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Effect of Practice Under Differing Degrees of Psychological Stress on Ability to Solve Problems Under Mild Stress

Penelope Miller Burdette-Finn
Loyola University Chicago

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EFFECT OF PRACTICE UNDER DIFFERING DEGREES
OF PSYCHOLOGICAL STRESS ON ABILITY TO
SOLVE PROBLEMS UNDER MILD STRESS

by

Penelope Burdette

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

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VITA

The author, Penelope Miller Burdette, is the daughter of Milton and Elizabeth Miller. She was born March 3, 1951 in Memphis, Tennessee.

Her elementary and secondary education were obtained in the public schools of Martin, Tennessee. She entered the University of Tennessee, Martin on the early college admission program after her junior year of high school. She attended the University of Tennessee, Martin from September, 1968 through January, 1972 at which time she transferred to the University of Tennessee at Knoxville. She received the degree of Bachelor of Science in June, 1972.

While attending the University of Tennessee, she was President of the Psychology Colloquium and the Student Rights Committee. She was awarded the Alumni Merit Award and the Alpha Delta Kappa Fraternity Award for Academic Excellence. She was selected as the Outstanding Upper Division Psychology Student and as a member of Who's Who Among Students in American Colleges and Universities for 1970 and 1971. In 1972 she was awarded a Danforth Fellowship.

In September, 1972 she entered the Johns Hopkins University graduate program in experimental psychology. She left the program in January, 1973 and worked until entering Loyola University in September, 1974.

She did her clerkship work at the Loyola Student Counseling Center and worked at Northwestern Memorial Hospital for her internship.

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INTRODUCTION

Stress has been defined in many ways. Architects define stress as "an extreme condition, involving tension, perhaps damage and some form of resistance to the straining force" (Cofer & Apply, 1964, p. 441). Physiologists working with physical changes caused by physical and psychological stresses define stress as the "non-specific response of the body to any demand made on it" (Selye, 1974, p. 10) or "the state of the organism following failure of normal homeostatic regulatory mechanisms of adaptation" (Selye, 1955, p. 625). Sociologists have talked of the same kind of stress situations as ones in which

most people either have insufficient means to deal with the situation, or, if sufficient means are available, lack the capacity to manipulate them effectively. Thus we can view stress situations from two perspectives: first, from the number of people who have difficulty in reversing the situation effectively; secondly, from the extent to which individuals have difficulty in reversing the situation. The first perspective defines what we might or might not consider stress situations. The second in part defines the magnitude of stress situations for particular persons. A situation that requires adaptation but one that the actor cannot reverse is, from his personal point of view, a stress situation (Mechanic, 1962, p. 210).

Psychologists, in their research, have used such definitions of stress as changes in galvanic skin response and heart rate (Houston, 1973; Geer & Klein, 1969); as frustration, anxiety, conflict, and tissue damage (Lazarus, 1966); or as prevention of gratification of needs (Pascal, 1951). In short, so many different definitions of stress have been used that the term stress has become a "collective term for

an area of study" (Lazarus, 1966, p. 28). Stress will be defined in this study as the state of the person where he perceives that his well-being (or integrity) is endangered and that he must devote energy to its protection.

Stress may be induced by a wide variety of conditions. Some stressful situations that have been studied have been combat (Grinker & Spiegel, 1945), parachute training (Holtzman & Bitterman, 1952), and natural disasters (Horowitz, 1976). Relatively non-specific conditions such as overcrowding (Christian, 1959), room changes (Mason, 1964), interpersonal relations breakdown (Jacobs, Spilken, & Norman, 1969; Spilken & Jacobs, 1971), and preparing for exams (Mechanic, 1962) have also been shown to cause stress reactions. Stress reactions can occur in the absence of actual physical or psychological danger. Threat or the anticipation of harm frequently produces a more severe stress reaction than does the actual confrontation with the danger (Cook & Barnes, 1964; Nomikos, Averill, Lazarus, & Opton, 1968). Lazarus and associates (Lazarus & Alfert, 1964; Lazarus, Spiesman, Mordkoff, & Davison, 1962) were able to induce stress reactions in students by the presentation of film about industrial accidents. The students were in no danger themselves. Film threat and actual shock threat reactions were shown to be indistinguishable by Alfert (1964).

In general purely psychological stressors act to either decrease the subject's certainty of his orientation or to threaten his well-being directly. This threat or uncertainty may be brought about by an excess or a deficiency of stimuli (sensory deprivation or sensory

overload) or by ambiguous or conflicting stimuli. In a situation with ambiguous or conflicting stimuli, the subject does not know how to respond or is required to perform two competing responses at the same time. For example, in an ambiguous situation the subject may not be presented with the information needed to make the necessary choices in a rational manner. Pavlov trained dogs to respond to a circular pattern to obtain reinforcement, but not to respond to an ellipse. He then successively decreased the distortion of the ellipse until the animal could no longer discriminate between the two. The dogs became upset, phobic, and irritable. Pavlov's dogs were under stress caused by an ambiguous situation when they could no longer distinguish between the circle and the ellipse. A conflicting situation may also involve the subject in a decision in which his perceptions differ from those of others or he must use information from two equally credible sources who disagree (Cofer & Apply, 1964).

Situations that are stressful for some individuals do not have that effect on other individuals. Selye (1974) states that with physiological stressors "qualitatively different stimuli of equal toxicity do not necessarily elicit exactly the same syndrome in different people and even the same degrees of stress induced by the same stimulus may produce different lesions in different individuals" (p. 14). Interpretation of a psychological event as stressful is influenced by cognitive processes involving memory, judgment, thought, perception and learning. Even in natural disasters individuals are likely to appraise the situation differently from one another and therefore experience it differently in terms of stress.

There are three primary cognitive activities involved in assessing the degree of stress (Neufeld, 1976). First is the individual's appraisal of the potential danger in the situation. Included in this appraisal is the immediacy of the danger, the strength of the danger, the possibility of avoidance and the importance to the individual of what is threatened. His appraisal of counter-harm resources available is also important. These resources may be from the individual such as flight or coping mechanisms or from the environment such as assistance from others. Finally there is the effectiveness of coping mechanisms at reducing the threat without disrupting the individual's life. Neufeld describes the degree of stress for an individual as a ratio between his appraisal of the stressor aversiveness and his appraisal of his coping efficiency. As the strength of either of the variables changes, so does the force of the stress reaction.

Responses to Stress

Selye (1956, 1961, 1975) describes the general pattern of a response to a stressor in his General Adaptation Syndrome. He describes three stages of response. The first stage is an alarm phase in which the organism experiences an initial shock in which his resistance is lowered, closely followed by a counter-shock phase in which his defenses are mobilized. The mobilization of his defenses begins a stage of resistance during which the organism attempts to neutralize the threat. If the threat persists and the organism's attempts to neutralize it are unsuccessful, the organism may reach the final stage of exhaustion and ultimately death.

Cofer and Apply (1964) describe a similar sequence of responding although they elaborate more on the psychological manifestations of the response to stress. The first reaction to systematic stress is increased emotionality. Emotions are stronger and more labile. The second response is subjective feeling of distress, and the person seeks to reduce these feelings by taking defensive action to cope with the threat or to reduce the dysphoric feelings. The person has a choice of several mechanisms based on behavioral, cognitive, or decisional alternatives to attempt to control the possible harm. For example, he may attempt a direct action on the environment to avert or decrease the threat. This is a behavioral choice. He may exert cognitive control by reinterpreting the events in a less stressful manner using psychological defensive mechanisms such as denial, repression or intellectualization. Or he may make a decisional choice between separate courses of action or combinations of coping mechanisms (Averill, 1973).

As a person fails to neutralize the threat, he goes through a succession of defenses. Behaviors directed toward goal attainment and defenses that would aid in this process are replaced with defenses that are oriented more and more toward ego protection and less towards task completion. For example, a student preparing for an important test may comfort himself and spur himself to further study with the thought, "If my classmates can do it, so can I. I'm as good as they are in other classes, so if I study as much as they do I'll probably do as well on the test." This rationalization may serve to bind anxiety so that the student is able to study. Once the student is

taking the test and facing questions he cannot answer, he may deny the importance of the test (I can take it over) or redirect his anxiety by scapegoating the teachers for asking unfair questions. Neither of these behaviors facilitate his doing well on the test, but both protect his self-esteem.

The person under psychological stress undergoes some well-defined behavioral changes. The initial effect of stress is usually improved performance, but, as the stress continues,

deteriorative effects are noticeable in all aspects of performance, of judgment, of relationships with others and with oneself. The subject exhibits tendencies toward rigidity of response, including inflexibility, inability to profit from experience and to use new information, and inability to shift when shift is necessary or to persevere when perseverance is required. There is an increase in suspiciousness, hostility, irrationality, and errors and a decrease in speed of performance. The degree of deterioration appears to be highly correlated with the intensity of the instigation of the stressor. (Cofer & Apply, 1964, p. 461)

In abrupt severe stress situations such as a natural disaster or an accidental death, the stress response does not end when the event has passed. Survivors and bystanders frequently report lengthy periods of denial, emotional numbing and behavioral constriction. They experience intrusive and repetitive dysphoric ideas and feelings. Horowitz (1976) describes several specific syndromes he has identified by interviewing survivors of accidents and concentration camps. The events are as follows: 1) fear of a repetition of the event; 2) shame over helplessness and lack of control of the event; 3) rage at the source of the stress (This rage may produce conflict with the person's sense of social morality especially if the rage is felt toward a loved one who died); 4) guilt or shame over aggressive

impulses (The survivor may harbour destructive fantasies toward the course of the disaster such as the driver of the other car and may suffer intense guilt feelings over these fantasies. The survivor may feel an intense need to look at the accident victims to assess the extent of the potential danger but feel guilty for his "ghoulish impulses"); 5) survivor guilt (The survivor may feel guilty about his relief that he was one of the ones spared); 6) fear of aggressivity (He may fear that he will act out his aggressive fantasies. He has already experienced not being in control and he may fear where this will lead him); 7) fear of identification or merger with victims; 8) sadness in relation to real or symbolic loss.

Research With "Stress"

Research on stress has ranged from the prediction of syndromes or predicted courses of the reaction to rape (Burgess & Holmstrom, 1974) and dying (Kubler-Ross, 1969) to various attempts to correlate physiological measures with personality correlates or subjective feelings of stress (Goldstein, Alexander, Clemens, Flagg, & Jones, 1965; Goldstein, Jones, & Kinder, 1964; Geer & Klein, 1969; Holtzman & Bitterman, 1956; Mandler, Mandler, Kaemen, & Sholiton, 1961; Mordkoff, 1964; Schachter, Williams, Rowe, Schachter, & Jameson, 1965; and Speisman, Lazarus, Mordkoff, & Davidson, 1964). While syndromes have been successfully identified, results on physiological correlates have been very mixed. Correlations among physiological measures such as heart rate, galvanic skin response, blood volume in the fingers and stressful conditions and reported affective discomfort have varied

widely between studies. There are, however, a few statements that seem to be accurate based on experimental results. During intellectual tasks under stress, people whose heart rate increases seem to perform better, but under aversive event conditions, people whose heart rate decreases perform more efficiently (Wood & Obrist, 1964). Accelerated heart beat seems to lead to dampening of reactivity to aversive or distracting environmental stimulation. It frees people solving intellectual tasks from external distraction. A low heart rate enables people to attend to the environment when such attention is necessary for coping (Lacey & Lacey, 1958; Lacey, 1967). Obviously, studies in which accelerated heart rate was used as a proof that subjects were under stress must be reevaluated in light of the type of stress involved. Several studies have found that the most efficient people at solving problems under stress were those who showed the greatest autonomic reactivity (Blatt, 1961; Kagan & Moss, 1962; Levine & Scotch, 1970) leading to the belief that physiological reactions constitute an attempt of the subject to cope with stress and are not direct measures of the stress but perhaps of the coping efficiency. Subjects with the greatest autonomic reactivity seem to be the ones who face stress and master it with the highest frequency.

Coping styles under stressful conditions have also been studied. Lazarus (1966) found that people tend to first attempt an active coping style (fight or flight) and only after this attempt failed did they resort to cognitive styles such as rationalization, denial or intellectualization. Goldstein and associates (Goldstein, Alexander, Clemens, Flagg, & Jones, 1965; Goldstein, Jones, & Kinder, 1964) were

able to separate subjects into three categories of copers--avoiders, sensitizers and non-specific defenders. Avoiders use repression or denial to avoid recognition of the threat. Sensitizers use intellectualization, reaction formation and projection and are more likely than avoiders to ruminate about the threat and to verbalize its impact. Goldstein found that the non-specific defenders were more able to cope with stress than either of the groups who used specialized coping strategies. Houston (1973) found subjects who used a high amount of denial performed better on a memory task under the threat of shock than did those who did not use denial. Speisman et al. (1964) found that intellectualization was more effective than denial in reducing anxiety for students and airline executives while watching a stressful film. Neufeld (1975) found although people who used denial reported feeling less stressed than people who did not use much denial, their physiological measures remained very reactive. Denial of threat seems to help performance when there is an active defense possible (avoiding shock) but does not seem to be useful in circumstances where the subject has no active means of coping and must rely on cognitive coping.

The great majority of studies of stress and verbal performance show deterioration or impairment as the result of the stressful experimental conditions. Through studies of stress induced by real or reported failure, Zeller (1950) has shown failure experiences to decrease the subject's ability to learn while positive experiences increase it. He attributed this decrement to the repression of items failed that he found in his subjects during an experiment with nonsense

syllables. Subjects learning the same material learned much faster when they were not told if they had failed an item. Subjects were less likely to recall an item that they had been told they had missed than an item where no feedback was given. Other studies have demonstrated that reasoning and thinking is more apt to be adversely influenced by failure stress than is visual or rote memory (Lantz, 1945), and that stress produced by time pressure decreases performance by producing an increase in errors and variability (McKinney, 1933).

Attempts to predict performance under stress or to discover personality correlates of behavior under stress have not met with much success. Several studies have presented correlations that were significant but were too small to be of any practical value. Subject groups which have been found to perform poorly under stress include submissive children, maladjusted children, low dominance women, college students with low grades, and people who score highly in two experimental scoring categories on the Rorschach. The U.S. Government through the OSS and the Aviation Psychological Program attempted to discover how to predict performance in combat or training school. No significant relationships were found between individual differences on the tests attempting to predict ability to cope with stress and in later performance (Lazarus, Deese, & Osler, 1952).

Problems in Stress Research

Research on people's response to stress is beset by a number of difficulties due to the subjective nature of the stress response. As was mentioned earlier, the strength of the reaction to stress depends

on the subject's labeling of the degree of possible harm and his own resources for dealing with it. Since appraisal of the threat and appraisal of coping efficiency will be idiosyncratic to each individual it is difficult to define for experimental purposes a situation that will be equally stressful for all participants. A subject feels stressed only when a motive of some importance to his integrity is threatened--he must be involved to feel stressed (Mahl, 1949). Researchers frequently use failure at solving problems or sensory overload while solving problems to induce stress in the laboratory. Laboratory subjects vary widely in their intrinsic need to excel at solving problems or performing on the pursuit rotor. Grinker (1957) and Berkum (1962) and their associates found in their experiments on hospital patients and armed forces trainees that despite elaborate arrangements to place the subjects under stress, the subjects trusted that the experimenters would not do anything that was harmful or not in the subject's best interests and therefore the subjects did not experience stress reactions. Not only do individuals respond idiosyncratically, but also the artificiality of the experimental situation may lead the subjects to question the reality of the supposed stresses in the situation.

Even in experimental situations that might be objectively threatening to motives of equal importance to the subjects and in which all subjects expect the stressful event to occur, differences in individual awareness can still cause the subjects to respond as if to different threats. Subjects may differ in their awareness of the details of the stimulus. They differ in the personal characteristics

that make the stimulus threatening and in the relationship between the stimulus and the psychological system that it threatens. That is, the contingencies and constraints involved in coping with the threat differ for each person as do the emotional reactions to threat (Lazarus, 1961). People may respond physiologically as if they feel equally stressed, but differ in their tendency to identify a feeling of stress (Neufeld, 1975; Green & Swets, 1966).

The most common ways of producing stress for experimental purposes are films, failures, and information overload. There are several difficulties in induced stress experiments. The previously mentioned problem of motivation is one difficulty. It is difficult to define a task that all subjects are equally anxious to complete successfully and that all subjects will interpret in the same way. Experimenter credibility is another problem in producing stress in the laboratory--do the subjects believe the appearance of the threatened event is imminent.

Failure or threat of failure at a task has been the method most frequently used in experiments on stress. The subject may be presented with an insoluble task, or he may be interrupted before he could possibly finish, or he may be given false information that he failed. There are two confounds that are specific to failure stress. One is that a subject who is falsely told he has solved problems incorrectly may change his correct strategy in an attempt to perform more effectively and therefore decrease his performance scores. Another confound is learned helplessness. A subject who is presented with aversive circumstances that he cannot control or who experiences

continued failures which he believes he cannot control, performs more poorly than a subject who receives the same number of aversive experiences but believes he controls them (Bensen & Kennelly, 1976; Wortman, Panciera, Shusterman, & Hibscher, 1976). Failure-induced stress may decrease the performance of the subject in ways specific to failure but not to stress.

Motivation is frequently a confound in experiments on stress. On simple or boring tasks, stress can frequently increase efficiency due to increased motivation (Smock, 1956). On the other hand, high degrees of motivation or fear seem to produce an impairment of performance in most tasks. Unfortunately there is no way of assessing with any degree of confidence the degree of motivation of subjects and therefore no clear way to transfer information learned in the laboratory to real-life situations.

Experimental research on stress is difficult to interpret. The studies are rarely comparable due to differences in sampling and in measuring and producing stress. Physiological and subjective measures of stress have been found to be unreliable. Due to individual differences in motivation and interpretation of events, experimenters are usually unable to separate responses due to stress from a number of other confounding variables.

Inoculation to Stress Hypothesis

The theory of particular interest in this study is the inoculation to stress theory. Selye (1961) in proposing the immunization to stress theory concluded that by prior exposure to a stressful situation

a person can be "inoculated" against stress so that he will be more able to perform in later stress situations than if he had not been "inoculated." This theory is used in many training programs in medicine, graduate school, such as training in sociology and clinical psychology, and the armed forces. The students are trained in a situation that is typically very stressful with the intention of teaching them to handle stress. Frequently the training stress is more severe than will later be encountered in practice. Part of the reason for such severe levels of stress is to be found in the intrinsic nature of training programs--the attempt to learn as much as possible in the shortest amount of time, and part is found in the belief that learning to cope with severe stress will improve later performance in less stressful situations.

The evidence from physiological studies seems to strongly support the theory. In 1961 Selye found that small doses of a hormone treatment which produced physiological stress could be gradually built up over time and would increase the tolerance of the rat for that hormone. The rat could adapt to physiological stress. Selye felt that physiological stress was similar to psychological stress and, in fact, that psychological stress could cause physiological damage.

Selye (1955) found that animals placed under physiological stresses showed physical deterioration leading to death although none of the stresses by itself was life threatening. In rats who were stressed only by being immobilized, Selye found enlarged adrenal glands, diseased stomach and kidneys, and shrinkage of the thymus.

The similarities between physiological and psychological stress

were further explored by Wolff (1953, 1954, 1958) and Hinkle (Hinkle & Wolff, 1957). This research demonstrated physiological changes due to psychological stress as have Spilken and Jacobs (1969, 1971) and Manuk and associates (Manuk, Hinrichsen, & Ross, 1975). Spilken and Jacobs (1971) found college and medical students who were under strong stresses were more apt to seek treatment for physical problems than were their peers who were under less stress. Physiological stress reactions have also been produced by purely psychological means (Shannon & Isbell, 1963). It has been demonstrated that physically measurable stress reactions can be produced not only by physically threatening situations but also by socially threatening situations such as poor peer relations and vicarious experience of injury (Wolff, 1953; Lazarus & Alfert, 1964). If a physiological reaction to psychological stress is indeed comparable to a psychological reaction to psychological stress, the evidence supports the immunization theory.

Further support for the immunization theory comes from the statement of Volkart (1951) that "adjustment and control of stress result from the subject's ability to compare present situations with similar ones in the past and revise actions and judgments in light of past experience" (p. 218). Learning theory would seem to agree that a prior opportunity to reinforce effective coping styles and to extinguish ineffective ones would enhance the subject's ability to cope with similar situations in the future. The question then seems to be --Is there such a thing as a manner of coping with stress that can be learned? If so, can we describe it in a way that would enable us to teach it to people who have to function in stressful situations?

Current Study

This study was designed to be a first step in testing the immunization against stress hypothesis. It is an attempt to discover if subjects who practice a complex reasoning task under highly stressful conditions are more efficient in performing the task under mildly stressful conditions than are subjects who practiced under little or no stress. Can one learn some strategy from experience with high stress that better enables one to perform under moderate or high stress? If people seem to be able to perform more effectively in the mild stress condition to be presented in this study when they had prior practice in high stress, that would seem to indicate that there is some inoculation effect and that it merits further investigation.

Since the subjects were to be undergraduate college students, a testing situation was chosen on the basis that it would be a relatively realistic situation for these subjects and less liable to be interpreted in an idiosyncratic manner. Reasoning and thinking are more apt to be affected by stress than rote or visual memory (Lantz, 1945); therefore, a modified block design task such as the one on the Weschler Adult Intelligence Scale was used. Prior instructions have been shown to influence the severity of stress responses (Lazarus & Alfert, 1964; Neufeld, 1976; Speisman et al., 1964). Different sets of instructions were used to induce stress so that confounds of task and failure-induced stress were avoided.

There were four primary hypotheses to be explored in this study. The first hypothesis was that students who learned the task under high stress would be more effective performing it under mild stress

than students who learned under low or mild stress. A second hypothesis was that students who learned under high stress would be more effective under all performance conditions than students who learned under mild or low stress. The third hypothesis was that students who trained under high stress would habituate to high stress and therefore be better able to increase their scores to meet the demands of a high stress performance situation than would people who were trained under low stress and had no prior experience with high stress. The final hypothesis was that students trained under high stress would be less likely to increase their errors when performing under high stress than students with no prior training experience in high stress.

METHODS

Subjects

The subjects were 45 students at Loyola University who volunteered for this experiment to fulfill a requirement for research experience for their introductory psychology course or who freely volunteered without credit from more advanced classes. Twenty-three women and twenty-two men participated. Prior to beginning the experiment, subjects were advised that it was possible for them to withdraw if they felt the experiment was too distressing and that no penalty would be involved. No subjects withdrew.

Procedures

A randomized block design was used in assigning subjects to treatment conditions. Groups of five subjects were randomly assigned to one of the nine treatment combinations. Each group was asked to solve a number of block designs under instructions calculated to place them under differing amounts of stress. The low stress groups of subjects were merely asked to "Please solve these problems." No time limits were mentioned. The second group of subjects was given instructions calculated to induce mild stress. They were told "Please solve these problems as quickly as you can. The experimenter wants to know how other people knowing how well you do will influence your problem solving." The high stress group of students were told "Please solve these problems as quickly as you can. At the end of the period

you will be asked to stand, give your name, and tell how many designs you were able to solve. Some of you may be familiar with some of the designs if you have done the experiment on intelligence tests, but we don't expect this to influence your scores. In fact I should be able to give you a very rough estimate of your IQ when you report your scores." At the end of the initial testing period for these students, if asked about the IQ scores, the experimenter stated that she did not have the norms with her and no IQ feedback was given.

The stress inducing instructions were chosen by administering a rating scale to students who were taking introductory psychology the semester prior to the subjects of the present investigation. The students were asked to rate 11 sets of instructions on a seven-point scale as to which would make them feel more uncomfortable if the instructions were presented in an experimental situation. One hundred and forty students were used for the first evaluation. At the first rating the instructions' ratings involved too much overlap between medium stress and high or low stress to be acceptable to this researcher. Instructions with maximum overlap were eliminated and remaining instructions were reworded on the basis of the ratings to increase or decrease their stress value. The refined set of instructions was presented to another undergraduate psychology class. These ratings are presented in Table 1.

All subjects solved problems for 10 minutes, then were given a ten-minute break in which they were asked to fill out the Affect Adjective Check List (AACL) as an interpolated activity which also served to focus the subject's attention on their feelings.

Table 1

Ratings of Experimental Stress Inducing Instructions by Undergraduates

<u>Instructions</u>	Not Stressful		Moderately Stressful			Very Stressful	
	1	2	3	4	5	6	7
Please solve these problems.	18	15	4	5	2	-	-
Please solve these problems as quickly as you can. The experimenter wants to know how other people knowing how you did will influence your problem solving.		5	7	10	13	6	-
Please solve these problems as quickly as you can. At the end of the period you will be asked to stand, give your name, and tell how many you were able to solve. Some of you may be familiar with some of the designs if you have done the experiment on IQ tests, but we don't expect this to influence your scores. In fact, I should be able to give you a very rough estimate of your IQ when you report your scores.						10	28

In the second part of each experiment the five members of each group were placed again in one of the three conditions. Subjects solved block design problems for five minutes under instructions attempting to place them in low stress, moderate stress, and high stress conditions. The low stress subjects were asked to "Please solve these problems as quickly as you can." Subjects with prior mild and high stress experience who were to be tested in low stress condition were told in addition that "These are new designs and are not part of any test." They were assured that their scores on these designs were confidential. The mild instructions and the high stress instructions were the same as in previous conditions.

The five subjects in a group were each given a set of nine blocks. They were presented with square designs on cards and asked to duplicate the designs with as few blocks as possible. The designs required the subjects to use four or nine blocks. The designs were a combination of Weschler Adult Intelligence Scale designs and designs created by the researcher. The designs are presented in Appendix A. The designs were presented in the same order for all conditions. Different sets of designs were used for the 10-minute and the 5-minute testing periods. The subjects worked in screened study carrels. Upon completion of a design, they raised their hands and the experimenter recorded the accuracy of the design. To minimize disturbance, the experimenter signaled completion of recording of the designs by a light touch on the subjects' shoulders. The subjects had been instructed to then begin work on the next design.

After the five-minute problem-solving period, subjects were

asked once again to complete the AACL and were debriefed. Each subject was asked not to discuss the details of the experiment until March after all data had been collected.

RESULTS

Since comparisons were to be made between scores during the performance phases of the experiment and scores of increases in number correct from practice to performance and since the subjects all learned the task under differing conditions, the data were analyzed to determine correlations between practice scores, increase scores, and performance scores. The analysis indicated that although increases in score showed a negatively correlated trend relationship with practice scores, $r_{43} = -.28$, $p < .06$, there was no significant difference in practice scores for the nine groups, $F_{8,36} = .78$, $p < .62$, as shown in Table 2. Therefore any significant differences in increases would be very unlikely to be due to differences in practice scores and difference scores could be used in evaluating hypotheses.

The means and standard deviations for subjects under the three levels of practice and performance stress are presented in Table 3. The data relevant to the hypotheses were analyzed by the ANOVA and Analysis of Covariance. The results are presented in Table 4 through Table 9.

The first hypothesis was that students who learned the task under high stress would be more effective in performing the task under moderate stress than those who were trained under low or moderate stress. No significant difference as a function of practice type was found in performance scores, $F_{1,14} = .002$, $p < .962$, or increase scores, $F_{1,14}$

Table 2

Comparison of Practice Scores Across Nine Treatment Combinations

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Practice score	8	4.306	0.775	0.627
Error	36	5.556		
Total	44	5.328		

Table 3

Means and Standard Deviations for Practice, Performance and Increase Scores Across Groups

<u>Practice- Performance Conditions</u>	<u>Practice Scores</u>		<u>Performance Scores</u>		<u>Increase Scores</u>	
	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>
Low-Low	3.2	1.304	5.8	2.683	2.6	2.702
Low-Moderate	3.6	2.702	6.6	1.817	3.0	2.345
Low-High	2.4	0.548	5.4	1.140	3.0	1.000
Moderate-Low	2.4	2.408	4.8	0.837	2.4	1.817
Moderate-Moderate	2.8	2.280	5.0	5.263	2.2	3.362
Moderate-High	3.6	2.074	6.2	1.924	2.6	1.517
High-Low	1.7	1.304	4.2	2.074	2.5	2.168
High-Moderate	4.8	4.359	6.0	3.684	1.2	2.000
High-High	3.2	2.198	4.8	2.950	1.6	1.517

= 1.48, $p < .244$ (See Table 4). The results of this analysis do not support the first hypothesis.

The second hypothesis was that people who learned under high stress would perform more effectively than people who learned under low or moderate stress. There was no significant difference due to the type of practice on increase scores, $F_{2,42} = 1.04$, $p < .362$, or performance scores, $F_{2,42} = .35$, $p < .71$ (See Table 5).

The third hypothesis was that people who learn under high stress conditions are better able to increase their scores to meet the demands of a high stress situation than are people who learn under low stress. This was assessed by comparing the initial ability of each person (practice score) with his/her performance ability under high stress. Contrary to expectation, it was found that people who were trained under low stress were able to increase their scores significantly more than people trained under high stress conditions, $F_{1,18} = 4.99$, $p < .03$. Since the finding of a correlation between practice scores and performance scores had been made, the relationship was analyzed with practice scores as a covariate. There was a significant covariance, $F_{1,17} = 6.17$, $p < .02$, but the main effect of practice conditions with the effect of practice scores removed remained at a nearly statistically significant level, $F_{1,17} = 3.81$, $p < .06$ as is shown in Table 6.

A fourth hypothesis was that error scores would increase less under stress for subjects trained under high stress than for subjects trained under moderate or low stress. Error score was analyzed for correlations with either practice score, $r_{43} = -.17$, $p < .274$, or

Table 4

Comparison of Performance and Increase Scores for Students' Performance Under Moderate Stress Who Have Been Trained Under Low or Moderate Vs. High Stress

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Training effects on Performance Scores	1	.033	.002	.962
Error	13	14.069		
Total	14	13.067		

Training effects on Increase Scores	1	9.633	1.489	.244
Error	13	6.469		
Total	14	6.695		

Table 5

Comparison of Performance and Increase Scores Across Practice Stress Levels

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Training effects on Increase Scores	2	4.356	1.040	0.362
Error	42	4.187		
Total	44	4.195		

Training effects on Performance Scores	2	2.489	0.353	0.705
Error	42	7.054		
Total	44	6.846		

Table 6

Comparison of Increase Scores for Low vs. High Stress Practice
with Practice Scores Covaried

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Covariate Practice Scores	1	15.224	6.171	0.024
Increase Scores	1	9.389	3.806	0.068
Error	17	2.467		
Total	19	3.503		

performance score, $r_{43} = -.002$, $p < .991$. No significant correlation was found. Errors in the practice phase were found to be negatively correlated with increase in errors, $r_{43} = -.62$, $p < .001$. If McKinney's (1933) finding holds true that people performing under high stress are more likely to make errors, this correlation could artificially support the fourth hypothesis. Table 7 shows that an ANOVA found no significant difference in errors made during high stress conditions of practice as compared to moderate or low stress conditions, $F_{1,43} = .71$, $p < .31$. There was no significant difference in increase in errors as they performed under moderate or high stress for subjects trained under low or moderate stress compared to subjects trained under high stress (See Table 8).

In order to determine if there was an interaction between the level of practice and the level of performance, a factorial design performed. The factorial design (See Table 9) showed no main effects.

Table 7

Comparison of Practice Errors During Practice
Under High Stress Vs. Low or Moderate Stress

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Practice errors	1	0.711	1.077	0.305
Error	43	0.660		
Total	44	0.662		

Table 8

Comparison of Error Increase During Moderate or High Stress Performance for Subjects
Trained Under Low or Moderate Stress Vs. High Stress

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Error Increase	1	0.267	0.240	0.628
Error	28	1.111		
Total	29	1.082		



Table 9

Factorial Design of Differences in Performance Scores

	<u>Degrees of Freedom</u>	<u>Mean Square</u>	<u>F</u>	<u>Significance of F</u>
Practice Scores	2	3.89	0.8474	NS
Performance Scores	2	0.664	0.145	NS
Intergroup	4	3.386	0.737	
Within groups	36	4.590		

DISCUSSION

The hypothesis that people who are trained under high stress will be more efficient while performing under moderate stress than will people trained under low or moderate stress was not supported by the results of the present study. Contrary to the expectations of the inoculation against stress theory, people who learned under low stress were better able to increase their scores than people who learned under high stress and little support was found for any effect of different training phase stress levels on later performance.

Since no significant differences were found between treatment groups, the question must arise as to whether the subjects felt stressed. The crux of the question is whether the treatment conditions were actually different since the treatment itself was different levels of stress. The fact that there was a significant increase in scores for people trained under low stress versus people trained under high stress indicates that at least in those instances, there was indeed an effect due to treatment. The low stress subjects responded significantly more effectively when they were given instructions calculated to make them feel more stressed indicating that they perceived the second situation to be different from the first. Observation of the expressions on the subjects' faces and their audible gasps as they were given the instructions mentioning IQ in the high stress condition would also provide some anecdotal evidence that they were affected

by the different sets of instructions. Whether the feeling that was elicited was anxiety or anger is open to question. The subjects had "volunteered" for the experiment to fulfill a requirement for a class. They seemed to be aware and experimentally-sophisticated young people. (In one trial where the subjects had to verbally report their scores, one woman did outstandingly well. Another subject later said she had assumed that she was a confederate put there to make them feel more anxious.)

Motivation can complicate interpretation of any performance task. There seems to be no method to effectively equalize the motivation for any group of people performing any task short of life or death issues (which are frowned upon in experimental settings). Some subjects will always by virtue of their psychological makeup seek more strongly to please the examiner while others may fear failure or feel bored or enjoy and rise to the challenge of the task. The particular stress used in this study was chosen specifically for this student population where presumably a value is placed by most students on ability to solve problems. Threat of a public announcement of IQ is probably anxiety-arousing in most people, particularly in students who are currently making their living or at least preparing for their careers by competing in a context that requires them to use their minds. This threat in this particular population seems to be one of the more universal ones. Despite the care taken to choose a universal stress and groups of treatment conditions to help control for bias in the results, individual subject differences produced wide variability in scores which may have obscured any real treatment effects.

Another problem with motivation is in the varying degrees of interest different students may feel toward solving the block design tasks offered. Smock (1956) found that on simple or boring tasks, stress can increase efficiency by increasing motivation. This would be a possible explanation for the increase in scores for people trained under low stress over people trained under high stress when they performed under high stress. The people trained under low stress may have been somewhat bored by the task, but their efficiency increased when they felt more motivated to perform. This hypothesis can be checked by comparing the scores of the trained low-performed mild people and the trained mild-performed high people with the low-low and mild-mild people. There is approximately the same increase in stress for each group although it is merely an assumption that the mild stress condition was sufficient stress to increase motivation. No significant differences were found for these increases indicating that increased motivation was probably not a major factor in the increased scores. The other corollary of Smock's research was that high degrees of motivation or fear seemed to produce an impairment in performance. The U-shaped drive-to-performance relationship has been documented many times. Increased levels of drive produce increased performance until the optimum combination is reached. Thereafter increased drive results in decrement in performance. This might account for the trend in the data that indicated that people who learned the task under high stress performed more poorly under all conditions than people who learned under low or mild stress. The high stress in the learning phase may have impaired their ability to learn the task.

The amount of stress experienced by an individual is a function of the ratio between the subject's perception of possible harm and his assessment of his/her resources available to deal with the situation (Neufeld, 1976). In this experiment a task was used that was novel to all subjects to minimize the subject's ability to feel assured of his/her skill to deal with the task adequately. The possible harm was a threat to the subject's self-esteem if his score did not compare favorably with his peer's scores. The investment each subject had in comparing favorably on a block design task or an IQ task may have varied although care was taken to minimize the variability by choosing a task that would be relevant to the student's current life tasks of solving intellectual problems and taking tests. An additional attempt to assess the importance of the threat to these students was in the selection of the instructions to be used. The instructions were chosen from a list of instructions given in the prior semester to college students who were taking the same course the subjects in the present study would be taking. These students were asked to imagine how they would feel if given these instructions in the type of experimental situation they too had participated in that semester. The instructions chosen from their ratings showed little variability in the tendency for college students to interpret them idiosyncratically, therefore the possible threat would seem to be equally clear to most students. It would seem that the major differences may have been manifested in students' individual assessments of their own resources to cope with the threat. For example, the slight tendency for people trained under low stress to perform more effectively than people

trained under high stress might be explained by the opportunity during practice to become familiar with the designs, to feel successful in solving them since there were no demands in the low stress condition to perform well, and to therefore reassess their ability to handle the task successfully. If this speculation is correct, people trained under low stress may have been actually feeling less stress during high stress performance than people who practiced in a high stress situation. The high stress practice people had no opportunity to feel successful about their ability to handle the task well. They may therefore have felt much more stressed during the high stress performance than people who practiced under low stress. This hypothesis might have important implications for training people to function in stressful situations. It would seem to indicate that training people to master tasks under low stress decreases their perception of threat when a stressful situation arises.

Learning theory would seem to propose almost the opposite conclusion. The training of people under the condition in which they were to perform would seem to enable them to learn which strategies are successful in that situation and which are not. They would not need to make use of generalization to transfer their learning from one type of situation to another and so would seem better prepared to cope. The present study did not support this position. People who practiced under high stress were no more effective in performing under high stress than were people who practiced under low stress. For effective coping strategies to be learned, the adaptive responses must be reinforced and the maladaptive responses must not receive

reinforcement. People practicing under high stress did not seem to learn coping responses which would help them perform more effectively than people who had not before experienced high stress. Why were they unable to profit from their experience with the task? Were there no coping strategies that would help them deal with the task under high stress? Could one of the effects of high stress be to interfere with the reinforcement received by the subject or with his ability to profit from reinforcement?

Another necessary condition for experienced threat is experimenter credibility. The subject must believe that the threatened event will indeed take place even in the laboratory setting. In this study events were used that the experimenter had complete control over (requesting the reporting of scores out loud, giving IQ estimates). There was little reason for the subjects to believe that the threatened events would not occur.

The use of time pressure to induce stress has been shown to cause an increase of both errors and variability on the part of subjects (McKinney, 1933). Time pressure was part of the stress involved in this experiment. Both the high and moderate stress groups were asked to solve the problems as quickly as possible. There does not, however, seem to be any indication that in this instance, using time pressure in combination with a demand to perform accurately, there was any resulting increase in errors or intro-individual variability during high stress conditions. A possible explanation for the lack of error increase might be that although no request for speed was made in the low stress instructions, the experimental situation may have communicated

an implicit demand.

Another possible confound is that the present study used college freshmen and sophomores as subjects. The data was gathered near the beginning of the semester. Since students were required to take part in a certain number of experiments to supplement their test grades, timing of the selection may have introduced an uncontrolled bias. There was not random selection for all students in Psychology 101. The students who participated in this experiment were people who chose to begin collecting credits early in the semester. Is there a difference between students who sign up for experiments early in the semester and those who wait until the last few weeks? Are these students more achievement oriented, more compliant to the demands of authority or more anxious than most students? These questions cannot be answered at this time. A speculation on the effect of the bias might be that these students are more concerned than average about their grades and might therefore be more susceptible to the stress of this experiment.

A further challenge to the design of this study was the artificiality of the timing for both the learning and the performance parts of the experiment. Subjects had a very few minutes to practice a completely new task. They were then almost immediately required to perform it. The contrast-context effects of this timing may have obscured any real differences. The students may not have had enough temporal distance from the first set of instructions to be able to respond to the second set of instructions as a separate situation.

Another effect of the short practice time might be to increase

the ability of the subject to perform under high stress. One of Selye's (1961) stages in his General Adaptation Syndrome is the resistance phase. In this phase the subject responds to the threat by increased efficiency, but as the subject begins to tire, the extra competence begins to disintegrate. The short duration of the practice and performance phases in this experiment would not allow for the dissipation of the resistance phase. The greater decrement in high stress performance for people trained in high stress versus people trained in low stress may in fact be an artifact of the low stress trained people being in the resistance phase while the people trained under high stress may be beginning to tire rather than any different learning due to type of practice. Although it is probable that people who had practiced under low stress were less tired after the practice period, it seems improbable to this researcher that 15 minutes of solving block design problems would be sufficient to significantly exhaust the subjects. Work cited by Cofer and Apply (1964) states that the initial effect of stress on performance is frequently to improve it. It seems more probable that the initial boost of the stress excitement had worn off for the High-High subjects during the performance period and this effect was the reason that the Low-High subjects performed more effectively. A study with longer periods of stress is needed to answer these questions. If the present study is repeated using a larger number of subjects and longer practice and performance times, it might be informative to compare the score for the first half of the testing period with the score for the second half to see if the decay predicted by Cofer and Apply does indeed take place.

The optimal method for inducing stress in a laboratory depends upon the situation in which the theory is being used and the types of stress likely to be encountered in that situation. This specificity of types of stress leads to experimental difficulties. To test the applicability of the inoculation against stress theory as it is used in military training would require measuring combat stress. Measuring stress during combat training would not be difficult, but obtaining performance scores on a field of battle seems almost impossible and simulated battlefields have been shown to be ineffective (Berkum, 1962). As was mentioned before, in spite of the use of live ammunition during training exercises, soldiers did not feel significantly threatened since they knew they were participating in an experiment and they trusted that the experimenters would not endanger them. To use subjects in an experiment without their knowledge violates ethical considerations and letting them know it is an experiment reduces stress.

A more realistic inducement of stress to test the hypothesis as it might be used in university training programs might include with the threat of loss of self-esteem, fear of failure (washout of program) and sensory overload (excessive amount of material to learn in a short amount of time). An accessible experiment to test the hypothesis in this connection might be to compare performance of two groups of graduate students who have prepared for qualifying exams by either studying an extensive reading list to be tested in two days of essay written exams or who have written papers or taken a series of smaller exams on the same material. Each student will be relatively equally motivated if the consequences of failure are the same for both types of

examinations. Consequences of failure should be comparable for all students although there may be individual differences in appraisal of threat due to differences in students' beliefs about their coping resources. Although experimental random assignment of students to treatment types is not practical or ethical, a change in school catalogue is not uncommon in which one year's class is under one system and the next year's class is under the new catalogue. There seems to be little reason to believe that one class will be very dissimilar from the next barring major changes in selection procedures. A few months after the exam, the students could be required to take another exam to compete for assistantships available. If this exam is not already part of the method used in the program to determine the assignment of a limited number of assistantships, the researchers would, of course, have to develop another method of examination for which the students would be motivated to do well. It would be interesting to see which group of students retained more of the material and was able to express it on the test. This design would encompass a much longer time span than the current study and would give the subjects time to habituate to the stressful learning situation. It could test the effects of learning for a series of performances under moderate stress versus learning for a single performance under high stress when later performance is to be under high stress (competing for funding). The assumption here (mostly from personal experience) is that the possibility of failing a test over a small amount of material is less stressful than is the possibility of failure on a test over a large amount of material. To this researcher, the writing of papers to satisfy a

criteria seems the least stressful of all ways of satisfying it. Objective evaluation of this assumption should probably be done before this experiment is attempted.

Another experiment using the natural stress of qualifying examinations might be to ask students prior to their exam (while they were under stress) to learn a task or a piece of material. They could then be compared with students learning the same material while not under stress or the same subjects could be asked to learn a similar piece of material after qualifying exams when they were no longer under stress. Using this model would eliminate the need to determine which method of giving qualifying exams is most stressful, but it would also be less germane to gaining information on designing training programs. An added problem with this design would be motivating students preparing for qualifying exams to learn an added piece of material, although that might be somewhat handled by using material already assigned in another class.

The inoculation against stress theory as it is practiced in the armed forces and in many graduate training programs consists of immersing the subjects in conditions of high stress to better prepare them to deal with stressful conditions in the future. No evidence was obtained in this study to support this interpretation. In fact, the trends in the data seemed to indicate that people trained under high stress did less well than people trained under low or moderate stress. As Selye (1961) spoke of his stress experiments using physiological stresses, he said that gradually increasing the level of hormone enabled his rats to gradually build up a tolerance to it. The corollate to this theory

would require that training programs begin with low levels of stress and gradually increase the "dose."

In a behavioral context, the questions might be the relative efficacy of flooding versus desensitization. Flooding is "exposing a subject to anxiety-provoking stimulus while preventing the occurrence of avoidance responses" (Rimm & Masters, 1974, p. 348). The subject is thrown into a high stress situation and is required to function there. Since he cannot escape, he learns to cope. Once one has learned to cope with high stress, he will no longer find it as anxiety-arousing as he did previously. Desensitization or more accurately, graduated extinction, since no competing response of relaxation is specifically reinforced, would involve exposure of the subject to low levels of stress, gradually increasing the stress so the subject finds himself able to cope with increasing levels of stress while not being overwhelmed. Behaviorists have found that "the results of studies concerned with the effectiveness of . . .flooding/response prevention are quite mixed, and the studies themselves tend generally to be so methodology-poor as to be inconclusive" (Morganstern, 1972, p. 331). Evidence seems to point strongly to the fact that desensitization does decrease anxiety and avoidance behavior in the face of the stimulus (Davison, 1968; Fenichel, 1945; Lang & Lazovik, 1963; Lang, Lazovik, & Reynolds, 1965). Mixed results have been the outcome of experimental attempts to compare desensitization with flooding on phobic patients. Strahley (1965) found flooding to be more effective than desensitization. Brock (1967) found no difference. DeMoor (1970) found both to be effective, but desensitization produced better results

at a later follow-up. All of these studies lack a no-treatment control group. It seems that the behavior theorists cannot answer the question of a gradual versus sudden exposure to stress for us either.

Further research in this area is needed to evaluate the inoculation against stress hypothesis. While no firm conclusion can be drawn, due to the short duration of the intense stress and the probable context effects, still, indications from this study are that learning under low stress might be more effective than learning under high stress when the subject will be required to perform a reasoning task under high stress.

SUMMARY

This study was an attempt to assess the effect of levels of stress while learning a complex reasoning task on performance of that task under stress. There were four primary hypotheses to be explored in this study. The first hypothesis was that students who learned the task under high stress would be more effective performing it under mild stress than students who learned under low or mild stress. A second hypothesis was that students who learned under high stress would be more effective under all performance conditions than students who learned under mild or low stress. The third hypothesis was that students who trained under high stress would habituate to high stress and therefore be better able to increase their scores to meet the demands of a high stress performance situation than would people who were trained under low stress and had no prior experience with high stress. The final hypothesis was that students trained under high stress would be less likely to increase their errors when performing under high stress than students with no prior training experience and high stress situations.

A randomized block design was used in which 45 undergraduate students learned to solve block design tasks under low, moderate, or high stress and then performed under a different stress level. Stress was induced by a series of verbal instructions that had been previously rated by another group of students as stress producing. Differences

in performance scores, error rates, and amount of increase from practice to performance were analyzed.

No significant differences were found to support the hypotheses. In fact, the trend seemed to be for people who were trained under low stress to perform more effectively than any other group. One possible explanation for these findings might be that people who had had success experiences with the low stress condition might not have been as anxious under the high stress instructions and were thereby able to perform effectively.

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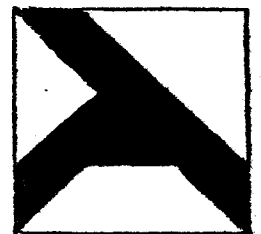
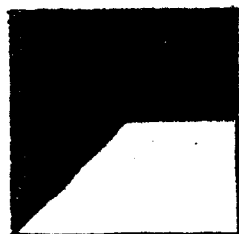
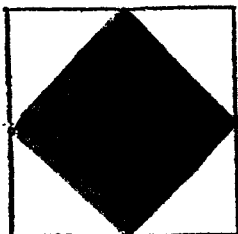
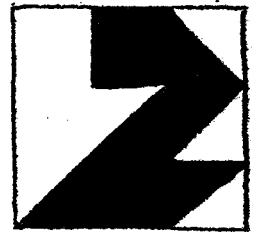
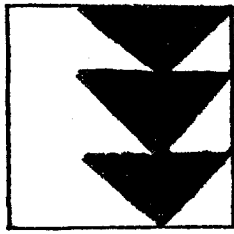
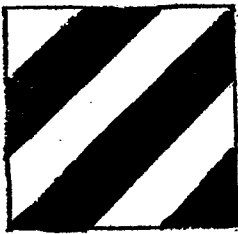
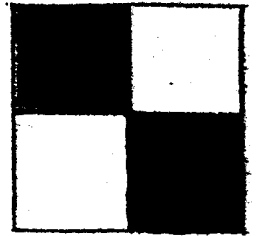
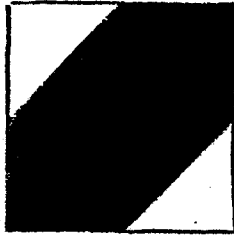
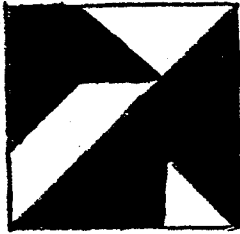
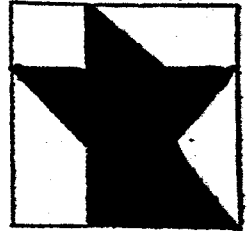
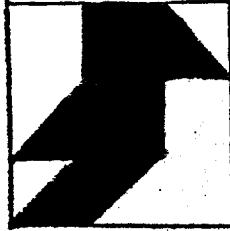
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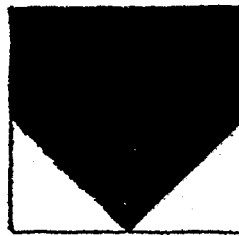
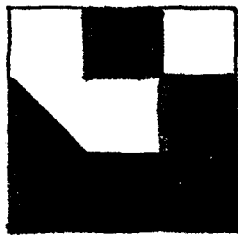
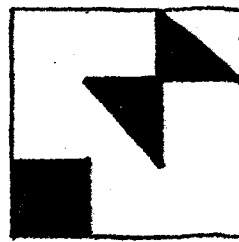
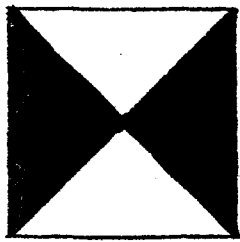
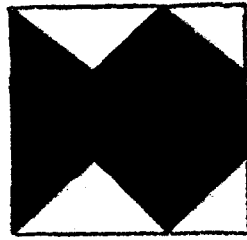
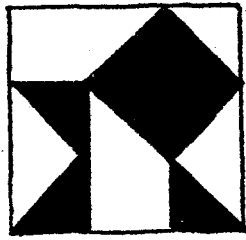
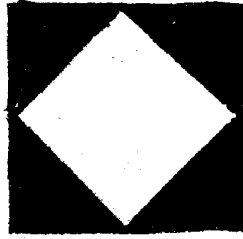
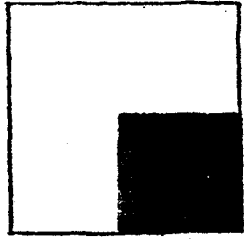
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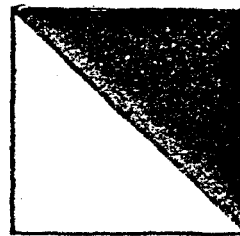
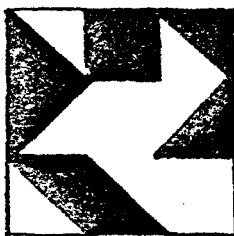
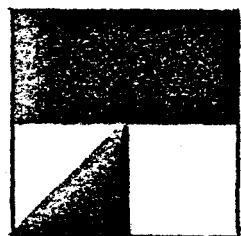
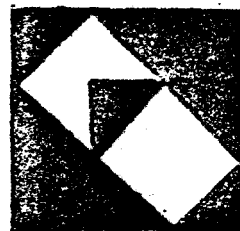
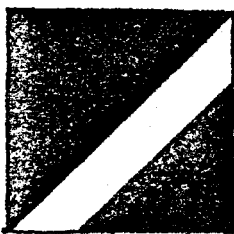
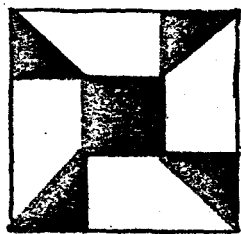
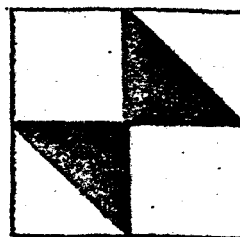
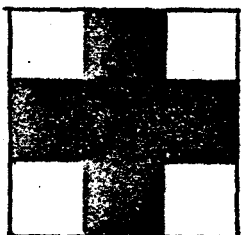
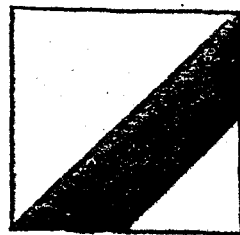
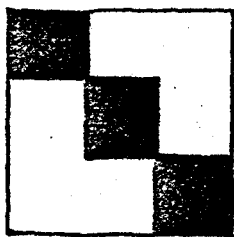
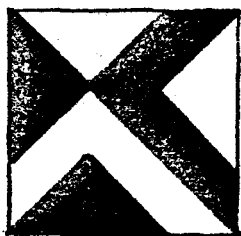
APPENDIX A

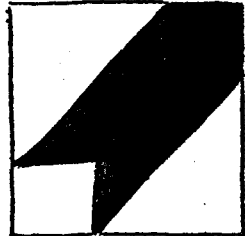
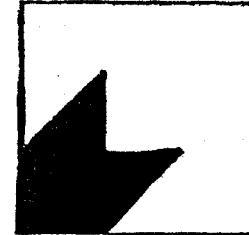
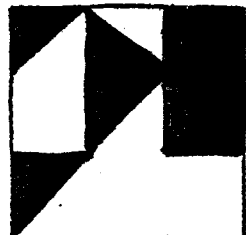
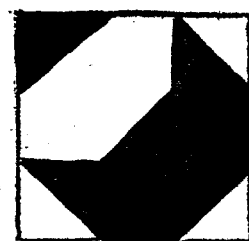
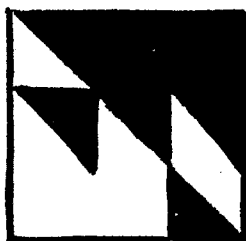
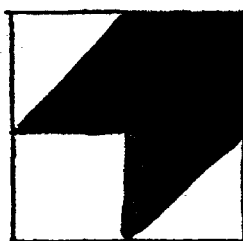
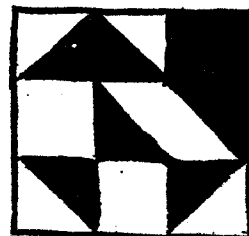
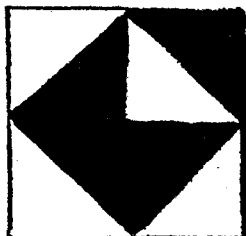
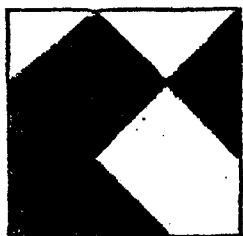
Practice Designs





Performance Designs





APPROVAL SHEET

The thesis submitted by Penelope Burdette has been read and approved by the following committee:

Dr. Alan DeWolfe, Director
Professor, Psychology, Loyola

Dr. James E. Johnson
Associate Professor, Psychology, Loyola

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 by the Committee with reference to content and form.

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

Date

7/14/78

Director's Signature

Alan S. DeWolfe