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## An Investigation of the Effects of Experimentally Induced Stress upon Figure Rotations

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AN INVESTIGATION OF THE EFFECTS OF EXPERIMENTALLY  
INDUCED STRESS UPON FIGURE ROTATIONS

by

Edward Wittert

A Dissertation Submitted to the Faculty of the Graduate School  
of Loyola University in Partial Fulfillment of  
the Requirements for the Degree of  
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## LIFE

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## CHAPTER I

### THE PURPOSE

Stress is an inevitable part of the human condition and the manner in which it is responded to and handled determines in large part whether it will facilitate constructive behavior or result in maladaptive performance decrements. Some of the recent studies of emergency psychotherapy and crisis intervention therapy point to some different meanings of the concept of stress. Rappaport (1962) notes the lay concept of stress as disaster and adds that stress is commonly interpreted as a stressful event or situation, and/or a stressful stimulus. Stress, in common parlance, has a negative connotation --- it is a burden under which a person either survives or falls apart. Volhard (1951) cites the "growth-promoting potential" of stressful crisis states, noting that the stress of a crisis is a catalyst that shakes up old habits, elicits new responses and is a major force in directing and leading to new developments. Under stress, new coping mechanisms can arise that serve to strengthen adaptations.

The literature is full of studies of stress upon different kinds of functioning, i.e., psychomotor, perceptual, intellectual, learning, etc. In a review of the literature on the effects of psychological stress on performance, Lazarus, Deese and Osler (1952) comment that the overall findings suggest that stress produces performance decrements on comparatively complex tasks and facilitates performance on simple tasks. In a later survey of the literature dealing with cognitive behavior under stress, Zaidi (1959) notes that the researchers demonstrated (not always conclusively) that under stress-

inducing conflicts, the organism sooner or later exhibits disorganized behavior of some degree and intensity. Child (1954), in a review of the literature, notes that in general the research findings show that as tasks become more complex, high-anxious subjects show increasingly poorer performance than low-anxious subjects. It is apparent that if we are to effectively study the effects of stress on human organisms, we shall have to continue to aim at scientific investigations of smaller aspects of behavior under stress, for our current understanding of stress is far from complete. Moreover, as Funkenstein et al (1957) note, it is important to study healthy individuals. The authors comment that most studies of stress have examined disturbed individuals, and the knowledge gained thereby has been obtained primarily from disordered processes in sick people. To understand the manner in which people react to threat, however, the authors maintain that the variability in performance among healthy people should be studied.

Lazarus, Baker, Braverman and Mayer (1957) note that stress involves the thwarting of a motive and its occurrence depends in part upon an individual's motivational characteristics. In a recent publication, Lazarus (1966) infers the presence of stress from reports of disturbed affects, motor-behavioral reactions, changes in adequacy of cognitive functioning and physiological changes. Reality can be misinterpreted as a reflection of impaired cognitive activity in the attempt to cope. According to Lazarus, the key intervening variable in psychological stress analysis is the concept of threat which is characterized by the anticipation of future harm and is dependent upon cognitions; as the degree of threat increases, the coping processes become more primitive.

Lazarus (1966) and Easterbrook (1959) indicate some of the research findings which show how anxiety, as a response to threat, interferes with

normal cognitive functioning. The cognitive disturbance under threat takes the form of a narrowing or a limiting of the perceptual field. According to Lazarus (1966), the inadequate performance comes not from the intervention of emotions directly into thought processes, but instead the threat unbalances the psychological system of motives, beliefs, abilities, appraisal of stimuli, etc. Thus, the "emotion" does not cause the trouble; the real cause is the recognition of the threat and the subsequent cognitions that come before the effort to cope with it. The psychological processes of stress are cognitive and depend upon appraisal. Cognitive processes exist before the emotion and the individual is inclined to interpret situations in particular ways because of a given cognitive structure.

There are three main explanations of cognitive performance under stress: drive interpretations (Spence, 1958) which assume that drive multiplies strengths of all habits including those related to task performance, and high anxiety thus increases the strength of both correct and incorrect responses; interference interpretations (Child and Waterhouse, 1952), which maintain that anxiety interferes with those responses necessary for effective task performance; and reduction of cue utilization interpretations (Easterbrook, 1959) which describe a narrowing of attention and the perceptual field ---- on some tasks a reduction of cues improves performance because irrelevant cues are excluded, on others it impairs performance because it excludes cues necessary to successful task performance.

The present study attempts to utilize a clinical assessment technique (the Minnesota Percepto Diagnostic Test) to experimentally study a behavior (rotational behavior) which is hypothesized from the foregoing to be influenced by a personality state of anxiety. A pilot study conducted earlier by



the author (see appendix) suggested that figure rotation anomalies do occur under stress in a non-psychiatric population. In this study, anxiety is defined as a state, not a trait, i.e., it is not a characteristic the subject carries around with him or a disposition to react in a certain way to a variety of situations. It is instead a response to a given set of stress-inducing conditions as defined in the study. Lazarus (1966) makes the point that much of the research on stress does not make it clear that the response occurs to known stimulus conditions and therefore is probably determined by those conditions.

This study investigates how normal individuals respond in an attempt to adjust to a visual field. By attempting to quantify the data, the hope is to add some information to the study of perceptual processes with normals so as to better understand and more validly apply a specific clinical tool involved in the evaluation of abnormal personality.

To the writer's knowledge, there is no published research on rotational anomalies among non-psychiatric populations. As will be reviewed in detail later, most of the investigations obtaining significant results use "labeled" psychiatric groups as the experimental group and a nonpsychiatric, "normal" control group. As a consequence, rotational phenomena are routinely regarded as a serious pathological indicator of one degree and type or another. No studies, to the writer's knowledge, have investigated whether rotational phenomena can occur among a normal adult population under specified conditions. If indeed they can occur under certain conditions, clinicians would then do well to examine all the conditions under which a rotational anomaly was observed in clinical practice. If it could be shown that rotations do not significantly occur in nonpsychiatric groups, then the presence of rotations in

test protocols could confidently be taken to indicate the presence of psychopathology.

Previous research discusses the phenomena of figure rotations utilizing almost exclusively the Bender-Gestalt test with children and few adults, without controlling for rotational artifacts, using scoring systems of doubtful reliability, and making interpretations on the basis of quantified subjective judgments. This study attempts to correct for these omissions by utilizing a well-standardized, objectively scored, rigidly administered measure of proven reliability to investigate the relationship of stress to rotational behavior. Moreover, this study attempts to avoid what this investigator and others regard as methodological deficiencies of many other studies of perceptual processes that deliberately use ambiguous stimuli and/or very quick exposure times which themselves can influence the results in an unwanted fashion.

To summarize the purpose of this study, then, it is hypothesized that normal subjects under two kinds of stress, i.e., high ego involvement and difficult tasks, will become sufficiently disorganized so as to rotate figure patterns significantly more as compared to non-stressed control group. The interaction effects of the two aspects of stress, i.e., ego involvement and task difficulty will also be investigated.

There is one other aspect to the study. Bender (1952) has noted that schizophrenic children rotate rhythmically, almost as if the figures on the horizontal plane tend to be "pulled" around into a vertical figure. Werner and Wapner (1954), in a more theoretically refined statement of this behavior, maintain that "visual directional dynamics" exist as behaviorally measured events and have demonstrated the effects of visual dynamics inherent in

figures with respect to their position in reference to the apparent median plane. According to these authors, visual dynamics affect the equilibril state of the organism and "pull" the organism in the direction of the dynamics, a "pull" that is counteracted by an organismic pull in the opposite direction.

According to their sensory-tonic theory, the low-stress subjects, not being in a state of disequilibria, would be less subject to "pull" because they could more effectively differentiate between their own bodies, the figure and the ground, and therefore better follow the test instructions. High-stress subjects, on the other hand, already in a state of disequilibria, should be more affected by the pull of visual dynamics and should rotate not only quantitatively more but consistently in the direction of how they perceive the pull of the stimulus. Their rotations should have more of a vectorial character. It is therefore hypothesized that, according to sensory-tonic theory, high-stress rotators will not only rotate both significantly more than their control counterparts, as hypothesized previously, but also in the same direction. That is, it is also hypothesized that the vectorial "pull" of the figures themselves will result in rotations in the same direction.

## CHAPTER II

### REVIEW OF THE RELATED LITERATURE

#### Perceptual Psychopathology and Perception under Stress.

Shagass (1965) notes that the neurophysiological correlates of perception are at rather primitive levels. He states that while the visual afferent system is essential for vision, it is not the sum total of visual experience and that we still do not know very much about coding, decoding, information correlation and information utilization processes involved in perception. He takes note of newer motivational approaches to perception which imply that the stimulus interacts with the pre-existing neural state and is influenced by the personality, prior experience and feelings of the perceiver. His own experiments on cerebral responsiveness to sensory stimulation showed that a cortical response is a necessary but not sufficient condition for sensory awareness and found a significant difference in cortical response amplitude between "patients" and "non-patients." He demonstrated physiological changes accompanying psychopathology and found physiological differences between the groups with the same stimuli.

Outlining phenomenological theory, Snygg and Combs (1949) comment that the effect of a person's perception of a threat to self is to reduce his perceptual field to the area of the perceived threat. When the perceptual field is narrowed, the person is unable to select more adequate behavior from the field. According to the authors, this has relevance to constrictive defenses and inadequate psychological adjustments; therapy allegedly reduces the threat and allows the person to discover new and better perceptions about himself

and his relationship to the world. In a similar vein, Janis (1962) comments that when fear is intense, indiscriminate attention occurs as characterized by decreased mental efficiency and regressive thought processes involving poor discrimination. Postman and Bruner (1948) also find that, under stress, perceptual behavior is disrupted, disintegrated, reckless, less adaptive and less well-controlled.

Several studies specifically investigated relationships between stress, needs and perception. Combs and Taylor (1952) found that threat sentences took longer to code than neutral sentences and concluded that the effect of threat is to restrict perception to the field of threat. Schwab and Iverson (1964), using the IPAT Anxiety Scale, examined the effect of anxiety upon recognition of deviations from typically perceived visual patterns. They hypothesized that since high anxious subjects tend to persevere along expected lines they will be more resistant to perceiving figural distortions. This was borne out. The high-anxious subjects' ability to shift from familiar to less familiar figures was retarded. One interpretation made was that high-anxious subjects tend to feel more secure with more stable and secure figures.

Hare (1963) found that when estimated time intervals were followed by shock they tended to be overestimated to a greater degree than when no shock was given. This is an illustration of findings in general that increased anxiety leads to greater overestimation of short temporal intervals. It is hypothesized that anxiety may increase the number of experienced stimuli so as to increase estimated time interval. Kohn (1954) studied recall of details from pictures and stories under varying degrees of induced stress and concluded that emotional stress reduces the scope of complex perceptual

activity. Jenkins (1957) showed that the size of valued objects is perceptually accentuated. A narrowing of attention associated with an emotional component can influence the estimation; the "ground" effects are reduced as the stimulus becomes central. A somewhat similar study with animal subjects was performed by Klein (1957); errors in estimation of sizes of experimental stimuli were increased in groups of thirsty rats compared to the control group. Calloway and Thompson (1958) found that in matching size of objects, subjects made objects larger when one foot was in ice water or when following inhalation of amyl nitrate. The authors infer a decrease in awareness and reactivity under sympathetic discharge leading to a reduction of reaction to distance cues.

Wall and Guthrie (1959) obtained visual thresholds for words connoting "success" and "failure," and "security" and "insecurity" from students under threat of dismissal for poor scholarship. They found a negative correlation between academic success and visual thresholds of words connoting failure, and a negligible correlation between success words and academic success. Academic success was positively related to ease of seeing "failure" words and, to a lesser extent, to seeing "insecurity" words. The hypothesis was confirmed that those who showed high thresholds to "failure" words do less well academically. The authors conclude that anxiety interferes with perceptual processes (the higher thresholds for "failure" words is a defensive pattern) and thus interferes, too, with scholastic success.

#### Cue Utilization, Drive and Interference Hypotheses.

Eriksen (1965) comments that the major contribution of the studies on need and perception is probably the methodology in eliciting and measuring

ego defensive activity under threat. What actually happens, however, is still largely unclear because of the conceptual crudity and technical methodological deficiencies. One major theoretical proposal involves the effectiveness and efficiency of cue utilization. The generalization is made that the number of cues utilized in a given situation tends to decrease with an increase in emotion. It is hypothesized that emotions thus tend to reduce the amount of information in use at any one time and that the field of attention becomes narrower in emotionally disturbed subjects. In short, the perceptual field is reduced.

Easterbrook (1959) has reviewed the evidence in support of the hypothesis that diminished cue utilization ability results in perceptual distortion. Bursill (1958), Calloway and Thompson (1953), Combs and Taylor (1952), and Beier (1951) have shown that the range of cue utilization shrinks under stress as a result of shrinkage of the perceptual field. How anxiety impairs the use of cues has been demonstrated by Basowitz, Persky, Korchin and Grinker (1955), Moffitt and Stagner (1956), Granger (1957), Stater and Stater (1944), and Eysenck (1948), who discovered impaired night vision among neurotics. Eysenck and Granger (1957) later performed a series of experiments on perceptual processes and mental illness; they found that neurotic and psychotic subjects were slower in three dimensional perception and also scored lower on visual acuity.

Increased stimulus generalization under emotion was demonstrated by Eriksen (1954), Kamin, Bendra, Clark and Wakesberg (1955), and Rosenbaum (1953 and 1954). The phenomenon of "perceptual defense," i.e., emotional reactions occurring before recognition, interfering with the perceptual process and resulting in increased recognition duration thresholds, have been

investigated by Davis (1958), Postman and Bruner (1948), Rockett (1956), Eriksen and Browne (1956), Hochberg and Brooks (1958) and Rosen (1954). Calloway and Dembe (1958), in reviewing the literature, found a correlation between narrowed attention and central sympathomimetic activity, particularly in the reticular system. Using drugs instead of inducing stress to narrow attention, they hoped to more specifically isolate some physiological correlates of narrowed attention. They conclude that the changes in attention possibly reflect underlying neurological change, specifically that certain changes in the reticular formation may be related to changes in the focus of attention.

From the foregoing, it is seen that the proponents of the "cue utilization" hypothesis suggest that "drive," as used in the Hullian experiments, results in attention-narrowing rather than increased competition of responses. An increase of anxiety therefore leads to reduction in range of cue utilizations. Easterbrook (1959) attempts to bridge the two positions as follows: the facilitation or disruption of behavior by emotion depends upon the complexity of the behavior and the range of cue utilization available to the person; as cue reduction takes place, task irrelevant cues are reduced first, then task relevant cues.

Spence (1958) however, adheres rather strictly to the "competing response" hypothesis that anxiety acts as a drive stimulus to behavior. In brief, it is hypothesized that in simple conditioning tasks drive differences combine with the habit strength of the dominant response in an individual's hierarchy of responses to raise and strengthen the excitatory potential. In more complex tasks involving more than one dominating response, anxiety raises the response strengths for all responses in the response hierarchy



and the probability of the right response being made is reduced. Anxiety is thus negatively related to performance because the more competing responses, the more interference there will be. A representative study partially supporting this hypothesis in the area of perception was performed by Saltz and Rioch (1961). Investigating the effects of stress upon previously acquired differentiations, the authors introduced electric shock and found performance decrements, particularly with originally low-level performers. The results were interpreted as supporting the Hullian Drive theory, i.e., stress had a detrimental effect upon performance because the incorrect responses had a high hierarchal position as a function of anxiety.

Child and Waterhouse (1952) advocate still a third explanation of performance decrements under stress, i.e., the "interference" hypothesis. Their hypothesis is perhaps best illustrated in their criticism of the Barker, Dembo and Lewin (1941) experiments. Child and Waterhouse interpret from the fact that most of the children showed a lower "constructiveness" of play in the frustration situation than in the free-play situation to simply mean that frustration of one activity produces a lower quality of performance in the second activity because frustration leads to interfering responses incompatible with the responses of the second activity. Whereas Barker, Dembo and Lewin interpreted the performance decrement as "regression," Child and Waterhouse employ the "interference" explanation. They maintain that frustration implies the individual has not reached his goal and keeps attempting to reach it through responses which necessarily interfere with the second and different activity. Also, that responses are evoked by the very nature of frustration itself, i.e., anxiety, anger, aggression, attempts at self-justification and/or escape, etc. These latter responses, too, can interfere

with effective performance in the second activity.

#### The Work of Witkin and his Co-Workers.

Witkin (1948) became interested in the perception of the upright. He first hypothesized that individuals orient themselves according to kinesthetic experience and the visual field, i.e., seeing and feeling. In one of his first experiments he separated the gravitational standard of the upright from the standard of the visual field by using a tilting chair and studied individuals' perception of straightness apart from their own bodies. He found that individuals differed considerably in the manner in which they perceived the upright to the extent that it was difficult to generalize about the perception of the upright in any experimental group. He assumed that these marked differences in spatial orientation must come from differences in the characteristics of the perceivers. Further reported research (1954) developed this idea. Witkin divided people into field-dependent and field-independent groups; in the former group, perceptions are thought to be dominated by background influences and, in the latter group, there exists a stronger capacity to differentiate objects from their background.

Witkin (1962) also has found that children are more field dependent early in perceptual development and tend to become less so as they grow up. He has formulated a differentiation hypothesis: with increased development the individual is better able to distinguish the separateness of objects, is able to perceive objects as separate from their backgrounds, and in general is able to better structure experience.

The relevance of Witkin's work to the present study is that through his investigation of the process of orientation toward the upright in space,

he demonstrated that orientation involves using a frame of reference, that perceptual errors vary according to the amount of information obtained from surroundings, that perceptions of a field are functions of visual directional cues, and that individuals tend to adjust their bodies to the vertical or adjust the visual field to the vertical when not otherwise restricted.

### Sensory-Tonic Theory.

Wapner and his co-workers (1951) have also maintained that visual processes are not isolated events and that states of the perceiver are important factors in perceptual organization. The basis of sensory tonic field theory of perception is that the state of the organism is a crucial part of perceptual events, that perception is the result of interaction between the stimulus and the state of the organism. The theory states that with change in the state of the perceiver, a change in perception is expected and that even if the stimulus is visual its perception will be affected by stimulation coming from non-visual sources. In support of these contentions, they showed that extraneous electrical stimulation to the neck and extraneous auditory stimulation significantly affected perception of verticality. Their experiments on perceptual organization in space (Werner and Wapner, 1949) demonstrated that body tonus (referring to organismic tension, motion and posture) interacts with sensory factors and affects spatial orientation. Wapner and his co-workers (1951) also showed that visual perception is significantly affected by rotation around the subject's vertical axis and that such rotation induced shifts in otherwise stable stimulus objects.

According to Werner and Wapner (1952), the sensory-tonic field theory of perception attempts to account for both psychophysical facts and those

discovered by clinical and social scientists, i.e., shows how visual and personal factors are not mutually exclusive but tend to interact. Because any stimulation affects muscular tonus it is sensory tonic in nature. So the stimulus arouses not just the retina and other visual areas but the total organism.

Using ambiguous stimulus patterns and flashing luminous silhouettes, Werner and Wapner (1954) tried to demonstrate the existence of visual "directional dynamics" that "pull" the organism in the direction of the dynamics; this "pull" is counteracted by an organismic pull in the opposite direction. Wapner (1964) further describes directional dynamics as the vectorial quality projected by some objects, i.e., qualities of direction and force. Using ambiguous, dimly illuminated stimulus objects in a completely dark room, he found that the physical position of the apparent median plane shifted in the direction opposite to the directional dynamics of the stimulus object. The hypothesis is that the visual dynamics of the stimulus object affects the state of equilibrium of the organism by exerting a pull which is in turn counteracted by an organismic pull in the opposite direction.

#### Figure Rotations.

First, some comments about figure-ground perception in general seem in order. Wertheimer (1923) first began working with specific visual patterns in order to study Gestalt principles of perceptual organization. Woodworth (1938) summarizes some of Wertheimer's factors that determine "grouping" behavior as follows: nearness or proximity, sameness or similarity, common fate (movement in the same direction), continuity, symmetry and balance, conformity with the individual's momentary set and the individual's past

experience.

Koffka (1935) utilizes the concept of figure and ground as important to Gestalt theory. According to him, the "goodness" of a configuration depends heavily upon "internal forces," i.e., continuity, completion and closure. He maintains a figure's characteristics depend upon the setting in which it is perceived. The more congruent the figure and ground, the more stable the figure.

Allport (1955) comments that figures stand out against ground and that figural elements cluster according to organizing and unifying effects. Perception takes place through the interrelationships within wholes; nothing ever occurs by itself but is influenced by the parts. More recently Graham (1965) comments that the field of perception of forms is complex and lacks a cohesive theoretical framework. He defines ambiguous figures as "stimuli ... grouped in such a way as to provide equal (or nearly equal) probabilities of eliciting two different responses" (p. 503). Vernon (1937) notes that a visual perceptual field is organized into two parts, figure and ground, and perception consists in the emergence of the figure from the ground. He differentiates figure from ground as follows: "figure" has form, structure, solidness, surface color, may appear to stand out in front and its structure comes from its contour. The "ground", on the other hand, has no form, is ill-defined and is unaffected by the figure's contour.

Goldstein and Scheerer (1941) were among the first to adapt Gestalt figure-ground observation to the study of the abnormal personality. From their experiments with subjects copying colored cube designs, they conclude that abnormal personalities have less distinct appreciation of figure-ground relationships based upon a lessened ability to generalize and abstract.

Abnormal subjects have greater difficulty grasping principles underlying visual cues. They maintain that the less integrated the personality, the less definite and less stable the perceptions; conversely, they assume that if the perception is unstable or disturbed, so might be the personality according to the degree of the perceptual distortion.

There have been a number of studies relating figure rotation distortions to different psychopathological groups. Bender (1938), using nine of Wertheimer's original patterns, found that rotational tendencies exist in various psychopathological and organic conditions. Griffith and Taylor (1960) found that clinical groups within one neuropsychiatric hospital tended to rotate, but they used only test files or the psychology service of a neuropsychiatric hospital without a control group; from this the authors conclude that Bender-Gestalt rotations are of clinical diagnostic significance. Hanvik and Anderson (1950) found that brain damaged patients rotated more than did a control group whose presenting complaint on admission was low back pain. Silverstein and Mohan (1962) obtained statistics on the incidence of Bender-Gestalt rotations in a hospital for mentally retarded persons and found that 40-50 per cent of the patients had at least one rotation (defined as 45 degrees or more). Byrd (1956) attempted to establish test factors differentiating children needing psychotherapy from well adjusted children and found that a rotation of more than 15 degrees significantly discriminated between the groups; well adjusted children showed significantly less rotation. Clawson (1959) found that both school and clinic children evidenced at least some amount of severe rotation (90 to 180 degrees) but differed significantly on small rotations (15 degrees). She mentions that small rotations thus may have greater diagnostic value but no hypothesis was formulated. Koppitz (1958)

found that rotation was one scoring category differentiating between good and poor students and hypothesized that either immaturity or loss of control due to confusion or regression accounts for rotational difficulties. Bender (1952) mentions that schizophrenic children exhibit tendencies to rotate. She hypothesizes that the bound areas of perceptual patterns are weakened rhythmically and therefore so is their relationship to the background. Figures on a horizontal plane tend to be pulled around into vertical figures. Halpin (1955) found no rotational differences between brain injured and matched normal children, but her definition of rotation seemed excessively severe (90 degrees).

The developmental pattern of rotational behavior has been studied by Fabian (1945). The tendency to rotate horizontal configurations to the vertical position is present in normal pre-schoolers and those beginning school. Its occurrence lessens with maturity and disappears at 7-8 years. Persistence of rotational behavior, according to Fabian, can indicate mental deficiency or organic brain dysfunction; also, he hypothesizes that infantile behavior patterns can inhibit the learning process and can be revealed by regressive visual-motor tendencies such as rotation.

In accounting for the significant differences in rotation between groups of normal, neurotic and schizophrenic children, Fuller and Chagnon (1962) suggest that the more emotionally disturbed an individual is, the less likely he can use necessary cues to avoid rotation. Both availability of cues and figure ground orientation can operate to produce rotation. Their results suggest that the more emotionally disturbed, excited or aroused a child is, the less he is able to perceive cues necessary to avoid rotation. In another study using schizophrenic children, Fuller (1965) found that

schizophrenic children rotated more than did the controls. He hypothesizes that stable individuals should be better able to ignore inappropriate cues, whereas the perceptions of disturbed individuals are influenced either by reduction in cue utilization and/or mis-interpretation and distortion of the available cues. He suggests a perceptual organizing process involving internalization and externalization of objects and maintains the function of a perceived object is to provide cues the individual uses in coping with the situation and satisfying his needs, and that the individual is dependent upon these cues. When external cues are diminished or are complex, inner resources significantly determine behavior; when inner resources are weak, inaccurate perceptions are reflected.

#### A Review of some Methodological Considerations of Figure Rotations and Stress Research.

In yet another paper, Fuller (1963) is quite critical about the experimentation on figure rotating. Hutt (1960) has already described the various ways rotation can occur; the design card may be rotated in reference to the paper, the paper may be rotated in reference to the design card, and the reproduction itself may be rotated even when card and paper are not. Fuller (1963) claims most if not all previous researchers failed to distinguish and control for the ways rotations can occur, failed to use consistent and reliable measurement methods and failed to develop a rationale for variations in rotations between different populations. It is therefore inappropriate to make inferences about rotations in different populations if it is not specified just how a rotation is produced. In short, failure to control for the way a rotation is produced reduces the significance of



rotations.

In support of the notion of stimulus variables causing rotation is a study by Williams et al. (1956). Using a Block Design Rotation Test, the authors studied the effects of symmetry, orientation of figure, orientation of ground and congruency of figure and ground, and they found that each could independently influence rotation. Similarly, Griffith and Taylor (1961) found that Bender-Gestalt rotations can be related to the fact that the card's long axis is oriented at 90 to the long axis of the paper. In other words, rotations can be caused by the subject orienting the design to the paper and thereby turning the design.

Hannah (1958) likewise tested the hypothesis that the way the stimulus is presented can influence rotations. He found that the group of patients oriented vertically to the designs produced fewer rotations than the control groups who were presented standard horizontal Bender-Gestalt cards. The implication strongly existed that more than just the design itself, i.e., figure-ground interaction, can cause rotations.

In an attempt to answer whether Bender-Gestalt reproductions were independent of particular motor techniques, McPherson and Pepin (1955) had subjects reproduce the designs both on paper and with felt on a felt board. Since the reproductions were not significantly different, the authors concluded that Bender-Gestalt reproductions are more influenced by covert perceptual responses than motor techniques.

Deese (1962) notes that the experimental design of stress research studies generally involves selecting subjects who have high anxiety potential by psychometric tests or selecting conditions which arouse a stress state in a representative sample of subjects. He notes that correlations between

such measures of personality and skilled behavior are small and sometimes contradictory. He suggests abandoning the concept of stress as a state of the individual and consider stress as a class of stimulus events, i.e., stressful situations or conditions which result in communicated discomfort or correlates of discomfort such as physiological measures.

Kurz (1964) doubts whether any one set of conditions can uniformly function as stressors. Investigating the effects of different stressors upon learning and performance, he concludes that the particular effects of stressors probably vary with the task and the manner in which the stressor is presented.

Berkun, Bialek, Kern and Yaki (1962) comment upon what may happen in an experimental study of stress. In investigating the effects of stress upon performance, one typically exposes the subjects to a hostile atmosphere and measures their response. However, defensive phenomena develop during the stage of inducing fear; the subjects rationalize that they would not be deliberately exposed to danger, that they were actually safe and that they were expected to act scared. This so-called "cognitive defense" is not usually examined, accounted for or controlled. The authors list four requirements for experimentally researching the effects of stress on performance: it is necessary to measure the performance of acts relevant to the stressful environment, and objective measurement of performance level must be obtained, it is necessary to allow for possible differences in effect of serious threats to life as compared with the effects of laboratory stresses, and the test-taking "set" or the experimenter-oriented motivation on the part of the subjects should be controlled. As an operational definition of stress, the authors advocate both a physiological response in conjunction with a performance measure where the distribution of scores of the experimental subjects

differs significantly from the distribution of comparable scores in the control group.

Witkin and his co-workers (1954) take issue with the notion that personal factors become important only in the case when the perceived situation is ambiguous. The authors recommend using stimuli which, while not fully obvious, are not extremely ambiguous and vague, as are tachistoscopic presentations and similarly impoverished stimulus conditions. The Witkin group maintains that individual differences obtained under such impoverished stimulus conditions do not necessarily correspond to variations in a particular personality characteristic and may be instead a function of ego defensive personal factors. In other words, the artificially ambiguous situation itself may elicit particular defensive or otherwise personal reactions in the subjects and lead to performance differences that do not vary along a single continuum of personality functioning. These subjective influences induced by the ambiguity of the situation itself can interfere with the perceptual process to the extent that the experimenter may not be measuring effects he thinks he is measuring. Similarly, the reliability of performance is questionable under reduced stimulus conditions; different personal factors are more likely to influence performance at various points in the same situation when the stimulus conditions are unduly vague.

Other investigators have made similar criticisms. Jenkins (1957), in a review of the literature on studies of perception, notes that most perception experiments deliberately make the stimulus ambiguous, either by brief or unclear exposure and that these conditions in themselves can distort the results. Pratt (1950) found that when the subject is given fuller information his perception is more stimulus-bound and less dependent upon subjective

factors.

There have been numerous studies on the effects of praise and blame on performance. In a review of the literature over a fifty year period (from 1913 to 1964) on such effects on school children, Kennedy and Willcutt (1964) conclude that praise has been found generally to improve performance and blame has impaired performance; blame seems to exert an inhibiting effect upon performance.

Heart rate measures have been employed as indicators of stress. Thiesen et al. (1964) used the degree and duration of heart rate elevation in response to stress tasks and concluded that heart rate response is a sensitive and convenient measure of stress associated with achievement motivation. The authors define stress as being present "when adaptive mechanisms of the living organism are taxed or strained as manifested by a response of sustained physiological tension" (p. 184). Sapira and Shapiro (1966) found that subjects attempting to perform an impossible task (using the Stroop color card test) experienced an average pulse rate increase of 7.3 beats per minute during "failure."

## CHAPTER III

### PROCEDURE

The effect of stress on figure rotation performance was investigated on the basis of ego involvement and task difficulty in a 2 x 2 factorial analysis of variance design (i.e., high and low ego involvement; easy and hard task). Thus, subjects served in one of the four following conditions: high ego involvement, hard task; high ego involvement, easy task; low ego involvement, easy task; low ego involvement, hard task.

#### Subjects

The subjects were 60 freshman and sophomore male students at Loyola University with a mean age of 18.7. There were two Negroes and 78 white students. The subjects were randomly divided into four equal groups of 20 each, and randomly assigned to each of the four conditions. (Three subjects were rejected; two because they were college juniors and one because he said he was recently diagnosed as having multiple sclerosis.)

#### Materials

The materials included a stop watch, lists of digits and arithmetical problems, a complicated-looking table of figures, a deck of cards, a glossy notebook cover sprayed with a silicone lubricant, a piece of acoustical tile, a deck of cards, sheets of  $8\frac{1}{2}$  x 11 inch plain paper, a fine-point ball point pen and the six designs of the Minnesota Percepto Diagnostic Test.

The Minnesota Percepto Diagnostic Test consists of six designs copied

by the subject. These designs are scored for the degrees of rotation. It is difficult for the subject to consciously aim for correct responses, since he does not know the scoring technique. The test is assumed to be independent of culture, education, intelligence and reading ability. The authors, Fuller and Laird (1963), claim that the Minnesota Percepto Diagnostic Test provides an objective, rapid method to determine if adults have a personality disturbance, organic brain damage or are normal, if children have a schizophrenic disturbance, emotional disturbance or are normal, and if reading disability among certain children is caused by organic brain damage, primary retardation or secondary retardation. The rationale of the test stems from Gestalt perceptual experiments from which were formulated the principles of inhomogeneity, interaction of figure-ground, laws of grouping and pragnanz. The test was standardized on groups of adults and children diagnosed as schizophrenic, organic, and emotionally disturbed, and children with reading disability.

#### Procedure

There are three phases to the procedure. During the introductory period, lasting five minutes, the subjects were engaged in informal, casual, neutrally toned conversation typically revolving around identifying information (name, age, grade level, phone number), academic interests, etc.

The second phase consisted of the pretest period. Low Ego Involvement subjects were told that the experimenter is a graduate student in psychology interested in collecting data on how the typical college student handles a series of tasks. The experimenter added that each individual's results will be lumped together with everyone else's and anonymously analyzed all together. No additional comments were made to these subjects during the

pretest or test phase of the experiment.

High Ego Involvement subjects were told that the experimenter is a graduate student in psychology interested in measuring the ability of typical college students on some verbal and nonverbal intelligence tests. These subjects were told also that their results will be compared to other students to see how well they stack up. A running stream of consistently negative feedback was also given to these subjects during the second or pretest phase of the experiment. This took the form of a sharply exclaimed "Wrong" whenever a mistake was made accompanied, on the examiner's part, by strong, authoritarian, emotionally projected attitudes and overt comments of disgust, incredulity, harshly critical pronouncements, facial, head-shaking and other gestures with similar negative implications, etc. For example, if a subject hesitated or gave a wrong answer to an arithmetic problem, he was disgustedly asked what was wrong with him, couldn't he perform sixth grade arithmetic, etc. In addition, the examiner often referred frowningly to his complicated list of figures while telling the subject he fell below average for his group. In short, the total examiner performance was designed to instill an attitude of failure into the High Ego involvement subjects.

Easy Task subjects were asked to successively count backwards by two's from 100 for 30 seconds, to repeat 5-digit numbers forward and 4-digit numbers backwards, to solve four simple arithmetic problems, and stack two playing cards up against each other in the shape of a tent on a fairly rough surface (acoustical tile).

Hard Task subjects were asked to count backwards by seven's from 100 for 30 seconds as fast as they could while keeping perfect accuracy. (High Ego Involvement/Hard Task subjects were forced to repeat the series from the

beginning each time they made an error.) Then each Hard Task subject was asked to repeat 9-digit numbers forward and 8-digit numbers backward, solve difficult arithmetic problems, and then stack playing cards in a series of interconnecting "tents" or "tepees" on a slippery, glossy, silicone-treated surface.

The third or "test" phase consisted of administering the Minnesota Percepto Diagnostic Test to all subjects. During this administration, no additional comments other than the standard instructions were made to the subject and no feedback of any kind was given; the table was cleared of the stop watch and the complicated-looking chart. Each subject was given a sheet of white paper  $8\frac{1}{2}$  x 11 placed directly in front of him in a vertical position. Each card was placed about one inch above the top of the sheet and centered. With rectangular cards the edge of the card was parallel to the top edge of the paper. With the diamond-shaped cards, the examiner made certain that the figure was perpendicular or parallel to the top of the paper, depending on the card. The subjects were not allowed to turn the paper or the card at any time.

Following the third and last phase of the experiment, it was quite obvious after testing a few subjects that many of them appeared quite uncomfortable; even hand tremors were noticeable in several of the high-stress subjects. An informal inquiry was therefore initiated, the results of which indicated that many subjects reacted with considerable self-depreciation and situational anxiety about their performance. Accordingly, the examiner reassured each subject as to his performance, indicated that things were not the way he (subject) thought and that his results would in no way whatsoever affect his academic standing; at the same time, the exact purposes and details



of the experiment were not communicated to the subjects but they were encouraged to call the experimenter in a few weeks for the results.

The Minnesota Percepto Diagnostic Test was then objectively scored for degrees of rotation (to one degree) using a professional protractor, a metal-edged ruler and a special accountant's fine-point pencil. In measuring degrees of rotation, three lines were drawn: a base line running tangent to the lowest point on the figure, a line perpendicular to the base line which orients the scorer to the true axis of the figure, and then a line along the actual axis intersecting the midpoint of the figure. The deviation of the actual axis line from the perpendicular line gave the degrees of rotation. Following the test manual, if the perpendicular line and the third line were the same, it was nonetheless assumed in such cases that a rotation of one degree is present and is recorded as that.

Before any test protocol was scored the names and group assignments were blocked out and all scoring was done blind.

The Minnesota Percepto Diagnostic test performance of all subjects, other than those in the Low Ego Involvement/Easy Task group, and those scoring below 25 degrees, were also examined individually to determine whether rotations tended to occur in one direction. For the purposes of this study, a directional bias was assumed for these subjects if they rotated consistently in one direction in five out of the six cards.

## CHAPTER IV

### RESULTS

First, the mean degrees of rotation were obtained for each condition. Table 1 summarizes the results.

Next, it was determined whether or not the variation of each independent variable, i.e., Ego Involvement and Task Difficulty, affected rotational performance. The results are summarized in Table 3. The difference between the two conditions of High Ego Involvement and Low Ego Involvement were statistically significant ( $F = 14.87$   $p < .001$ ).

The difference between the two conditions of Easy Task and Hard Task were statistically significant ( $F = 14.23$   $p < .001$ ).

Next, it was determined whether or not an interaction effect existed between Ego Involvement and Task Difficulty. The interaction was not statistically significant. Figure 1 illustrates this lack of interaction.

Next, all the conditions were compared with one another in terms of the difference in mean degrees of rotation. Table 2 summarizes the results. In general, the hypothesis was confirmed that stress, considered as a function of both task difficulty and ego involvement, would produce rotational anomalies in a non-psychiatric population. Each of the conditions differed significantly from one another with the exception of the Low Ego Involvement/Hard Task and the High Ego Involvement/Easy Task condition; these conditions did not differ significantly. The greatest difference in rotation occurred between the least stressed and the most stressed conditions, i.e.,

between the Low Ego Involvement/Easy Task condition and the High Ego Involvement/Hard Task condition.

Finally, it had been hypothesized that subjects who rotated would show a rotational bias not only in degree but also in direction. The direction of rotation was analyzed for all subjects with 25 degrees or more rotation who rotated five out of the six designs in one direction. Ten subjects out of 40 showed a rotational bias in one direction. These results are not statistically significant.

Table 1

Mean degrees rotation for each condition

		Ego Involvement	
		Low	High
Task Difficulty	Easy	17.40 (S.D. = 2.29)	31.05 (S.D. = 3.58)
	Hard	30.80 (S.D. = 2.39)	42.25 (S.D. = 3.92)

Table 2  
 Tests of significance between mean degrees  
 of rotation for each group

Group	M <sub>d</sub> (degrees rotation)	<u>t</u>	<u>p</u>
LE : HT / LE : ET	13.4	4.06	.01
LE : HT / HE : HT	11.4	2.50	.05
LE : HT / HE : ET	0.25	0.06	N.S.
LE : ET / HE : HT	24.9	5.45	.001
LE : ET / HE : ET	13.6	3.23	.01
HE : HT / HE : ET	11.2	2.12	.05

**Table 3**  
**Analysis of Variance of the Rotation Scores**

Source of Variation	Sum of Squares	df	Mean Square	<u>F</u>	<u>P</u>
Overall between	(6200.05)	(3)			
Between ego involvement	2900.05	1	2900.05	14.87	.001
Between task difficulty	2775.79	1	2775.79	14.23	.001
Interaction: ego involve- ment x task difficulty	524.21	1	524.21	2.69	N.S.
Within groups (error)	<u>14,822.70</u>	<u>76</u>	195.03		
Total	21,022.75	79			

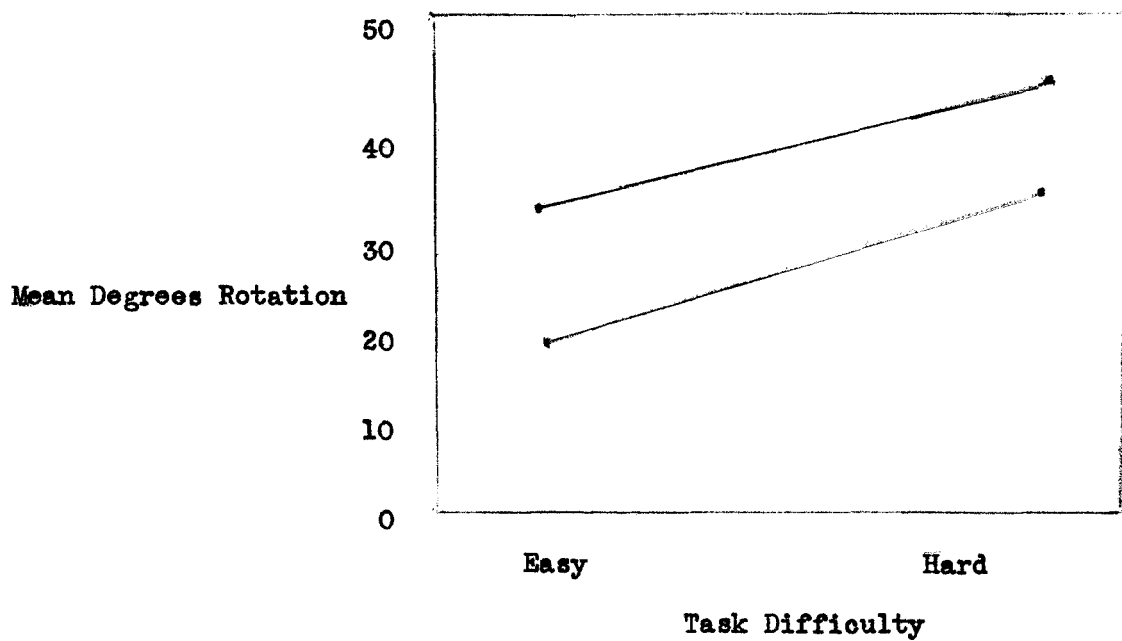


Figure 1. Illustration of interaction between amount of ego involvement and task difficulty

## CHAPTER V

### DISCUSSION

The results seem to coincide with previous research findings that stress generally produces performance decrements, particularly in complex tasks, and high stressed subjects show poorer performance than low stressed subjects. It would appear from the data that this generalization also holds for figure rotational performance, for the data suggest that figure rotations increased significantly with stress as a function of both ego involvement and task difficulty.

Each of the three experimental conditions showed significantly greater rotational deviations than the lowest stress condition (Low Ego Involvement-Easy Task). This was to be expected, particularly since the pilot study data showed a marked trend toward significant differences with far fewer subjects.

The finding that both the Low Ego Involvement-Hard Task condition and the High Ego Involvement-Easy Task condition differed significantly from the lowest stress condition is perhaps not so surprising either since there was an element of stress in each condition. In the High Ego Involvement-Easy Task condition, the subjects were open to harsh criticism even though the tasks were relatively easy to perform; invariably, they would make some errors, if only through carelessness and, if they did not, they were told that their responses were either too slow, or too inaudible, or that they seemed to lack confidence in their answers compared to other students, etc. Subjects in the Low Ego Involvement-Hard Task condition were similarly stressed



without experimenter needling, simply because they knew they were not performing as expected, i.e., most of them were unable to complete the tasks accurately and often demonstrated their knowledge of failure by admitting their inadequacy, blushing, smiling sheepishly, head-shaking and other similar responses. It is perhaps incorrect, therefore, to assume that there was little ego involvement in this condition, since the subjects obviously had negative feedback from their performance without any comments to that effect from the experimenter. Similarly, in the High Ego Involvement-Easy Task condition, one cannot infer with complete confidence that the tasks were indeed so easy to perform; the critical comments of the experimenter might have contributed to "task difficulty" simply by distracting the subjects from the task at hand. This seemed particularly true for the card stacking task that immediately preceded the "test" period; several subjects in the High Ego Involvement-Easy Task condition exhibited marked difficulty in stacking up two cards against one another simply because their hands were trembling. A few subjects in this group even knocked down the stack while they were assembling the others.

What is particularly interesting is that both the Low Ego Involvement-Hard Task, and the High Ego Involvement-Easy Task conditions differed significantly from the highest stress condition, i.e., the High Ego Involvement-Hard Task condition. An analysis of the main effects of each independent variable revealed that both task difficulty and ego involvement independently and significantly affected rotational performance. However, when employed together as stressors, they combined to increase rotational deviations significantly. Whether this has general applicability cannot be determined from the data, since the Minnesota Percepto Diagnostic Tests has previously been

shown to be particularly sensitive to intellectual and emotional disorganization and it may be that task difficulty and ego involvement acting in concert would not produce greater significant deviations in other kinds of tasks than either would acting alone. Nevertheless, future research on stress might investigate this problem.

In view of the foregoing findings it is rather surprising that there was no significant interaction at the .05 level between ego involvement and task difficulty. One would tend to expect that the difficulty of the task would influence rotational performance particularly as the level of ego involvement affects rotational performance as the difficulty of the task increases.

The finding that there was no significant amount of rotation in any one direction is not viewed as a refutation of the Warner-Wapner hypothesis of visual directional dynamics, for the data are much too sketchy and not enough is known as yet about directional biases as applied to figure rotation phenomena.

The results appear to confirm the general hypothesis that individuals subject to emotional stress will not perceive as accurately as subjects not exposed to stress and specifically, that individuals under stress will tend to produce significantly greater figure rotations than subjects who are not deliberately stressed. It is assumed that high stress subjects will have difficulty organizing the perceptual field and that the ensuing distortion is a crucial factor in performance. It can be inferred that the high stress subjects seem less able to attend to external cues relevant to successful task performance; they seem less able to draw cues from the environment, or misinterpret the ones available, or become less sure of incoming signals

and stimuli, or there is an increase in the number of stimuli to be discriminated. In some way, individuals under stress seem to become less oriented to what is figure and what is ground; the dominant features of the situation become task irrelevant cues which block out less dominant ones and the "ground" tends to assume greater importance in influencing the perception of the figure. The three theories of decreased performance under stress conditions discussed previously, i.e., drive theory, interference theory and reduction-of-cue-utilizations theory all contain some of the elements of the foregoing interpretations, any one of which could be offered as an explanation of the data.

Unfortunately, none seems totally adequate, for the research designs of not only this study but previous studies too have not been sufficiently sophisticated to differentiate between the theories. Nor has the research on visual-motor tasks generally, and figure rotations specifically, carefully described just what actually happens in a so-called "visual-motor" activity.

The present author makes this point because of some of his observations during the "pretest" and "test" phase following the stress-inducing tasks which created marked hand tremors in many of the subjects. Perhaps it was an error to have the card-stacking task last in the stressor sequence but it can just as easily be inferred that it was the stressor battery as a whole and not the card-stacking task itself that created the hand tremors. At any rate, trembling hands were observed in a majority of the High Ego Involvement-Hard Task condition, and also in some subjects in the other experimental conditions.

The question, therefore, in the writer's opinion that has to be asked

is whether the theories of performance decrements under stress, as they apply to visual-motor tasks, tend to over-emphasize the visual aspects of perception and under-emphasize the motor functions. In other words, is the performance decrement a result of visual misperception and poor visual form perception, or is it a failure of motoric difficulty in drawing and a failure of visual-motor coordination. Asked still another way, can the observed disordered functioning be related, as Leton (1965) has suggested, to disturbances in the motor area, or in the peripheral efferent pathways of the nervous system, or even in central associative processes providing proprioceptive feedback, rather than in visual perceptual centers? Unfortunately, answers to these questions cannot as yet be provided but the observations from the data do raise certain doubts as to the validity of the current theoretical approaches, especially as they apply to visual-motor functioning.

In view of these theoretical uncertainties, perhaps the most important conclusion of this study is that a non-psychiatric population subjected to a controlled stress situation will tend to show rotational anomalies on a visual-motor performance task. This suggests that some individuals undergoing psychological assessments in clinical situations who produce figure rotations may be doing so as a result of situationally-related anxiety and not necessarily because they are chronically and seriously disturbed. Therefore, the occurrence of figure rotations, in and of themselves, should not be taken as an indication of psychosis, cranial pathology or mental deficiency.

## CHAPTER VI

### SUMMARY

The purpose of this study was to investigate the effects of experimentally induced stress upon figure rotation performance in a nonpsychiatric population. The major hypothesis was that normal subjects under stress will become sufficiently disorganized so as to rotate figure designs significantly more as compared to a low-stressed control group.

The effect of stress on figure rotation performance was investigated on the basis of ego involvement and task difficulty in a 2 x 2 factorial analysis of variance design, i.e., high and low ego involvement; easy and hard task. Thus, subjects served in each of the four following conditions: high ego involvement, hard task; high ego involvement, easy task; low ego involvement, easy task; low ego involvement, hard task.

The subjects were 80 freshman and sophomore male students at Loyola University with a mean age of 18.7. The procedure involved three phases: the first phase consisted of an introductory period in which all subjects were engaged in informal conversation. The second, or "pretest" phase, consisted in randomly assigning each subject to the four experimental conditions, so that there were four groups of 20 subjects each. The third, or "test" phase, consisted of administering the Minnesota Percepto Diagnostic Test (a quantitative measure of figure rotations) to all subjects according to the standardized procedure.

The results, in mean degrees rotation for each condition, showed that the high ego involvement-hard task, high ego involvement-easy task and low

ego involvement-hard task conditions differed significantly from the low ego involvement-easy task condition. There was no significant difference between the high ego involvement-easy task and the low ego involvement-hard task condition. There was a significant main effect of both ego involvement and task difficulty but the interaction effect was not significant at the .05 level. The direction of rotation was analyzed for all subjects with 25 degrees or more rotation who rotated five of the six designs in one direction; rotational bias was not found to be significant.

The results were discussed in terms of confirming the general hypothesis that individuals subject to stress will not perceive as accurately as subjects not exposed to stress. The results were also discussed in terms of drive theory, interference theory and reduction-of-cue-utilization theory; in view of some of the observations made during the investigation, neither theory seemed to fully account for the obtained results. The author postulated a fourth explanation of the results that focuses more upon motor performance and suggested future research should pay more attention to an analysis of the visual-motor response itself.

Finally, it was concluded that a nonpsychiatric population subjected to a controlled stress situation will tend to show rotational anomalies on a visual-motor performance task. It was therefore suggested that clinicians interpret figure rotations with caution when they appear in clinical testing situations since their presence might be a function of situational anxiety rather than severe psychopathology.

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## Appendix 1

## Pre-test and Test Instructions

Low Ego Involvement

As an introduction to what we'll be doing I wanted to tell you that I'm a graduate student in psychology interested in collecting a lot of data on how the typical college student handles some tasks and problems. Your results will be lumped together with everyone else's and analyzed all together --- we won't even use your name.

High Ego Involvement

As an introduction to what we'll be doing I wanted to tell you that I'm a graduate student in psychology interested in measuring the ability of typical college students on some non-verbal intelligence tests. Your results will later be compared to other students to see how you stack up with them.

Easy Task

First, I'd like you to count backwards by two's from 100. Begin.

Now I'd like you to repeat these numbers after me when I've finished.

32796                      49636                      83154

Now say the numbers backwards after me.

582                      6439                      4273

Here are some simple arithmetic problems. How much is 106 and 105? How many oranges can you buy for 25¢ if one orange costs 5 cents? A bill collector collected 50¢ from each of 10 customers. What is the total amount he collected? How many hours will it take a man to walk 10 miles at the rate of 2 miles an hour.

Next I'd like you to stack 2 cards against each other in two sets as shown in this diagram.

## Appendix 1 (contd.)

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Hard Task

First, begin counting backwards by seven's from 100 as fast as you can while keeping perfect accuracy. Begin.

Now I'd like you to repeat these numbers after me when I've finished. 275862527      396426382

Now say them backward after me. 72896531      473912865

Here are some problems involving arithmetical operations. You are to do the problems as quickly as you can.

A man's salary is \$60 a week. If 15% of his pay is withheld for federal income tax and 3% is withheld for state taxes, what is his total take home pay?

Eight men can finish a job in 6 days. How many men will be able to finish it in  $1/3$  day?

Now I want you to stack 2 cards on edge against each other in series as shown on this diagram.

Minnesota Percepto Diagnostic Test instructions:

I am going to show you 6 cards one at a time. Each card contains a figure. Copy the figure on this paper. Do not move the card or the paper. Number each figure as you draw it.

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Appendix 2  
Figure Rotation Raw Scores (in Degrees)

Low Ego Involvement: Easy Task Condition

Subject	Designs						Total
	1	2	3	4	5	6	
1	1	1	1	4	2	2	11
2	1	1	7	1	2	1	13
3	1	2	2	3	1	14	23
4	4	1	1	8	3	10	27
5	4	2	4	1	10	4	25
6	5	1	1	5	7	5	24
7	4	1	9	6	20	3	43
8	10	3	7	4	8	6	38
9	1	3	2	2	3	1	12
10	1	1	1	1	1	1	6
11	4	1	1	1	1	1	9
12	2	5	3	1	8	1	20
13	1	1	1	1	1	1	6
14	2	3	3	1	2	1	12
15	7	1	2	7	1	1	19
16	1	2	1	1	5	1	11
17	3	1	1	1	3	1	10
18	1	1	1	1	1	1	6
19	1	7	3	1	1	5	18
20	3	6	1	2	1	2	15



## Appendix 2 (contd.)

## Figure Rotation Raw Scores (in Degrees)

Low Ego Involvement: Hard Task Condition

Subject	Designs						Total
	1	2	3	4	5	6	
1	3	9	2	11	4	11	40
2	5	1	1	1	1	1	10
3	3	4	4	5	1	1	18
4	5	2	7	3	5	5	27
5	3	5	4	2	6	5	25
6	5	7	10	1	4	11	38
7	15	3	6	4	3	2	33
8	9	1	11	4	1	20	46
9	10	8	10	1	4	1	34
10	5	7	2	5	6	18	43
11	7	7	7	4	3	1	29
12	9	11	1	7	4	6	38
13	6	1	4	10	3	20	44
14	3	7	1	3	3	7	24
15	2	1	1	6	10	11	31
16	1	5	5	1	5	1	18
17	7	8	6	1	9	2	33
18	1	5	1	2	3	5	17
19	9	6	5	13	6	8	47
20	8	2	4	3	3	1	21

## Appendix 2 (contd.)

## Figure Rotation Raw Scores (in Degrees)

## High Ego Involvement: Easy Task Condition

Subject	Designs						Total
	1	2	3	4	5	6	
1	8	4	11	3	10	2	38
2	2	1	2	4	5	1	15
3	1	40	1	3	1	3	49
4	1	7	9	13	6	5	41
5	4	4	7	7	2	4	28
6	6	1	5	5	1	2	20
7	1	4	1	2	2	1	11
8	5	2	2	8	1	6	24
9	3	3	7	2	1	1	17
10	2	7	5	12	7	10	43
11	11	1	3	5	1	11	32
12	1	2	4	25	1	9	42
13	7	3	7	4	7	10	38
14	5	9	8	5	8	1	36
15	3	9	3	6	3	1	25
16	4	1	5	1	3	1	15
17	15	1	9	20	2	33	80
18	4	6	2	5	7	1	25
19	1	7	1	10	5	1	25
20	3	2	6	1	4	1	17

## Appendix 2 (contd.)

## Figure Rotation Raw Scores (in Degrees)

## High Ego Involvement: Hard Task Condition

Subject	Designs						Total
	1	2	3	4	5	6	
1	19	7	19	6	16	14	81
2	10	1	17	5	16	14	63
3	13	2	11	5	7	12	50
4	4	8	3	6	1	5	27
5	1	11	5	1	2	1	21
6	5	10	10	1	4	3	33
7	1	9	15	15	1	8	49
8	6	15	9	7	4	6	47
9	6	8	10	1	9	1	35
10	5	3	9	4	1	5	27
11	12	8	15	5	15	9	61
12	1	6	7	2	12	6	34
13	4	10	2	4	1	5	26
14	12	32	6	2	4	13	69
15	3	2	1	10	13	36	65
16	6	1	6	11	4	5	33
17	7	15	1	2	7	7	39
18	1	2	3	8	6	5	25
19	8	2	5	7	2	14	38
20	6	5	3	2	1	5	22

## Appendix 3

## Pilot Study

Under the direction of Dr. Leroy Wauck and with the assistance of Dr. J. Warren Thiesen a pilot study was undertaken to 1) validate the series of stressors 2) to make a preliminary investigation of any significant differences between High-Stress and Low-Stress groups on a test of figure rotations 3) to determine whether the introduction of mild time pressures significantly affects performance in either group and 4) to observe whether perfectionistic strivings would create difficulties in the present experiment.

For the purposes of the pilot study, the following definition of stress was used (Thiesen et al., 1964, p. 184): "stress is present when the adaptive mechanisms of the living organism are taxed or strained, as manifested by a response of sustained physiologic tension."

The subjects were 14 freshman and sophomore students at Loyola University, ranging in ages from 17 to 21. These 14 were sub-divided into 2 groups of 7 each; the High-Stress group contained 4 females and 3 males and the Low-Stress group contained 5 females and 2 males.

The subjects were brought into the testing room, attached to the polygraph at once, and were alternated as follows: for the first 10 minutes the examiner engaged them either in innocuous, informal conversation or allowed them to remain quietly alone (with the polygraph operator present but silent. This variation in procedure was related to another study that was being undertaken simultaneously and it was assumed that this arrangement would not affect the results of the present study).

After the initial accommodation with the testing equipment, the subjects in both the Low-Stress and High-Stress groups were treated according to the stress and non-stress procedures previously described. Following the stress (and non-stress) period the Minnesota Percepto Diagnostic Test was administered under the rigid conditions previously described.

In analyzing the heart rate data, the time was divided into 5 periods: Pre-stress, stress, MPD Cards 1-2, MPD Card 3, MPD Cards 4-6. The last two heart-rate segments were obtained to determine if there was a significant change in heart rate as a function of introducing a mild time pressure; upon presenting Card 4, the experimenter told all subjects that there was a chance that the test might be too easy when they have as much time as they like and they were requested to finish each design within 15 seconds. This comparison was needed to determine if both stress batteries could utilize a mild time pressure to correct for possible perfectionistic tendencies on the part of some subjects without causing a significant difference in stress between the groups at that point.

## Appendix 3 (contd.)

The results of the pilot study were as follows: first both groups were compared as to difference in mean heart during the 10 minute pre-stress period. The mean of the Low-Stress group was 87.6 beats per minute during that period and the mean of the High-Stress group was 85.7 beats per minute. This difference is not statistically significant.

Table A summarizes the mean heart rate figures for each period, i.e., the Pre-Stress, Stress, MPD Cards 1-2, MPD Card 3, MPD Cards 4-6. Figure 1 graphically illustrates the per cent changes in heart rate from the pre-stress period for both groups during and following the stress period. It is seen that the control group mean heart rate increased less than 3 per cent during the non-stress tasks and thereafter declined below the level of the pre-stress period. The experimental group mean heart rate, however, accelerated to almost 20 per cent of the Pre-Stress period and remained elevated throughout the remainder of the experiment. These differences are statistically significant at the .003 level (Mann-Whitney U test;  $U = 4$ ).

Next, the differences in heart rate were examined between the two groups at the point at which card 3 was administered and the mean heart rate during cards 4-6 (Table B). These differences were not found to be statistically significant (Wilcoxon Matched Pairs Signed Ranks Test).

Finally, the MPD test was scored as to degrees of rotation to determine whether High-Stress subjects performed significantly poorer on a rotational task as hypothesized. Although the results were not statistically significant, the trend definitely suggests that with only a few more subjects the differences would probably have been significant. (Mann Whitney U Test:  $U = 13$ , .082 level of significance.)

The results seem to suggest that the stress battery employed does indeed function as a stressor and that the High-Stress subjects were actually under significantly greater stress than were their control counterparts. With this validation of the stressors, it is felt that this stress battery can be utilized intact.

It was also found that an introduction of time pressures did not significantly alter heart rate. However, it was also noted that none of the 14 subjects tested were at all exaggeratedly perfectionistic in their performance, so it is rather doubtful whether such time pressures really have to be included at all in the main study.

The unmistakable trend toward significance in the differences between the two groups on the task measuring figure rotation anomalies strongly suggests that individuals under stress may likely perceive inaccurately and are inclined to rotate more. However, more subjects will have to be employed before this can be conclusively demonstrated.

## Appendix 3 (contd.)

Table A.  
Mean heart rate control group subjects  
throughout each period

Subject	1	2	3	4	5	6	7
Pre-Stress	87.8	94.6	84.8	88.6	95.2	66.6	95.8
Stress	93.6	99.6	82.6	87.6	97.2	68.4	99.6
Heart rate change	5.8	5.0	-2.0	-1.0	2.0	1.8	3.8
Heart rate % change	6.6	5.3	-2.4	-1.1	2.1	2.7	4.0
Cards 1-2	84.0	93.6	79.2	85.8	90.6	72.0	93.0
Heart rate change	-3.8	-1.0	-5.6	-2.8	-4.6	5.4	-2.8
Heart rate % change	-4.3	-1.1	-6.6	-3.2	-4.8	8.1	-2.9
Card 3	81.6	100.2	78.6	84.0	88.8	70.8	88.8
Heart rate change	-6.2	5.6	-6.2	-4.6	-6.4	4.2	-7.0
Heart rate % change	-7.1	5.9	-7.3	-5.2	-6.7	6.3	-7.3
Cards 4-6	76.8	103.8	78.0	86.4	88.2	76.8	93.6
Heart rate change	-11.0	9.2	-6.8	-2.2	-7.0	10.2	-2.2
Heart rate % change	-12.5	9.7	-8.0	-2.5	-7.4	15.3	-2.3

## Appendix 3 (contd.)

**Table B.**  
**Mean heart rate experimental group subjects throughout each period**

Subjects	8	9	10	11	12	13	14
Pre-Stress	102.5	78.2	89.7	85.4	73.4	81.0	90.0
Stress	127.8	102.6	94.8	97.2	76.8	115.8	102.6
Heart rate change	25.3	24.4	5.1	11.8	3.4	24.8	12.6
Heart rate % change	24.7	31.2	5.7	13.8	4.6	43.0	14.0
Cards 1-2	133.2	98.4	112.8	88.8	75.6	115.2	97.2
Heart rate change	30.7	20.2	23.1	3.4	2.2	34.2	7.2
Heart rate % change	30.0	25.8	25.8	4.0	3.0	42.2	8.0
Card 3	122.4	100.2	102.0	97.6	71.4	111.0	93.6
Heart rate change	19.9	22.0	12.3	12.2	-2.0	30.0	3.6
Heart rate % change	19.4	28.1	13.7	14.3	-2.7	37.0	4.0
Cards 4-6	124.2	106.8	115.2	85.2	76.2	113.4	93.6
Heart rate change	21.7	28.6	25.5	-0.2	2.8	32.4	3.6
Heart rate % change	21.2	36.6	28.4	0.0	3.8	40.0	4.0

## Appendix 3 (contd.)

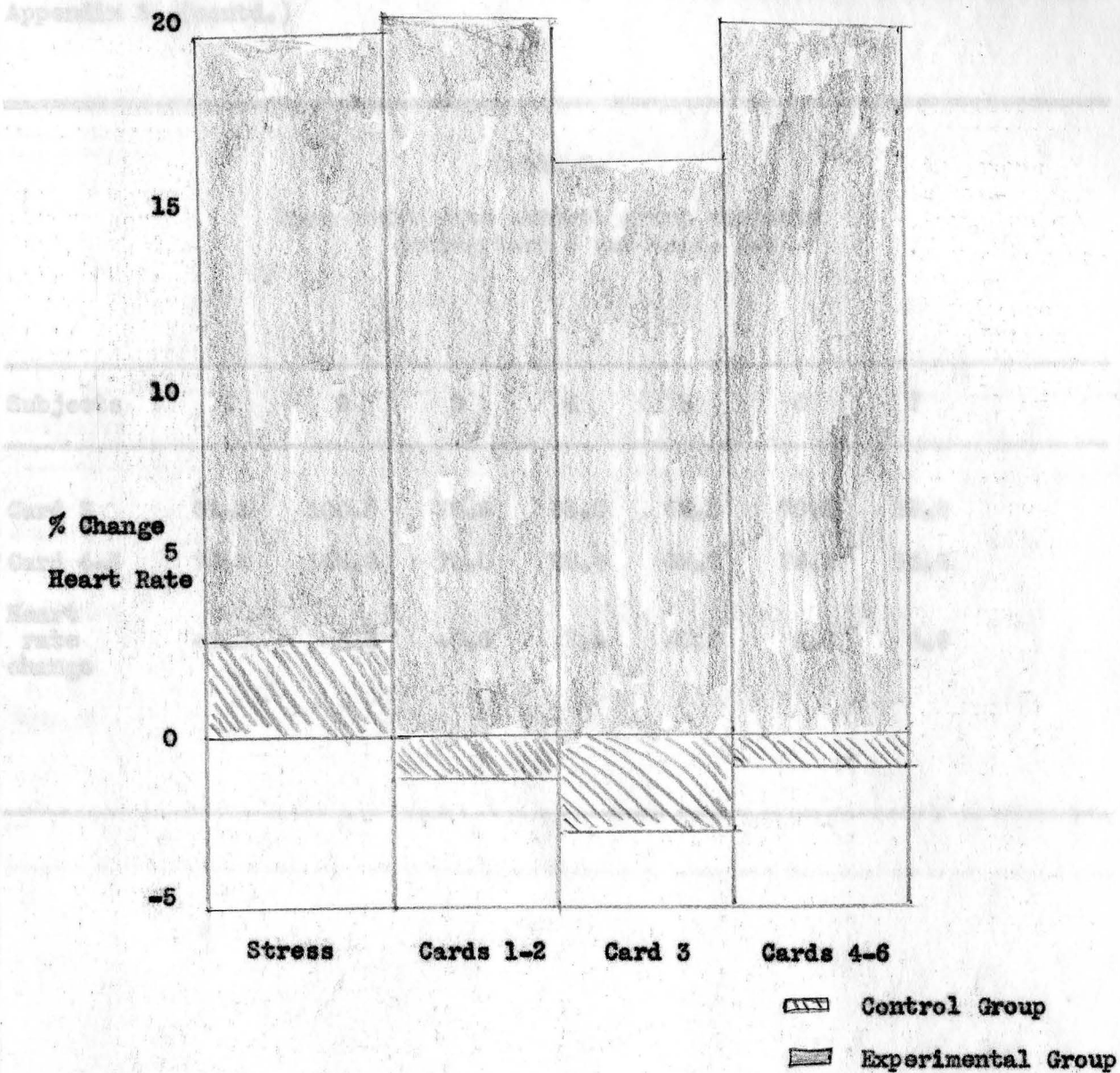


Figure 1. Per Cent Changes in Heart Rate from Pre-stress Period for Both Groups During and Following Stress.



## Appendix 3 (contd.)

Table C.

Mean heart rate control group subjects  
during Card 3 and Cards 4-6

Subjects	1	2	3	4	5	6	7
Card 3	81.8	100.2	78.8	84.0	88.8	70.8	88.8
Card 4-6	76.8	103.8	78.0	86.4	88.2	76.8	93.6
Heart rate change	-4.8	3.6	-0.8	2.4	-0.8	6.0	4.8

## Appendix 3 (contd.)

Table D.

Mean heart rate experimental group subjects  
during Card 3 and Cards 4-6

Subjects	8	9	10	11	12	13	14
Card 3	122.4	100.2	102.0	97.6	71.4	110.0	93.6
Card 4-6	124.2	106.8	115.2	85.2	76.2	113.4	93.6
Heart rate change	1.8	6.6	13.2	-12.4	4.8	2.4	0.0

APPROVAL SHEET

The dissertation submitted by Edward M. Wittert has been read and approved by three members of the Department of Psychology.

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

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

23 May 1968  
Date

Leroy A. Wauke  
Signature of Advisor