significantly higher number of CR's during both conditioning and extinction. High anxiety subjects were therefore more resistive to extinction than low anxiety subjects. These findings corroborated those of Taylor's and are congruent with Hull's hypotheses on learning an avoidance response, assuming anxiety to be a drive. Female subjects, both high and low anxious, made significantly more CR's during the conditioning trials than did the males. This sex difference was not obtained for the extinction trials.

Only one study has been reported testing the relationship between anxiety and an instrumentally conditioned avoidance response. Davidson, Payne, and Sloane (1964) felt that the conditioned eyelid response used by Taylor, Spence, and others actually involved instrumental conditioning rather than classical conditioning. Worse yet, use of the eyelid response resulted in ambiguous data, e.g. some eyeblinks could be attributed to a
startle response to the CS. They proposed to use a clear-cut instrumentally conditioned avoidance response to see if anxiety levels had the same effect as with the eyelid response. They used an auditory tone for the CS, an electric shock administered to the index finger as the UCS, and finger withdrawal as their CR. Galvanic skin response (GSR) ratings, classically conditioned to the CS were also obtained. Their subjects were college students: male medical students and females enrolled in Bachelor of Arts programs. There were 50 acquisition trials and 20 extinction trials. Ratings of subjects anxiety levels were obtained by using the Taylor MAS on both sexes, and a psychiatric rating of anxiety with the males only. There were no significant correlations between the two measures of anxiety and the GSR on either acquisition or extinction. Scattergram analysis showed no curvilinear relationships which would account for a lack of significant correlations. The findings then did not, in the main, corroborate the Taylor, Spence, Farber findings, nor did they validate Hull's hypotheses concerning drive and extinction rates. Some sex differences were found. Females tended to produce, though not to a statistically significant degree, more CR's during extinction than did males. Females tended to have higher GSR ratings than did the males during acquisition. The findings on finger withdrawals during acquisition are in line with Spence and Farber's (1953) findings that women condition more readily to an avoidance response than do males.

Another approach to the relationship between anxiety and the extinction of an avoidance response is to use a Galvanic skin response (GSR) or a psychogalvanic response (PGR) as a classically conditioned criterion measure.
Kubis and Welch (1946) used 24 patients of varying diagnoses, all of whom were diagnosed as having anxiety by the psychiatric staff, and 22 normal college students in their experiment. The UCS was a buzzer, the CS was the word KAX in a memory drum along with other words, and the criterion was a PGR rating. The pathological anxiety group conditioned more quickly and persisted in their responses to a significant degree over the students. Kubis and Welch concluded that anxiety levels were responsible for the results. However, the study was rather poorly designed and controlled.

Bitterman and Holtzman (1952) utilized 37, male, university students and divided them into high and low anxiety groups on the basis of the MAS. They were also rated for susceptibility to anxiety independently on the basis of psychometric indices (the Rorschach Inkblot Test and the Minnesota Multiphasic Personality Inventory) and performance in a laboratory stress situation. An electric shock served as the UCS, a buzzer as the CS, and a GSR rating as the criterion measure. Results showed that on the basis of the ratings from the psychometric and performance sources, the high anxious group conditioned more readily and extinguished less readily than the low anxious group. The results were significant. Using the MAS scores as a criterion of anxiety, the results were in the same direction but were not statistically significant.

Mednick (1957) in an interesting study examined the effects of a rest interval between acquisition and extinction trials for high and low anxiety subjects. Unfortunately he failed to use any statistical procedures to test the significance of the differences he found. He used college students and
divided them into high and low anxious on the basis of the MAS. A loud buzzer served as UCS, a word in a memory drum as CS, and a PGR rating served as a criterion measure. After acquisition, the high anxious and low anxious subjects underwent eight extinction trials in three subgroups: one group underwent extinction immediately after acquisition; another group received a ten minute rest between acquisition and extinction; a third group underwent a 24 hour delay between procedures. Under the no delay procedure the high anxiety subjects showed greater responsivity throughout conditioning and extinction (as measured by the PGR) and also more resistance to extinction than did the low anxiety subjects. These results agreed with those of Spence, Taylor, et al. However, the data also showed that the ten minute rest interval speeded up extinction for the high anxiety group and they extinguished faster than the low anxiety group. Furthermore, there was less of a difference in PGR responsivity, but the positions reversed for later trials.

No sex differences were investigated during extinction. These latter results do not necessarily contradict the hypotheses of Spence, Taylor, et al. Rather they argue for the acute nature of the anxiety evoked in this experiment such that it rapidly dissipated in a less stressful situation.

Using 19 psychiatric admissions at a Veterans Administration hospital, Gilberstadt and Davenport (1960) took GSR ratings using an electric shock as the UCS and a buzzer as the CS. Three ratings of anxiety were used to divide the subjects into high, medium, and low anxiety groups. Those ratings were MAS scores, psychiatric ratings, and clinical ratings by three clinicians using blind test data including the MMPI. There were no significant
differences in extinction rates between the various anxiety groups based on any of the three rating methods. Based on the clinical ratings only, there was a significant difference in conditioning responsivity with the high anxiety group being higher than the medium anxiety group, which in turn was higher than the low anxiety group. The findings, with the one exception noted, did not support those of the Taylor and Spence group.

Champion and Jones (1962) attempted to settle a question Spence originally raised. This concerned whether the perseveration of a classically conditioned avoidance response in experiments using an extended CS-UCS interval during extinction was due to drive (anxiety) factors or the mental "set" that the UCS would be coming. Champion and Jones used 33 college students and a GSR rating conditioned to an electric shock (UCS) signalled by a tone (CS). Half of the subjects received forward and half backward conditioning. Half of each one of the conditioning groups received random UCS presentations during extinction and the other half no UCS. The results showed that the subjects receiving the random UCS presentations during extinction were significantly more resistant to extinction than those receiving no UCS. The results are interpreted as supporting the Hullian hypothesis that drive (as maintained by UCS presentations) is responsible for resistance to extinction of a classically conditioned aversive response.

Finally, Bringmann (1967) tested two alternate hypotheses, chronic vs. acute, concerning the nature of human anxiety. Specifically, is anxiety a chronic personality trait which is always evidenced, or is it an acute personality state which arises in stressful situations in people who are
predisposed toward it? Bringmann also examined the relationship of anxiety to the intensity of noxious stimulation and its energizing effect in simple learning situations. One group of 17 subjects with high scores and one group of 15 subjects with low scores on the Heinemann Forced-Choice version of the MAS were used in the non-noxious condition. A GSR was conditioned to the CS, the word "light", with a 70 decibel tone serving as the non-noxious UCS. A 90 decibel tone served as a noxious UCS for another group of 20 high and 16 low anxious subjects. In addition the effects of these conditions on a simple learning situation, namely the generalization from the word "light" to related words, was studied. A significant interaction between anxiety levels and UCS intensity was obtained for both the conditioning, including the generalization trials, and the extinction trials. The analysis of variance yielded a significant interaction at p < .01 for the conditioning trials and at p < .05 for the extinction trials. The results are interpreted as meaning that anxiety, as measured by the MAS, is largely an acute reaction to different levels of stress. The results support Taylor and Spence's hypotheses.

A great deal of animal research has been done to study the effects of drive on extinction. Since the primary focus of the present project is on human anxiety, only the more important animal studies will be reviewed.

Heathers and Arakelian (1941) used rats in a bar pressing for food experiment. Drive was defined by the amount of time spent deprived of food. They found that rats with high drive levels make significantly more CR's during extinction in a given number of opportunities than do animals with
low drive. However, they also found that the effective habit strength varies directly with the strength of the appropriate drive. When habit strength was equated, stronger drive produced a somewhat (non-significant) greater weakening of the bar pressing reaction during extinction. In this case, the stronger the drive, the greater amount of extinction effect produced per unreinforced reaction. This latter result, with habit strength equated, is contrary to what would be predicted from a Hullian standpoint. According to Hull, with habit strength equated higher drive should make for lengthier extinction. The results are also contrary to Skinner's speculations. Skinner hypothesized that the stronger the drive the greater the initial rate of performance during extinction. But with complete extinction the number of CR's should be the same for all strengths of drive.

In 1946 Miller added to the knowledge of the effects of drive on extinction. He demonstrated that the failure to extinguish of an avoidance response is due to an acquired drive and not the mere automatic persistence of a fixed habit. Rats were used to avoid an electric shock by running from one compartment to another. When the door was closed in the shock compartment the rats learned to press a bar to open the door and go on escaping. Miller obtained over 500 extinction trials with some rats after only one shock.

Strassburger (1950) obtained results on the effect of both habit strength and drive on extinction. He used rats who were trained to press a bar for food in a factorial design. There were three reinforcement conditions ranging from one to thirty reinforcements, and five deprivation conditions, ranging from one to forty-seven hours. The reinforcement conditions varied habit strength and the deprivation conditions varied drive
strength. The extinction trials took place at the next feeding time, twenty-three hours later. There was a significant difference in resistance to extinction as a function of number of reinforcements with the larger number of reinforcements being more resistive to extinction. This finding is in line with Hullian hypotheses: the stronger the habit strength, the more resistive the response to extinction. However, Strassburger's second finding did not fit Hullian theory. He did not find resistance to extinction to be uniformly related to deprivation or drive at any of the three levels of reinforcement.

Reynolds et. al. (1952) employed rats in a bar pressing for food situation with drive defined as deprivation. The results indicated that in those learning situations where a relatively large amount of reward is employed per reinforcement, high drive animals extinguish more readily than low drive animals. This result was statistically significant at the .05 level using an analysis of variance with a logarithmic transformation. With low reward situations there was a non-significant tendency for low drive animals to extinguish more readily than high drive animals. The results appear to contradict Hullian hypotheses.

Campbell and Kraeling (1954) designed a factorial experiment to study the effects of both training and extinction drive levels on habit strength during extinction. They were responding to the results of several previous studies by Kendler, Teel, Hillman et. al. who found that neither drive level during acquisition nor drive level during extinction had any effect on habit strength during extinction. This finding is in line with Hullian hypotheses.
Campbell and Kraeling used four different deprivation periods during acquisition of a running response for food and four deprivation periods during extinction. The results showed that running speed during the first six extinction trials varied directly with the acquisition drive level but did not vary significantly with the extinction drive level. Resistance to extinction, as measured by the number of trials to an extinction criterion, was not influenced by either training or extinction drive levels. One conclusion from these results is that amplitude and resistance to extinction measures cannot be used alternatively. The results also contradict those of Kendler, Teel, et al. and are contrary to Hull's implicit assumption that animals trained under different drive levels develop comparable habit strengths.

Cautela (1956) studied the effects of drive on the rate of extinction with rats trained in a discrimination task to obtain food. All the rats were trained to obtain food in a black/white discrimination task under 23 hours of food deprivation. They were then extinguished under either 0, 6, 12, 23, 47, or 71 hours deprivation. It was found that the number of CR's increased up through the 23 hours of deprivation. But then the CR's declined gradually through the 71 hour deprivation condition. There was a significant difference in CR's between the 0, 6, and 12 hour groups combined and the 23, 47, and 71 hour groups combined. These curious results were explained in Hullian terms by pointing out that drive, or deprivation, acts as both an energizer and as a cue stimulus. It is assumed that the cue value of drive is stronger than the energizing value. So longer deprivation periods resulted in a decline of CR's because the cue value weakened due to stimulus generalization even though the energizing value increased.
Lewis and Cotton (1957) used rats to further verify Campbell and Kraeling's results showing the effects of drive on acquired habit strength. They used a factorial design with three acquisition deprivation conditions and three extinction deprivation conditions. Their results showed that level of acquisition drive significantly affected acquisition running time. Level of acquisition drive also significantly affected the extinction running time for the first 12 trials only and the number of responses to the extinction criterion. Level of extinction drive significantly affected extinction running time. None of the drive variables had any effect on spontaneous recovery. Lewis and Cotton conclude that drive strength does affect habit strength, though weakly, and does affect performance in both acquisition and extinction. The results are generally in agreement with some of Spence's modifications of Hullian hypotheses.

Barry (1958) continued the work of Campbell & Kraeling and Lewis & Cotton. He trained rats to acquire food by running. He subdivided the experiment into three stages: acquisition, early extinction, and later extinction. He combined these stages factorially with two drive levels, high and low. His results showed that high drive rats ran faster than low drive rats in all three stages. Furthermore, with previous drive equalized, performance was increased by higher drive. These findings are in line with those of Spence, Taylor, et al. and Hullian hypotheses. Barry also found that high drive rats ran faster than low drive rats for the first few trials of early and later extinction even when drive was equalized. The conclusion here is that drive level influenced habit strength at an earlier level in
line with the findings of Campbell & Kraeling and Lewis & Cotton. Averaging high drive and low drive together, during early extinction a drive different from training led to slower running; during later extinction, a drive different from training led to faster running. These last results were interpreted as being due to the effects of the change in drive stimulus.

Kendrick (1960) attempted to study the effects of drive and effort on the extinction of a running response to obtain water in rats. One group of rats was extinguished under 23 hours deprivation in a ten foot runway. A second group of rats was extinguished under 1 hour deprivation in a four foot runway and a third group in a ten foot runway. There were no significant differences in days to extinction of the response between the first and second groups or the second and third groups. These differences would have been expected to have been obtained in terms of Hull's hypotheses. There was a significant difference in days to extinction between the first and third groups showing that drive differences overcome effort differences: the third group extinguished significantly faster than the first group. In terms of the number of trials to extinction, the second group extinguished faster than the first group while there were no significant differences between the second and third groups. The general conclusion to be drawn is that effort had no appreciable effect on extinction. Also, low drive rats extinguished faster than high drive rats in line with Hull's hypotheses. Kendrick explained his results in terms of a modification of Hull's theory, namely antagonistic habits: habit strength vs. conditioned inhibitions.

The debate over whether an avoidance response resists extinction because it avoids the UCS or terminates the CS is a continuous one.
Robinson (1961) brought further evidence to bear on the issue. He demonstrated the persistence of a CS avoiding, lever-pressing response in the absence of apparent motivation. The subjects were 80 rats in four experimental and three control groups. The subjects first learned to run to the opposite compartment of a shuttle box to avoid the UCS, which was a just subtetanizing electric shock. They then learned a secondary response of lever pressing to avoid the CS, a light and buzzer, with shock absent and running prevented. After rigorous extinction of the running response, which was difficult (mean trials = 2,541), the lever pressing continued unabated. Some spontaneous recovery of the running response occurred, but lever pressing continued with substantial strength after the running was again extinguished. The results would seem to agree with Kamin's (1957) results showing the importance of both UCS prevention and CS termination.

Singh (1967) explored the mutual effects of drive and effort on extinction as did Kendrick (1960). Like Kendrick he found that rats working under high drive or deprivation in a food acquiring situation make significantly more extinction responses than do rats working under low drive. But unlike Kendrick he found a significant interaction between drive and effort. Specifically, low drive animals made significantly more extinction responses under high effort conditions than under medium or low effort conditions. High drive animals made significantly more extinction responses under medium effort conditions than under low or high effort conditions and there was a non-significant trend in the same direction for medium drive animals. These results would not seem to be in line with predictions from Hullian theory.
Somewhat tangentially to the present project's purposes, Jenkins and Daugherty (1951) designed an experiment to compare Skinnerian and Hullian predictions concerning drive and extinction rates. Skinner originally contended that drive influenced the rate of responding in extinction but not the amount or length of extinction responding. Later he revised his theory to say, like Hull, that drive does affect the amount and length of responding in extinction. Jenkins and Daugherty, using pigeons in a food pecking situation, found that the amount of extinction responses varies directly with drive. Furthermore, an increase in drive after extinction is relatively complete at a lower drive level produces a gross recovery in the conditioned behavior. These findings are completely in line with Hullian theory.

The final animal experiment to be reviewed is quite close to the present experimental project under consideration. Moyer (1957) used rats to study the effects of emotionality on extinction. An index of emotionality, defecation and urination rates in an open field test, was obtained for all subjects. According to Mowrer, escape or avoidance in a shock situation results in anxiety reduction because the stimulus cues associated with the shock are avoided. Inasmuch as an emotional animal responds more strongly to an anxiety producing stimulus, it would be expected that the more emotional animal's avoidance response would take longer to extinguish. Moyer trained his rats to run across an electrified area, which was previously neutral, to a safe area. The rank-order correlations between extinction rates and the measures of emotionality were non-significant. Moyer had two explanations for his lack of results. First, he felt that the open field test might not
be a good test of emotionality in rats. Secondly he felt that different levels of anxiety and learning may have been generated by the cues of the shock box irrespective of the inherent emotionality of the subjects. But this latter prospect is tantamount to saying that his hypotheses as derived from Yerkes were wrong. The latter explanation also goes contrary to Hull's theory.

**Literature Related to Hypothesis III**

The question of the relationship of anxiety to performance level on tasks is an important one. If the Spence hypothesis concerning the energizing effect of anxiety is accurate the clinical question arises as to what level of anxiety ceases to be helpful and starts to become disruptive. Which type of task facilitates a moderate amount of energizing anxiety and which type of task induces huge amounts of disruptive anxiety also remains to be determined.

Estes and Skinner (1941) attempted to determine the effect of anxiety on conditioning and extinction in rats. Anxiety was defined as an emotional state arising in response to some current stimulus which in the past had been followed by a disturbing stimulus. In this case it was a tone followed by an electric shock. It was found that the use of the previously conditioned tone significantly reduced bar pressing for food behavior in rats. It was also found that there was much more disturbance in food behavior by using the previously conditioned tone than by periodically using an unexpected electric shock alone. After a rest period the food response rose again to its pre-anxiety period level. It was further discovered that anxiety
depressed the rate of responding during extinction of the food response.

Maltzman et al., (1953) attempted to design an experiment to directly test Hullian hypotheses concerning the energizing effect of drive on habit strength. First they divided their subjects into high and low anxious subgroups on the basis of whether they were above or below the median on the MAS. Next they introduced their subjects consecutively to two problem-solving tasks involving a mental set. This mental set was equated with habit strength. The first problem solving task consisted of water jar problems. The subjects first learned a dominant mental set which favored indirect solutions. Next problems favoring direct solutions were presented. Thus the previously learned mental set was incongruent with the mental set needed for correct solutions in the later problems. It was found that the tendency to shift mental sets to the correct one needed was inversely related to anxiety level. The second problem solving task involved anagram solving. The learned dominant mental set in this case was congruent with the correct mental set needed for later problems. In this situation it was found that high anxiety subjects made fewer errors than low anxiety subjects. The results seem to be a confirmation of Spence and Taylor's hypothesis than anxiety acts as a drive energizing the dominant habit strength.

Deese et al., (1953) attempted to explain the superior performance of high anxiety subjects on learning tasks in a slightly different way than Taylor and Spence. Ninety college students were selected on the basis of extreme scores on the Winne (1951) neuroticism inventory which was reported to correlate with the MAS in the order of .55, with no items in common. The subjects having learned a list of twelve nonsense syllables were then
divided into three groups. The first group had electric shock administered to them for incorrect responses during learning. The second group had electric shock administered at random for both correct and incorrect responses. A third control group received no shock. The control group was used as a baseline to measure differences in the other two groups. Small but consistent differences in the learning curves were found with the control group. High scorers on the neuroticism scale were consistently higher in the control group than low scorers. In the first group or in the avoidance condition a large difference was found in the learning curves between high scoring and low scoring groups, in favor of the high scorers on the neuroticism scale. This large difference was found to be due to both a facilitation of the high scorers and a decrement in the low scorers, in comparison with the control group. In the second or random shock group a difference was also found between high scorers and low scorers in the same direction as group one. However, this difference was not as great as that with the avoidance group. The difference in learning curves for the random shock group was found to be due almost entirely to a decrement in the low scorers group in comparison with the control group. Deese et. al., interpreted these results to mean that Taylor and Spence's explanation of this kind of an effect in terms of anxiety acting as a drive is too simple. They explained their results in light of the MAS's positive correlation with the psychasthenia scale on the Minnesota Multiphasic Personality Inventory and negative correlation with the hysteria scale on the same test. They then saw high anxiety people, or in this case those who scored high on the neuroticism inventory, as psychasthenics who would react to stress and anxiety in a cool, intellectual way.
Similarly low anxiety people would be hysteroid, very emotionally labile and likely to lose control in a stress situation. Deese's reasoning is far from adequate. The difference between the high scorers in the avoidance group and the random shock group is left unexplained in terms of Deese's theory. Secondly it is rather cavalier to state that Taylor's and Spence's interpretation of their results is too simple when this assertion is based on a .55 correlation between Winne's neuroticism scale and the MAS. A correlation of .55, accounting for only 30 per cent of the common variance, would leave the possibility of a large number of different interpretations open.

Crager (1960) hypothesized that with low motivational instructions on a problem solving task high and low anxiety subjects should do equally as well. However, with high motivational instructions, such as describing a difficult task as easy, high anxiety subjects should do more poorly than low anxiety subjects. The theory behind this is a modification of the Taylor/Spence hypothesis. High motivational instructions should be stressful enough to induce interfering anxiety responses more readily in high anxiety subjects than in low anxiety subjects. Crager tested college students individually using anagram solving as his task. The instructions either described the task as easy when it was actually difficult (high motivational) or were very reassuring (low motivational). Subjects were divided into high and low anxious. The results did not show the expected anxiety level by motivational instructions interaction. However, the performance of high and low anxiety female subjects did correlate positively with one type of interfering anxiety response measure, namely, negative self references. The
results fail to confirm the Taylor/Spence hypotheses concerning anxiety and problem solving.

Farber and Spence (1953) used 80 undergraduate students divided into high and low anxious on the basis of the MAS. Once again they found a significant difference in eyelid conditioning in favor of the high anxiety subjects. In addition they found that the stylus maze performance of the high anxiety subjects was significantly poorer than that of the low anxiety subjects with the more difficult points of choice providing the greatest difference between the two groups. Farber and Spence explained their results in terms of complex tasks generating more competing responses or habits. The greater level of drive with the high anxiety subjects energizes the strongest or most probable habit which is often not the correct habit. This results in poorer performance for high anxiety subjects with complex tasks. However, with simple tasks the correct response or habit is the only one to get energized by the high drive of high anxiety subjects. This results in a performance on simple tasks for high anxiety subjects which is superior to that of low anxiety subjects.

In 1956, Janet Taylor reviewed the previous literature on the relationship of anxiety to task performance and learning. She found the experimental results to be contradictory concerning the effects of anxiety on task performance although the majority of the studies did favor the hypothesis that she and Spence derived. Taylor once again formulated her hypothesis in Hullian terms. High anxiety subjects should perform better with simple tasks because the correct response is usually highest in the habit strength hierarchy. Therefore the higher drive levels of the high anxiety subjects
would energize this habit and lead to a performance superior to that of low anxiety subjects. More complex tasks result in an increase in the number of competing responses in relation to the correct response. The possibility becomes greater that an incorrect response will be highest in the habit strength hierarchy. In the case of complex tasks the high drive level of high anxiety subjects makes it more probable that they will perseverate in an incorrect response and turn in a performance inferior to that of low anxiety subjects.

Hill (1957) has made an excellent theoretical criticism of Taylor and Spence's adaptation of Hull's theory concerning the interaction of habit strength and drive. Hill says that Taylor and Spence assumed that higher drive levels in high anxiety subjects led to an inferior performance on complex tasks in two ways. First, the strongest habit in the habit strength hierarchy may not be the correct one. Secondly, the correct habit may be the strongest in the habit strength hierarchy at low levels of drive, but an increase in drive level raises competing habits above the threshold so that they are as strong or stronger than the correct habit. Concerning the first way above, Hill makes the observation that as soon as the subject's learning curve on the task goes above chance the correct habit in the hierarchy must be the strongest one. In this case subjects with high drive or high anxiety should perform better on complex tasks but do not. Only in studies where the wrong habit strength was maximized through reinforcement at a particular point in the learning curve did low drive subjects legitimately (i.e. in line with the theoretical objections Hill makes) do better than high drive subjects. On those studies where the right habit strength was maximized, low
drive subjects still did better than high drive subjects, contrary to Taylor and Spence's theory. Also, Hill pointed out, at the end of the learning curve where the correct habit strength is becoming the strongest for all subjects we should predict a spurt in performance of high drive subjects. But Malmo and Amsel (1948) found a decrement at the end of the learning curve for high drive subjects. With regard to Taylor and Spence's second theory concerning high drive level subjects' poorer performance on complex tasks, Hill said that Taylor posits overlapping oscillation of threshold levels for correct and incorrect habits. With low drive levels the correct habit strength is above the threshold and the incorrect habit strength is below it. With a sufficient increase in drive the incorrect habit strength is raised above the threshold. But, Hill said, this increase in drive would energize the correct habit strength even more and keep it stronger than the incorrect habit strength. Studies showing the effects of drive on habit strength bear Hill out. Hill's final conclusion was that if you operationally define drive level by MAS scores, as Taylor and Spence did, and test Hull's hypotheses, you end up refuting these hypotheses. Hill offered a solution in the form that equating drive level with MAS scores may be a wrong assumption.

Tallarico and Reitman (1959) explored the relationship between anagram solution and anxiety levels, as the present research project does. Previously Wiggins (1957) had found a significant negative correlation between anxiety levels, as measured by the MAS, and multiple solution anagram solving ability. Wiggins used 68 night school psychology students and gave them the anagrams before administering the MAS. Tallarico and Reitman
theorized that perhaps the order of anagram and MAS presentation affected Wiggins' results. In their own study Tallarico and Reitman used 176 summer school psychology students. One group received the anagrams first and then the MAS and the other group got the reversed order. Using Wiggins' ordering of anagrams and then the MAS, a negative but non-significant \( p < .05 \) correlation was obtained. The reverse order yielded a positive but non-significant correlation. The over-all correlation between anagram solving and MAS scores was \(-.033\), which was not significant at the .05 level. Spence and Taylor's hypotheses on problem solving were not substantiated in this study.

A final word should be said concerning Cole and Sipprelle's (1967) statement on insight in a conditioning experiment such as the present one. The present project used anagram solving as a task to mask the main line of investigation which concerns anxiety levels and extinction rates. The investigator felt that conscious manipulation of the results might be more likely without such a cover task. It is possible that some previous experimental failures in the same line of investigation were due to such a lack of control of conscious manipulation. However, Cole and Sipprelle's statement makes it more likely that conscious insight on the part of the subject into the nature of the experiment does not materially affect the results. They stated that insight, defined as the ability to verbalize the S-R contingency of acquisition, has been found to be unrelated to the extinction of an operantly conditioned verbal response. In all likelihood it is probably safe to generalize this finding to the present project.
Summary

The purpose of the present experimental project was to test Taylor and Spence's hypotheses concerning the relationship of anxiety levels to extinction, conditioning, and problem solving. Taylor and Spence have hypothesized that high anxiety subjects should condition more readily and extinguish less readily than low anxiety subjects. High anxiety subjects should also perform better than low anxiety subjects on simple problem solving tasks but worse on complex tasks.

The literature seems to support Taylor and Spence's contention that high anxiety subjects condition more readily than low anxiety subjects. Experimental evidence appears to be split on Taylor and Spence's theory that high anxiety subjects extinguish less readily than low anxiety subjects. While much of the research from Spence's own laboratory supports his hypotheses on extinction, support from independent researchers has been variable. Experimental evidence also splits on whether high anxiety subjects do better on simple tasks and worse on complex tasks than low anxiety subjects.
Subjects

The subjects for this experiment were students enrolled in introductory psychology courses at Loyola University. There were 97 subjects in all. Fifty-two of the subjects were high anxious (as defined below) and 45 were low anxious. Each of these two groups contained approximately equal numbers of male and female subjects. There were 27 males and 25 females in the high anxiety group and 26 males and 19 females in the low anxiety group. With a few exceptions, practically all of the subjects were freshmen. Subjects for the two groups were chosen randomly from all the high and low anxiety students in the introductory psychology courses.

Experimenter

The investigator served as experimenter for all subjects.

Materials

The subjects were assigned to high and low anxiety subgroups on the basis of their scores on a paper and pencil test of manifest anxiety, the Nicolay-Walker Personal Reaction Schedule (1966). This test has been demonstrated to correlate highly \( r = .70 \) with the Taylor Manifest Anxiety Scale (Taylor, 1951) and was administered in group form as part of a regular classroom exercise at the beginning of the school semester. The Nicolay-Walker PRS measures three relatively pure subtypes of anxiety: motor tension; object; and personal inadequacy. Subjects were placed in the high anxiety
experimental group if their combined scores from the three anxiety subtype scales were one standard deviation or more above the mean for college students. Two of the PRS's anxiety subtypes measure anxiety which is aroused over a concern about external sources of threat: motor tension and object. The third subtype reflects a concern over an internal threat, personal inadequacy, particularly in interpersonal situations. Persons scoring high on the personal inadequacy scale might not feel anxious with an external threat like white noise in the present experiment. Therefore, two or more of the three anxiety subtype scores had to be one standard deviation or more above their respective means for the subject to be placed in the high anxiety group. Subjects were placed in the low anxiety experimental group if their combined scores from the three anxiety subtype scales were one standard deviation or more below the mean for college students. In addition, two or more of the three anxiety subtype scores had to be one standard deviation or more below their respective means. Furthermore, the scores for all experimental subjects on the MMPI K scale (Hathaway and McKinley, 1951) which is embedded in the Nicolay-Walker PRS, had to be less than one standard deviation above the mean for college students in order to control for dissimulation in a socially desirable direction on the anxiety scales.

The experimental task involved solving a list of 45, 5-letter anagrams of high word frequency and low bigram rank (Dominowski, 1967).

The CS in the experiment was a 40 watt red light bulb mounted on a small stand. The UCS was white noise pre-recorded on a tape and played on a Wollensak 1500 SS Monophonic tape recorder. The volume control on the recorder was set at 3.5, delivering 78 decibels unilaterally through bilateral ear-
phones when the earphones were placed next to a General Radio sound meter. The actual decibel level should be increased 20 decibels due to reverberation produced when the earphone is actually fitted to the skull. Thus the effective decibel level is of the order of 100 decibels at 10,000 cycles per second. This frequency and intensity were found to be very unpleasant without being injurious to the subject.

The presentation of both the CS and the UCS was controlled by a special Lafayette control timer consisting of eight plug-in time delay relays connected to provide a repetitive sequence of timed intervals. The fourth relay controlled the CS and was set for a two second exposure. The fifth relay was set at zero so that there would be no delay between the CS and the UCS which was controlled by the sixth relay and which was also set for a two second exposure. The other five relays were all set at maximum providing a twelve second delay between CS/UCS presentations.

The final piece of equipment was a Suffern switchbox with a simple depression switch in front and a jack for the earphones in back. Depression of the switch automatically recycled the timing sequence from the beginning. If the switch was depressed during the presentation of the CS, the cycle began again and the UCS, the last stage of the cycle, was avoided. The Suffern switchbox was attached to both the tape recorder and the timer. All electrical equipment operated on 110v, alternating current.
Procedure and Instructions

The subjects were tested individually by the experimenter. Each subject was met outside the test room by the experimenter and ushered into the room and asked to have the designated chair. The subject was seated at a table with the list of anagrams (a copy is contained in the appendix of this study) and a pencil directly in front of him. To the subject's right and in the middle of the table was the Suffern switchbox with the cutoff switch and the earphones plugged into it. To the left of the subject and to the extreme rear of the table was the red light bulb or CS. The experimenter then took a seat to the subject's right in front of the tape recorder and timing box. A waist high screen was situated between the subject and the experimenter. This screen blocked out the subject's view of the lower half of the experimenter and the tape recorder and timing box, but allowed full view of the subject and his equipment by the experimenter.

As soon as both subject and experimenter were comfortably seated the subject was asked to give his full name, birthdate, age, number of years of education completed, and father's occupation. The instructions were then read to him by the experimenter (the instructions are contained in the appendix of this study). If the subject was left-handed he was allowed to move his chair closer to the switch box in order to make it easier to reach.

After the subject had placed his name at the top of the anagram sheet the experimenter activated the timer. The CS then appeared twelve seconds later for an interval of two seconds and was immediately followed by the UCS for two seconds. Another twelve second interval followed before the next presentation of the CS.
Subjects were considered to have failed to condition if they had not made ten consecutive avoidance responses by the fourtieth presentation of the CS-UCS sequence. Ten consecutive avoidance responses preventing the occurrence of the UCS by depressing the cut-off switch after the start of the CS was the criterion for conditioning. The tape recorder was shut off by the experimenter once this criterion had been met and the UCS was eliminated. This began the extinction sequence. Extinction was defined as ten consecutive failures to depress the cut-off switch upon presentation of the red light CS. A subject was considered to have perseverated if he persisted in the avoidance response through 200 trials, including the conditioning trials. All experimental subjects fell into one of three categories: those who failed to condition; those who conditioned and extinguished; those who conditioned and perseverated.

Upon completion of the avoidance conditioning and extinction sequence the subject was instructed that the experiment had ended. He was then thanked for his time and cooperation and any questions he might have had about the nature of the experiment were answered. Questions about selection criterion were answered by a rather vague reference to stratified sampling on the basis of age, sex, etc. This was to avoid any possible detrimental effects to the subject which might be involved in a discussion of his anxiety level. All other questions were answered in a straightforward manner. Finally the subject was asked to refrain from discussing the experiment with classmates since many of them were still potential subjects.
CHAPTER IV

RESULTS

One hundred subjects were run in the experiment. Of these 100 subjects 3 had to be dropped from consideration leaving a total sample consisting of 97 subjects. The following reasons caused the 3 subjects to be dropped from final consideration: one low anxiety male apparently failed to understand the connection between the CS and UCS and repetitively depressed the switch, thus failing to condition; one male and one female from the high anxiety group had to be dropped from consideration due to an experimenter error in letting them have more trials than allowable to condition. Table 1 shows the total number of subjects in each category of conditioning and extinction.

TABLE 1

Number of Male and Female Subjects
Who Conditioned and Extinguished

<table>
<thead>
<tr>
<th></th>
<th>Total N = 97</th>
<th>Males (M) = 53</th>
<th>Females (?) = 44</th>
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<tbody>
<tr>
<td></td>
<td>High Anxiety</td>
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<tr>
<td>Failed to Condition</td>
<td>M = 14  F = 14</td>
<td>M = 15    F = 14</td>
<td></td>
</tr>
<tr>
<td>Conditioned and Extinguished</td>
<td>M = 4   F = 9</td>
<td>M = 3      F = 2</td>
<td></td>
</tr>
<tr>
<td>Conditioned and Perseverated (200 trials)</td>
<td>M = 9   F = 2</td>
<td>M = 8      F = 3</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>N = 52 (M=27; F=25)</td>
<td>N = 45 (M=26; F=19)</td>
<td></td>
</tr>
</tbody>
</table>
Hypothesis 2a. states that there will be a significant difference in the percentage of high and low anxiety subjects who extinguish and who perseverate in conditioned responses (CR's) up to a predetermined standard (200 trials including the conditioning trials).

With regard to hypothesis 2a., the proportion of high anxiety subjects who extinguished after conditioning to all high anxiety subjects who conditioned was 13/24 or .5416. The proportion of low anxiety subjects who extinguished after conditioning to all low anxiety subjects who conditioned was 5/16 or .3125. The correction for continuity due to a small N in this case was .052. A test for the significance of the difference between proportions yielded a critical ratio of 1.1048 (McNemar, 1962). This ratio fails to reach significance. A two-tailed test with degrees of freedom approaching infinity requires a ratio of 1.96 to reach significance at the .05 level. The difference was in the direction of more high anxiety subjects extinguishing than low anxiety subjects.

Hypothesis 2b. states that there will be a significant difference between high and low anxiety subjects in terms of the number of CR's made after the avoidance response has been conditioned and the extinction procedure has been begun. Table 2 lists the means and standard deviations of the conditioned responses during extinction of those subjects who met the conditioning criterion.
TABLE 2
Mean Number of Conditioned Responses Made After
the Conditioning Criterion Had Been Met with Their SD's

<table>
<thead>
<tr>
<th></th>
<th>High Anxiety (N = 24)</th>
<th>Low Anxiety (N = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>98.375</td>
<td>131.625</td>
</tr>
<tr>
<td>SD</td>
<td>76.416</td>
<td>77.257</td>
</tr>
</tbody>
</table>

Since the distribution of conditioned responses made after the conditioning criterion had been met was bimodal in form, a t-test could not be computed. Instead, a Mann-Whitney U test (Siegel, 1956) was computed employing the correction for tied scores. The combined ranks for the high anxiety subjects' scores yielded a value of 435.5 while the combined ranks for the low anxiety subjects' scores yielded a value of 384.5. A U of -56.5 was computed which yielded a z score of -1.56. With a two-tailed test a z < -1.56 has a p = .1132. Since the obtained z score has a probability of occurring more than .05 by chance, we conclude there is no significant difference in conditioned responses between high and low anxiety subjects. The direction of the obtained difference was in favor of high anxiety subjects making fewer conditioned responses than low anxiety subjects.

Hypothesis 1a. states that high anxiety subjects will condition more readily to an avoidance response than will low anxiety subjects in terms of the percentage of subjects who meet the conditioning criterion. With regard to hypothesis 1a., a proportion of 28/52 or .5384 was obtained by comparing those high anxiety subjects who failed to condition to all high anxiety
subjects. The proportion of low anxiety subjects who failed to condition to all low anxiety subjects was 29/45 or .6444. A test for the significance of the difference between proportions yielded a critical ratio of 1.0663. A one-tailed test with degrees of freedom approaching infinity requires a value of 1.2016 to reach significance at the .1 level. The comparison of proportions failed to reach significance at the .1 level. The direction of the difference was in favor of more high anxiety subjects conditioning to an avoidance response than low anxiety subjects.

Hypothesis 1b. states that high anxiety subjects will condition more readily than low anxiety subjects to an avoidance response in terms of the number of trials until the conditioning criterion is met. The maximum number of trials until the conditioning criterion was met was 40. It was decided to also test Hypothesis 1 in terms of the number of CR's made by the two anxiety groups before the conditioning criterion was met. This would provide an additional, independent test, analogous to Hypothesis 1b. A check of the data revealed that almost all of the subjects who conditioned provided two kinds of conditioned responses. One kind of response was to depress the switch before the UCS or white noise began, thus providing a true conditioned avoidance response. The other kind of response was to depress the switch after the UCS or white noise had begun, thus providing a conditioned escape response. Since the present research project is concerned with hypotheses revolving around avoidance responses rather than escape responses it was decided to analyze the data in two ways, both with and without the escape responses. Thus it was possible to see the influence of the conditioned escape responses on the results. Table 3 lists the means and standard
deviations of the number of trials and conditioned responses made before the conditioning criterion was met for the two anxiety groups.

TABLE 3

Mean Number of Trials and Conditioned Responses Made Before the Conditioning Criterion Was Met With Their SD's

<table>
<thead>
<tr>
<th>Group</th>
<th>High Anxiety (N = 24)</th>
<th>Low Anxiety (N = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trials Before Conditioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>19.042</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>9.176</td>
</tr>
<tr>
<td></td>
<td>CR's Before Conditioning (Without Escape Responses)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>14.125</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>5.223</td>
</tr>
<tr>
<td></td>
<td>CR's Before Conditioning (With Escape Responses)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>17.583</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>8.371</td>
</tr>
</tbody>
</table>

To determine whether there was a significant difference between the means of the two anxiety groups in trials to conditioning and conditioned responses before conditioning (both with and without the conditioned escape responses) three t-tests were computed. To reach significance with a one-tailed test and 38 degrees of freedom a value of 1.304 must be obtained at the .1 level. With trials of conditioning a t value of 1.2883 was obtained, failing to reach significance at the .1 level and in the opposite direction from that predicted. With responses before conditioning, a value of .6318 was obtained when the conditioned escape responses were not included. A value of .9463 was obtained with the escape responses included. Both failed
to reach significance at the .1 level. Both results were in the expected
direction of high anxiety subjects making more CR's than low anxiety subjects
before the conditioning criterion was met.

Hypothesis 3 states that there will be a significant difference in the
number of anagrams solved during the experiment in the following direction:
low anxiety subjects will solve more anagrams per minute than high anxiety
subjects. Table 4 lists the means and standard deviations of the solved
anagrams per minute of the two anxiety groups.

<table>
<thead>
<tr>
<th>TABLE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Number of Solved Anagrams</td>
</tr>
<tr>
<td>Per Minute With Their SD's</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>High Anxiety (N=52)</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>SD</td>
</tr>
</tbody>
</table>

A one-tailed critical ratio test with degrees of freedom approaching
infinity requires a value of 1.2816 to reach significance at the .1 level.
A value of .7491 was obtained testing the difference between the means of
the solved anagrams for the two anxiety groups. This value fails to reach
significance at the .1 level. The results are however in the predicted
direction.

A test (Finer, 1962) for homogeneity of variance was used to check the
homogeneity of variance assumption for t-tests. Table 5 lists the various
maximum acceptable values.
### TABLE 5
Comparison of Variances to Satisfy Homogeneity of Variance Assumption for t-Tests

<table>
<thead>
<tr>
<th>Variance Comparison</th>
<th>Maximum Acceptable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trials Before Conditioning</td>
<td>2.920</td>
</tr>
<tr>
<td>CR's Before Conditioning (No Escape R's)</td>
<td>2.876</td>
</tr>
<tr>
<td>CR's Before Conditioning (With Escape R's)</td>
<td>2.756</td>
</tr>
<tr>
<td>Number of Anagrams</td>
<td>1.704</td>
</tr>
</tbody>
</table>

As can be seen from an inspection of Table 5, none of the obtained variance comparison values exceeds their respective maximum acceptable values at the .01 level of confidence. It should also be noted that the t-test has been proven to be robust with respect to the homogeneity of variance assumption (Box, 1954).

An inspection of Table 1 reveals possible significant sex differences in the number of males and females who extinguished and perseverated in both the high and low anxiety subgroups. However, only one group had a sample size large enough to meet assumptions to test the significance of the difference between proportions. The other possible comparisons contained too few subjects and violated the assumption of an N sufficiently large (McNemar, 1962). The one valid comparison involved the number of male and female high anxiety subjects who conditioned and extinguished. The proportion of high anxiety males who extinguished to all those who conditioned was $4/13$ or...
The proportion of high anxiety female subjects who extinguished to all those who conditioned was 9/11 or .8181. The correction for continuity in this case was .0839. A test for the significance of the difference between proportions yielded a critical ratio of 2.0942. A two-tailed test with degrees of freedom approaching infinity requires a ratio of 1.96 to be significant at the .05 level. Significantly more males perseverated and significantly more females extinguished in an instrumental avoidance response among high anxiety subjects.
CHAPTER 5

DISCUSSION

The purpose of this study was to test the effects of anxiety levels on conditioning, extinction, and problem solving using an instrumentally conditioned avoidance response. Taylor (1951) and Spence & Taylor (1951) had hypothesized that manifest anxiety functions as drive and should therefore act consistent with Hullian (1943) laws concerning the effects of drive. A review of the literature revealed considerable independent support of Taylor and Spence's hypothesis that high anxiety subjects condition more readily than low anxiety subjects with an avoidance response. However, the literature seems conflictual concerning Taylor and Spence's second and third hypotheses. Their second hypothesis was that high anxiety subjects extinguish less readily than low anxiety subjects with a conditioned avoidance response. Their third hypothesis was that high anxiety subjects perform better than low anxiety subjects on a simple problem solving task and worse on a complex problem solving task.

The results of the present experiment failed to find significant differences between the high and low anxiety subjects on conditioning, extinction, or anagram solving. Tests involving conditioning used number of subjects, trials to conditioning, and responses to conditioning as criterion. All failed to reach significance. Using number of subjects and number of conditioned responses as a criterion, the results were in the predicted direction of high anxiety subject's conditioning more readily than low anxiety subjects. Using trials until the subject conditioned as a criterion, the results were in the
opposite direction from the predicted with high anxiety subjects conditioning less readily than low anxiety subjects. Tests involving extinction utilized number of subjects and number of conditioned responses as a criterion. Both sets of data involving extinction were in the direction of high anxiety subjects extinguishing more readily than low anxiety subjects. The results from anagram solving were in the predicted direction of high anxiety subjects solving less anagrams than low anxiety subjects.

Fifty-seven out of 97 subjects failed to condition. The question arises as to why the majority of the subjects in the experiment failed to condition. The proportional test for hypothesis 1a. showed no differential effects of anxiety levels on failure to condition. The answer probably lies in the design of the experiment itself. Since the CS/UCS presentations and the anagram solving took place concurrently, it was possible for the subjects to attend more or less exclusively to the anagram solving. This differential attending may partially be responsible for large numbers of subjects failing to condition. Secondly, Dinsmoor (1968) reviewed a series of experiments (Barry and Harrison, 1957; Harrison and Tracy, 1955; Campbell and Bloom, 1965) which showed white noise to be a relatively poor noxious stimulant in aversive conditioning with animals. Subjects were found to take much longer to condition and give fewer responses with white noise than with other forms of noxious stimuli. If these findings can be generalized to human subjects then it is possible that the majority of subjects in the present experiment did not have enough trials to condition. A maximum of 40 trials was allowed for the subjects to condition. The experimenter was concerned about the effects of repeated intense bursts of white noise on the subjects' hearing.
however and for this reason decided to keep exposures to a minimum. Finally, Hoffman (1966) provides another possible explanation for subjects failing to condition. He discussed the effects on aversive conditioning with animals of the intertrial interval. Aversive conditioning was fastest with an intertrial interval of about five minutes. The present project employed an intertrial interval of twelve seconds. It is possible that if the intertrial interval had been longer the conditioning would have proceeded faster and more subjects would have conditioned.

Because of the contradictory findings in the literature no prediction of direction was made with the major hypotheses concerning extinction. However, the results of the present experiment are in a direction opposite to Taylor and Spence's hypothesis that high anxiety subjects should extinguish less readily than low anxiety subjects. Why this should be remains to be explained. A factor that must be taken into account in the present experiment is that the conditioning/extinction and anagram solving took place at the same time. Conceivably an academic type task, such as solving anagrams, in an academic setting among college freshmen should bring the need to achieve into play. A strong need to achieve might cause a subject to concentrate on anagram solving and to ignore the avoidance responding, thus facilitating extinction. In order to examine the relationship between the need to achieve and anxiety level, the need to Achieve scale of the Edward's Personal Preference Schedule (Edwards, 1954) was administered to one of the participating introductory psychology classes. The administration of this scale took place on a regular class day after all the subjects had been run for the present experiment. Thirty-nine subjects who participated in the
experiment were present that day. Table 6 lists the number of subjects and the means and standard deviations of the need to Achieve T scores for the subjects in each category.

**TABLE 6**

Number of Subjects and Mean Need to Achieve T Scores for Sample of Conditioning Experiment Subjects with Their SD's

<table>
<thead>
<tr>
<th></th>
<th>High Anxiety</th>
<th>Low Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed to Condition</td>
<td>M 47.30</td>
<td>49.90</td>
</tr>
<tr>
<td></td>
<td>SD 10.45</td>
<td>10.19</td>
</tr>
<tr>
<td></td>
<td>N 15.00</td>
<td>13.00</td>
</tr>
<tr>
<td>Conditioned and Extinguished</td>
<td>M 59.00</td>
<td>49.60</td>
</tr>
<tr>
<td></td>
<td>SD 11.58</td>
<td>4.03</td>
</tr>
<tr>
<td></td>
<td>N 3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Conditioned and Perseverated</td>
<td>M 48.60</td>
<td>43.00</td>
</tr>
<tr>
<td></td>
<td>SD 7.13</td>
<td>3.39</td>
</tr>
<tr>
<td></td>
<td>N 3.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

For each of the three categories: failed to condition, extinguished, and perseverated, t-tests were run to test the differences between high and low anxiety subjects on the need to Achieve data. Table 7 shows the comparison of variances to meet the homogeneity of variance assumption for the t-test (Winer, 1962).
TABLE 7
Comparison of Variances for Need to Achieve Data to Satisfy Homogeneity of Variance Assumption for t-Tests

<table>
<thead>
<tr>
<th></th>
<th>Variance Comparison Values</th>
<th>Maximum Acceptable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed to Condition</td>
<td>1.05</td>
<td>$F_{.95}(12,12) = 2.69$</td>
</tr>
<tr>
<td>Extinguished</td>
<td>8.26</td>
<td>$F_{.95}(2,2) = 19.0$</td>
</tr>
<tr>
<td>Perseverated</td>
<td>4.98</td>
<td>$F_{.95}(2,3) = 9.55$</td>
</tr>
</tbody>
</table>

For the failed to condition group a t-test between the scores for the high and low anxiety subjects yielded a $t=.6206$. This value fails to reach significance at the $p<.05$ level. With a two-tailed test and 24 df, a $t=2.06$ is required at $p<.05$.

For the extinguished group a $t$ value of 1.0768 was found for the scores of the high and low anxiety subjects. This value fails to reach significance at the $p<.05$ level. With a two-tailed test and 4 df, a $t=2.78$ is required at $p<.05$.

For the perseverated group a $t$-test between the scores for the high and low anxiety subjects yielded a $t=1.177$. This value fails to reach significance at the $p<.05$ level. With a two-tailed test and 5 df, a $t=2.57$ is required at $p<.05$.

Although all three $t$-tests failed to reach significance the direction of the results, as shown by the distribution of mean need to Achieve scores in Figure 1, does suggest a rationale for explaining why there was a tendency
Fig. 1. Mean Need to Achieve Scores
for high anxiety subjects to extinguish more readily than low anxiety subjects.

The large proportion of high anxiety subjects with a strong need to Achieve could be expected to attend to the anagram solving as an achievement involved academic task. This attending would not be diverted by a stimulus which was merely noxious and not personally threatening. These subjects' high drive state, made even higher by the initial presence of the noxious stimulus, would tend to facilitate attending to the achievement involved task. There would be correspondingly less attention directed to the avoidance responding which in turn could be expected to facilitate quicker extinction. The low need to Achieve subjects among the low anxiety group could be expected to attend less to the anagram solving and more to the avoidance responding. This in turn would facilitate their perseverating in the avoidance responding during extinction.

Another possible way to explain the direction of the results concerning the major hypothesis on extinction is in terms of Epstein's (1967) findings. He found that people characterized as having low anxiety levels perceive anxiety building in themselves in the early stages of stress. They then begin to cope with this anxiety early, using small steps to dissipate or constructively channel the anxiety as it grows. People characterized as having high anxiety, on the other hand, allow anxiety to build up to major proportions. When the anxiety is at a sufficiently intense level they then institute all or none measures to cope with it. These measures are usually only partially successful.

According to Epstein's paradigm, high anxiety subjects in an avoidance conditioning situation would initially allow their anxiety to build. Thus
they would take longer to condition because they would initially not take measures, i.e. not aversively condition, to reduce their anxiety. This would explain the larger number of trials until the conditioning criterion was met for the high anxiety subjects. Their response to the stress, in this case the UCS, would be an all-or-none type reaction in an attempt to cope with their anxiety. They could be expected to extinguish quickly once their anxiety levels dropped due to the avoidance of the UCS. The low anxiety subjects, on the other hand, could be expected to start early in dealing with their anxiety by making avoidance responses. They would then continue to deal effectively with their anxiety by avoiding the stress and would resist extinction. The larger number of conditioned responses made by the high anxiety subjects before conditioning was achieved could be explained in this paradigm as a function of the larger number of trials the high anxiety subjects needed before conditioning. Per block of trials of course the low anxiety subjects would make more conditioned responses before conditioning than high anxiety subjects. This would seem to be the case. If the mean number of trials before conditioning (from Table 3) is divided into the mean number of conditioned responses (without the escape responses) a value of .74 for the high anxiety subjects and .84 for the low anxiety subjects is obtained. This supports the contention that the low anxiety subjects made more conditioned responses per block of trials than the high anxiety subjects before the conditioning criterion was met.

Still another explanation of the results of the present experiment is provided by the theorizing and research of Broen and Storms (1967). They originally were interested in the thought disorder of schizophrenics as
manifested in their confused and jumbled speech. To explain this phenomenon, Broen and Storms developed a theory of response interference in non-psychotic persons and applied it to schizophrenics. The theory was also tested empirically with both non-psychotics and schizophrenics and generally held up quite well. Only those aspects of their theory which were developed around non-psychotic persons are relevant to the present research project.

Broen and Storms used the Hullian concept of drive and habit strength combining in a multiplicative manner to produce response strength \((DxH = RS)\). Since habit strength reflects learning history, a stimulus which in the past has been associated with more than one response will evoke a hierarchy of habit strengths that are arranged in accordance with past association frequencies. Broen and Storms added to this schema a new concept, a response-strength ceiling that is lower than maximum \(DxH\). When the dominant response habit strength is low early in training the full multiplicative effect of drive times habit strength may occur. Later in training when the dominant response habit strength \((H_D)\) is high, the RS ceiling restricts the full increase in the strength of the dominant response. Meanwhile the multiplicative effect of high drive increases the response strength of competing responses \((RS_C)\) more than the response strength of the dominant response \((RS_D)\) because the habit strength of competing responses \((H_C)\) is high. The net effect is a reduction of the difference between the strengths of dominant and competing responses \((RS_D - RS_C)\). The reduction in \(RS_D - RS_C\) due to higher drive decreases the probability of the dominant response and increases the probability of the competing response. Thus subjects with high drive would do worse than subjects with low drive later in training but better
earlier in training.

Broen and Storms' theory can be applied to the present research. Subjects were chosen on the basis of extreme scores on a scale of Manifest Anxiety. High anxiety subjects are presumed to have high drive levels in a stress situation, in line with Taylor's work (1951). Similarly low anxiety subjects are presumed to have low drive levels in a stress situation. Early in conditioning high anxiety subjects should do better than low anxiety subjects according to Broen and Storms. This is because early in conditioning the response strength ceiling has not been reached and drive can interact in a multiplicative fashion with habit strength. Reference to Table 3 shows the applicability of the above hypothesis with reference to the conditioned responses made before the conditioning criterion was met. There was a tendency (though statistically non-significant) for high anxiety subjects to make more responses than low anxiety subjects.

The same theory of Broen and Storms would explain why low anxiety subjects tended to perseverate in conditioned avoidance responses more than high anxiety subjects. As the number of trials increased the high anxiety subjects would be expected to reach the response strength ceiling for the dominant response habit strength. At the same time the high drive level would be increasing the response strength of competing responses, such as anagram solving. The net effect would be the reduction in $R_{SD} - R_{SC}$ that Broen and Storms posit and a decrease in the probability of the dominant response occurring and an increase in the probability of competing responses. This would increase the probability of the extinction of the avoidance response. At the same time the dominant response habit strength of the low
anxiety subjects would not have reached the response strength ceiling and the multiplicative effects of drive with the \( H_D \) could occur. The \( R_{SD} - R_{SC} \) difference would remain high and the probability of the perseveration of the avoidance response would be high.

The results with anagram solving, though non-significant, were in the expected direction. A review of the literature indicated two studies, one supportive (Wiggins, 1957), and one non-supportive (Tallarico and Reitman, 1959) of Spence's hypotheses concerning anxiety level and problem solving using a complex task such as anagram solving.

Over all, the failure to reach significance of the test results in the present experiment does not lend support to the three hypotheses proposed in the Introduction. These hypotheses followed Taylor and Spence's thinking concerning the relationship of anxiety levels to conditioning, extinction, and problem solving. Partial support is lent to those hypotheses concerning conditioning and problem solving by the fact that the majority of the test results in these two instances were in the predicted direction. However, the failure to reach significance of the extinction data leaves the relationship between anxiety levels and the extinction of an avoidance response a disputed question (as the literature revealed). Furthermore, the direction of the extinction data was opposite to that proposed by Taylor and Spence. Either Taylor and Spence's theory concerning anxiety and extinction is inaccurate or other unknown factors are influencing the results.

A word must be said about the significant sex difference found. There was a significant difference between the high anxiety males and females who conditioned. This difference was in favor of females extinguishing and
males perseverating. Such a difference is hard to interpret since a review of the literature reveals very little research interest in this specific area. So a meaningful theoretical basis for interpretation is lacking. Secondly, sex differences lie outside the stated purposes of the present experiment. Finally, a total of eight critical ratio and t-tests were run on the present data. The probability becomes rather high that one of these tests will yield a significant difference. Whether the difference is meaningful, however, remains for future research to determine.
Hullian hypotheses on the nature of drive have led to much contemporary research. Typical of such research was that of Kenneth Spence and Janet Taylor. They hypothesized that manifest anxiety, as measured by a paper and pencil test such as the MAS (Taylor, 1951), should act as drive. In line with Hull's original hypotheses, high anxiety subjects should condition more readily and extinguish less readily than low anxiety subjects with an avoidance response. Furthermore, high anxiety subjects should do better on simple problem solving tasks and worse on complex problem solving tasks than low anxiety subjects. The research literature generally supports Taylor and Spence's hypotheses on the relationship between anxiety levels and conditioning. Investigators are sharply divided on their hypotheses concerning anxiety levels and extinction and problem solving.

The present work seeks to clarify the nature of the relationship of anxiety to both extinction and problem solving using an instrumentally conditioned avoidance response. Very little work has been done in this area using an instrumental conditioning paradigm. Most of the previous research had utilized a classical conditioning paradigm.

Ninety-seven students in an introductory psychology course at Loyola University were used as subjects. Fifty-two were classified as having high anxiety and 45 as having low anxiety on the basis of their scores on the Personal Reaction Schedule (PRS) (1966). The PRS is a paper and pencil test which measures manifest anxiety. In addition their K scale scores from the
Minnesota Multiphasic Personality Inventory had to be within acceptable limits in order to control for faking in a socially desirable direction on the PRS. All subjects were told that their task was to solve a series of 5 letter, high word frequency anagrams. While they were solving the anagrams, the conditioning and extinction was carried out. A red 40w light bulb served as the CS. One hundred decibels of white noise played from a Wollensak tape recorder and delivered monaurally through bilateral earphones served as the UCS. The CS was presented for two seconds and immediately followed by the UCS for another two seconds. There was a twelve second interval between CS/UCS presentations. The subjects could prevent the occurrence of the UCS by depressing a switch on a Suffern switch box at any time during the presentation of the CS. This then recycled the whole process for another CS/UCS presentation.

On all three sets of data, conditioning, extinction, and anagram solving, appropriate critical ratio, t-tests, and Mann-Whitney U tests were run to test the differences found. No significant differences were found between the high and low anxiety subgroups for any of the three major hypotheses. With the extinction data the direction of the results was opposite from that predicted by Taylor and Spence. There was a tendency for high anxiety subjects to extinguish more readily than low anxiety subjects. The conditioning data was generally in the predicted direction: high anxiety subjects in an aversive conditioning situation tend to condition more readily than low anxiety subjects. The anagram solving data was also in the predicted direction: high anxiety subjects tended to solve fewer anagrams per minute than low anxiety subjects.
The results failed to confirm Taylor and Spence's hypotheses on the relationship between manifest anxiety and conditioning, extinction, and problem solving. Concerning extinction, the results were in the opposite direction from that predicted by Taylor and Spence. Several theoretical approaches were considered in order to explain the results with the extinction and conditioning data.
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INSTRUCTIONS TO SUBJECTS

Your task is to solve the anagrams in front of you - that is, to formulate an English word from each set of letters. Each set of letters does form one word if put in the proper sequence. You are to work as quickly as possible. As you are working you may hear a very unpleasant noise through the earphones which you will put on. This noise will annoy you and slow down your work. There is a way to prevent hearing this noise altogether which involves using the button on the box to your right. In other words you can prevent the noise from beginning if you so choose. You will have to figure out how to prevent hearing this noise. When using the button however, you may only use your writing hand to depress it and do not continuously depress the button. Any questions? Put on the earphones and remember to work as rapidly as possible. Do not forget to use your writing hand only to depress the button.
<table>
<thead>
<tr>
<th>Name</th>
<th>Anagram 1</th>
<th>Anagram 2</th>
<th>Anagram 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLKAB</td>
<td>WINOS</td>
<td>ZPEIR</td>
<td></td>
</tr>
<tr>
<td>DICLH</td>
<td>ANTEK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECOF</td>
<td>GIEWH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GTHIL</td>
<td>APESU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHKIT</td>
<td>OLMED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LECPA</td>
<td>ANICB</td>
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APPROVAL SHEET

The thesis submitted by Mr. Anthony P. Gillette, has been read and approved by members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval with reference to content and form.

The thesis is, therefore, accepted in partial fulfillment of the requirements for the degree of Master of Arts.

14 January 1970

Signature of Advisor