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THE EFFECTS OF ANXIETY, STRESS, AND TYPE OF TASK ON PROBLEM SOLVING PERFORMANCE

By

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ABSTRACT

The present study examined the relationship between anxiety, stress, and the nature of the task. A total of 40 male and 60 female subjects were selected on the basis of their scores on two anxiety scales. Half of each group was considered to be "high anxious" (HA), while the other half was "low-anxious" (LA). Both HA and LA groups were then subdivided randomly into either the "high stress" or "low stress" condition. All subjects completed each of four tasks. These were: Logical Reasoning; Letter Series; Ingenuity; and Word Production. Two of the tasks: Logical Reasoning; and Letter Series; were thought to tap convergent thought processes in that adequate performance required the "zeroing in" upon the one correct answer. Conversely, the Ingenuity and Word Production tests, were assumed to involve divergent thought patterns since optimal performance was achieved through a flexible, "outward-ranging" approach which included consideration of the many possible solutions to this type of problem. It was felt that increased levels of arousal due to anxiety and stress would prove to be more detrimental to the latter than to the former type of task. The results were as follows:

1. The performance of HA subjects was generally inferior to that of LA subjects.

2. Stress had a detriment effect upon performance of divergent tasks but not upon that of convergent tasks.

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1. The performance of HA subjects was generally inferior to that of LA subjects.

2. Stress had a detriment effect upon performance of divergent tasks but not upon that of convergent tasks.

In view of the above findings, which were not amenable

to interpretation by either Drive or Interference theories, a theoretical analysis of the results was attempted. It was suggested that the inferior performance of HA subjects was due to the interfering effects of "task-irrelevant" response tendencies. The affects of stress, it was proposed, were similar for both LA and HA subjects, that is, in response to stressful stimulation, the range of environmental cue utilization was reduced thus reducing the flexibility of performance. Whether or not a loss of flexibility due to a narrowed range of cue utilization was detrimental to performance was dependent upon whether the task required a "wide-ranging" flexible approach (divergent task) or a "narrow" cautious one (convergent task).

It was felt, in conclusion, that the results partially supported the basic contention that the effect of anxiety and stress upon performance are largely a function of the type of task. Although HA subjects were generally inferior in performance, stress either did or did not effect the performance of all subjects depending upon whether the task was convergent or divergent in nature.

ACKNOWLEDGEMENTS

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INTRODUCTION

During the past two decades there has been a great deal of research performed by experimental psychologists seeking relationships between anxiety and performance. A probable reason for the increased volume of research during the 1950's, was the development of the Taylor Manifest Anxiety Scale (MAS) (Taylor, 1951; 1953). Due to the burgeoning research literature in this general area, it is possible to discern definite trends where anxiety scales have been employed (Sarason, 1960). Of particular interest to the present study are two such research trends. The first of these focuses upon anxiety and task related variables. For example, the task to be performed by subjects may be extremely simple or very difficult. The most relevant question to be asked here would be, "does the anxiety level of an individual differentially effect his performance depending upon the specific characteristics of the task which he must perform?" The second trend, most relevant to the present study, poses the question, "do situational variables interact with anxiety to effect performance?" For example, the degree of stress generated in the experimental situation either by the employment of noxious stimuli or ego-involving instructions, might differentially effect performance, depending upon the initial anxiety level of the individual.

Anxiety and the Nature of the Task

One problem which immediately becomes apparent when one considers the nature of a specific task is the relative definitions of simplicity or complexity. Both of these terms have immediate "intuitive" meaning but, when confronted with the problem of definition, one realizes that a host of variables are involved.

One definition which has proven useful theoretically is that supplied by Farber and Spence (1953) which states that a complex task is one in which a large number of competing response tendencies are present. This definition is formulated on the basis of Hullian Drive Theory and its subsequent modification by Taylor and Spence (1952) and Spence (1958). The drive level interpretation of anxiety assumes that response strength (R) is a function of the excitatory potential of the organism (E) which, in turn is a multiplicative function of a learning factor (H) and a generalized drive factor (D), thus: $R = f(E) = f(HxD)$. (Spence, 1958).

To put it another way:

1. Level of performance reflects the habit strength of a given response multiplied by the drive level of the organism.

2. All response habits (correct or incorrect) in a given situation are multiplied by drive level.

3. Drive level (at least in aversive situations) reflects the emotional responsiveness of the organism.

4. Scores on the MAS are believed to be a measure of this persisting emotional responsiveness.

On the basis of this formulation, it would be predicted that in a simple learning situation (one in which the correct response was foremost in the hierarchy) subjects exhibiting the greatest amount of D would be expected to perform in a manner superior to all other groups. Conversely, were the correct reponse initially low in the habit hierarchy, the subjects with high levels of D would be expected to perform at a lower level than those with lower drive levels. Let us examine some of the evidence bearing upon the above theoretical framework.

Anxiety and Conditioning

Spence and his associates at the University of Iowa reasoned that in a situation where only one response was possible (reflex), subjects of higher drive level would condition more quickly in reponse to noxious stimulation than their low D counterparts. Thus, they postulated that performance in a situation involving eyeblink conditioning to a puff of air administered to the eyes would be a positive function of the intensity of the puff of air and the score on the Taylor Anxiety Scale, which is used as an indicator of the initial level of D in subjects, (Spence, 1958). Spence (1964) in a review of the literature bearing on this issue, reports that 21 of 25 studies have supplied supporting evidence for a drive theory interpretation of eyeblink conditioning.

Despite the impressive array of evidence supporting drive theory in simple conditioning situations, it is not without its opponents. Hilgard and his associates (1951), for example, have suggested that anxiety-prone individuals are more apprehensive and have a greater fear of bodily harm, thus the conditioned stimulus becomes threatening and their reaction to it is defensive in nature. A test of this alternate hypothesis was conducted (Bindra, Paterson, and Strzelecki, 1955) using salivation (a non-defensive response) as the response to be conditioned. It was found that, in response to the smell of food, subjects who had been food deprived for varying lengths of time, did not differ significantly in degree of salivation. In a similar vein, Franks (1957a) has reasoned that: a) since the Spence-Taylor paradigm states that total effective drive of the organism at any given moment is determined by the combined strengths of all the organismic needs present at that moment; and b) since this includes all needs without regard for the type of reinforcement; then c) increases in such primary drives as hunger and thirst should produce a state of greater conditionability in the deprived organism. Franks (1957a) then designed an experiment to test the above reasoning. A group of subjects were evenly divided into high drive and low drive subgroups. The high drive group was food, water, and tobacco deprived for a day, while the low drive group consumed its normal quota. Following this both groups were subjected to a

period of eyeblink conditioning and no significant difference was found between the performance of either group. Thus predictions derived from drive theory were not supported. Although these studies cannot be construed as a crushing defeat for drive theory, it does indicate that one should not accept deductions drawn from the theory without close scrutiny.

Anxiety and Task Complexity

Although findings have been overwhelmingly in favour of drive theory in relation to conditioning experiments, the issue becomes more clouded when one considers the literature bearing on the effects of anxiety in performance of more complex tasks. Spence (1958) has pointed out that in order to assess the effects of drive on complex tasks, "it is necessary to have, in addition to drive theory, a further theoretical network concerning the variables and their interaction that are involved in the particular learning activity (p. 137)." He goes on to point out that such "theoretical schemas" are, at present, in a very rudimentary state.

A complex task, as defined by Farber and Spence (1953), is one involving a number of competing response tendencies. A derivation from drive theory on the basis of this definition would be: in a situation involving a large number of competing response

tendencies in which the correct response is initially low in the hierarchy, "high anxious" (HA), individuals will perform more poorly than their "low anxious" (LA), counterparts since drive multiplies habit strengths indiscriminately. As a test of the above hypothesis, Taylor and Spence (1952) reported that in verbal maze performance, LA subjects performed significantly better than HA subjects over all, and when choice points were arranged in order of difficulty, the trend indicated that HA subjects performed most poorly at the most difficult choice points. The authors attributed their findings partly to competing and perseverative response tendencies. A similar study (Farber and Spence, 1953) involving a stylus maze, confirmed the above findings with HA subjects performance deteriorating in positive relation to the number and strength of interfering response tendencies at each choice point. Assuming that incorrect competing response tendencies are due to remote associations (Spence et al. 1956) it should be possible to experimentally control the strengths and numbers of these competing tendencies. Montague (1953) attempted this using a serial rote learning task with difficulty defined in terms of intralist similarity of items and association value. His findings supported the hypothesis that the performance of HA subjects would improve as association value of items increased and inter-item similiarity decreased.

Research with serial tasks have not uniformely upheld drive

theory as evidenced by a replication attempt by Axelrod, Cowen, and Heilizer (1956) of Farber and Spence's (1953) findings. These investigators found no significant differences between HA and LA groups and concluded that their results did not support "simple deductions from Hullian Theory". However, as pointed out by Spence, Farber and McFann (1956) and Spence (1958), knowledge concerning the relative strengths of correct or incorrect response tendencies is at a rather primitive level. Thus, these investigators have abandoned using this type of task in favour of paired-associates learning which they regard as more suitable test of drive theory (Feldman, 1964).

Paired-Associates Learning

In paired-associates learning, subjects are required to respond to the stimulus word (or nonsense syllable) with another word (or syllable) with which it has previously been paired. Since characteristically, words tend to become associated with other words in varying degrees and these associative strengths remain relatively constant among individuals of the same culture, (see Haagen,1949), then it is possible to a large extent, to assess the relative simplicity or difficulty of a paired-associates word list in a priori fashion. Thus, on a list containing pairs of high-associative value (and with a minimal degree of synonymity between stimulus and response words), it would be expected, on the basis of drive theory, that HA subjects would perform better than

their LA counterparts. Conversely, LA subjects should perform more adequately when the list involved a high degree of competition (low associative strength, high synonymity of stimulus words). The first of these predictions has been borne out in a number of studies, (e.g. Spence, Farber and McFann, 1956a, Spence, Taylor and Ketchel, 1956b, Standish and Champion, 1960). Taylor and Chapman (1955) for example, using lists of nonsense syllables with low intra-list similarity (few interfering response tendencies), found that HA subjects performed at a higher level than those with low A-scale scores. This finding is analogous to those involving eyeblink conditioning. In addition, it was found (Spence, Farber and McFann, 1956a; and Spence, Taylor and Ketchel 1956b), that HA subjects performed less well than LA subjects when the task involved competition.

As may be expected, research involving paired-associates lists and anxiety has not gone unchallenged. Willett and Eysenck (1962) and Willett (1964) attempted to replicate the Standish and Champion (1960) study and to generally test various deductions drawn from drive theory formulations. One important difference however, between Eysenck's and the Iowa experiments was, that instead of selecting subjects on the basis of the Taylor MAS, stress was manipulated in a "real life" situation. High Drive subjects were candidates applying for entrance to an apprenticeship training

program in which only those scoring highest on the selection test battery were accepted. Low Drive subjects consisted of students already enrolled at the school. In neither of these studies was the predicted interaction between drive level and task difficulty observed. These investigators attempted an explanation of their findings in terms of a dual concept of drive in which anxiety can have both interfering and facilitating effects (Jones, 1960). This conception will be discussed at greater length later in the text. In addition, Heilizer, Axelrod, and Cowen (1956) found no difference in groups differing in anxiety level on a complex verbal learning task, Korchin and Levine (1957) found that LA subjects performed better than HA on an easy (Hi Association) paired-associates task and Besch (1959) using the same competitive list as that in Spence, Farber and McFann's (1956) study, found that the main effects of anxiety were insignificant. In view of these contrary findings, Saltz and Hoehn (1957) devised a somewhat rigorous test of predictions derived from Hullian/Spence drive theory. These researchers believed that many of the studies supporting the theory confounded response-competition with task difficulty. Thus, they attempted to control both of these variables in such a way that their respective effects might be determined. In one experiment, they varied competition level while holding difficulty constant. In another experiment they compared easy but competing material with difficult but non-competing

material. The results indicated that increased difficulty but not increased competition of material contributed to the poorer performance of HA subjects.

The diversity of findings in regard to drive theory predictions, indicate that factors other than task variables must influence the performance of subjects scoring at the extremes of the manifest anxiety scale. One assumption implicit in the use of the Taylor scale is that subjects scoring at the upper end experience a chronically high degree of anxiety and thus respond emotionally, whether the situation is stressful or not. An alternative hypothesis to this (the emotional reactivety hypothesis), (Spence, 1958) is that HA subjects react more strongly to situations containing a degree of stress. Support for this latter hypothesis is indicated by Lucas (1952) who found that while failure reports concerning performance on a serial learning task helped improve the learning of LA subjects, HA subjects performance declined. Spence and Spence (1966) have indicated preference for the emotional reactivity hypothesis stating that "....in designing experiments to test implications of theory about the effects of drive on performance, it would be wise to deliberately include stressful stimulation....in order to increase the probability that anxiety groups will differ in emotionality in the experimental situation". (p. 307). With regard to this, a review of studies involving situational stress seem in order at this point.

Anxiety and Situational Variables

In the present review, two things will be attempted: 1) to assess the effects of stress on performance; and 2) to assess the interaction of stress variables with anxiety and their subsequent effect upon performance. An excellent review of the earlier literature concerning stress variables has been provided by Lazarus, Deese and Osler (1952). These authors have indicated that stress in the experimental situation is usually produced in either one of three ways or by a combination of more than one of these three basic methods:

1. Stress produced by shock.
2. Stress produced by varying the subject's level of task involvement (ego or task orienting instructions).
3. Stress produced by issuing reports of failure.

Each of these methods will be considered separately.

Shock as a Stressor

Despite the large number of successes of Spence and his associates in demonstrating the facilitative effects of noxious stimulation (puff of air to the eyes) in eyeblink conditioning, the generalization of this effect to other tasks (although blinking one's eyes can hardly be construed as a task) with other forms of noxious stimuli (e.g. shock) has not produced the desired uniformity of

findings. Drive theory would predict that in response to shock, HA individuals would perform better on a simple task but more poorly as the task increased in difficulty, due to the fact that increased drive level will interact indiscriminately with all response tendencies present in the situation. In general, the effect of shock has been either to disrupt performance of all subjects in verbal learning experiments, (Deese, Lazarus and Keenan, 1953; Lazarus and Longo, 1953; Reece, 1954) or to have no significant effect (Lazarus, Deese and Hamilton, 1954; and Brown, 1966).

Using meaningful material (i.e. words) and the verbal learning paradigm of Spence, Farber and McFann (1956), Besch (1959) found that contrary to drive theory which predicted that "increases in noxious stimulation would yield increases in those effects attributed to drive", shocked subjects performed more poorly on both the competitive and non-competitive paired-associates lists. Similar effects were found by Lee (1961) although performance on a difficult list was significantly effected by shock for all subjects.

The efficacy of drive theory is further clouded when one considers the differential effects of shock on the performance of high and low anxious subjects. One of the most suprising findings when one inspects this interaction, is that in many cases, of

all groups in the various experiments reported here, LA subjects who had been shocked, performed the most poorly (Deese, Lazarus and Keenan, 1953, Besch, 1959; Lee, 1961).

In addition Besch (1959) has demonstrated that shock does not facilitate performance of HA subjects when the correct response is predominant, a finding which received support from a series of experiments conducted by Farber and Spence (1956) concerning the effects of anxiety on reaction time in which these investigators failed to find a significant effect of drive level (anxiety).

What is one to make of these confusing findings? A possible answer to this dilemma comes from a number of sources (Eriksen, 1954 and 1966; Deese, Lazarus and Keenan, 1953; Saltz, 1970 and 1971). Eriksen (1954) for example, has suggested that rather than actually measuring anxiety per se, the Manifest Anxiety Scale (MAS) reflects the various methods employed by subjects in containing anxiety (i.e. defense mechanisms). He identifies the LA subject with the hysterical type as derived from MMPI profiles (the characteristic defense mechanism of the hysteric is avoidance which is wholly inappropriate in a situation involving unavoidable shock). On the other hand, individuals identified as highly anxious by the MAS, have profiles resembling the psychasthenic type whose characteristic defensive maneuvers are rationalization and intellectualization.

Thus, as Saltz (1970 and 1971) suggested, extreme scores on the manifest anxiety scale, rather than isolating HA and LA types, are identifying individuals who are sensitive to different types of stress. Saltz goes on to re-interpret the findings of the eyeblink conditioning experiments in terms of a reduction of LA subjects' performance due to noxious stimulation rather than an increase in that of HA subjects. This would bring the Iowa group's findings in line with those of Bindra et al. (1955) who found no performance difference (in salivation) when a non-defensive drive (hunger) was the unconditioned stimulus. The above theoretical approach will receive additional credibility from consideration of the effects of other types of situational stress variables upon performance.

The focus of the present review has, to this point, been primarily concerned with the drive aspects of anxiety and with testing the adequacy of drive theory (Taylor and Spence, 1952; Taylor, 1956; and Spence, 1958), in dealing with various research findings. The results may best be described as ambiguous. In the following section, the bulk of research to be examined will be concerned with the associative aspects of anxiety as emphasized by Mandler and Sarason, 1952; Sarason, Mandler and Craighill, 1952; and Child, 1954. The basic assumptions of associative theory are as follows:

1. There exists a complex interaction among such variables as anxiety level, stressful instructions and task complexity in determining performance level.

2. Highly anxious subjects tend to react to evaluative situations with responses which, although anxiety reducing, are inappropriate to the task, (i.e self-relevant).

3. Low anxious subjects are generally not hampered by such "task-irrelevant" responses and tend to make more responses which are "task-relevant".

4. In a situation which involves ego-orienting instructions responses previously learned by subjects in response to stressful test situations are cued-off. (e.g. feelings of inadequacy, anticipation of failure, implicit attempts at leaving the test situation).

5. Low anxious individuals, not being plagued by such responses to anxiety, respond to stress with increased motivation to do well.

6. When the third factor is introduced (task-difficulty), it may be viewed as an added stress factor and differentially effects performance in the above manner.

7. Based upon the above formulations, it would be expected that as test material becomes more difficult and stress is increased, then HA individuals should perform at a lower level than their LA counterparts.

I. Q. Orientation

When one considers the over-all effects of I.Q. orientation upon performance, (i.e. leading the subject to believe that his

performance on a particular test will be a good indicator of his intellectual capabilities and/or a good predictor of his academic success or failure) it becomes readily apparent that it either facilitates performance (Romanow, 1958; Sarason, 1957a and b; Sarason and Palola, 1960; Vogel, Baker and Lazarus, 1958; Kalish, et al. 1956) or has no over-all effect (Sarason, 1956, 1959, 1961; Sarason and Sarason, 1957; Allison, 1970; Nicholson, 1958), although a few studies have demonstrated a tendency for I.Q. orientation to be detrimental to performance (Parkes, 1961; Katchmar, Ross and Andrews, 1958).

Considering the differential effects of I.Q. orientation upon subjects of varying anxiety levels provides a possible solution to the lack of clear cut results indicated above. Sarason (1956) for example, had subjects perform a serial rote-learning task under two levels of motivational instructions. He found that, while I.Q. orientation facilitated the performance of Middle and Low Anxious subjects, it was detrimental for High Anxious subjects.

Nicholson (1958) in a study similar to that of Sarason's (above), found that under task-orientation (i.e. subjects were asked to do well as a favour to the experimenter), there was no difference between the performance of low and high anxious groups whether the task was easy or difficult. However, under ego-orienting instructions, LA subjects' performance improved relative to

that under task-orientation, while HA performance declined. These results are essentially the same as Sarason's (1956 and 1957b) and indicate that HA subjects are adversely effected by increased stress (as created by I.Q. orientation) on serial rote-learning tasks. Since in all of the above studies, performance differences do not occur between HA and LA groups prior to the ego-involving instructions (which is contrary to predictions from basic drive theory), then something inherent in the instructions must contribute to the performance decrease of HA subjects and to the increase in LA. These results then would best be interpreted in terms of the Mandler/Sarason type of formulation relating the poor performance of stressed, highly anxious subjects to task-irrelevant response tendencies which presumably interfere with those responses which are "task relevant".

In tasks involving other factors than rote-learning however, (e.g. reasoning and organization) results become a little more difficult to explain.

Sarason and Palola (1960) in a series of 3 experiments, found that in digit symbol performance involving tasks of varying difficulty, that high anxious subjects' performance was adversely effected by ego-involving instructions but only on the difficult task. This finding was corroborated by Scharf (1964) who demonstrated that HA subjects performed more poorly under ego-stress only on the most difficult items of an anagram task.

Fleischer (1966) found that the level of HA performance was inferior to that of LA subjects on a number of complex cognitive tasks but that ego-stress was not a significant factor, a result similar to that of Sarason and Russell (1965) who found HA subjects to be consistently inferior to LA on a difficult anagram task.

Although less clear-cut, the above findings generally support a response interference interpretation of the effects of anxiety. Sarason and Palola, (1960); and Scharf, 1964; provided evidence for a three way interaction of anxiety, instructions and task difficulty, while Fleischer (1966) and Russell and Sarason (1965), though failing to find a triple interaction could well argue that a non-stress condition did not exist in view of the inherently stressful nature of their very difficult stimulus materials.

Let us now consider the effects of failure reports as a stress producing agent.

Failure Stress

When considering the over-all effects of failure reports upon performance, one is struck by the fact that they are in partial opposition to those involving I.Q. orientation. The bulk of experimental evidence from studies involving failure stress indicate the following: 1. Failure stress serves to reduce performance level (Moldowsky and Moldowsky, 1952; Sarason, 1956; Sarason and Sarason 1957; and Krop, Alegre and Williams, 1969). Sarason 1956 for

theory as evidenced by a replication attempt by Axelrod, Cowen, and Heilizer (1956) of Farber and Spence's (1953) findings. These investigators found no significant differences between HA and LA groups and concluded that their results did not support "simple deductions from Hullian Theory". However, as pointed out by Spence, Farber and McFann (1956) and Spence (1958), knowledge concerning the relative strengths of correct or incorrect response tendencies is at a rather primitive level. Thus, these investigators have abandoned using this type of task in favour of paired-associates learning which they regard as more suitable test of drive theory (Feldman, 1964).

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findings. Drive theory would predict that in response to shock, HA individuals would perform better on a simple task but more poorly as the task increased in difficulty, due to the fact that increased drive level will interact indiscriminately with all response tendencies present in the situation. In general, the effect of shock has been either to disrupt performance of all subjects in verbal learning experiments, (Deese, Lazarus and Keenan, 1953; Lazarus and Longo, 1953; Reece, 1954) or to have no significant effect (Lazarus, Deese and Hamilton, 1954; and Brown, 1966).

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all groups in the various experiments reported here, LA subjects who had been shocked, performed the most poorly (Deese, Lazarus and Keenan, 1953, Besch, 1959; Lee, 1961).

In addition Besch (1959) has demonstrated that shock does not facilitate performance of HA subjects when the correct response is predominant, a finding which received support from a series of experiments conducted by Farber and Spence (1956) concerning the effects of anxiety on reaction time in which these investigators failed to find a significant effect of drive level (anxiety).

What is one to make of these confusing findings? A possible answer to this dilemma comes from a number of sources (Eriksen, 1954 and 1966; Deese, Lazarus and Keenan, 1953; Saltz, 1970 and 1971). Eriksen (1954) for example, has suggested that rather than actually measuring anxiety per se, the Manifest Anxiety Scale (MAS) reflects the various methods employed by subjects in containing anxiety (i.e. defense mechanisms). He identifies the LA subject with the hysterical type as derived from MMPI profiles (the characteristic defense mechanism of the hysteric is avoidance which is wholly inappropriate in a situation involving unavoidable shock). On the other hand, individuals identified as highly anxious by the MAS, have profiles resembling the psychasthenic type whose characteristic defensive maneuvers are rationalization and intellectualization.

Thus, as Saltz (1970 and 1971) suggested, extreme scores on the manifest anxiety scale, rather than isolating HA and LA types, are identifying individuals who are sensitive to different types of stress. Saltz goes on to re-interpret the findings of the eyeblink conditioning experiments in terms of a reduction of LA subjects' performance due to noxious stimulation rather than an increase in that of HA subjects. This would bring the Iowa group's findings in line with those of Bindra et al. (1955) who found no performance difference (in salivation) when a non-defensive drive (hunger) was the unconditioned stimulus. The above theoretical approach will receive additional credibility from consideration of the effects of other types of situational stress variables upon performance.

The focus of the present review has, to this point, been primarily concerned with the drive aspects of anxiety and with testing the adequacy of drive theory (Taylor and Spence, 1952; Taylor, 1956; and Spence, 1958), in dealing with various research findings. The results may best be described as ambiguous. In the following section, the bulk of research to be examined will be concerned with the associative aspects of anxiety as emphasized by Mandler and Sarason, 1952; Sarason, Mandler and Craighill, 1952; and Child, 1954. The basic assumptions of associative theory are as follows:

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1. There exists a complex interaction among such variables as anxiety level, stressful instructions and task complexity in determining performance level.

2. Highly anxious subjects tend to react to evaluative situations with responses which, although anxiety reducing, are inappropriate to the task, (i.e self-relevant).

3. Low anxious subjects are generally not hampered by such "task-irrelevant" responses and tend to make more responses which are "task-relevant".

4. In a situation which involves ego-orienting instructions responses previously learned by subjects in response to stressful test situations are cued-off. (e.g. feelings of inadequacy, anticipation of failure, implicit attempts at leaving the test situation).

5. Low anxious individuals, not being plagued by such responses to anxiety, respond to stress with increased motivation to do well.

6. When the third factor is introduced (task-difficulty), it may be viewed as an added stress factor and differentially effects performance in the above manner.

7. Based upon the above formulations, it would be expected that as test material becomes more difficult and stress is increased, then HA individuals should perform at a lower level than their LA counterparts.

I. Q. Orientation

When one considers the over-all effects of I.Q. orientation upon performance, (i.e. leading the subject to believe that his

performance on a particular test will be a good indicator of his intellectual capabilities and/or a good predictor of his academic success or failure) it becomes readily apparent that it either facilitates performance (Romanow, 1958; Sarason, 1957a and b; Sarason and Palola, 1960; Vogel, Baker and Lazarus, 1958; Kalish, et al. 1956) or has no over-all effect (Sarason, 1956, 1959, 1961; Sarason and Sarason, 1957; Allison, 1970; Nicholson, 1958), although a few studies have demonstrated a tendency for I.Q. orientation to be detrimental to performance (Parkes, 1961; Katchmar, Ross and Andrews, 1958).

Considering the differential effects of I.Q. orientation upon subjects of varying anxiety levels provides a possible solution to the lack of clear cut results indicated above. Sarason (1956) for example, had subjects perform a serial rote-learning task under two levels of motivational instructions. He found that, while I.Q. orientation facilitated the performance of Middle and Low Anxious subjects, it was detrimental for High Anxious subjects.

Nicholson (1958) in a study similar to that of Sarason's (above), found that under task-orientation (i.e. subjects were asked to do well as a favour to the experimenter), there was no difference between the performance of low and high anxious groups whether the task was easy or difficult. However, under ego-orienting instructions, LA subjects' performance improved relative to

that under task-orientation, while HA performance declined. These results are essentially the same as Sarason's (1956 and 1957b) and indicate that HA subjects are adversely effected by increased stress (as created by I.Q. orientation) on serial rote-learning tasks. Since in all of the above studies, performance differences do not occur between HA and LA groups prior to the ego-involving instructions (which is contrary to predictions from basic drive theory), then something inherent in the instructions must contribute to the performance decrease of HA subjects and to the increase in LA. These results then would best be interpreted in terms of the Mandler/Sarason type of formulation relating the poor performance of stressed, highly anxious subjects to task-irrelevant response tendencies which presumably interfere with those responses which are "task relevant".

In tasks involving other factors than rote-learning however, (e.g. reasoning and organization) results become a little more difficult to explain.

Sarason and Palola (1960) in a series of 3 experiments, found that in digit symbol performance involving tasks of varying difficulty, that high anxious subjects' performance was adversely effected by ego-involving instructions but only on the difficult task. This finding was corroborated by Scharf (1964) who demonstrated that HA subjects performed more poorly under ego-stress only on the most difficult items of an anagram task.

Fleischer (1966) found that the level of HA performance was inferior to that of LA subjects on a number of complex cognitive tasks but that ego-stress was not a significant factor, a result similar to that of Sarason and Russell (1965) who found HA subjects to be consistently inferior to LA on a difficult anagram task.

Although less clear-cut, the above findings generally support a response interference interpretation of the effects of anxiety. Sarason and Palola, (1960); and Scharf, 1964; provided evidence for a three way interaction of anxiety, instructions and task difficulty, while Fleischer (1966) and Russell and Sarason (1965), though failing to find a triple interaction could well argue that a non-stress condition did not exist in view of the inherently stressful nature of their very difficult stimulus materials.

Let us now consider the effects of failure reports as a stress producing agent.

Failure Stress

When considering the over-all effects of failure reports upon performance, one is struck by the fact that they are in partial opposition to those involving I.Q. orientation. The bulk of experimental evidence from studies involving failure stress indicate the following: 1. Failure stress serves to reduce performance level (Moldowsky and Moldowsky, 1952; Sarason, 1956; Sarason and Sarason 1957; and Krop, Alegre and Williams, 1969). Sarason 1956 for

example, had subjects perform 14 trials with a serial list of nonsense syllables after which half were issued reports of failure, while the other half received a neutral communication. All subjects then performed another trial with the same list. It was found that the failure report adversely effected the performance of both high and low anxious subjects; 2. Failure stress has no over-all effect on performance (Mandler and Sarason, 1952; Lucas, 1952; Waterhouse and Child, 1953; Sarason, 1957c; Weinberg, 1960; Sarason, 1961). Weinberg (1960) for example, varied the effects of 2 levels of failure and two levels of personalization of failure on performance of a task which had subjects name as many words as possible with a given beginning and within a specified time period. It was found that neither of the stress variables had a significant over-all effect upon performance; 3. A few studies have found failure stress to have had a facilitative effect upon performance, (Rosenberg and Lauber, 1961; and Truax and Martin, 1957) but these are in the minority.

One general conclusion which may be forwarded at this point with regard to the above findings is that I.Q. orientation and reports of failure are separate constructs which to a certain extent, produce different effects. A similar point has been noted by Parkes (1961) and Saltz (1971). It has also been suggested that they each occupy a point along a stress continuum (Spence, 1966).

Failure Stress and Anxiety Level

In opposition to the above studies which indicated that stress was debilitating to all subjects whether anxious or non-anxious, a number of verbal learning studies have indicated that under the influence of failure reports, the performance of highly anxious individuals has been markedly inferior to non-failure conditions, while non-anxious subjects' performance varied from inferior to superior in respect to failure stress (Sarason, 1961; Sarason, 1957b & c; Lucas, 1952). Lucas (1952) for example, found that while failure reports improved the performance of LA subjects, (improvement being positively related to the number of failure reports), they were detrimental to the performance of HA subjects on a test of immediate memory for consonants. In addition, similar findings have been indicated using a complex speed task (Katchmar, Ross and Andrews, 1958), a block design test (Mandler and Sarason, 1952) and IQ-like test performance (Waterhouse and Child, 1953).

In view of its theoretical import, the Mandler and Sarason (1952) study will be given a more thorough consideration here. All subjects in this study were given 6 trials on a Block Design problem (Kohs #13) and a digit symbol test. Following this, they were issued with a neutral communication or one indicating that they had either done well or poorly. Equivalent forms of the initial tests were then administered. It was found that the intervening

success or failure report was facilitative for LA performance but debilitative for HA subjects. It was concluded that HA subjects perform optimally when no further reference is made to the testing situation and the LA subjects exhibit the best performance under failure-induced stress conditions. These findings support the contention of the above researchers, that on the basis of prior learning, reference to the testing situation will evoke, in highly anxious subjects, a large number of "task-irrelevant" response tendencies which will serve to reduce performance level. LA subjects on the other hand, not being hampered by task-irrelevant response tendencies, will benefit from the increased motivation and thus exhibit increments in performance level.

It is of interest to note that, in a number of the studies cited above, (e.g. Sarason, 1957c; Katchmar, Ross and Andrews, 1958), performance differences between HA and LA groups occurred only following failure reports. And Sarason (1961) on a task calling for the solution of 13 difficult anagrams has indicated that prior to the failure report, HA were superior to both MA and LA groups, while the opposite was apparent following the report. These findings tend to favour the associative rather than the drive conception of anxiety, although drive theory could account for the above findings by postulating a curvilinear relationship between drive and performance. Eysenck (1957) elaborates at length and provides experimental evidence consistent with the foregoing speculation.

From the theoretical point of view however, the "interference hypothesis" suggested by Child (1954) as an alternative to drive theory, has been incorporated into the Iowa group's formulations regarding drive and anxiety (Spence, 1966). These researchers have stated that task-irrelevant responses emphasize the function of drive stimulus or SD (rather than D) which has the capacity to evoke both learned and unlearned responses which may be either overt or covert (Hull, 1943 cited in Spielberger, 1966). Thus Spence and Spence (1966) state:

> "Among the responses aroused by the SD associated with a persisting emotional responsiveness in human Ss, we hypothesize, are those that may be described as task-irrelevant, e.g. heightened autonomic reactions or covert verbalizations reflecting self-depreciation, anger, desire to escape, etc. To the extent that the situation is one in which irrelevant tendencies are elicited and the task is one in which the particular irrelevant tendencies elicited by SD interfere with correct responding, a hypothesis that states that such tendencies are more easily aroused in high anxious Ss leads to the prediction that the performance of high anxious Ss will be inferior." (p. 308)

Spence and Spence (1966) have indicated however, that the response interference hypothesis may only be valid in situations involving a degree of deliberately induced stress (as in Sarason's studies), since it has been demonstrated that HA subjects do not always perform at a lower level on complex tasks as Child's (1954) notion would suggest.

The answer to the theoretical issues are not forthcoming at this point, but the implications of the various bodies of research are clear: the effects of anxiety upon performance cannot be a simple function of drive level (e.g. How could a simple drive interpretation predict that while LA subjects with stress perform better than LA subjects without stress, while HA subjects with stress are inferior to HA subjects without stress?) but rather must be a complex interaction among such variables as anxiety level, stress and the type of task. This includes not only the presence or absence of stress, but also consideration of the type of stressor used.

The following section will be concerned with the effects of anxiety level and ego-involvement on problem solving behaviour.

Anxiety and Problem Solving

To this point, the primary focus has been upon either simple tasks such as those found in conditioning experiments (those involving only one response tendency) or complex verbal learning tasks of varying difficulty level. Although these tasks are excellent for experimental purposes (e.g. minimizing the effects of prior experience), one might note as has Levitt (1967) that, ".....rote learning is not of great importance in human life, and what there is of it seldom takes place under the kind of conditions imposed by the researcher". (p. 140) The present section deals

with performance in problem solving, an activety which presumably comes closer to approximating the "real-life" situation. Problem solving as distinct from learning, "differs only in degree from other classes of learning and performance, the degree of difference depending upon the extent to which problem-solving demands location or integration of previously learned responses" (Duncan, 1959 cited in Levitt, 1967). Despite the multiplex problems involved with adequately defining the tasks used in this area of research and of controlling the many extraneous variables, were these factors defined and held constant, it might be expected, on the basis of research discussed to this point, that the prevalence of high levels of anxiety in the problem-solving situation would cause a decrease in the level of performance. Let us examine the evidence bearing upon this point.

One of the more commonly used verbal problem solving tasks are anagrams, which are simply mixed-up words. The task is to rearrange the scrambled letters into a meaningful word. Although there exists some conflicting evidence, research into the effects of anxiety and stress on anagram solution has produced some uniform results. A number of studies (e.g. Russell and Sarason, 1965; Harleston, 1962) found that over-all low anxiety was associated with better performance in the solution of anagrams. Harleston

(1962) for example, used subjects of three differing levels of anxiety. He found an over-all linear relationship between anxiety and problem solving with low anxious subjects performing best, followed by middle anxious and then highly anxious. In addition, the difference between High and Low anxious subjects' performance, increased as a function of the difficulty of the anagrams. On the other hand, it has been found (Scharf, 1964) that subjects of different anxiety levels did not perform differently until an element of stress had been introduced into the situation at which point HA performance became inferior to that of LA but only on difficult anagrams. There was no effect of anxiety or stress on the easier problems which is essentially in agreement with the findings of Tallarico and Reitman (1959). Russell and Sarason (1965) demonstrated that although HA subjects consistently performed at a lower level than LA subjects, there was no over-all effect of stress instructions on a list of difficult anagrams. This finding is not in agreement with those of Sarason (1961) who found that HA subjects using the same list of difficult anagrams as Russell and Sarason (1965) performed at a higher level than either middle or low anxious subjects in the "no-stress" condition. The opposite was true when a stressful communication was administered prior to test performance.

To add to these already confusing results, Daniels (1968) found, that while task difficulty had a significant effect on performance level and the differential effect of motivational instructions was marginally significant ($p < .06$), there was no effect due to anxiety and none of the interactions were significant.

The most parsimonious statement at this point, although it does not seem to have complete verity, is that the situation most likely to produce optimal degrees of response interference for HA subjects is one where not only is the task difficult, but an element of threat has also been introduced. Without both of these elements, results are inconsistent.

Another fruitful area in research involving anxiety and problem solving has dealt with problems which would fall under the general heading of reasoning. It becomes immediately apparent when one considers the relevant research in this area, that performance does not follow the simple difficulty plus stress formula suggested above. Assuming that reasoning tasks are generally quite difficult, one might expect to find performance differences between subjects differing in anxiety level. A number of studies however, have not borne out this expectation (e.g. VanBuskirk, 1961; Maltzman, et al., 1956; Block, 1963; Fleischer, 1966 and Taylor, 1968). VanBuskirk (1961) for example, had sub-

jects of differing anxiety level perform on two complex reasoning tasks (Thurstone's 1938, figure analogies and logical deduction tests), each with varying levels of difficulty. It was found, contrary to prediction, that as complexity increased, no performance differences occurred between High and Low Anxious subjects on the figure analogies. In addition, with increasing complexity, HA subjects performed better on logical deduction problems. VanBuskirk interpreted these findings as supporting the hypothesis that, since HA subjects are more committed to performing well, their performance will be superior (relative to LA subjects) in a situation where there is no ego-involving threat. Unfortunately he did not verify this statement regarding the effects of stress. Fleischer (1966) however, has provided some evidence regarding the effects of stress and anxiety level in performance of the Concept Mastery Test which involves both the identification of synonyms and antonyms and the completion of analogies. He found that neither the effects of anxiety level nor that of stress had any bearing upon performance. In addition, Block (1963) has indicated that in performance of a number of reasoning problems, both HA and LA subjects were superior to a middle anxious group in the "no stress" condition. And while LA tended to do better than HA in response to stress (shock), the performance of all stressed

groups improved relative to non-stressed groups.

Two other studies (Taylor, 1968 and Maltzman, Eisman and Brooks, 1956) both employing logical reasoning tasks, have indicated that no significant difference was apparent between High and Low Anxious groups. In fact the latter study found LA to be, though not significantly, associated with poorer performance.

In summary then with regard to experiments concerning the effects of anxiety on general reasoning problems, it would seem that either there is no effect due to anxiety or that higher levels of anxiety are associated with superior performance. Although evidence is slim, it would seem that the added element of stress serves either to improve performance or has no effect.

The Alternate Uses Test (AUT) and the Consequences Test (CT) devised by J. P. Guilford and his associates (see Guilford, 1967) have served as stimulus material in a number of researches involving anxiety and problem solving (e.g. Feldhusen, Denny and Condon, 1956; Fleischer, 1966; Klein, Fredericksen and Evans, 1969; Krop, Alegre and Williams, 1969; and Uhes, 1970). The Alternate Uses Test requires subjects to list as many uses as they can think of for a common object (e.g. a brick), while the Consequences Test poses a number of hypothetical problem situations for which one must list as many possible outcomes as he can think of.

Two studies (Fleischer, 1966 and Klein et al., 1969) have indicated that superior performance on this type of test is generally associated with low levels of anxiety, while one study (Feldhusen, et al., 1965) found no relationship between performance on the Consequences Test or the Alternate Uses Test and differing anxiety levels.

Fleischer (1966) although finding a consistent difference in performance of these tests favouring LA subjects, did not find a relationship between stress and performance. But Krop et al., (1969) found that the introduction of stress prior to the administration of the CT and AUT significantly reduced performance level (it is unfortunate that these latter investigators divided their groups on the basis of stress and not with regard to initial anxiety level).

On the basis of rather scanty evidence then, it might be concluded that while anxiety level is a factor which is associated with the quality of performance on such tests as Consequences and Alternate Uses, the effects of stress are ambiguous. Fleischer (1966) however, has suggested that a possible reason for this lack of effect on the stress factor might be due to what he describes as "test-wise" subjects and Sperber (1961) feels that S must accept the test situation as something which is important to participate

in rather than something which can be conveniently avoided. It is suggested that more care should be devoted to insuring that stress producing instructions are, in fact, stressful.

Synthesis

The foregoing review of literature relevant to the effects of anxiety on problem solving behaviour has produced, what at first glance, would seem to be a series of conflicting findings. However, if one were to assume, as does Fleischer (1966) that the effects of anxiety are a function of specific stimulus factors inherent in certain tasks, a partial answer to this conflict might be forthcoming. Such tests as Alternate Uses and Consequences are characteristically ambiguous, divergent (Guilford, 1967) and require subjects to exercise a great deal of independent thought and judgement. If one can further assume, in concurrence with a number of other investigators (e.g. Korchin and Levine, 1957; Harleston, 1962; Ruebush, 1960), that in situations which are inherently stressful, HA subjects will react in a cautious, conforming manner, then faced with such tests as AUT and CT, it seems reasonable that HA subjects performance would be inferior to that of LA subjects.

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Korchin (1964) has proposed that a continuum of attention organization exists, extending from no voluntary focusing to a flexible

shifting from broad to narrow attention as the situation requires. Korchin assumes that in response to stress, functioning along such a continuum is reduced:

> "....at lower levels, the attentional field becomes more limited and focused. Whether such constriction disturbs or facilitates performance in a particular situation depends in large measure on the demands of the task whether it requires that a broader or narrower range of cues be utilized. (pp. 70-71).

In a similar vein, Ruebush (1960) theorizes that the "..... effect of anxiety on performance .....is mediated primarily by defensive reactions to anxiety", and that whether anxiety will facilitate or detract from performance, depends largely upon the nature of the task. Assuming that one such defensive reaction was excessive cautiousness, Ruebush, has indicated that HA subjects performed at a higher level than did their LA counterparts on the Witkin Embedded Figures Test which requires subjects to find a simple figure embedded within a more complex one. In short, it would seem that in a situation where excessive cautiousness is called for, HA subjects performance will be facilitated. In addition, since anxiety and stress serve to reduce flexibility (Gynther, 1967; Kaplan, 1966; Parkes, 1961; Tecce, 1965; Korchin and Levine, 1957), then HA subjects might be expected to perform at a higher level on tasks which require a lesser degree of flexibility.

J. P. Guilford (1956 and 1967), has conducted extensive factor analytic research of cognitive processes. Among other things, he has defined two broad classes of intellectual strategies referred to as divergent and convergent production. Convergent thinking involves the channeling or controlling of thought processes in a particular direction: e.g. the drawing of deductions that are "logic-tight" in that they are uniquely determined by the given information. Divergent thought processes, on the other hand, require that one must search in various directions and consider many possible responses to a problem. Some factors included under the term "divergent thinking" are adaptive flexibility and originality. In fact, Guilford considers divergent thought to be the most important factor in creativity.

A number of studies have indicated a non-significant relationship between anxiety scores and performance on intelligence tests (Carrier and Jewell, 1966; Zdep, 1966; Allison, 1970) for reviews of this literature see Spielberger, 1966; Ruebush, 1963 and Sarason, 1960). In addition, Allison (1970) manipulated stress as a variable and found neither the main effects of anxiety or stress nor their interactions to be related to I.Q. test performance. It may be emphasized at this point that much of the research concerned with general reasoning problems and anxiety, used as stimuli, material from standard intelligence tests (e.g. VanBuskirk, 1961; Maltzman, Eisman and Brooks, 1956; Fleisher, 1966). As indicated above, these types of tests seem to involve the use of cognitive processes

which may be subsumed under the general heading of convergent thinking. It is suggested that problems of the convergent nature are not as susceptible to the effects of high levels of anxiety since "cautiousness" as suggested by Ruebush (1960) or the "narrowing of cognitive organization" (Korchin, 1964), due to anxiety, are the types of strategies required for adequate performance on such tasks.

Conversely, it is suggested that the poor performance of HA subjects on such tests as Alternate Uses and Consequences, reflect the divergent nature of these tasks. Assuming as does Guilford, that the strategy involved in performing divergent tasks requires ranging outwards and searching freely through a large number of possible responses, then a cautious, narrow approach to such problems might be expected to reduce the adequacy of performance.

Summary

In the foregoing review of research, the effects of anxiety and stress upon performance have been discussed from the two current major theoretical points of view. These have been described as: the Iowa group under the auspices of Spence and his associates; and the Yale group of Mandler and Sarason. It has been demonstrated (if implicitly) that these theoretical positions are not as widely diverse as a cursory inspection might indicate. Both groups have conceptualized anxiety within a stimulus-response framework, and both agree that anxiety has drive properties. The basic difference

however, is one of emphasis. While the Iowa group tends to emphasize the notion that drive indiscriminately energizes all habit tendencies present in a given situation, the Yale group places accent upon the mediating responses to the energizing aspect of anxiety.

As a result of differing points of emphasis, it has been the thesis of the present review that definite research trends may be distinguished. The first of these deals with the interaction between anxiety and the nature of the task. In this area, the Iowa group has made an attempt to conceptualize task simplicity or complexity as a function of the relative numbers and strengths of habits, operative in a given situation. While research with simple reflex learning (conditioning) has yielded some uniform results, attempts to control habit hierarchies of more complex tasks have not supplied convincing evidence in support of drive theory. In addition, due to the great difficulty of controlling the complexity variable to satisfy the rigour of the Hull-Spence framework, drive theory, at this time, seems inadequate for generalization to more difficult problem-solving situations.

The second major research trend emphasizes the interaction of extra-task variables (e.g. situational variables) with anxiety and considers their subsequent effects upon performance level. Interference theory (Yale group) has provided the major theoretical background for research in this area and although there exists an

implicit belief in the existence of a pervasive trait of anxiety, these investigators are more interested in a depth analysis of anxiety in a particular stressful situation (i.e. one involving some degree of evaluation). A number of studies concerned with anxiety and situational variables were examined and provided conflicting findings. Some studies indicate that "high anxious (HA)" subjects perform in a manner superior to "low anxious (LA)" subjects when the situation is not stressful. Other studies find no difference between groups whether stressed or not. A few studies have even indicated an increase in HA performance as a function of stress. And finally HA subjects have been inferior to LA subjects under stress but only on the most difficult tasks.

In view of these often contradictory results, the present review examined a number of studies dealing with the interaction of anxiety, stress and a variety of problem-solving situations. Implicit in this section was the question, "does the nature of the task interact with anxiety and stress variables in determining performance level?" It was suggested that tasks in which a high anxiety level would be detrimental, are those which require flexible, wide-ranging cognitive strategies. On the other hand, it was also suggested that anxiety may not exert as marked an influence upon the performance of tasks which involve a systematic

search for a single correct answer. These suggestions are based upon the assumption that such responses to anxiety as cautiousness and the narrowing of cognitive organization are detrimental to the former, but possibly not to the latter type of task.

The present study was designed to test the above assumptions and was guided by the general hypothesis that: the effects of anxiety and stress upon peformance are mediated, to a large extent, by specific stimuli inherent in the task. The experimental design was a 2 X 2 factorial with two levels of anxiety (high and low) and two levels of stress (high and low). Each subject performed four experimental tasks, performance on which comprised the dependent variables. Two of these tasks were conceptualized as convergent and two were divergent.

METHOD

Subjects

The 40 male and 60 female subjects in the present study were selected from a pool of 450 Introductory Psychology students at Lakehead University. Selection was based upon extreme scores on the Institute for Personality and Ability Testing (IPAT) Anxiety Scale (Cattell, 1957) and the Test Anxiety Scale (TAS) (Sarason and Ganzer, 1962).

Materials

A total of six tests were used in the present study. Of these, two were the independent variable measures (i.e. the anxiety scales) and four were the independent variable measures (i.e. experimental material.

Copies of each test used can be found in the appendices.

Subject Selection Tests (Independent Variables)

It was felt, in view of the often contradictory findings of research which has used general and specific anxiety scales interchangeably, that a high score or a low score on both anxiety measures would provide a more inclusive assessment of anxiety level in the present study. The present rationale is based upon Spielberger's (1966) model of the State-Trait Anxiety dichotomy in which "A-State" is conceptualized as a transitory condition of the organism which varies in intensity and fluctuates over time. "A-Trait", on the other hand, is viewed as a relatively stable individual difference factor. An individual high in "A-Trait" may be expected to perceive

a wide range of objectively non-threatening situations as threatening. In short, a high "A-Trait" person is viewed as being anxiety prone. Conversely, a low "A-Trait" person would not be expected to exhibit anxiety in a wide variety of situations. From the foregoing discussion it may be deduced that although a high "A-Trait" individual may react emotionally to many situations (i.e. with high "A-State" reactions) this is not necessarily the case in all situations. Conversely, because an individual is low in "A-Trait" does not mean that he will never exhibit "A-State" reactions, that is, be anxious. Based upon the above reasoning it may be seen why research using general or specific scales separately, often had confusing results. In view of this, the present study posed two general questions to each potential subject: a) "Are you an anxious person?" and b) "Do evaluational situations such as I.Q. tests and examinations make you anxious?" Negative replies or positive replies to both of these general questions operationally defined whether an individual was classified as "High Anxious" or "Low Anxious" in the present study.

I. The Institute for Personality and Ability Testing (IPAT) Anxiety Scale consists of 40 items presented in a test booklet labeled The Self Analysis Form (Appendix A). This test yields three scores:

1. Overt Anxiety (symptomatic anxiety).
2. Covert Anxiety (not consciously exhibited anxiety).
3. Total Anxiety (composite of 1 & 2).

The total score was used in the present study.

There were two main reasons for selecting this particular measure of general anxiety rather than such others as the Taylor Manifest Anxiety Scale (MAS):

1. The present test was developed as a result of extensive research using factor analytic techniques in which the final 40 items were selected from a pool of several thousand.
2. The IPAT was constructed specifically for the diagnoses of anxiety while the MAS was primarily a research tool.

II. The Test Anxiety Scale (TAS) (Appendix B) consists of 16 forced choice items selected by Sarason and Ganzer (1962) from the larger pool comprising Mandler and Sararon's (1952) Test Anxiety Questionnaire (TAQ). This instrument was designed to assess the emotional reactions of subjects confronted with such evaluative situations as examinations and intelligence tests.

The shorter (TAS) measure of test anxiety was used in order to reduce the time spent by subjects in completing the two questionnaires. Levitt (1967) has indicated that shorter forms of anxiety questionnaires have invariably been shown to have a very high positive correlation with their respective full scale scores.

Experimental Material (Dependent Variables)

The four tests administered to each subject during the course of the experiment were: the Logical Reasoning Test (Hertzka and Guilford, 1955); the Letter Series Test (Adapted from the Nufferno Test, Furneaux, (1963); the Ingenuity Subtest Form A of the Flanagan

(1957) FACT battery; and a Word-Production Test.

Two of the above experimental tasks (the Logical Reasoning and the Letter Series Tests) were considered to incorporate the essential characteristics of problems requiring convergent thought processes, that is, requiring a logical search for a single correct answer. The two remaining tasks (the Ingenuity Test and the Word Production Test) were considered to require primarily divergent thought processes for adequate performance, that is, a wide-ranging problem solving approach which takes into consideration the many possible answers to this type of problem. It was felt that divergent thinking requires a greater degree of flexibility than does convergent thinking (Guilford, 1967).

Convergent Tasks

I. The Logical Reasoning Test (Appendix C) presents the subjects with two premises and a choice of four conclusions only one of which is logically correct. Hertzka and Guilford (1955) point out that the items are based upon logical principles and cover the 15 valid syllogistic forms. Although Guilford includes this test under evaluation in his "Structure of Intellect" model (Guilford, 1959) it was felt essentially that the test fits the general conception of "zeroing in" on one correct answer.

II. The Letter Series Test (Appendix D) is of the type first used by Thurstone in his Primary Mental Abilities battery. The items used in the present study are drawn from the Nufferno Level Test (GL/2c.46). Thurstone has demonstrated that problems of this nature are excellent for the measure of inductive-reasoning ability.

Guilford and Merrifield (1960) have indicated that this type of test falls within the category designated Convergent Production of Symbolic Relations in the "Structure of Intellect" model. The test requires that the subject indicate which letter properly continues the sequence of each series of letters. There are 15 items in the test and the score is based on the total number of correct items.

Divergent Tasks

I. The Ingenuity Test (Appendix E) developed by Flanagan (1959) presents the subject with a series of problem situations for which an "ingenious" solution exists. Flanagan (1963) has defined ingenuity (distinct from creativity) as being ".....shown by inventing or discovering a solution to a problem. The emphasis.....is on the existence of a problem and the demonstration of a quality of genius in solving it in an unusually neat, clever or suprising way [p. 92]." The operational definition of ingenuity then, in this case, is the production of unusually clever ideas, which could not be derived from a logical routine or mechanical process, to fit the needs of a real problem situation. The format of the test consists of a number of problem situations for which the ingenious solutions are stated except that a number of key words are omitted near the end. Five sets of first and last letters of key words are then provided as choices for the solution of each problem. The problems presented are believed to meet criteria conditions set forth by the author. These are as follows:

A. A clear cut problem is presented, the solution for which most people would not know before hand. The solution must fulfill the requirements set down in the authors operational definition of ingenuity.

B. The individual is required to think of the solution rather than recognize it.

C. No detailed knowledge of the problem area is required.

D. Once the solution is "thought of" S will experience a certain sense of closure in having arrived at a good solution.

In general, this test seems to meet the requirments for evoking the type of cognitive strategy described as flexible and calls for a search through a large number of possible alternative responses. Since solutions could not be arrived at by a process of deductive reasoning from the given facts, it was felt that this test required a much different problem-solving approach than that required by the Logical Reasoning and Letter Series Tests.

II. The Word-Production Test (Appendix F) is of the type described by Guilford (1967) as measuring Divergent Production of Symbolic Units (DSU) which Thurstone in his PMA battery refers to as "word-fluency". In this test, S is required to write as many words as he can think of having a specified beginning and ending. As with the Ingenuity Test, it was felt that a test of this nature required an "outward ranging" type of approach for adequate performance.

Procedure

Pretest. All potential subjects were required to complete the

IPAT and TAS approximately one month prior to the experiment proper. The correlation between the two tests was .39. On the basis of IPAT and TAS scores, two groups each comprising 50 subjects were selected. One group was composed of 30 Low Anxious (LA) females and 20 LA males while the other had 30 High Anxious (HA) females and 20 HA males. A highly anxious subject was considered to be one who had scored in the upper 20% of the TAS distribution ($\geq$ 11) and above 40 on the IPAT. A low anxious subject in the present study was defined as one who scored in the lower 20% of the TAS distribution ($\leq$ 6) and below 28 on the IPAT. The mean IPAT score for the entire sample of subjects was 34.2 with a standard deviation of 8.0. Thus, it was decided that cut-off points for selection of the experimental groups would be one standard deviation above or below the mean (i.e. 26 or less and 42 or more). A problem, however, was encountered at this point. Although there were enough subjects scoring high or low on either one of the anxiety scales separately, when enforcing the strict selection criteria of the present study (i.e. high or low scores on both tests) the number of eligible subjects became less than optimal* . In view of this, the cut-off points were made somewhat less stringent (28 or less and 40 or more) on the IPAT. This procedure was felt to be justi-

* It may be noted that this finding lends credence to the rational supplied earlier for using two anxiety scales. Had only the general scale (IPAT) been used, for example, the high anxious group may have contained subjects high in "A-Trait" whose level of "A-State" was not raised by test situations. Conversely, the low anxious group might have contained a number of subjects made very anxious ("A-State") by a test situation.

fied in view of the fact that a number of published studies (e.g. Taylor, 1968) had simply used the mean as the cut-off point for operationally defining high or low anxious groups of subjects.

Experimental Session. A classroom was used as the experimental setting and subjects were tested in groups of 25 by an experimenter other than the one who had administered the anxiety questionnaires. Half of the HA and half of the LA subjects were randomly assigned to either the stress or no stress condition with the stipulation that there be 10 males and 15 females in each group.

Instructions

Ss in the stress condition were issued the following instructions from what was felt to be a highly credible source:

> Good afternoon, my name is Dr. _____, Chairman of the Psychology Department. My reason for being here today is to explain to you the nature of the research in which you are about to participate. For some time now, the Psychology Department has been researching a new type of intelligence test which has in the past, proven to be a good predictor of success in university. Unfortunately, although a lot of work has been done with the test, it has been of the longitudinal variety where the test was administered to high school students who were then contacted five years later to determine how well they had progressed in university. It was found in general, that those high school students who had scored high on the test, did well in university. Students who obtained an average score were subsequently mediocre university students. Many of this group dropped-out of school before graduating. Of the group who did poorly in the test very few entered university at all. Your purpose for being here then, is to help us establish some normative data from students already in university in order that in the future we may better be able to predict on a year to year basis, whether or not a student would continue in university. I assume that all of you have done quite well academically to this point, so we will expect your good performance on the test.

In contrast, Low Stress subjects were issued the following instructions:

> The reason why we have asked you to be here today is in order that you may help us prepare for a research project to be conducted by the Psychology Department. The problems which we would like to use in this project are quite difficult and we are not quite sure how long it will require to complete them. So what we have done is put a time limit on each section of the test which is probably insufficient. All we ask is that you do as well as possible under the circumstances and not worry if you fail to complete each section.

Three of the tests were quite impossible to complete during the alloted time. These were the Logical Reasoning and Letter Series and Ingenuity Test. Stressed subjects when doing the Word-Production Test were provided with false and unattainable norms against which they could assess their performance.

Following the instructions, all subjects were issued booklets containing the test materials with appropriate instructions for each test. The experimenter read the instructions aloud while the subjects were instructed to follow along silently. The experimenter then solicited any questions, informed Ss of the amount of time alloted for the appropriate section, and issued the signal to begin.

Since a completely counterbalanced design was not feasible due to the number of subjects, a partially counterbalanced design was used. Half of each subject group received booklets in which the two convergent tasks appeared first, while the other half had booklets with the divergent tasks appearing first.

At the conclusion of the experimental session all subjects were completely debriefed. They were told that the orienting communication had been false and that the experiment had really involved the effects of anxiety and stress upon performance. They were also encouraged not to worry if they thought that they had done poorly since the test material was very difficult and no-one was expected to perform well.

RESULTS

The anxiety scale scores of male and female subjects on both the IPAT Anxiety Scale and the Test Anxiety Scale (TAS) were compared by means of t-tests. Since no significant differences were found, male and female subjects were combined to form a single group.

TABLE I

MEAN SCORES AND STANDARD DEVIATIONS
OF EACH GROUP ON EACH OF THE ANXIETY SCALES

		TAS		IPAT	
		LOW STRESS	HIGH STRESS	LOW STRESS	HIGH STRESS
LOW ANX.	$\bar{X}$	4.40	3.72	22.32	21.48
	S.D.	1.26	1.47	4.14	5.38
HIGH ANX.	$\bar{X}$	12.36	12.40	48.56	48.80
	S.D.	1.19	1.47	5.30	5.85

Table I presents the means and standard deviations of scores on each test for each of the subgroups. An examination of Table I reveals that while there was, as expected, a large difference between the scores of high anxious (HA) and low anxious (LA) subjects, the scores of each group when subdivided by treatment conditions (i.e. Low Stress and High Stress) were approximately equal ($t < 1$, df= 48, n.s.).

The statistical treatment performed on each dependent variable consisted of a 2X2 factorial analysis of variance. Thus, the performance of LA and HA subjects was compared under Low Stress and High Stress conditions on each test. The results of each analysis will be reported separately.

Logical Reasoning

TABLE 2

MEAN SCORES OF LA AND HA SUBJECTS IN LOW AND HIGH STRESS CONDITIONS ON LOGICAL REASONING

	LOW STRESS	HIGH STRESS	$\bar{X}$
LO. ANX.	25.00	22.64	23.82
HI ANX.	17.84	19.48	18.66
$\bar{X}$	21.42	21.06	

A 2X2 factorial analysis of variance was conducted on the performance data of the Logical Reasoning Test. The two factors comprising the present analysis were high and low levels of anxiety and high and low levels of stress. Only the main effect of anxiety was significant ($F=14.32$, df 1/96, $p < .001$).

An examination of Table 2 reveals that LA subjects performed better than HA subjects.

A summary of the analysis of variance performed on the Logical Reasoning Test data can be found in Appendix G.

Letter Series

TABLE 3

MEAN SCORES OF LA AND HA SUBJECTS IN LOW AND HIGH STRESS CONDITIONS ON LETTER SERIES

	LOW STRESS	HIGH STRESS	$\bar{X}$
LO. ANX.	8.76	8.04	8.40
HI. ANX.	6.36	8.08	7.22
$\bar{X}$	7.56	8.06	

A 2X2 factorial analysis of variance was conducted upon the performance data from the Letter Series Test. The two main factors were high and low levels of anxiety and high and low levels of stress. Anxiety was shown to have a significant effect upon performance ($F=9.68$, df 1/96, $p < .01$). An examination of Table 3 reveals that HA subjects did not perform as well as LA subjects. There was also a highly significant interaction between stress and anxiety ($F=7.46$, df 1/96, $p < .01$). Table 3 reveals the nature of the above interaction indicating that while LA subjects in the low stress condition performed better than LA subjects in the high stress condition, HA subjects in the low stress condition performed at a lower level than HA subjects in the high stress condition.

Appendix H contains a summary of the analysis of variance done on the Letter Series performance data.

Ingenuity

TABLE 4

MEAN SCORES OF LA AND HA SUBJECTS IN LOW AND HIGH STRESS CONDITIONS ON INGENUITY

	LOW STRESS	HIGH STRESS	$\bar{X}$
LO. ANX.	12.48	10.40	11.44
HI. ANX.	9.88	8.60	9.24
$\bar{X}$	11.18	9.50	

A 2X2 factorial analysis of variance was done on the Ingenuity Test performance data with high and low levels of anxiety and high and low levels of stress comprising the two factors. The analysis indicated that anxiety significantly effected performance ($F=12.54$, df 1/96, $p < .001$). An examination of Table 4 reveals that HA subjects performed at a lower level than did LA subjects. The main effect of stress was also highly significant ($F=7.31$, df 1/96, $p < .01$). It can be seen from Table 4.that subjects in the low stress condition performed better than subjects in the high stress condition.

Appendix I contains a summary of the analysis of variance done on the Ingenuity Test performance data.

Word Production

TABLE 5

MEAN SCORES OF LA AND HA SUBJECTS IN LOW AND HIGH STRESS CONDITIONS ON WORD PRODUCTION

	LOW STRESS	HIGH STRESS	$\bar{X}$
LO. ANX.	37.72	30.28	34.00
HI. ANX.	31.68	27.52	29.60
$\bar{X}$	34.70	28.90	

A 2X2 factorial analysis of variance was conducted upon the results of the Word Production Test. The two factors were low and high levels of anxiety, and low and high levels of stress. There was a highly significant effect of anxiety upon performance ($F=7.70$, df 1/96, $p < .01$). An examination of Table 5 reveals that LA subjects were superior in performance to HA subjects. In addition, the main effect of stress was highly significant ($F=13.37$, df 1/96, $p < .001$). An examination of Table 5 indicates that the performance levels of subjects in the high stress condition was inferior relative to that of subjects in the low stress condition.

A summary of the analysis of variance performed on the Word Production data will be found in Appendix J.

Summary of Results

1. Logical Reasoning

   a) LA subjects performed better than HA subjects.

2. Letter Series

   a) LA subjects performed better than HA subjects.

   b) LA subjects in the low stress condition performed better than LA subjects in the high stress condition while HA subjects in the low stress condition did not perform as well as HA subjects in the high stress condition. Thus, there was a significant interaction between anxiety and stress.

3. Ingenuity

   a) LA subjects performed better than HA subjects.

   b) Subjects in the low stress conditions performed better than subjects in the high stress conditions.

4. Word Production

   a) LA subjects performed better than HA subjects.

   b) Subjects in the low stress conditions performed better than subjects in the high stress conditions.

Copies of other analyses and supplementary data not mentioned in the foregoing text can be found in the appendices.

Discussion

The general hypothesis of the present research was that the effects of anxiety and stress upon performance are dependent upon the nature of the task. This prediction has received partial support. Although the main effect of anxiety was constant across tasks, performance was effected differentially by stress, depending upon the nature of the task. On two of the tasks there was no significant effect due to stress: on one of these two tasks there was a significant interaction between stress and anxiety which indicated the LA subjects under low stress performed better than LA subjects under high stress, while HA subjects under low stress did not perform as well as HA subjects under high stress. Results of the other two tasks indicated that performance in the high stress condition was markedly inferior to performance in the low stress condition.

Viewed in their entirety the above results are difficult to interpret in terms of either Drive Theory or Interference Theory. It may be recalled that in the Hullian Scheme, performance level in any situation is determined by multiplying the drive strength of the organism with the strength of the necessary response, thus the formula, E(xcitatory potential) = D(rive) x H(abit). In a simple situation involving only one response tendency, the organism with the highest level of drive(D) would be expected to perform best. In situations involving more than one response tendency, prediction of the outcome requires more than a simple consideration of drive

level. In addition to D, the relative number and strengths of habits operative in the situation must be determined. Were the correct response initially high in the hierarchy then a high level of D would be expected to facilitate performance. Conversely, were the correct response initially low in the hierarchy, then a high level of D would be expected to disrupt performance because D energizes all response tendencies whether they are correct or incorrect. In addition, the higher the level of D the more competing response tendencies there will be which will attain suprathreshold value (i.e. become available for serious competition with the correct response).

When considered within the above theoretical framework, the results of the present study are not easily explained. It would seem reasonable in view of the difficulty of the experimental tasks and the fact that subjects had no previous practice on these tasks, resulting in a great number of competing response tendencies, that HA subjects would perform more poorly than LA subjects. Correct responses in a large number of cases would be expected to occupy a non-dominant position in the hierarchy. Thus the higher the D level the more incorrect responses which would be energized and the greater the probability of an incorrect response. The fact that HA subjects performed more poorly in the present study than LA subjects is interpretable in terms of basic Drive Theory. But, consideration of the stress variable across tasks and subjects poses a number of problems. Subjects in the high stress condition would be expected to function at a higher D level than subjects in the low stress condition. This situation would be expected, theoretically, to yield

a similar pattern of results to that found by comparing the performances of HA and LA subjects. To put it simply, Drive Theory would predict that in a situation where the correct response was low in the habit hierarchy subjects in the high stress condition would be expected to perform at a lower level than subjects in the low stress condition. This was not the case on all tasks in the present experiment. On two tasks, there was no apparent debilitating effect of stress. In fact, on one of these two tasks, a significant interaction between anxiety and stress indicated that while LA subjects under high stress did not perform as well as LA subjects under low stress, HA subjects under high stress performed better than HA subjects under low stress. The other two tasks yielded results in line with Drive Theory prediction as both HA and LA subjects in the high stress condition performed more poorly than HA and LA subjects in the low stress condition. The fact remains however, that Drive Theory could not predict the results of performance on all the tasks.

As mentioned earlier, the present results seem not to be entirely explainable in terms of either Drive or Interference Theory. It may be recalled that Interference Theory postulates a complex interaction among such variables as anxiety level, stress and task complexity. Highly anxious subjects supposedly respond to evaluative situations with anxiety reducing though often task inappropriate responses. In stressful situations high anxious subjects tend to react with such previously learned responses to test-like situations as feelings of indadequacy and anticipation of failure, thus, their performance suffers. Low anxious individuals on the other hand are

apparently not effected by such interfering response tendencies and their performance benefits from the additional motivation provided by a stressful communication. A generalization drawn from the above framework would be that HA subjects in low stress situations should perform better than HA subjects in high stress situations. Conversely, LA subjects in low stress situations would be expected to perform more poorly than LA subjects in high stress situations. A brief review of the results of the present study is all that is needed to demonstrate that they do not conform to the above theoretical predictions. On two tasks there were no main effects due to stress. On one of these tasks there was a significant interaction between anxiety and stress which indicated that LA subjects in the low stress condition performed better than LA subjects in the high stress condition, and that HA subjects in the low stress situation did not perform as well as HA subjects in the high stress situation. These findings are diametrically opposed to what would be predicted from Interference Theory. On the other two tasks the performance of both LA and HA subjects in the high stress condition was inferior to the performance of HA and LA subjects in the low stress condition. This finding is in accord with Interference Theory prediction for the HA subjects but not for the LA subjects. In summary then, it seems quite apparent that neither Drive nor Interference Theory can explain all of the results of the present experiment. These results have demonstrated that the effects of stress are dependent upon the nature of the task. Since neither Drive nor Interference Theory can explain the obtained results, the present author will attempt a theoretical

explanation.

It was suggested earlier in the present paper that a possible framework within which experimental (problem-solving) tasks might be categorized, was the "Structure of Intellect" model (Guilford, 1967). Two broad classes of thought processes which are relevant to the present study, have previously been described. These are: 1. Convergent thinking, which involves the channeling of thought processes in a particular direction and the deduction of "logic-tight" conclusions which are uniquely determined by the given information; and 2. Divergent thinking, which involves a "wide-ranging" cognitive strategy and the consideration of many possible solutions to a given problem. Of the four experimental tasks used in the present study, two were considered to be largely convergent in nature (Logical Reasoning and Letter Series), and two were thought to have the characteristics of divergent tasks (Ingenuity and Word Production). In line with the above dichotomy the following discussion will deal separately with Convergent and Divergent tasks.

Convergent Tasks

The finding that Low Anxious (LA) subjects performed better than High Anxious (HA) subjects was unexpected. Van Buskirk (1961) who used similar tasks, found anxiety to be associated with superior performance, especially on the more complex tasks. Van Buskirk interpreted his results as supporting the general hypothesis that the performance of HA subjects would be superior due to a greater

commitment of these subjects to do well, as long as the situation did not involve the use of severe, ego-oriented threat. In addition, a number of investigations (e.g. Nicholson, 1958; Sarason, 1956 and 1957b) have indicated that under low stress conditions there was no difference between the performance levels of LA and HA subjects on rote learning tasks. These investigations found in addition, that in response to an "ego-oriented" communication, the performance of LA subjects improved while that of HA subjects declined. Contrary to the above findings the present results indicated that there was no main effect of stress on performance of convergent tasks. There was however, a significant interaction between anxiety and stress variables in performance of the Letter Series Test which indicated that LA subjects in the low stress condition performed better than LA subjects in the high stress condition while HA subjects under high stress performed better than HA subjects under low stress. A similar trend was evident, though not significantly so, for the Logical Reasoning Test.

The most problematic of the above findings, at least from a theoretical point of view, are: 1. the general inferiority of HA subjects performance compared to that of LA subjects; 2. the lack of a main effect due to stress, and 3. the unusual trends involved in the interaction between anxiety and stress. As emphasized previously, the present results seem not to be predictable within either a Drive or Interference theory framework.

A theoretical orientation which could prove fruitful in

the present context is suggested by the work of a number of independent researchers (e.g. Easterbrook, 1959; Korchin, 1964; Zaffy and Brunning, 1966; and Wachtel, 1968) who have demonstrated that one of the major effects of increasing degrees of arousal is to cause the organism to focus sharply upon these aspects of the attentional field which are judged to be immediately relevant, and to temporarily "tune-out" peripheral aspects or events. An example of this would be the work on incidental learning where it has been demonstrated (e.g. Wachtel, 1968) that high levels of arousal are facilitative to the performance of a central task but hinder the learning of a peripheral one.

Korchin (1964) expresses the above effect most succinctly when he points out that at high normal levels of arousal:

> .....the attentional field becomes more limited and focused. Whether such constriction disturbs or facilitates performance in a particular situation depends in large measure on the demands of the task, whether it requires that a broader or narrower range of cues be utilized. (p. 71)

Although as a general hypothesis regarding the relationship between arousal and performance, the range of cue utilization has been tested empirically using only relatively simple tasks, it may be helpful in explaining the results from the convergent tasks in the present study. Before tackling this problem however, it is necessary to consider the nature of the low stress situation in the present study since a number of experimenters (e.g. Ruebush, 1960; Van Buskirk, 1961; Nicholson, 1958) have reported that either HA subjects have performed better or that there was no difference

between the performances of HA and LA subjects under low stress conditions on a variety of tasks. The studies of Ruebush (1960) and Van Buskirk (1961) are of particular import in the present context since these researchers used tasks quite similar to those conceptualized in the present study as convergent. It is quite conceivable, in retrospect, that the low stress in the present study was, in fact, quite stressful for a number of reasons. For example, the study took place at the beginning of the academic year and all subjects were certainly naive as to the nature and purpose of psychological experimentation. In addition, subjects performed a number of difficult tasks in a test-like atmosphere and in the presence of a number of fellow students. These and other situational variables could very well have made this "low stress" situation, at least moderately stressful.

The results of performance on the convergent tasks indicate that HA subjects were inferior to LA subjects. In view of the above speculations regarding the possibility of the low stress situation being moderately stressful it is conceivable that LA subjects performed better because they benefited from the increase in motivation, while the performance of HA subjects was impeded by such "task-irrelevant" response tendencies as self-disgust, fear of punishment or loss of self-esteem etc. Conceptualized in this way the above results could be predicted from either a Drive or Interference theory framework. However, a consideration of results of performance in the high stress condition tends to cloud the issue.

There was no main effect of stress in performance of either of the convergent tasks and there was a significant interaction between anxiety and stress on the Letter Series Test which indicated that LA subjects in the low stress condition performed better than LA subjects in the high stress condition while HA subjects in the low stress condition were inferior to HA subjects in the high stress condition. The above interaction finds little precedent in the literature of the area which leads to the suspicion that it was anomalous.* In view of this, until more evidence is gathered on the above point it seems more fruitful to pursue the reasons for the lack of a decline in performance as a function of stress rather than emphasizing that a significant interaction (indicating that LA subjects in the low stress condition performed better than LA subjects in the high stress condition, while HA subjects under high stress performed better than HA subjects under low stress) occurred.

It has been suggested that the generalization regarding the reduction in cue utilization as a function of stress would be helpful in explaining the present results. Easterbrook (1959) describes the range of cue utilization as, "...the total number of

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* A set of t-tests performed on the data have indicated that while there was no significant difference between the performance levels of LA subjects in low and high stress conditions ($t = 1.16$, df 48, N.S.), the performance of HA subjects in the high stress condition was significantly better than that of HA subjects in the low stress condition ($t = 3.36$, df 48, $< .01$).

environmental cues in any situation that an organism observes, maintains an orientation towards, responds to, or associates with a response [p. 183]." Whether this focusing effect would increase or decrease performance level would (as Korchin (1964) has emphasized) depend to a large extent upon the nature of the task being performed.

By definition, convergent tasks require "logic-tight" deductions uniquely determined by the given information (i.e. the "zeroing-in" on the one correct response). It is suggested that performance on this type of task is less likely to be effected by the reduction in flexibility due to a reduction in cue utilization. Thus, it is suggested that although a stressful communication heightens the arousal level of all subjects and these subjects respond defensively with a reduction in cue utilization thus making functioning less flexible, a reduction in the flexibility of performance is not detrimental for convergent tasks which require a cautious and narrow problem-solving approach.

A summary of the foregoing analysis seems reasonable at this point. It has been suggested that the low stress condition in the present experiment was in fact moderately stressful. While LA subjects performance benefited from the increased motivation due to this moderately stressful situation, that of HA subjects was impeded by "task-irrelevant" response tendencies. In the high stress situation, it was proposed that, subjects responded to the stressful communication with a reduction in the range of cue utilization which as a consequence reduced the flexibility of performance.

Since convergent tasks by definition do not require a flexible and wide-ranging approach, but rather, a cautious and narrow one, performance on these tasks was not reduced by stress. In short, HA subjects were inferior to LA subjects but a stressful communication did not effect performance because of the nature of the task.

Divergent Tasks

The results of divergent task performance indicated the HA subjects performance was inferior to that of LA subjects and that the performance of both LA and HA subjects in the high stress condition was lower than that of LA and HA subjects in the low stress situation. In view of the prior analysis of convergent task performance, which indicated the existence of a moderate degree of stress in the "low stress" situation, the divergent task analysis will follow the same lines. While the performance of LA subjects benefited from the increased motivation due to moderately stressful conditions, that of HA subjects was impeded by the interfering effects of "task-irrelevant" response tendencies. The introduction of a stressful communication in the high stress condition served to reduce the range of cues utilized by subjects. As emphasized earlier, the above process tends to exclude certain aspects of the environment and thus makes behavior less flexible. By definition, divergent tasks are best performed by using a flexible wide-ranging problem-solving approach. It is conceivable then, that the finding that low stress subjects performed better than high stress subjects on divergent tasks,

was due to the fact that a reduced range of cue utilization impeded performance on this type of task. It is proposed then in summary that the performance of HA subjects was inferior to that of LA subjects because the intrusion of "task-irrelevant" response tendencies interfered with the adequacy of HA subjects performance. In addition, the inferior performance of subjects in the high stress condition relative to that of subjects in the low stress condition was suggested as being due to the fact that a reduced range of cue utilization was not conducive to the performance of divergent tasks.

The present analysis is similar in certain respects to that of Fleischer (1966) who suggested that the sensitivety of anxiety to divergent types of tasks is largely a function of specific stimulus factors inherent in these tasks:

> "Tests....which are sensitive to anxiety seem to be ambiguous and divergent and seem to demand independence of thought and judgement. This may reflect a tendency on the part of HA individuals to behave in a cautious and conforming manner in situations which are vague, unclear, novel, or lifelike, or in which there is no easily discernable, external criteria of "correctness" so that they must use their own judgement." (p. 81)

Summary of the Present Theoretical Interpretation: HA subjects were generally inferior in performance to LA subjects due to their greater tendency to respond in stressful situations with "task-irrelevant" response tendencies (e.g. fears of failure). The stressful communication, it was proposed, had a similar effect upon all subjects which produced different results across tasks. The proposed effect was that stress served to reduce the range of

cues utilized by subjects which consequently reduced the flexibility of performance. Convergent tasks, by definition require a lesser degree of flexibility for adequate performance. Thus, performance level did not decline as a function of stress. Divergent tasks, on the other hand, require a flexible, wide-ranging approach for good performance. Thus, performance declined as a function of stress. Essentially, the present theoretical interpretation makes use of the Interference Theory concept of "task-irrelevant" response tendencies to explain the consistent effect of anxiety across all four tasks and uses the notion of reduced cue utilization to explain why stress had differential effects upon performance depending upon the nature of the task.

Implications for Future Research

The present study has suggested a number of lines of research and methodological refinements which might be useful to pursue in the future.

The major finding was that although high anxiety was consistently related to inferior performance, the effect of stress upon performance depends upon the nature of the task. Since all of the tasks in the present study were relatively difficult, and since stress differentially effected performance depending upon whether the nature of the task was convergent or divergent, the first implication for future research is for theoretical refinement. A more rigorous theoretical and experimental analysis of defensive

reactions to anxiety and stress, and a closer scrutiny of a large number of task/differential instruction situations might contribute to the more accurate prediction of problem-solving behaviour of people at differing levels of emotionality.

A specific suggestion which might be worth investigating is a replication attempt of the finding that HA subjects in the high stress condition on Letter Series did better than HA subjects in the low stress condition. This type of effect finds little precedent in the literature dealing with the subject but has potential theoretical import. If, for example, the finding was anomolous, then it might be concluded that stress does, in fact, effect both LA and HA subjects in a similar manner and that the effect depends upon the nature of the task. From this point of view, it would be more feasible to treat anxiety and stress as separate constructs and to design future research with this in mind.

A great deal of research, has in the past, been concerned primarily with the difficulty dimension of experimental tasks. Thus, anxiety and stress were expected to be instrumental in the reduction of performance level as task difficulty increased. Results bearing upon this prediction have been inconclusive. In the present study, the difficulty dimension was not the primary focus. Rather, the type of problem-solving strategy required for adequate performance on a given task was considered. Thus, the finding that stress effects performance differentially depending upon the type of task suggests that future research might concern itself with holding the

difficulty dimension constant while varying the type of task. While this suggestion may be quite difficult to implement, a possible approach to this end might be through the use of the "Structure of Intellect" model (Guilford, 1956, 1959, 1967). Guilford has defined through factor analytic techniques, a wide assortment of parameters and categories of intellectual performance. In addition, he provides a large number of tests which presumably tap each of these cognitive processes. In addition, it might prove fruitful to conduct depth analyses of problem solving approaches most adequate for a given set of tasks and then to vary anxiety and task difficulty level across stress conditions.

A few methodological changes are suggested for future research. These are: a) the inclusion of a "middle-anxious" subject group in order to provide a broader range of subjects along a continuum of anxiety; b) the addition of a neutral instruction group in order that other possibly stressful features of the experimental situation might be assessed; c) an attempt to create a minimally stressful test situation in order that subject variables and environmental variables in response to stress might be extrapolated. This might be achieved through a program of individual testing over a number of sessions; and d) the implementation of a device by which the experimenter might assess each subjects response to the test situation (e.g. whether or not the stress provoking communication was, in fact, stressful).

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SELF ANALYSIS FORM

NAME _____ TODAY'S DATE _____
First Middle Last

SEX _____ AGE _____ OTHER FACTS _____
(Write M or F) (Nearest Year) (Address, Occupation, etc., as instructed)

CONFIDENTIAL

Inside this booklet you will find forty questions, dealing with difficulties that most people experience at one time or another. It will help a lot in self-understanding if you check Yes, No, etc., to each, frankly and truthfully, to describe any problems you may have.

Start with the two simple examples just below, for practice. As you see, each inquiry is actually put in the form of a sentence. By putting a cross, X, in *one* of the three boxes on the right you show how it applies to you. Make your marks now.

1. I enjoy walking..... ☐ Yes ☐ Occasionally ☐ No

A middle box is provided for when you cannot definitely say Yes or No. But use it as little as possible.

2. I would rather spend an evening:
(A) talking to people, (B) at a movie..... ☐ A ☐ In between ☐ B

About half the items inside end in A and B choices like this. B is always on the right. Remember, use the "In between" or "Uncertain" box only if you cannot possibly decide on A or B.

Now:

1. Make sure you have put your name, and whatever else the examiner asks, in the place at the top of this page.
2. Never pass over an item but give some answer to every single one. Your answers will be entirely confidential.
3. Do not spend time pondering. Answer each immediately, the way you want to at this moment (not last week, or usually). You may have answered questions like this before; but answer them as you feel *now*.

Most people finish in five minutes; some, in ten. Hand in this form as soon as you are through with it, unless told to do otherwise. As soon as the examiner signals or tells you to, turn the page and begin.

STOP HERE—WAIT FOR SIGNAL

A

1.	I find that my interests, in people and amusements, tend to change fairly rapidly	True ☐	In between ☐	False ☐
2.	If people think poorly of me I can still go on quite serenely in my own mind	True ☐	In between ☐	False ☐
3.	I like to wait till I am sure that what I am saying is correct, before I put forward an argument	Yes ☐	In between ☐	No ☐
4.	I am inclined to let my actions get swayed by feelings of jealousy	Sometimes ☐	Seldom ☐	Never ☐
5.	If I had my life to live over again I would: (A) plan very differently, (B) want it the same	A ☐	In between ☐	B ☐
6.	I admire my parents in all important matters	Yes ☐	In between ☐	No ☐
7.	I find it hard to "take 'no' for an answer", even when I know what I ask is impossible	True ☐	In between ☐	False ☐
8.	I doubt the honesty of people who are more friendly than I would naturally expect them to be	True ☐	In between ☐	False ☐
9.	In demanding and enforcing obedience my parents (or guardians) were: (A) always very reasonable, (B) often unreasonable	A ☐	In between ☐	B ☐
10.	I need my friends more than they seem to need me	Rarely ☐	Sometimes ☐	Often ☐
11.	I feel sure that I could "pull myself together" to deal with an emergency	Always ☐	Often ☐	Seldom ☐
12.	As a child I was afraid of the dark	Often ☐	Sometimes ☐	Never ☐
13.	People sometimes tell me that I show my excitement in voice and manner too obviously	Yes ☐	Uncertain ☐	No ☐
14.	If people take advantage of my friendliness I: (A) soon forget and forgive, (B) resent it and hold it against them	A ☐	In between ☐	B ☐
15.	I find myself upset rather than helped by the kind of personal criticism that many people make	Often ☐	Occasionally ☐	Never ☐
16.	Often I get angry with people too quickly	True ☐	In between ☐	False ☐
17.	I feel restless as if I want something but do not know what	Very rarely ☐	Sometimes ☐	Often ☐
18.	I sometimes doubt whether people I am talking to are really interested in what I am saying	True ☐	In between ☐	False ☐
19.	I have always been free from any vague feelings of ill-health, such as obscure pains, digestive upsets, awareness of heart action, etc.	True ☐	Uncertain ☐	False ☐
20.	In discussion with some people, I get so annoyed that I can hardly trust myself to speak	Sometimes ☐	Rarely ☐	Never ☐

CONTINUE ON NEXT PAGE.

A Score

1. Through getting tense I use up more energy than most people in getting things done — True ☐ Uncertain ☐ False ☐

2. I make a point of not being absent-minded or forgetful of details — True ☐ Uncertain ☐ False ☐

3. However difficult and unpleasant the obstacles, I always stick to my original intentions — Yes ☐ In between ☐ No ☐

4. I tend to get over-excited and "rattled" in upsetting situations — Yes ☐ In between ☐ No ☐

5. I occasionally have vivid dreams that disturb my sleep — Yes ☐ In between ☐ No ☐

6. I always have enough energy when faced with difficulties — Yes ☐ In between ☐ No ☐

7. I sometimes feel compelled to count things for no particular purpose — True ☐ Uncertain ☐ False ☐

8. Most people are a little queer mentally, though they do not like to admit it — True ☐ Uncertain ☐ False ☐

9. If I make an awkward social mistake I can soon forget it — Yes ☐ In between ☐ No ☐

10. I feel grouchy and just do not want to see people: (A) occasionally, (B) rather often — A ☐ In between ☐ B ☐

11. I am brought almost to tears by having things go wrong — Never ☐ Very rarely ☐ Sometimes ☐

12. In the midst of social groups I am nevertheless sometimes overcome by feelings of loneliness and worthlessness — Yes ☐ In between ☐ No ☐

13. I wake in the night and, through worry, have some difficulty in sleeping again — Often ☐ Sometimes ☐ Never ☐

14. My spirits generally stay high no matter how many troubles I meet — Yes ☐ In between ☐ No ☐

15. I sometimes get feelings of guilt or remorse over quite small matters — Yes ☐ In between ☐ No ☐

16. My nerves get on edge so that certain sounds, e.g., a screechy hinge, are unbearable and give me the shivers — Often ☐ Sometimes ☐ Never ☐

17. If something badly upsets me I generally calm down again quite quickly — True ☐ Uncertain ☐ False ☐

18. I tend to tremble or perspire when I think of a difficult task ahead — Yes ☐ In between ☐ No ☐

19. I usually fall asleep quickly, in a few minutes, when I go to bed — Yes ☐ In between ☐ No ☐

20. I sometimes get in a state of tension or turmoil as I think over my recent concerns and interests — True ☐ Uncertain ☐ False ☐

STOP HERE. **BE SURE YOU HAVE ANSWERED EVERY QUESTION.** **B Score**

Appendix B

NAME_____AGE_____DATE_____

SEX_____(M or F) FACULTY & YEAR_____

The following are sixteen questions dealing with feelings and attitudes expressed by many people regarding taking examinations. Please mark-off the responses (True-False) that best describes your feelings. It is important that you answer all questions.

1. While taking an important examination, I perspire a great deal. True_____False_____

2. I get to feel very panicky when I have to take a surprise exam. True_____False_____

3. During test, I find myself thinking of the consequences of failing. True_____False_____

4. After important tests I am frequently so tense that my stomach gets upset True_____False_____

5. While taking an important exam I find myself thinking of how much brighter the other students are than I am. True_____False_____

6. I freeze up on things like intelligence tests and final exams. True_____False_____

7. If I were to take an intelligence test I would worry a great deal before taking it. True_____False_____

8. During course examinations, I find myself thinking of things unrelated to the actual course material. True_____False_____

9. During a course examination, I frequently get so nervous that I forget facts I really know True_____False_____

10. If I knew I was going to take and intelligence test, I would feel confident and relaxed beforehand True_____False_____

11. I usually get depressed after taking an exam. True_____False_____

12. I have an uneasy, upset feeling before taking a final examination. True_____False_____

13. When taking a test, my emotional feelings do not interfere with my performance. True_____False_____

14. Setting a good grade on one test doesn't seem to increase my confidence on the second. True_____False_____

15. After taking a test I always feel I could have done better than I actually did. True_____False_____

16. I sometimes feel my heart beating very fast during important tests. True_____False_____

Appendix C

INSTRUCTIONS AND EXAMPLE

In this part, each item consists of two statements that are followed by four conclusions. The task is to examine each pair of statements, and to decide which one of the four given conclusions is the correct one.

Example:

No birds are insects
All swallows are birds

Therefore:

(A.) No swallows are insects
B. Some birds are not swallows
C. All birds are swallows
D. No insects are birds

Since insects include no birds, and birds include all swallows, conclusion "A" is correct. You would record this simply by encircling conclusion "A" as above. Please note that a correct conclusion is not just a repetition of the contents of one of the statements. Rather, it is derived from both statements.

You will have 15 minutes to complete this section. Please do not begin until the signal is given.

2. No footballs are round.
All handballs are round.

Therefore:

A. No handballs are footballs.
B. Some balls are not round.
C. All handballs are balls.
D. Some round things are not footballs.

2. All pilots are courageous.
Some women are pilots.

Therefore:

A. Some courageous individuals are not pilots.
B. Some men are pilots.
C. Some women are courageous.
D. Some women are not courageous.

3. No salesmen are bashful.
All hucksters are salesmen.

Therefore:

A. Some salesmen are not hucksters.
B. No hucksters are bashful.
C. All hucksters are brash.
D. Some bashful individuals are salesmen.

4. All representatives are agents.
No agents are competitors.

Therefore:

A. No competitors are representatives.
B. Some competitors are not agents.
C. Some agents are representatives.
D. No competitors are agents.

5. All little girls are cute.
Some little girls are fat.

Therefore:

A. Some little girls are not fat.
B. Some cute individuals are not little girls.
C. No fat little girls are cute.
D. Some fat individuals are cute.

6. Some posters are not effective.
All posters are advertisements.

Therefore:

A. Some posters are effective.
B. Some advertisements are not posters.
C. Some advertisements are not effective.
D. Some effective things are not posters

7. No educators are stubborn.
All teachers are educators.

Therefore:

A. No teachers are stubborn.
B. Some educators are teachers.
C. All teachers are reasonable.
D. Some stubborn individuals are educators.

8. No healthy individuals are patients.
Some executives are healthy individuals.

Therefore:

A. Some healthy individuals are not executives.
B. Some patients are healthy individuals.
C. Some patients are executives.
D. Some executives are not patients.

9. Some novels are classics.
All classics are recommended readings.

Therefore:

A. All novels are recommended readings.
B. Some recommended readings are novels.
C. Some classics are not novels.
D. Some recommended readings are not classics.

10. Some women are mothers.
All women are females.

Therefore:

A. All mothers are females.
B. All females are women.
C. Some females are mothers.
D. Some women are not mothers.

GO ON TO THE NEXT PAGE

11. All fire engines are red.
No hearses are red.

Therefore:

A. No fire engines are red hearses.
B. Some red things are not fire engines.
C. All hearses are black.
D. No hearses are fire engines.

12. Some songs are hits.
All hits are money-makers.

Therefore:

A. Some songs are not hits.
B. Some money-makers are songs.
C. Some hits are not songs.
D. Some songs are not money-makers.

13. All divers are swimmers.
Some divers are sailors.

Therefore:

A. Some sailors are swimmers.
B. Some swimmers are not divers.
C. All sailors are swimmers.
D. Some divers are not sailors.

14. All automobiles are cars.
All convertibles are automobiles.

Therefore:

A. Some automobiles are not convertibles.
B. Some cars are convertibles.
C. All cars are automobiles.
D. All convertibles are cars.

15. No railroad engines are airplanes.
Some railroad engines are coal-burners.

Therefore:

A. No airplanes are coal-burners.
B. Some coal-burners are not airplanes.
C. Some railroad engines are not coal-burners.
D. No airplanes are railroad engines.

16. No mares are singers.
Some singers are women.

Therefore:

A. No women are mares.
B. No mares are women.
C. Some women are not mares.
D. Some singers are not women.

17. All citizens are voters.
No minors are voters.

Therefore:

A. Some citizens are minors.
B. All minors are non-voting citizens.
C. No minors are citizens.
D. Some voters are not minors.

18. No feathers are straight.
All arrows are straight.

Therefore:

A. Straight feathers are arrows.
B. No arrows are feathers.
C. Some straight things are not arrows.
D. Some things are not straight.

19. All artists are creative.
Some scientists are not creative.

Therefore:

A. Some scientists are not artists.
B. No artists are scientists.
C. Some creative individuals are not artists.
D. Some scientists are creative.

20. No snails are racers.
Some dogs are racers.

Therefore:

A. No snails are dogs.
B. Some dogs are not snails.
C. Some racers are not dogs.
D. No dogs are snails.

21. No executives are timid.
All managers are executives.

Therefore:
A. All managers are timid.
B. No timid individuals are executives.
C. Some executives are managers.
D. No managers are timid.

22. No rumors are reliable.
Some dangers are rumors.

Therefore:
A. Some dangers are not rumors.
B. Some dangers are not reliable.
C. No reliable things are rumors.
D. Some rumors are not dangers.

23. Some chisels are dull.
All chisels are tools.

Therefore:
A. Some tools are dull chisels.
B. Some tools are chisels.
C. Some tools are dull.
D. Some chisels are not dull.

24. All oilmen are rich.
Some Texans are oilmen.

Therefore:
A. Some Texans are rich.
B. Some oilmen are not Texans.
C. All Texans are rich.
D. Some rich individuals are not oilmen.

25. No territories are self-governing.
Some islands are territories.

Therefore:
A. Some territories are not islands.
B. Some islands are self-governing.
C. No self-governing areas are territories.
D. Some islands are not self-governing.

26. No taxes are desirable.
All earnings are desirable.

Therefore:
A. No earnings are taxes.
B. All earnings are taxed.
C. Some earnings are not taxed.
D. Taxes are less desirable than earnings.

27. All primates are apes.
No apes are monkeys.

Therefore:
A. Some apes are primates.
B. No monkeys are primates.
C. Some primates are not monkeys.
D. Some monkeys are not apes.

28. All clerks are wage-earners.
Some married men are clerks.

Therefore:
A. Some wage-earners are not clerks.
B. Some clerks are not married men.
C. All married men are wage-earners.
D. Some married men are wage-earners.

29. All soldiers are men.
All sergeants are soldiers.

Therefore:
A. All sergeants are men.
B. Some soldiers are sergeants.
C. Some men are not sergeants.
D. Some sergeants are not men.

30. All writers are authors.
No authors are imitators.

Therefore:
A. Some writers are not imitators.
B. Some imitators are not authors.
C. No imitators are writers.
D. Some authors are writers.

GO ON TO THE NEXT PAGE

31. Some workers are productive individuals.
All productive individuals are assets

Therefore:
A. Some productive individuals are not workers.
B. All assets are productive.
C. Some workers are not assets.
D. Some assets are workers.

32. All dressmakers are girls.
All finishers are dressmakers.

Therefore:
A. Some girls are not finishers.
B. All finishers are girls.
C. Some dressmakers are finishers.
D. Some girls are not dressmakers.

33. Some engineers are designers.
All engineers are graduates.

Therefore:
A. Some graduates are designers.
B. Some engineers are not designers.
C. Some graduates are engineers.
D. All designers are graduates.

34. All senators are elected.
Some governors are not elected.

Therefore:
A. Some elected individuals are not senators.
B. Some governors are elected.
C. Some governors are not senators.
D. No senators are governors.

35. All mistakes are errors.
No solutions are errors.

Therefore:
A. Some errors are mistakes.
B. No solutions are mistakes.
C. Some errors are not solutions.
D. Some solutions are not mistakes.

36. All submarines are vulnerable.
Some submarines are killers.

Therefore:
A. Some killers are vulnerable.
B. Some killers are submarines.
C. Some vulnerable things are not submarines.
D. Some killers are not vulnerable.

37. No generals are youngsters.
Some soldiers are youngsters.

Therefore:
A. Some youngsters are not soldiers.
B. Some soldiers are not generals.
C. No soldiers are generals.
D. No generals are soldiers.

38. Some airplanes are not propeller-driven.
All airplanes are expensive.

Therefore:
A. Some propeller-driven things are not airplanes.
B. Some airplanes are propeller-driven.
C. Some expensive things are not propeller-driven.
D. Some expensive things are not airplanes.

39. No businessmen are federal employees.
Some businessmen are gamblers.

Therefore:
A. Some businessmen are not gamblers.
B. No federal employees are businessmen.
C. Some federal employees are gamblers.
D. Some gamblers are not federal employees.

40. No coins are stamps.
Some stamps are collector's items.

Therefore:
A. Some coins are collector's items.
B. Some collector's items are not coins.
C. Some collector's items are not stamps.
D. Some stamps are not coins.

STOP HERE

Appendix D

INSTRUCTIONS AND EXAMPLE.

In this test each problem is made up of a row of letters which is arranged according to some definite rule of its own. Study example (1) at the bottom of these instructions. It runs ABCDEFG. and it is easy to see that the letters here are simply in the usual alphabetical order. At the end of the row there is a dot and you have to work out which letter could be written in place of the dot without breaking the rule which applies to the rest of the series. For example (1) the answer is 'H', which continues the alphabetical order, and this has been entered in the answer space belonging to Example (1).

Look at Example (2). This follows a different rule. It is simply the alphabet written backwards, but with every alternate letter left out. The answer is 'P', and you should write this in the answer area by the side of Example (2) below as soon as you understand how the problem is solved.

Complete the remaining examples by yourselves writing in the answers in the space provided.

Examples	Answers
(1) ABCDEFG.	(1) H
(2) Z X V T R .	(2)
(3) BBBCCCDD.	(3)
(4) GHIJKL.	(4)
(5) DCBAZYX.	(5)

You will now be given 15 minutes to complete this part of the test. Please do not turn over until the signal.

Start here

(1) AXAYBXBYCXCY.

(2) AZAAYAAXAAWAA.

(3) ABCXYZDEFXYZG.

(4) RWSTVUUVWTSR.

(5) EFEFCDGHGHCD.

(6) RTUVUVXYZYZBCDCD.

(7) Z A C F J N Q S .

(8) GHIGIJKLKMNOMOPQR.

(9) QUSWAYCGEIMK.

(10) TUVRSTUPQRST.

(11) AMBCMDEFMGHIJ.

(12) ZAXZZXZYXZXXZ.

(13) A D G B E H C F .

(14) X F H Z J L B N P .

(15) GWVHIJUTSRKLMN.

(16) QRQRRPSRO.

(17) L O M P N .

(18) CEBDACZB.

(19) QKPOLMNMLNOP.

(20) YZAWXYZUVWXY.

Answers

(1)_____

(2)_____

(3)_____

(4)_____

(5)_____

(6)_____

(7)_____

(8)_____

(9)_____

(10)_____

(11)_____

(12)_____

(13)_____

(14)_____

(15)_____

(16)_____

(17)_____

(18)_____

(19)_____

(20)_____

END.

Appendix E

INSTRUCTIONS AND EXAMPLES.

This is a test of your ability to think of ingenious and effective ways of doing things. You are to think of the word or words that best answer the problems on the following pages. The clues to the correct solution for each problem are found in the paragraph describing it and the first and last letters of each missing word are given in one of the five alternate choices. First, think of the answer to the problem. Next, see if one of the five choices has the same first and last letter and the same number of missing letter spaces as your answer. Then, encircle the letter corresponding to the answer you have chosen.

Read the sample problem below and think of the word which will complete a clever and ingenious solution to this problem.

Sample problem:

A hostess for a children's party wanted to serve ice cream in an interesting manner, and she decided to make a clown for each child. She placed a ball of ice cream to represent the clown's head on a round cookie which served for a collar, and on top of this she inverted a

A. t_ _e.
B. u_ _i.
C. r_ _s.
(D) c_ _e.
E. t_ _r.

The word you should have thought of is cone, since this would give the clown an appropriate hat which could also be eaten and which could easily be obtained for this purpose. Choice D has "c" and "e" as its first and last letters, and two spaces for the "o" and "n" between. Therefore, D, the correct answer, has been encircled.

STOP HERE, DO NOT GO ON.

1. In the process of writing a report, several hundred reference books were used. It was decided that a list of the authors and the titles of the books would be included at the end of the report for bibliographic reference. In order to speed up the alphabetizing process for this bibliography it was decided that each reference would be listed on a small

A. n ___ s.
B. t ___ r.
C. r ___ d.
D. c ___ d.
E. s ___ e.

2. A scientist wished to determine whether the honey bee's ability to smell sweets required actual contact with microscopic air-borne particles of the substance or to reception of rays similar to light rays reflected from the substance. One step in checking this was to place a sweet with a strong odor in an enclosure with a swarm of bees. The sweet was contained in an airtight container made of

A. b ___ y.
B. f ___ r.
C. n ___ s.
D. r ___ l.
E. g ___ s.

3. Bob Johnson, a draftsman, keeps a compass lying loose in a desk drawer along with a lot of other equipment he needs frequently. Since he has more equipment than he has adequate room for, the desk drawer compartment is cluttered. Therefore, he has often pricked a finger on the compass point when reaching for a pencil or something else. To keep this from ever happening again, he embeds the compass point in an

A. a ___ l.
B. e ___ r.
C. l ___ d.
D. a ___ t.
E. e ___ e.

4. It is always a little difficult to measure the diameter of a pipe or round rod without using calipers. One man thought of a means of solving the problem by using a pair of pliers. He gripped the pipe with the pliers so that the tips of the jaws of the pliers were on opposite sides of the pipe. It was then very simple to get a fairly good measure of the diameter of the pipe by checking the distance between the tips of the pliers with an ordinary

A. p ___ e.
B. r ___ r.
C. w ___ e.
D. p ___ h.
E. c ___ l.

5. The guacharo, a South American bird, gives out squawks and shrieks as it flies through the jungle in almost total darkness. A scientist wanted to find out whether the bird was using the echoes from these sounds to avoid bumping into objects. After experimenting to establish the fact that the guacharos were able to fly in total darkness in an improvised darkroom without bumping into walls or objects, the scientist next had them try to fly when they were fixed so they couldn't

A. p ___ t.
B. c ___ e.
C. b ___ r.
D. t ___ g.
E. h ___ r.

6. A corporation advertises its new high fidelity phonograph as having "distortion-free performance which reduces rumble to an inaudible minimum." In the ad it shows a picture of a chicken and an egg to illustrate its claims. These claims are briefly stated in the accompanying slogan which contains the two words

A. Faithful l ___ t.
B. Faithful t ___ d.
C. Faithful r ___ n.
D. Faithful n ___ e.
E. Faithful s ___ l.

7. Using some material given him by a friend, a boy wove a large wicker basket to use as a knapsack to carry food and clothing on a hunting trip. He decided to make another basket and needed to know how much material to get. Since he had no records and had to order the material by mail he wanted a fairly accurate estimate. After some thought he finally hit upon the idea of determining the amount of material he should order by

A. w ___ g the basket.
B. s ___ g the basket.
C. l ___ g the basket.
D. h ___ g the basket.
E. c ___ g the basket

GO ON TO THE NEXT PAGE.

8. An outstanding optometrist has devised a type of glasses which enables people with highly impaired vision to read. The new glasses have been found to give some people who had only about 5% of normal vision as much as 90% of normal vision for reading. The principles used by the inventor were suggested to him by observing their effectiveness in the eyepiece of a powerful

A. o _ _ _ _ _ _ _ _ h.
B. n _ _ _ _ _ _ _ _ y.
C. r _ _ _ _ _ _ _ _ p.
D. p _ _ _ _ _ _ _ _ e.
E. t _ _ _ _ _ _ _ _ e.

9. An airplane manufacturer wishes to encourage engineers to learn about the increased opportunities for job-seekers that have recently been created in his firm. To emphasize what a small investment is necessary to get this valuable information, he placed at the top of his full page ad in a technical magazine a picture of a few pennies and a phrase, "For the price of a

A. r _ _ _ _ _ t p _ _ _ _ n."
B. p _ _ _ _ _ e s _ _ _ _ p."
C. w _ _ _ _ _ d q _ _ _ _ t."
D. d _ _ _ _ _ r s _ _ _ _ e."
E. s _ _ _ _ _ a w _ _ _ _ k."

10. A large department store planned to display new spring suits for women in its windows. The outstanding feature of the suits was the clever use of large and small checked fabrics in stylish combinations. For example, a coat made of fabric with large checks was shown with a suit made of a fabric with very small checks. The fashion coordinator was asked to write a window card which would attract attention and "sell" the suits and coats shown in the window. The card was to feature two check marks (✓ ✓) to tie in with the featured coats and suits.

The sign as finally prepared neatly reassured the customer. The wording used was:

A. D _ _ _ _ e c _ _ _ _ _ d for fashion.
B. R _ _ _ _ s t _ _ _ _ _ _ n for fashion.
C. F _ _ _ _ r d _ _ _ _ _ s for fashion.
D. K _ _ _ _ e a _ _ _ _ _ d for fashion.
E. T _ _ _ _ n w _ _ _ _ _ s for fashion.

11. A contractor was asked to build a two-bedroom house so that maximum use could be made of wall and cupboard space and so that housework could be kept to a minimum. The contractor eliminated a great deal of extra work by building in a double duty linen closet. This was made accessible from both bedrooms by placing one set of linen drawers between the two rooms. For each drawer each room had a separate set of

A. t _ _ _ _ s.
B. g _ _ _ _ s.
C. p _ _ _ _ s.
D. h _ _ _ _ s.
E. r _ _ _ _ s.

12. A man tells a friend of his who is a paint manufacturer he is going to paint the walls of a playroom white, with small irregularly spaced and irregularly shaped red dots all over. The manufacturer claims he can make a special paint which will do the entire job with a single application. He says he would make a white water-base paint and would force into it globules of red paint which would remain

A. u _ _ _ _ _ _ t because of their r _ d b _ _ e.
B. s _ _ _ _ _ _ d because of their o _ l b _ _ e.
C. u _ _ _ _ _ _ d because of their d _ y d _ _ e.
D. d _ _ _ _ _ _ d because of their r _ d t _ _ e.
E. p _ _ _ _ _ _ s because of their h _ o b _ _ e.

13. A company which maintained a line of gasoline stations along the East Coast received reports from its station attendants that very few people driving north had difficulty following its maps. However, drivers going south seemed to be confused and to turn right when they should have turned left and vice versa. One of the men on the travel staff of the company got an idea for a new map to be used by drivers going south. The new map was printed so that the southern states were at the

A. s _ t.
B. b _ r.
C. r _ e.
D. t _ p.
E. n _ b.

GO ON TO THE NEXT PAGE.

14. In the preceding problem the idea involved a change so that as compared with the old maps the names of the cities, towns, and so forth on the new maps were printed

A. b _ _ _ _ _ _ _ d l _ _ _ m.
B. r _ _ _ _ _ _ _ m s _ _ _ t.
C. a _ _ _ _ _ _ _ e f _ _ _ r.
D. m _ _ _ _ _ _ _ g t _ _ _ t.
E. u _ _ _ _ _ _ _ e d _ _ _ n.

15. A card file was being used to record information regarding a group of customers. The cards were 5" by 8". Since the information was being kept by customer number, the cards were arranged in that order. However, many times it was necessary to check the total number of customers being handled by one salesman. One solution would be to set up an independent file for each of eight salesmen, but this would involve copying the information twice, and maintaining several files. The solution was reached that just one file was needed, and the cards for the individual salesman could be quickly located by dividing the top of the cards into eight sections, one for each salesman, and cutting off part of the top of the card in such a way as to give each salesman's card a distinctive

A. l _ _ n.
B. r _ _ t.
C. t _ _ b.
D. w _ _ g.
E. b _ _ s.

16. A woman was planning to bake a cake with one chocolate and one white layer. She found that she did not have two small square pans but just one large rectangular pan. She decided she might still be able to bake the chocolate layer and the white layer at the same time in the rectangular pan if she used some aluminum foil. She cut the aluminum foil longer than the pan and placed the ends of the foil against each end of the pan. The extra foil she used as a

A. r _ _ _ _ _ _ t.
B. l _ _ _ _ _ _ e.
C. w _ _ _ _ _ _ d.
D. d _ _ _ _ _ _ r.
E. s _ _ _ _ _ _ a.

17. It was desired to get a large flock of a certain species of small birds to leave a very large airplane hangar. It was known that these birds would take flight rapidly if an "alarm call" was uttered by another bird of this type. Such a call could be produced by holding the feet of one of these birds while it struggled to get away. However, the call was ordinarily not heard by the other birds more than a few feet away. In order to get rid of the birds it was found that the alarm call could be obtained in a form that was convenient to use repeatedly, with the desired loudness, by holding one of the birds by the feet and making a

A. r _ _ _ _ _ _ _ g.
B. p _ _ _ _ _ _ _ e.
C. a _ _ _ _ _ _ _ e.
D. s _ _ _ _ _ _ _ s.
E. t _ _ _ _ _ _ _ y.

18. Some scientists were trying to determine whether the nightingale learns its song by imitating its parents or whether the song is inborn and merely requires the development of the bird's voice. In order to rule out any possibility of learning through imitation, the scientists decided to start with nightingale

A. f _ _ _ e.
B. r _ _ _ d.
C. e _ _ _ s.
D. s _ _ _ y.
E. c _ _ _ t.

19. In advertising a new suit for men, the manufacturer calls attention to the comfort of the suit, and the fact that it packs well and washes and dries without a wrinkle. They neatly summarized their points by heading their ad with the three words,

A. F _ _ _ _ t for travel.
B. S _ _ _ _ d for travel.
C. A _ _ _ _ t for travel.
D. P _ _ _ _ e for travel.
E. R _ _ _ _ m for travel.

GO ON TO THE NEXT PAGE.

20. It is possible to add vertical lines to the pages of a notebook or to rule blank paper quickly and easily by using a handmade stamp and a regular stamp pad. This solution makes it possible to vary the thickness of the lines by changing the tension of the material used. This special stamp is made from a block of wood, several thumbtacks, and three or four narrow

A. r_____r b_____s.
B. h_____t n_____s.
C. t_____k s_____s.
D. l_____e h_____s.
E. o_____d u_____s.

Appendix F
INSTRUCTION AND EXAMPLE

This section is divided into two parts, each five minutes in length. In each part you will be presented with the first and last letters of a word. The task is for you to write down as many words as you can think of having the given beginning and ending.

EXAMPLE:

B _____ E

badge, bake, besiege, browse, bone bubble, ... etc.

TIME LIMIT:

five minutes.

C_____E

TIME LIMIT:

five minutes.

D_____E

APPENDIX G

ANALYSIS OF VARIANCE COMPARING HA AND LA
Ss IN HIGH AND LOW STRESS CONDITIONS ON LOGICAL REASONING

SOURCE	df	M.S.	F
Anxiety	1	665.64	14.32***
Stress	1	3.24	.07
Anxiety x Stress	1	100.00	2.15
Error	96	46.49	-----
Total	99	------	-----

*** $p < .001$

APPENDIX H

ANALYSIS OF VARIANCE COMPARING HA AND LA
Ss IN HIGH AND LOW STRESS CONDITIONS ON LETTER SERIES

SOURCE	df	M.S.	F
Anxiety	1	34.81	6.98**
Stress	1	6.25	1.25
Anxiety x Stress	1	37.21	7.46**
Error	96	4.99	-----
Total	99	-----	-----

** $p < .01$

APPENDIX I

ANALYSIS OF VARIANCE COMPARING HA AND LA
Ss IN HIGH AND LOW STRESS CONDITIONS ON INGENUITY

SOURCE	df	M.S.	F
Anxiety	1	121.00	12.54***
Stress	1	70.56	7.31**
Anxiety x Stress	1	4.00	<1
Error	96	9.65	-----
Total	99	------	-----

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

APPENDIX J

ANALYSIS OF VARIANCE COMPARING HA AND LA
Ss IN HIGH AND LOW STRESS CONDITIONS ON WORD PRODUCTION

SOURCE	df	M.S.	F
Anxiety	1	484.00	7.70**
Stress	1	841.00	13.37***
Anxiety x Stress	1	62.24	1.07
Error	96	62.89	-----
Total	99	-----	-----

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

APPENDIX K

MEAN SCORES AND STANDARD DEVIATIONS
OF EACH GROUP AS A FUNCTION OF ANXIETY AND STRESS

		LOGICAL REASONING		LETTER SERIES		INGENUITY		WORD PRODUCTION	
		LOW STESS	HIGH STRESS	LOW STRESS	HIGH STRESS	LOW STRESS	HIGH STRESS	LOW STRESS	HIGH STRESS
LOW ANX.	$\overline{X}$	25.00	22.64	8.76	8.04	12.48	10.40	37.72	30.28
	S.D.	7.13	6.86	2.70	2.47	3.32	3.16	9.48	7.84
HIGH ANX.	$\overline{X}$	17.84	19.48	6.36	8.08	9.88	8.60	31.68	27.52
	S.D.	6.30	6.34	1.41	2.73	2.93	2.73	6.43	6.98