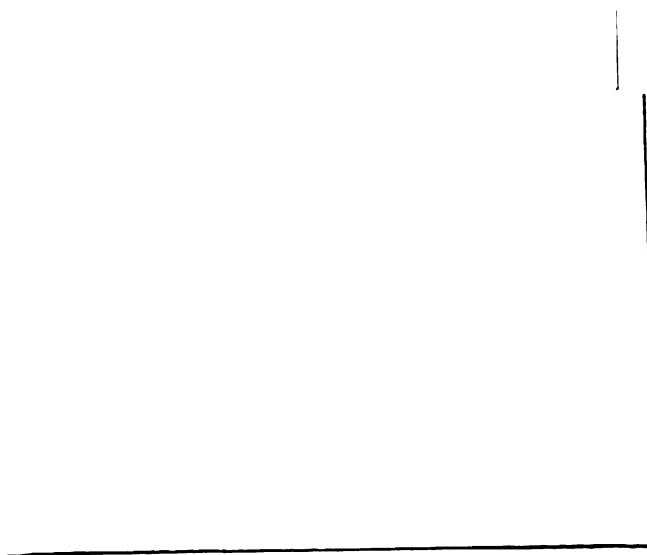


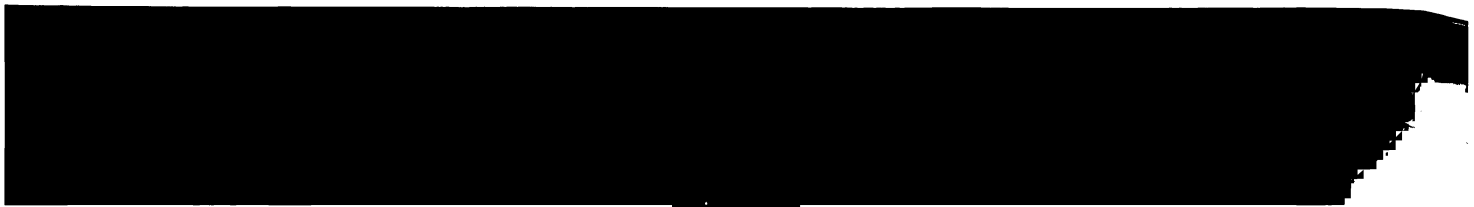
SOME RELATIONSHIPS BETWEEN ANXIETY,
COGNITIVE STYLE, AND PROBLEM SOLVING

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
Leon Darryl Thomander
1972



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ABSTRACT

SOME RELATIONSHIPS BETWEEN ANXIETY, COGNITIVE STYLE, AND PROBLEM SOLVING

By

Leon Darryl Thomander

In the present investigation 114 male undergraduates were assessed for academic ability and achievement, the presence of three types of anxiety (test anxiety, trait anxiety, state anxiety), the use of three different cognitive styles (flexible-rigid, impulsive-reflective, analytic-global), and performance on two types of deductive reasoning problem solving tasks. The subjects were divided into two groups of 57 and were tested during two sessions spaced one day apart. A completely counterbalanced 2 X 2 Latin Square design was used. One group of subjects experienced nonstress experimental conditions in the first session and stress conditions in the second session, while the reverse order of treatment conditions was used with the other group.

Four general questions were asked. (1) Will the measured anxiety, cognitive styles and strategies, and problem solving efficiency of subjects vary systematically with changes in psychologically stressful conditions? Although the treatment conditions were psychologically stressful enough to produce differences between groups in state anxiety, they did not significantly affect problem solving efficiency, problem solving

strategies, or performance on cognitive ability tests used as measures of cognitive styles.

(2) Will subjects who are measured as more anxiety prone tend to exhibit different patterns of cognitive styles and strategies than less anxiety prone subjects? The original set of data was reduced to 26 variables by means of several cluster analyses. The intercorrelations of these 26 clusters showed that high anxiety prone subjects tended to score lower on measures of academic ability, be less flexible as measured by a flexibility-rigidity scale, and while working on the problem solving tasks, they tended to lack carefulness, have poor concentration, dislike working on the problems, become frustrated, and make several strategy changes. These findings are consistent with the hypothesis that the worry component of anxiety interferes with performance by taking attention away from the task. Poor concentration, lack of carefulness, and strategy changes may all be indications of inability to maintain attention toward the task.

(3) Will subjects be measured as using the same cognitive styles consistently under different experimental conditions and across time? This question was not answered because the two kinds of style measures that were used in both sessions--cognitive ability measures and problem solving questionnaire measures--were found to be inadequate for use as indicators of styles as they are usually defined.

(4) Will the different measures of cognitive styles be shown to have construct validity? Neither the problem solving questionnaire measures nor the cognitive ability measures of style used in the present study were found to have convergent or discriminant validity as style measures. The findings indicate that if cognitive styles do exist as individual traits, they are very difficult to identify, and that some

instruments which have been used to assess them are of doubtful utility for that purpose. Although general cognitive processing characteristics that fit the usual definitions of cognitive styles were not found, certain more specific aspects of processing were identified. These were called cognitive strategies and were found to have some generality across time and problem types.

SOME RELATIONSHIPS BETWEEN ANXIETY,
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Leon Darryl Thomander

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1972

ACKNOWLEDGEMENTS

I would like to thank the members of my thesis committee for their help and guidance. In particular, I appreciate Richard Marshall, the committee chairman, for his guidance in planning the study, for many helpful suggestions on all phases of the project, and for encouraging me to think and write with greater precision and clarity. I want to express gratitude to John Hunter for the countless hours he spent giving invaluable help with the experimental design, statistical analysis, and interpretation of the results. Thanks also go to Donald Johnson for thoroughly reading the manuscript and for his helpful suggestions. Finally, I thank my wife, Nanci, for typing the final copy and for moral support throughout.

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I. INTRODUCTION

In a number of studies reviewed by Sarason (1960) and more recently by Spielberger and Gaudry (1971) negative relationships have been reported between a variety of intellectual performance measures and scores on anxiety scales. Anxiety is a hypothetical construct that is used to refer to a complex set of human reactions, characterized by feelings of tension and apprehension and by increased autonomic nervous system activity (Levitt, 1967), which frequently occur when people are subjected to various kinds of stress. Anxiety Scales typically consist of items which ask about the presence of certain physical (e.g., heart rate, perspiration level, stomach upset) and mental (e.g., worry, fear, self-doubt) behaviors which are used operationally as indicators of anxiety. When changes occur in these behaviors, inferences are made about changes in levels of anxiety. At the same time changes take place in the commonly used indicators of anxiety there may be other important changes taking place that are not measured by most anxiety scales. For example, there may be cognitive process changes that occur when people are subjected to stress which could help to explain the negative relationships consistently found between self-reported anxiety and intellectual or academic performance.

In the present study two aspects of mental functioning, cognitive styles and cognitive strategies, are investigated for the role they may play as mediators between psychological stress and overt performance on intellectual tasks. Four general questions are asked. The first two are concerned with the relationships between measures of anxiety, cognitive

styles and strategies, and intellectual performance. (1) Will the measured anxiety, cognitive styles and strategies, and problem solving efficiency of subjects vary systematically with changes in psychologically stressful conditions? (2) Will subjects who are measured as more anxiety prone tend to exhibit different patterns of cognitive styles and strategies than less anxiety prone subjects? The last two questions are concerned with whether the cognitive styles investigated in this study function as stable traits that can be used to differentiate one person from another. (3) Will subjects be measured as using the same cognitive styles consistently under different experimental conditions and across time? (4) Will the different measures of cognitive styles used here be shown to have construct validity, i.e., will they be found to be measures of the dimensions they have been hypothesized to measure? Before going on to a detailed look at these questions, a number of constructs will be clarified for use in this study and selected research from the literature pertinent to this investigation will be discussed.

Anxiety

Cattell and Scheier (1958) called attention to the lack of consensus among behavioral scientists concerning the meaning of the term "anxiety" when they reported locating more than 300 definitions. Sarbin (1968) has emphasized this lack of clarity and consensus by noting that "anxiety" has become an opaque metaphor. He cautioned against at least two mistakes that have commonly been made: (1) thinking of anxiety as a distinct entity that has an existence of its own independent of its behavioral referents, and (2) attributing a causal role to that entity. He has suggested "cognitive strain" as a new, less opaque metaphor to replace the term "anxiety" because it is more patently descriptive, it tends to

direct attention to behavioral referents, and it is less likely to be thought of as a cause in and of itself. Stress and strain are constructs which psychology has borrowed from the physical sciences. Stress refers to the forces applied to a structure or system and strain refers to changes in the system that result from the applied force. To the extent this analogy is accurate, measures of anxiety may be thought of as indicators of the amount of psychological stress a person is experiencing.

As was mentioned earlier, most anxiety scales contain behavioral referents for both the mental and physical aspects of anxiety. The scales may ask if these behaviors are present at the time the scale is administered, if they are present in general, or if they are present in specific kinds of situations. Depending on the context in which these questions are asked, the anxiety measured may be called general trait anxiety or a specific kind of state anxiety which is present only when certain environmental conditions are met. The concept of two quantitatively different types of anxiety, trait anxiety and state anxiety, came out of the factor analytic studies of Cattell and Scheier (1958, 1961). Spielberger has been the most active researcher with these two constructs and has developed scales for their measurement--the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, and Lushene, 1970). Trait anxiety refers to relatively stable individual differences in general anxiety or in anxiety proneness while state anxiety is considered to be a temporary condition. Correlations between the STAI-Trait Scale and other widely used measures of general anxiety--the Manifest Anxiety Scale (MAS) (Taylor, 1953), the IPAT Anxiety Scale (Cattell and Scheier, 1963), and the Affect Adjective Checklist (AACL) (Zuckerman, 1960)--range from .52 to .80 for college students (Spielberger, et. al., 1970).

State anxiety exhibited in academic testing situations has been called "test anxiety" (Mandler and Sarason, 1952; Sarason, 1958; Alpert and Haber, 1960).

Test anxiety scales are better predictors of academic performance than general anxiety scales (Alpert and Haber, 1960). Test anxiety has consistently been found to be associated with lower levels of academic achievement in elementary school, high school, and at the university level. Moderate but consistent negative relationships have been reported between various anxiety scales and measures of intelligence (Spielberger and Gaudry, 1971). Anxiety and intelligence appear to have an interactive effect on performance. High anxiety facilitates performance for subjects of high intelligence on simple tasks and most tasks of moderate difficulty. The combination of high anxiety and low intelligence leads to low performance except on very easy tasks (Spielberger and Gaudry, 1971).

The best evidence for the position that intelligence alone cannot account for low academic achievement in anxiety prone students comes from two studies which compare performance on learning tasks of subjects who have the same level of ability but who differ in test anxiety (Sarason, Davidson, Lighthall, Waite, and Ruebush, 1960; Wrightsman, 1962). These studies showed that under stressful conditions, in which the subjects were led to believe that their personal adequacy was being evaluated, the test anxious subjects performed more poorly, while under nonstressful conditions the test anxious and nontest anxious subjects did equally well.

Individual differences in anxiety reactions to different kinds of stress are commonly found. After reviewing a number of experiments in

which the MAS was used, Saltz (1970) concluded that some subjects were more susceptible to pain-induced stress while others were affected more by failure-induced stress. In academic settings, students high in trait anxiety are more likely than those who score low in trait anxiety to react to negative evaluations of their performance and to failure experiences with increased state anxiety (Spielberger and Gaudry, 1971). The performance of test anxious persons is most seriously disturbed under stress conditions which lead them to believe that their personal intellectual adequacy is being evaluated on the basis of their task performance. The performance of people who have low test anxiety scores, on the other hand, is not inhibited in evaluative situations; they may even do better under these conditions than in nonevaluative situations (Wine, 1971).

Inverse relationships have been found between measures of anxiety and self-esteem (Rosenberg, 1962; Suinn and Hill, 1964). High anxious subjects have been found to be more self-deprecatory, more self-preoccupied, and generally less content with themselves than less anxious subjects (Sarason, 1960). Thus, it is reasonable to assume that high anxious people are more easily threatened by situations in which their personal adequacy is evaluated. But what do high anxious persons do when they are threatened in this way that disrupts their intellectual performance?

Liebert and Morris (1967) have suggested that test anxiety is made up of two major components: worry and emotionality. The worry component is considered to be concern over performance and the emotional aspect is thought to be autonomic arousal. Wine (1971) has hypothesized that it is the worry component of anxiety that adversely affects performance. She

concludes that the self-focusing tendencies of high test anxious persons are activated by the pressures of testing situations: "the highly test anxious person responds to evaluative testing conditions with ruminative, self-evaluative worry and, thus, cannot direct adequate attention to task-relevant variables (Wine, 1971, p. 99)." This anxiety reaction which includes shifts in attention from the task to worry about self may be accompanied by changes in the cognitive styles and strategies a person is using. For example, on a timed test a person who is taking up part of the time with ruminative worry may respond to the task more impulsively, guessing, etc., in order to finish. Because he is hurried, he may also become less analytical in his approach. In a problem solving situation he may be less able or feel less free to think of a variety of possible solutions. Thus, he may stick rigidly with the first hypothesis that comes to mind. For some kinds of intellectual tasks, these changes in strategies and style could be in a direction opposite that required for their efficient solution, thus, compounding the already deleterious effects of reduced time spent attending to the task because of worry. It was the consideration of possibilities such as these which led to the present investigation of relationships between anxiety, cognitive styles and strategies, and intellectual performance.

Cognitive Styles and Strategies

In recent years many investigators of thinking have focused on the information processing mechanisms hypothesized to underlie intellectual performance. One important processing concept is that of cognitive styles which are used as labels for individual differences in how people think, i.e., the way in which they handle or process information; rather than what they think, i.e., the content of their thoughts; or the efficiency

or capacity of their thinking, i.e., abilities or skills. Cognitive styles are usually given a meaning similar to personality traits. They are considered to be enduring or persisting characteristics of cognitive processing that can be used to differentiate one person from another on a wide variety of intellectual tasks. Cognitive strategies, as they are defined in the present study, differ from cognitive styles in two ways: (1) strategies are regarded as smaller units of mental behavior; one cognitive style may be manifest in several different specific strategies, and (2) strategies vary to meet the demands of each new intellectual task, while the same styles are thought to be used consistently by an individual regardless of situational changes.

Cronbach (1970, p. 630) has taken issue with the notion that cognitive styles are stable personality traits. He believes that many tests which have been used as measures of cognitive styles are basically tests of mental ability. In order for the trait definition of cognitive styles to be supported it must be shown that they measure something different from that measured by ability tests, and that the same styles are used consistently across time and on different types of tasks. Several different measures of cognitive styles are used in the present study to facilitate the examination of their validity as individual traits. Three cognitive style dimensions are investigated: flexible-rigid, reflective-impulsive, and analytical-global.

The flexibility-rigidity style dimension as conceived in this study is made up of two components: (1) the breaking of sets or *Einstellung*, and (2) overcoming perseverative behavior, such as trying an unproductive hypothesis or strategy over and over again (Frederiksen, J., 1967). In both of these components flexible style requires the consideration of

several alternative ways of approaching the task at hand. Using a task involving the judging of the relative sizes of squares, Eriksen and Wechsler (1955) gave one group of subjects random shocks while the stimuli were being presented. The anxiety (shocked) group used their two favorite numbers more times when identifying squares than the non-anxious group when making judgements. This suggests that under these stressful conditions subjects reduced the variety of their responses, i.e., they responded more rigidly.

The impulsivity-reflectiveness style dimension refers to the tempo and carefulness with which people work on intellectual tasks (Kagan, 1965a). Persons who are classified as reflective tend to be more deliberate and cautious; they do not take many chances, and they spend more time on the task if allowed to do so. Impulsive style is characterized by the opposite approach to intellectual tasks, i.e., lack of carefulness, guessing, and working so quickly that accuracy is affected. Impulsiveness has been measured with a personality scale developed by Barratt (1959), but the most commonly used instrument is the Matching Familiar Figures Test (MFF) (Kagan, 1965b). On this test the amount of time taken on a series of visual discrimination tasks is used as an index of impulsivity-reflectiveness. Conflicting results have been reported in the literature in regard to the direction of the relationship between anxiety and impulsivity-reflectiveness. Barratt (1959), Messer (1970), and Ruebush (1960) reported that anxiety was associated with reflective style, while Jackson (1967) and Shulman, Loupe, and Piper (1968) found anxiety to be positively related to impulsivity.

The analytical-global cognitive style is usually measured with tasks that involve visual perception, but Witkin (1964) believes that it

can be identified in other kinds of intellectual activity. A widely used instrument for measuring this dimension is the Embedded Figures Test (Witkin, 1950), which requires the subject to find a simple pattern embedded in a more complex field. People who do this well are classified field-independent. They are viewed as tending to analyze or categorize stimuli based on subelements of a field (analytical) rather than based on the field as a whole (global).

Cognitive styles are assumed to play an integral role in many kinds of intellectual problem solving. Schroder and Hunt (1957) found that subjects who avoided a problem solving task on which they were failing were more anxious and rigid (not looking for alternate solutions) than were those who persisted in the face of failure stress. Kagan (1964c) has suggested some possible relationships between impulsive style, anxiety and problem solving. He hypothesized that a child who responds impulsively is more likely to start on the wrong path to finding a correct solution than is a child who reflects over the probable accuracy of many approaches before committing himself to one. Furthermore, Kagan (1964c) suggested that when the child realizes he is in error, he is likely to become more anxious and, consequently, his selection of a second solution path is likely to be impaired. Thus, a vicious circle may be set into action involving impulsiveness, anxiety, and defeat which could eventually result in the child withdrawing from problem solving situations. These suggested relationships have not, as yet, been demonstrated. More research needs to be done with these variables so that the reasons for inefficiency in problem solving may be discovered. In the present study the relationships between measures of three different style dimensions, three types of anxiety, and deductive reasoning problem

solving efficiency are examined. In addition, the construct validity of the three cognitive styles is investigated.

II. METHOD

Subjects were 114 male volunteers who were enrolled in introductory psychology courses at Michigan State University during Fall term, 1971. Data was collected during two sessions spaced one day apart. The number of subjects attending each session varied from about 10 to 25. Sessions were held in a large classroom (200 seat capacity). Subjects sat several seats from each other in order to reduce interpersonal awareness and distraction. To facilitate an investigation of the effects of stress on the use of cognitive styles, strategies, and problem solving efficiency, either stress or nonstress conditions were instituted during each session. The details of the stress and nonstress conditions are discussed in Section IV.

A completely counterbalanced 2 X 2 Latin Square design was used. One group of 57 subjects (Group I) experienced nonstress conditions in Session 1 and stress conditions in Session 2. The reverse order of treatment conditions was used with the other 57 subjects (Group II) which had the stress treatment in Session 1 and nonstress conditions in Session 2. Two forms of testing materials were prepared and both groups of subjects were given Form A in Session 1 and Form B in Session 2. This arrangement allows between group comparisons to be made within the same session on identical instruments under differing conditions. To the extent the two forms of each measure were parallel, Session 2 was a replication of Session 1 except for the stress manipulation. The design

is presented diagrammatically in Table 1. Also shown in Table 1 are the procedures used in each session. Session 1 lasted about an hour and a half, and Session 2 took about an hour and fifteen minutes. Session 1 took longer because two personality scale measures of style and two anxiety scales were administered in that session prior to the time experimental conditions were instituted.

Table 2 presents a list of the measuring instruments used. Included are measures for three different methods of style assessment, measures of anxiety, measures of problem solving efficiency, and measures of academic ability. These instruments will be discussed in detail in later sections. Samples of each are given in Appendix A through G.

In cases where data was not complete for a subject, his group mean for the measure in question was used as a substitute for his score. The analysis was carried out in several phases: (1) cluster analyses of the problem solving questionnaires, (2) testing for significant differences in means between groups within sessions, (3) testing for significant differences in means between sessions within groups, (4) cluster analysis of the cognitive ability measures of style, and (5) generating correlations between the reduced set of measures produced by the cluster analyses. Each phase of the analysis is discussed in detail in subsequent sections. In this section a brief description will be given of the analyses used to answer each of the questions mentioned in the introduction that are asked in the present study.

The first question is concerned with whether measured anxiety, cognitive styles and strategies, and problem solving efficiency vary systematically with changes in psychologically stressful conditions. Problem solving efficiency was measured with both time to solution and accuracy

Table 1
Procedures and Design

Procedures	Design	
	Group I	Group II
I. <u>Session 1</u>		
1. Pre Experimental Condition Measures		
A. Personality scale measures of cognitive style		
B. Achievement Anxiety Test		
C. STAI-Trait Scale		
2. Experimental Conditions		
A. Instructions	Nonstress	Stress
B. Practice Problems	"	"
C. Cognitive ability measures of cognitive style	Form A	Form A
D. Problem Solving Tasks	" "	" "
E. Problem Solving Questionnaires		
F. STAI-State Scale		
II. <u>Session 2</u>		
1. Experimental Conditions		
A. Instructions	Stress	Nonstress
B. Practice Problems	"	"
C. Cognitive ability measures of cognitive style	Form B	Form B
D. Problem Solving Tasks	" "	" "
E. Problem Solving Questionnaires		
F. STAI-State Scale		
G. Debriefing		

Table 2

Measuring Instruments

Instruments	Hypothesized to be a measure of:
I. Cognitive Style Measures	
1. Personality Scale Measures	
a. Flexibility-Rigidity Scale.	Flexible Style
b. Reflectiveness-Impulsiveness Scale. . .	Reflective Style
2. Cognitive Ability Measures	
a. Verbal Problems Test.	Flexible Style
b. Sign Changes Test.	" "
c. Object Uses: % Categories	" "
d. Matching Familiar Figures Test.	Reflective Style
e. Object Uses: Total (reverse scored) . .	" "
f. Hidden Figures Test	Analytic Style
g. Object Uses: % Part Responses	" "
3. Problem Solving Questionnaire Clusters	
a. New Approach, Strategy Change, Trial and Error, Fixated (reverse scored) . .	Flexible Style
b. Notes, Systematic, Deliberate, Careful	Reflective Style
c. Global (reverse scored)	Analytic Style
II. Anxiety Measures	
1. STAI-Trait Scale.	Trait Anxiety
2. Achievement Anxiety Test.	Test Anxiety
3. STAI-State Scale.	State Anxiety
4. Problem Solving Questionnaire Clusters: Frustrated, Concentrated (reverse scored), Enjoyed (reverse scored).	" "
III. Problem Solving Efficiency Measures	
1. Math Problem: Time.	Prob. Solv. Efficiency
2. Math Problem: Right/Wrong	" " "
3. Mystery Problem: Time	" " "
4. Mystery Problem: Right/Wrong.	" " "
IV. Academic Ability Measures	
1. High School Grade Point Average	Academic Achievement
2. College Entrance Examination Percentile . .	Academic Aptitude

of solution for a who-done-it type mystery deductive reasoning problem and a math riddle deductive reasoning problem. A self-report questionnaire followed each problem which was designed to assess the use of cognitive styles or strategies and the level of state anxiety present while the subjects were working on those tasks. State anxiety present during the entire experimental session was measured with the STAI-State Scale (Spielberger, et. al., 1970). A number of cognitive ability type measures of styles were also included to see if stress conditions had any effect on style usage as measured with this method. Treatment effects were investigated with phase 2 of the analysis--the comparison of mean differences between groups within sessions--and with phase 3--comparisons of mean differences between sessions within groups. These analyses are discussed in Sections IV and V.

To investigate the second question mentioned in the introduction, whether subjects who are more anxiety prone tend to exhibit different patterns of cognitive styles and strategies than subjects who are less anxiety prone, the data for all the measures listed in Table 2 was pooled across groups and averaged over sessions. A cluster analysis was performed on this data reducing it to a set of 26 variables. The intercorrelation matrix of these 26 clusters was then searched for unique patterns of relationships associated with high and low anxiety proneness. The results of this analysis are discussed in Section VII.

The third general question asked in the present study inquires into the consistency with which subjects use the same cognitive styles. Test-retest reliabilities across sessions were computed for the cognitive ability measures of style and problem solving questionnaire responses and were used as estimates of consistency in responding. This analysis

is covered in Sections III, IV and V.

The last question mentioned in the introduction asks if the measures used in this study to determine cognitive styles have construct validity. An examination was made of the convergent and discriminant validity of these measures (Campbell and Fiske, 1959). Perfect discriminant validity would be shown if measures of different styles made with the same method of measurement were found to be uncorrelated. Absolute convergent validity would be indicated if measures of the same style made with different methods were perfectly correlated. In testing for discriminant validity, the problem solving questionnaire measures of styles and the cognitive ability measures of styles were each subjected to cluster analysis to see if different styles emerged as distinct factors within the same method of measurement. Evidence for convergent validity was sought in the correlations between measures of the same styles given by three different methods: the problem solving questionnaires, the cognitive ability measures, and the personality scale measures. The details of these analyses are presented in Sections III and VI.

The problem solving questionnaire items were written to measure anxiety and the expression of three style dimensions: flexible-rigid, reflective-impulsive, and analytical-global. As part of the present study the questionnaires were cluster analyzed to determine which dimensions were represented on them. Since the results of this analysis have a bearing on all the other analyses, it will be discussed first.

III. COGNITIVE STRATEGIES USED ON THE PROBLEM SOLVING TASKS

This section is mainly concerned with the identification of the dimensions measured by the problem solving questionnaires. It was hoped that these dimensions included flexible, reflective, and global cognitive styles. If so, these dimensions could be correlated with the cognitive ability and personality scale measures of style to test for convergent validity (see Section VI). Since these dimensions provide measures of the styles or strategies used while working on the problems, they can be correlated with measures of problem solving time and accuracy to see if the styles or strategies used actually had any effect on problem solving efficiency.

Method

Two kinds of deductive reasoning tasks were included in the materials given to each subject, a who-done-it mystery problem and a math riddle word problem. One of each was included in each form of the materials. The mystery problems were adapted from a booklet of deductive reasoning problems by Summers (1968). The problem on Form A was called "Malice and Alice," and that on Form B was entitled "Murder in the Family." A maximum of eight minutes was allowed to reach a solution. The math problem on Form A was called "The Hotel Room Problem." Another version of it is commonly found in many popular quiz and puzzle books. The Horse-Trading Problem (Maier and Burke, 1967) was used on Form B. Four minutes were allowed to complete the math problems. Time spent on each problem was

recorded by the subjects from a large clock in the front of the room that showed elapsed time. The mystery problems were written out in the materials given to each subject, but the math problems were not. The math problems were read by the experimenter twice to the entire group of subjects present in each session. Each subject had in his materials a list of five answers from which he was to select the correct one. Timing started when the experimenter began reading the problem.

Following each problem in the materials was a true-false questionnaire designed to measure subjects' reports of the cognitive styles they used as well as the anxiety they experienced while working on the preceding problem. The questionnaire items were purposefully written to be indicators of flexible-rigid, reflective-impulsive, and global-analytic style dimensions and state anxiety specific to the problem solving task. The items were grouped on the basis of their apparent content according to these a priori dimensions. The mystery questionnaire contained 46 items, and the math questionnaire 35. The math and mystery questionnaires had 27 items in common, i.e., items having the same or almost the same wording. The mystery questionnaire had 18 items that were not on the math questionnaire, and the math questionnaire had seven items that were not represented on the mystery questionnaire. The same a priori factors were represented on both questionnaires.

The questionnaire data was cluster analyzed by using the MGRP subroutine of the PACKAGE system of computer routines (Hunter and Cohen, 1969). Cluster analyses were performed with the data from both groups of subjects combined on Session 1 (Form A) then replicated on Session 2 (Form B). The following criteria were used in identifying unique homogeneous factors: (1) each cluster must be internally consistent, i.e.,

the items in a cluster must be relatively highly correlated with each other, (2) each cluster must show external parallelism, i.e., all items in a cluster must have approximately the same level of correlation with the other clusters, and (3) the items in each cluster must be reasonably homogeneous in content. Once the clusters of items representing unique dimensions were identified, correlation coefficients were computed between the clusters on Session 1 and Session 2 which generated a matrix that included test-retest reliabilities ($r_{1,2}$). Then the data from both sessions was combined, and using the same cluster structure found previously, intercorrelations were computed between all the obtained clusters. Correlations were also computed between the clusters and problem solving time and solution.

Results

The first step in the analysis was to perform an oblique multiple groups factor analysis on the a priori item groupings. These a priori clusters failed to meet the criteria for unique homogeneous factors. The item groupings were then revised and factor analyzed several times until homogeneous clusters appeared. Mystery Frustrated (cluster 508) is presented in Table 3 as an example. All the rest of the clusters (clusters 509-519 for the math questionnaires and clusters 520-526 for the mystery questionnaires) may be referred to in Appendix H. At the top of the Table 2 the items in cluster 508 are written out as they appeared on the questionnaire. A minus sign before an item number indicates that it was scored opposite to the way it reads. The results of the cluster analyses on Session 1 (Form A) and Session 2 (Form B) are shown side by side in the lower portion of the table. Across the top of that portion are the item numbers. Down the left hand side are the item numbers

Table 3

Cluster 508: Mystery Frustrated

-
34. At times I felt discouraged.
44. After working on the problem for a while I began to feel frustrated.
- 45. This problem was easy for me to solve.
42. At times I worried that I might not be able to get the right answer.
43. Sometimes I wondered how well the other students were doing on this problem.

	<u>Form A</u>						<u>Form B</u>				
	34	44	45	42	43		34	44	45	42	43
34	52	51	37	37	24		41	54	29	32	04
44	51	46	42	36	14		54	55	31	32	15
45	37	42	29	22	20		29	31	16	18	05
42	37	36	22	27	20		32	32	18	28	23
43	24	14	20	20	10		04	15	05	23	04
508	73	68	54	51	32		64	75	39	53	20 Frustrated
509	-35	-48	-37	-25	-13		-37	-40	08	-18	-16 Concentrated
510	-28	-31	-22	-19	-19		-12	-19	-13	-22	-12 Enjoyed
511	44	32	36	25	26		31	24	11	35	10 Strategy Change
512	-32	-40	-37	-16	-16		-61	-55	-24	-31	-13 Careful
513	07	-04	-05	19	01		-06	-11	-09	15	12 Deliberate
514	26	10	15	25	17		01	-14	07	15	06 Global
515	18	09	14	10	21		03	01	14	-12	-07 Notes
516	-16	-23	-26	-01	02		-27	-33	-11	-31	00 Systematic
517	16	26	04	07	03		05	-03	-07	-13	-13 Trial and Error
518	-12	-14	09	-26	-26		-22	-18	-07	-13	-13 New Approach
519	05	12	18	19	14		22	07	-12	-09	04 Fixated
599	05	09	-05	-11	-11		12	04	-06	-05	-14 r pbi

(50), the numbers of the mystery questionnaire clusters (508-519) and point-biserial correlations (599) between Groups I and II, i.e., between treatment conditions. A point-biserial correlation of .19 is required to meet the .05 level of significance for treatment effects on any single item. None of the items showed significant treatment effects. Down the right hand side are the cluster names. Above the horizontal line are the item intercorrelation matrices. On the diagonal of these matrices are the communalities for each item. The communality is a measure of the percent of variance in each item which is accounted for by the factor measured by the cluster to which it belongs. Below the horizontal line are the correlations of each item (corrected for attenuation) with its own cluster (part-whole correlation) and with all the other mystery questionnaire clusters.

The three criteria used to define unique homogeneous clusters may be checked as follows: (1) Internal consistency is indicated in two ways: (a) each item should correlate more highly with its own cluster than with any other cluster, and (b) the coefficient alpha, which indicates homogeneity within the cluster (Cronbach, 1951) should be reasonably large (coefficient alphas for all questionnaire clusters are presented in Table 10 in Section IV.) (2) External parallelism may be checked by scanning down all the item columns simultaneously to see if the direction and magnitude of correlations are approximately the same for all the items with each cluster. (3) Homogeneity of content is checked by reading the items to see if they can all be logically connected in a reasonable way to the same dimension or factor.

Table 4 presents the distribution of questionnaire items in relation to their groupings by a priori style and anxiety dimensions (columns)

Table 4

Comparison of Problem Solving Questionnaire A Priori Item Groupings
and Item Groupings by Cluster Analysis

Item groupings by cluster analysis	A priori item groupings							
	Flexibility		Reflectiveness		Globalness		Anxiety	
	Math	Mystery	Math	Mystery	Math	Mystery	Math	Mystery
New Approach	3,4	3,4						
Strategy Change	1,2, 5,6,7, 34	1,2		17		31	20	
Trial and Error		5,6						
Fixated		8,10						
Notes			9,10	13,14				
Systematic			12,13	15,16				
Deliberate			14,15	20,21	18,19		25	
Careful	12			18,19, 22,23, 24				
Global						26,28, 29,30		36
Frustrated							21,22, 24,26, 28,33	34,42, 43,44, 45
Concentrated							27,29, 30,31, 32	37,39, 40,41
Enjoyed								33,35
Residual	8	7,9,11	11,17	25		27	23	32,38
Total no. items	10	11	8	13	2	6	14	14

and the groupings which resulted from the cluster analyses (rows). Twelve different clusters were formed from the four a priori item groupings. Seven were represented on both the math and mystery questionnaires and five were present only on the mystery questionnaire. These five clusters were, for the most part, made up of items appearing only on that questionnaire. Taking the source of the majority of the items in a cluster as a criterion, the a priori flexibility items formed four clusters: New Approach, Strategy Change, Trial and Error, and Fixated. The reflective items also formed four clusters: Notes, Systematic, Deliberate, and Careful. The global items formed one cluster on the mystery questionnaire--Global, and were an important part of the Deliberate cluster on the math questionnaire. The items written to tap anxiety formed three clusters: Frustrated, Concentrated, and Enjoyed. The names of the clusters were chosen to summarize the dimension measured by each cluster. Clusters which contained the same or very similar items on both the math and mystery questionnaires were given the same name.

The content of the New Approach cluster suggests that it is an indicator of the degree to which the first approach used on the problem solving tasks was chosen to fit the particular demands of each problem, rather than using the strategy or approach habitually used on this kind of task. Thus, it may tap the set breaking aspect of flexibility. The Strategy Change cluster is a measure of whether the subjects tried more than one strategy or approach for solving the problem. That does not necessarily mean that this cluster measures flexibility. A second strategy may be tried because the first one did not lead to the solution. The high positive correlations of the items in this cluster with the Frustrated cluster tends to support this latter interpretation. The

Trial and Error cluster measured the use of a nonlogical trial and error approach. Its items are negatively related to the Systematic cluster on the mystery questionnaire which measures the use of a rational systematic plan on the problem solving tasks. The Fixated cluster is a two item measure that taps the perseverative aspect of rigidity in problem solving, i.e., using the same hypothesis over and over again in attempting to solve the problem instead of trying a new hypothesis.

The meaning of the Notes cluster is clear--making notes while working on the problems versus doing all figuring without the aid of paper and pencil. The Notes cluster may measure one manifestation of the carefulness aspect of reflectiveness. The Deliberate cluster is somewhat different on each questionnaire. The Deliberate cluster on the math questionnaire is a combination of items that clustered into both the Deliberate and Global clusters on the mystery questionnaire. On the mystery questionnaire, the Deliberate cluster indicates whether or not the problem was read more than once before the subject decided how to attack it. The mystery Global cluster represents the global-analytic dimension. It emphasizes visualizing the entire problem as a unit and getting an overall picture rather than concentrating on details. In the math Deliberate cluster both trying to get the overall picture of the problem and taking time before deciding how to try solving it were included. This indicates that deliberate and global approaches are compatible. The different clustering on the two questionnaires is probably due to there being only two items on the math questionnaire written to represent the global-analytical dimension while there were six on the mystery questionnaire. But even on the mystery questionnaire, Global was one of the weakest clusters. Since the strongest items in math Deliberate are more similar in con-

tent to mystery Deliberate than they are to mystery Global, this math cluster was given the name "Deliberate." However, the cross correlations show that math Deliberate is more closely related statistically to mystery Global ($r = .18$) than it is to mystery Deliberate ($r = .07$).

The cluster that appears to most closely represent the carefulness aspect of reflectiveness is the Careful cluster. This cluster is made up of items that emphasize not guessing, not writing down an answer until the subject was sure it was correct, and being careful and cautious at all times. The Frustrated cluster is an indicator both of discouragement and worry about how well the subject was doing on the problem in comparison to others. The Concentrated cluster simply indicates whether or not the subject was having difficulty concentrating while working on the problems. The Enjoyed cluster measures whether or not the subject enjoyed working on the problems, taking them as an interesting challenge. These last three clusters--Frustrated, Concentrated, and Enjoyed were derived from a priori anxiety items. Their content suggests that they represent subjective states that may accompany or contribute to the level of anxiety experienced rather than being direct measures of the tension aspect of anxiety. The worry element in anxiety is apparent in the Frustrated cluster. As will be shown later in Section VI, these three clusters are highly related to the other anxiety measures used in this study, hence, they will be referred to as indicators of state anxiety specific to the problem solving tasks.

It is clear that the reduced set of variables produced by the cluster analyses is different from the a priori cognitive style groupings of items. Table 4 shows what occurred. The items written to

measure flexibility formed four clusters, the reflectiveness items formed four clusters, the global items remained one cluster on the mystery questionnaire and were absorbed into another cluster on the math questionnaire. The anxiety items formed three clusters. If the clusters that were constructed from items written to measure the same dimension are just measuring different aspects of that dimension, they should be correlationally related. If they are not related, then little confidence can be placed in the existence of the a priori dimensions as measured by these questionnaires.

Correlations between clusters grouped by a priori style dimensions are presented in Table 5. The clusters derived from the flexibility items show almost no interrelationship. Although there are some significant relationships between clusters in the reflectiveness group, those relationships were different on the math and mystery clusters. Among the mystery clusters, Systematic is positively related to Careful ($r = .46$) and negatively related to Deliberate ($r = -.22$), but Deliberate and Careful are not related nor is Notes correlated with any of the other three. All three of the math clusters in this group, Notes, Systematic, and Deliberate, are moderately positively related but the correlation between Notes and Systematic does not reach significance ($r = .17$). There were no significant correlations between the three clusters formed from the global-analytic items. The anxiety group, in contrast to the a priori style dimensions, shows strong correlations among all its clusters.

The anxiety clusters are the only ones that show clear evidence that they are all measuring something in common. Thus, it must be concluded that the problem solving questionnaires did not measure the three

Table 5

Correlations Between Problem Solving Questionnaire Clusters in each
of the A Priori Cognitive Style Groups

<u>Flexibility</u>		<u>518</u>	<u>511</u>	<u>517</u>	<u>519</u>	<u>526</u>	<u>522</u>	
Mystery New Approach	518	100						
Mystery Strategy Change	511	04	100					
Mystery Trial and Error	517	01	06	100				
Mystery Fixated	519	-06	12	-14	100			
Math New Approach	526	<u>28**</u>	02	08	-08	100		
Math Strategy Change	522	10	<u>21**</u>	-16	-10	09	100	
<u>Reflectiveness</u>		<u>515</u>	<u>516</u>	<u>513</u>	<u>512</u>	<u>524</u>	<u>525</u>	<u>523</u>
Mystery Notes	515	100						
Mystery Systematic	516	11	100					
Mystery Deliberate	513	-09	-22*	100				
Mystery Careful	512	-14	46***	-09	100			
Math Notes	524	<u>32***</u>	08	-04	04	100		
Math Systematic	525	-08	<u>21*</u>	-12	36***	17	100	
Math Deliberate	523	-07	05	<u>07</u>	00	21*	19*	100
<u>Globalness</u>		<u>514</u>	<u>513</u>	<u>523</u>				
Mystery Global	514	100						
Mystery Deliberate	513	13	100					
Math Deliberate	523	18	<u>07</u>	100				
<u>Anxiety</u>		<u>508</u>	<u>509</u>	<u>510</u>	<u>520</u>	<u>521</u>		
Mystery Frustrated	508	100						
Mystery Concentrated	509	-31***	100					
Mystery Enjoyed	510	-20*	27**	100				
Math Frustrated	520	<u>50***</u>	-22*	-25**	100			
Math Concentrated	521	-28**	<u>31***</u>	23*	-57***	100		

Note.--Cross correlations are underlined.

*p < .05
 **p < .01
 ***p < .001

hypothesized style dimensions they were designed to measure. The clusters appear to represent smaller units of cognitive behavior than can appropriately be called styles, hence, these clusters will be considered to represent cognitive strategies. The anxiety clusters will be referred to as measures of state anxiety present while subjects worked on the problem solving tasks.

Table 6 presents the complete intercorrelation matrix of all the problem solving clusters. There are four that are quite consistently intercorrelated within and between both questionnaires: Frustrated, Concentrated, Strategy Change, and Careful. The only exceptions are between math Strategy Change and mystery Concentrated, and between math Strategy Change and mystery Careful. Within the math problem, Strategy Change and Concentrated are significantly related. The direction of the correlations shows that frustration and changing strategies were associated with poor concentration and lack of carefulness.

Coefficient alphas for each cluster are presented in Table 10 in Section IV. The average size of the coefficient alphas for the mystery questionnaire clusters is .61 and for the math questionnaire cluster, .70. These are high enough to indicate that most of the clusters are quite homogeneous in content. The coefficient alphas for Sessions 1 and 2 are of comparable size for each cluster. This replication of cluster homogeneity lends confidence to the belief that the factors identified are not spurious.

Since identical questionnaires were used in both sessions, correlations between the same clusters on each session are estimates of coefficients of stability. Test-retest reliabilities ($r_{1,2}$) are shown in Table 10, Section IV. They are low when compared with the coefficient

Table 6
Intercorrelations of Math and Mystery Problem Solving Clusters

	<u>508</u>	<u>509</u>	<u>510</u>	<u>511</u>	<u>512</u>	<u>513</u>	<u>514</u>	<u>515</u>	<u>516</u>	<u>517</u>	<u>518</u>	<u>519</u>	<u>520</u>	<u>521</u>	<u>522</u>	<u>523</u>	<u>524</u>	<u>525</u>	<u>526</u>	
<u>Mystery Clusters</u>																				
Frustrated	508	100	-31	-20	38	-30	05	11	15	-23	-10	-19	01	50	-28	25	17	13	03	-11
Concentrated	509	-31	100	27	32	33	-06	-13	06	33	-09	-07	-13	-22	31	-04	-12	-11	11	-14
Enjoyed	510	-20	27	100	-05	17	-09	07	05	27	-13	-15	00	-25	23	-05	06	02	13	-07
Strategy Change	511	38	-32	-05	100	-38	28	24	14	-36	06	04	-12	26	-27	21	17	08	-01	02
Careful	512	-30	33	17	-38	100	-09	00	-14	46	-28	08	00	-34	34	-05	00	04	36	-01
Deliberate	513	05	-06	-09	28	-09	100	13	-09	-22	05	34	04	02	04	-02	07	-04	-12	-06
Global	514	11	-13	07	24	00	13	100	02	08	-08	11	03	12	-22	-09	18	05	00	01
Notes	515	15	06	05	14	-14	-09	02	100	11	-14	-20	04	08	-14	11	-07	32	-08	03
Systematic	516	-23	33	27	-36	46	-22	08	11	100	-39	-12	18	-25	18	-02	05	08	21	-15
Trial and Error	517	-10	-09	-13	06	-28	05	-08	-14	-39	100	01	-14	05	01	-16	-12	-17	-18	08
New Approach	518	-19	-07	-15	04	08	34	11	-20	-12	01	100	-06	-02	05	10	23	-03	-10	28
Fixated	519	01	-13	00	-12	00	04	03	04	18	-14	-06	100	-04	04	-10	-03	12	-10	-08
<u>Math Clusters</u>																				
Frustrated	520	50	-22	-25	26	-34	02	12	08	-25	05	-02	-04	100	-57	38	26	15	-03	10
Concentrated	521	-28	31	23	-27	34	04	-22	-14	18	01	05	04	-57	100	-28	-14	-04	23	-09
Strategy Change	522	25	-04	-05	21	-05	-02	-09	11	-02	-16	10	-10	38	-28	100	21	18	08	09
Deliberate	523	17	-12	06	17	00	07	18	-07	05	-12	23	-03	26	-14	21	100	21	19	07
Notes	524	13	-11	02	08	04	-04	05	32	08	-17	-03	12	15	-04	18	21	100	17	10
Systematic	525	03	11	13	-01	36	-12	00	-08	21	-18	-10	-10	-03	23	08	19	17	100	-29
New Approach	526	-11	-14	-07	02	-01	-06	01	03	-15	08	28	-08	10	-09	09	07	10	-29	100

Note. --Cross correlations are underlined.

$r \geq .19 = p < .05$

$r \geq .24 = p < .01$

$r \geq .30 = p < .001$

alphas. The average $r_{1,2}$ for both the mystery and math clusters is .23. This low average test-retest reliability indicates a lack of consistent responding among many subjects across sessions. This could be partially due to differences between the problems or inconsistencies in practice effects. The cross correlations between same name clusters from the mystery and math questionnaires are underlined in Table 6. The average cross correlation is .26. The ratio of test-retest correlation to coefficient alpha (average = .35) or the ratio of cross correlation to coefficient alpha (average = .40) may be used as an index of generality of the clusters across time or problem types. That this index is about the same across time or problem types indicates that the strategies and anxiety factors measured by the clusters are not specific to the type of problem. This is further evidence for the stable existence of these factors. Although the strategies show some generality across time and problem type, the low test-retest reliabilities indicate that they were probably not used consistently by all subjects.

The last set of results in this section are concerned with the relationships between the cognitive strategies used and state anxiety experienced while working on the problems and problem solving efficiency. These correlations are shown in Table 7. Working carefully and maintaining good concentration were helpful in solving the mystery problems, while trying the same hypothesis over and over hindered correct solution. Taking notes and getting frustrated took time but did not necessarily affect finding correct solution. On the math problems, a logical systematic approach was helpful in solving them. Working the problems systematically took more time, but it paid off in leading to right answers. As with the mystery problems, getting frustrated and taking

Table 7

Correlations of Problem Solving Questionnaire Strategy and Anxiety
Clusters with Measures of Problem Solving Efficiency

		<u>417</u>	<u>418</u>	<u>419</u>	<u>420</u>
Mystery Problem: correct	417	100			
Mystery Problem: time	418	00	100		
Math Problem: correct	419	03	-02	100	
Math Problem: time	420	16	34***	01	100
<u>Mystery Clusters</u>					
Strategy Change		02	04	-13	03
Fixated		-19*	11	-02	-16
Trial and Error		-12	-07	-08	-14
Notes		-06	34***	03	01
Systematic		07	05	14	-04
Careful		27**	-06	25**	09
Deliberate		05	-09	-22*	-10
New Approach		11	-09	-19*	21*
Enjoyed		06	06	17	-09
Frustrated		-06	29**	-06	08
Concentrated		23*	07	02	06
Global		03	-07	-06	-09
<u>Math Clusters</u>					
Frustrated		-07	-04	-02	20*
Concentrated		08	04	12	-02
Strategy Change		02	12	-03	42***
Deliberate		03	-09	05	23*
Notes		12	10	13	19*
Systematic		06	09	24**	23*
New Approach		12	-13	-05	15

*p < .05

**p < .01

***p < .001

notes added time but did not affect the solution. This was also the case for changing strategies and for deliberating before beginning on the math problems.

There were five answers to each math problem, only one of which was correct. Correlations between the math strategies and state anxiety and answer choice are presented in Table 8. Only six out of 70 correlations are significant. It was thought that some strategies might consistently lead to certain answers, but no meaningful pattern of relationships is evident between strategy and choice of answer.

Discussion

The use of questionnaires that are factor analyzed then correlated with measures of problem solving efficiency was found to be an effective method for identifying differences between problems in terms of the cognitive processes used in accurately and efficiently solving them. Similar use of the questionnaire technique has been made by Marshall (1972) investigating problem solving strategies and by C. Frederiksen (1969) who used them to help identify memory retrieval strategies for verbal learning tasks. The results of the cluster analyses of the questionnaires showed that the hypothesized cognitive style dimensions were not identified on the problem solving tasks. Instead, smaller, more specific units of reported problem solving behavior were isolated. These were labeled cognitive strategies rather than styles because they represent very specific subject characteristics that do not fit the content definitions of the styles under study. These strategies exhibited some generality across time and problem type. However, the low test-retest reliabilities obtained suggest that many subjects did not use them consistently.

Table 8
Correlations of Math Problem Strategy and Anxiety Clusters
With Choice of Answer

	Frustrated	Concentrated	Strategy Change	Deliberate	Notes	Systematic	New Approach
<u>Hotel Room Problem</u>							
1. $30 - 1 = 27 + 2$	03	-06	15	03	06	15	00
2. $30 - 2 = 27 + 1$	-10	06	-09	00	-11	-07	-11
3. $1 = 3 - 2$	01	-04	07	-05	-14	-08	10
4. $25 + 2 = 27^a$	03	06	-05	02	07	07	-07
5. $5 - 3 = 2$	05	-12	05	02	-05	-12	19*
<u>Horse Trading Problem</u>							
1. Lost \$10	-07	07	-14	-05	00	00	-10
2. Broke even	-14	07	-15	02	-23*	-01	-20*
3. Made \$10 _b	13	-11	10	01	00	-17	22*
4. Made \$20 _b	-07	11	01	06	11	28**	00
5. Made \$30	07	-10	02	-11	06	-19*	-11

a Correct answer to the Hotel Room Problem.

b Correct answer to the Horse Trading Problem.

*p < .05

**p < .01

The strategies were not related to each other in the way that would be expected if groups of them were measuring different aspects of the same cognitive styles. Thus, it is concluded that the questionnaires do not have discriminant validity as measuring instruments for the styles in question. Of course, this may be due, in part, to inadequacies in the questionnaires themselves. The highest cross correlation found was .50 for the Frustrated cluster. If this value was corrected for attenuation with the Spearman-Brown formula, it would be raised to .67 which demonstrates that reasonably good reliabilities can be obtained with this questionnaire method. Reliabilities could be improved if identical questionnaires were used on the two types of problems. Better items could also be written. More items could be constructed for some of the strategies; the global-analytic dimension in particular was inadequately represented.

The results also showed that the strategies which were associated with time taken to solve one type of problem and correctly solving it were not always associated in the same way with another type of problem. Since this was the case, it may be inferred that the ability to adjust strategies to match the requirements of different types of problems could be an aid to general problem solving efficiency.

Finally, positive interrelationships were found between changing strategies, poor concentration, lack of carefulness, and the Frustrated cluster which tapped discouragement and the worry component of anxiety. These relationships are consistent with the thesis proposed by Wine (1971) that worry detracts attention away from the task (poor concentration). In addition, these findings suggest that when worry is present, subjects are less careful and change strategies more. The Strategy

Change cluster does not appear to be a measure of flexibility, and it is possible that subjects who changed strategies more may have done so because they chose ineffectual strategies more often.

Further investigations of the construct validity of cognitive styles will be examined in later sections. Discriminant validity of the cognitive ability measures and the convergent validity shown by the personality scale measures, problem solving measures, and cognitive ability measures will be covered in Section VI.

IV. TREATMENT EFFECTS ON STATE ANXIETY, ABILITY MEASURES OF COGNITIVE STYLE, PROBLEM SOLVING STRATEGIES, AND PROBLEM SOLVING EFFICIENCY

The main question asked in this section is whether cognitive styles, cognitive strategies, and problem solving efficiency vary systematically with changes in psychologically stressful conditions. This involves four specific experimental questions: Are group means under stress versus nonstress conditions significantly different for: (1) measures of state anxiety, (2) ability measures of cognitive style, (3) reported problem solving strategies, and (4) time used and correct solution of the problem solving tasks?

In this section comparisons are made between groups within the same session to see if stress or nonstress conditions produced differences in strategy choice and style usage. In Section V strategy choice and style usage changes will be examined within groups across sessions. For the time being it will be assumed that the cognitive ability measures of style have construct validity. Their validity will be examined in Section VI.

If cognitive styles are stable personality traits, they should not be seriously affected by changes in external conditions. So one reason for trying to find out whether or not style usage differences are associated with differences in stress conditions is because of the bearing this has on the definition of cognitive styles. The other reason is to see if stress induced changes in styles (and in strategies) can help ac-

count for stress induced changes in problem solving efficiency.

Method

As was mentioned in Section II, a completely counterbalanced Latin Squares design was used for this phase of the study. Table 1 outlines the design and procedures used in each experimental session. One group of subjects (Group I) experienced nonstress conditions in experimental Session 1 and stress conditions in Session 2. The reverse order of treatment conditions was used with Group II which had the stress treatment in Session 1 and nonstress conditions in Session 2. Two forms of testing materials were prepared and both groups of subjects were given Form A in Session 1 and Form B in Session 2. This arrangement allowed between group comparisons to be made within the same session on identical measures under differing conditions.

Each subject was given a packet of test materials which had instructions on the first page. This page was read aloud by the experimenter, while the subjects silently read their own copy. For nonstress conditions the instructions were titled "Problems" and for stress conditions the heading was "Measuring Intellectual Abilities." Under stress conditions the instructions led the subjects to believe that they were taking an IQ test and encouraged them to do their very best. Then they were subjected to a failure experience by being given five minutes to "warm up" on some unsolvable practice problems. This was intended to be a combination of ego threat and failure stress. Nonstress conditions consisted of instructing the subjects that they would be working on a variety of problems so that the experimenter could learn more about differences in the way people like to work on these kind of tasks. They were told that achievement was not important and were en-

couraged to relax. These instructions were followed by five minutes to work on some easily solvable practice problems which was intended to be a success experience for the subjects. The practice problems were adapted from problems used on a collection of short tests of IQ (Eysenck, 1966). The actual instructions and practice problems as well as samples of all the other instruments used may be referred to in the Appendices.

At the end of Session 2 all subjects were given a debriefing which was intended to alleviate possible detrimental effects that may have occurred if any of them mistakingly assumed that they had done poorly on an IQ test. Questions were invited from the group, the reasons for the use of deception were made clear, and the true nature of the study was explained.

Two forms of cognitive ability and problem solving measures were prepared. The problem solving tasks were described in Section III. The cognitive ability measures used in this study were designed in the format usually found on tests of intellectual abilities, but they have been used extensively as indicators of cognitive styles. The tasks were presented in the same order on both forms and will be discussed in that order below.

The first task, the Verbal Problems Test (Wand, 1958) has been used as a measure of cognitive flexibility. Here it is used as an indicator of flexible style. On this task subjects must be able to ignore the contextual meanings of words to get a high score. Ten minutes were allowed to work on the Verbal Problems Test.

Next came the Hidden Figures Test (HFT) (French, Ekstrom, and Price, 1963). This test measures the cognitive factor known as Flexibility of Closure. The HFT is an adaptation, as is Witkin's Embedded Figures Test,

of the Gottschaldt Figures Test popularized by Thurstone. Subjects are required to find which one of five sample figures are embedded in each of 16 different complex patterns. In this study the HFT is used as a measure of field-independence which, according to Witkin (1964), is the perceptual task manifestation of analytical style. The HFT has correlated .62 with the individual form of the Embedded Figures Test and .44 with a group administered form (Jackson, Messick, and Myers, 1964). The time limit on the HFT was 10 minutes.

The Sign Changes Test (French, et. al., 1963) was next. It is another measure of cognitive flexibility that is less dependent on verbal ability than the Verbal Problems Test. It was used in this study to indicate flexible style. On this task, subjects are required to do simple mathematical calculations that are opposite those indicated by the symbols shown. For example $8 \div 4$ is read 8 multiplied by 4, and the correct answer is 32. This task had a two minute time limit.

The Sign Changes Test was followed by the Object Uses task which requires productive thinking. Goldner (1957) used this task to study individual differences in whole-part approach and flexibility-rigidity in problem solving. Subjects were given five minutes to name all the ways they could think of to use a common object. On Form A the object was "a cardboard box," and on Form B, it was "a sheet of newspaper." Responses were classified in three ways. Total number of uses listed in the five minute period allowed was used as an indicator of the impulsive-reflective style dimension. The percentage of total uses given that were in different categories was used as a measure of flexibility. The percentage of total uses given that required the object to be broken up into parts or pieces was used as a measure of analytical versus global style.

Four items from Shulman's adult form of the Matching Familiar Figures Test (Shulman, Loupe, and Piper, 1968) made up the next task. It was used as a measure of impulsivity. On each page there are seven drawings of a familiar object. One figure is the correct sample. Something is changed in five of the other six drawings. The subjects' task is to find the drawing that is exactly like the sample. Short solution times and high errors are the characteristics of impulsive responding. A maximum of three minutes was allowed on each item. They recorded their own elapsed time to solution for each item from a large clock placed in the front of the room.

Next followed the problem solving tasks and questionnaires. The last of the materials in each experimental session was a slightly modified version of the state anxiety form of the STAI (Spielberger, et. al., 1970). The modification was to put the items in the past tense--"I felt calm," instead of "I feel calm." Subjects were instructed to fill out the 20 item, four point scale according to how they felt during the entire experimental session.

Four sets of means and standard deviations were computed on all of these measures, one set for each group under each experimental condition. Point-biserial correlations were computed on Session 1 between Group I (nonstress) and Group II (stress), and on Session 2 between Group I (stress) and Group II (nonstress).

When one variable is continuous, as are the measures described above, and the other variable dichotomous, as are the treatment conditions, computer programs for giving Pearson r 's automatically yield point-biserial r 's. Another formula for the point-biserial r (Guilford, 1965, p. 322) is:

$$r_{pbi} = \frac{(M_p - M_q)}{\sigma_t} \sqrt{pq}$$

M_p = mean of one dichotomous group on the continuous variable

M_q = mean of the other dichotomous group on the continuous variable

p = proportion of cases in one group

q = proportion of cases in the other group

σ_t = standard deviation of the total sample on the continuous variable

If M_p is larger than M_q , r_{pbi} will be positive, otherwise it will be negative. Since r_{pbi} depends directly on the difference between the means of the two groups, a significant correlation indicates a significant difference between the means. Therefore, the usual t test of difference between the means can be used to test the significance of the departure of the correlation from zero and vice versa. The formula given by Guilford (1965, p. 163) was used in the present study:

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

Split-half reliabilities (r_{xx}) and coefficients of similarity ($\emptyset$) were computed for all the measures that had more than one item per form. The similarity coefficient is an index of the degree to which the two split halves correlate in the same way with all the other variables in an intercorrelation matrix. A coefficient of stability and equivalence ($r_{1,2}$) was computed for all the measures by combining groups within sessions and correlating their scores on Session 1 (Form A) with their scores on Session 2 (Form B).

A cluster analysis was performed on the STAI-State Scale. The same procedures and criteria were used as in the cluster analyses discussed previously in Section III. The analysis was performed first on

the data from both groups combined on Session 1, then replicated on Session 2 data.

Results

The reliabilities, means, and point-biserial correlations for the cognitive ability style measures, problem solving efficiency measures, and STAI measures of state anxiety are presented in Table 9. Measures for which r_{xx} and $\emptyset$ reliabilities were not calculated had only one item on each form. The Hidden Figures and Sign Changes Tests were shown to be very homogeneous, the Verbal Problems Test slightly less so, and the Matching Familiar Figures Test considerably less homogeneous. Test-retest reliability is indicated by $r_{1,2}$ to the extent that Form A and B measures are parallel. A low $r_{1,2}$ indicates either nonparallelism between forms or instability in subject performance over time. Table 9 shows that most of the test-retest reliabilites are high enough, relative to the size of r_{xx} and $\emptyset$, to indicate fairly consistent subject performance on the two forms. If the measures are rank ordered by the size of their internal consistency reliabilities and test-retest reliabilities, the same order is obtained. Thus, assuming that subject performance was stable, the single item measures with low test-retest reliabilities (Object Uses: % Categories, Math Problem, and Mystery Problem) probably would have had low parallel form reliabilities had it been possible to measure them.

Reliabilities for the STAI-State Scale are also shown in Table 9. Since identical scales were used on Forms A and B, $r_{1,2}$ is an estimate of a coefficient of stability. Relative to the high internal consistency reliabilites obtained, the test-retest reliabilities are quite low. Calculated separately, the test-retest coefficient for Group I was .54 while

Table 9

Cognitive Ability Measures of Style, Problem Solving Efficiency, and State Anxiety: Reliabilities and Treatment Effects

Measuring Instrument		Reliability ^a					Mean				r _{pbi}	
		ϕ		r _{xx}		r _{1,2}	Group I		Group II			
		Sess.	1	2	1		2	1	2	1	2	1
		Cond.						NS	S	S	NS	
Verbal Problems		.65	.79	.58	.69	.52	8.68	8.86	8.28	7.54	.07	.20*
Hidden Figures		.94	.94	.90	.89	.64	4.60	7.56	5.11	7.32	-.08	.03
Sign Changes		.80	.83	.70	.76	.55	20.40	22.30	20.00	22.26	.05	.00
O.U. total						.65	15.04	17.09	13.74	15.93	.10	.10
O.U. % categ.						.13	55.02	68.53	55.56	75.75	-.01	-.27**
O.U. % parts						.28	13.72	17.16	14.91	15.23	-.05	.11
MFF: correct		.46	.43	.39	.35	.20	2.60	2.89	2.67	2.47	-.03	.19*
MFF: time		.76	.69	.67	.68	.48	4.32	5.78	3.93	5.59	.14	.05
Myst. P. correct						-.02	.49	.35	.51	.44	-.02	-.09
Math P. correct						.02	.46	.46	.44	.39	.02	.07
Myst. P. time						.29	5.66	5.83	5.54	6.34	.03	-.13
Math P. time						.13	2.37	1.36	2.67	1.38	-.15	-.01
STAI-State Scale		.97	.97	.94	.95	.35	2.21	2.18	2.39	1.89	-.16	.29**
STAI-State: relaxed cluster				.89	.94	.40	2.36	2.32	2.08	2.58	.23*	-.16
STAI-State: tense cluster				.89	.87	.34	1.78	1.69	1.85	1.35	-.06	.37***

^a r_{xx} coefficients for the STAI relaxed and tense clusters are coefficient alphas. All other r_{xx} reliabilities are odd-even split half correlations corrected for attenuation with the Spearman-Brown formula.

*p < .05

**p < .01

***p < .001

that for Group II was .31. The lower value for Group II may reflect a greater variety of reactions to the treatment conditions among subjects in that group. As will be discussed shortly, Group II showed greater changes in state anxiety across sessions than did Group I. The full scale values for the STAI-State scale presented in Table 9 show that Group I (stress) was significantly more anxious than Group II (nonstress) during Session 2. During Session 1 the mean for Group II (stress) was higher than that for Group I (nonstress) but the difference between means did not reach significance ($p < .10$).

The cluster analysis of the STAI-State Scale showed that it contains two distinct factors, one for relaxed items (e.g., "I felt content," "I was relaxed") and one for the tense items (e.g., "I was tense," "I felt nervous"). The clusters may be referred to in Appendix H. Coefficient alphas, test-retest reliabilities, means and point-biserial correlations are presented for these clusters in Table 9. The tense and relaxed item clusters behaved somewhat differently for each group under the treatment conditions. In Session 1 the stress group was significantly less relaxed than the nonstress group, but there was no difference between them in tension. In Session 2 the stress group was significantly more tense than the nonstress group and was also less relaxed but not significantly so ($p < .10$).

Looking again at the full scale values for state anxiety, means are expressed in terms of single item values where 1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much so. There were 20 items on the scale so means expressed in total score values are as follows: Group I nonstress = 44.20, Group I stress = 43.60, Group II stress = 47.80, and Group II nonstress = 37.80. These measures may be compared with those

found by other researchers. Using college males, Spielberger, et. al., (1970) report means of 32.70 under relaxed conditions, 36.99 under normal conditions, and 43.01 for exam conditions in which students were led to believe that they were taking an IQ test. Thus, it may be concluded that subjects in Group I were about as anxious in both sessions as students usually are when taking IQ exams, and that subjects in Group II were even more anxious than that under stress conditions and returned to normal levels of state anxiety under nonstress conditions.

From the point-biserial correlations presented in Table 9 it can be seen that only three of 24 between groups comparisons of means on the cognitive ability style measures and problem solving tasks showed a significant treatment effect. Under stress conditions Group I did better on the Verbal Problems Test and on the Matching Familiar Figures Test: Correct. Under nonstress conditions, Group II produced a higher percentage of object uses of different categories. Pure treatment effects would have given point-biserial correlations of equal magnitude and opposite sign for each session. The three effects obtained were all in Session 2, so it is likely that they are the product of interactions between treatments and practice effects.

Table 10 presents the reliabilities, means and point-biserial correlations for the problem solving strategies and anxiety clusters. The reliability of these measures was discussed in Section III. Group means were not significantly different for any of the problem solving strategies or anxiety clusters on either Session 1 or Session 2, i.e., there were no treatment effects on these measures. Thus, stress conditions did not cause changes in strategy or the approach used on either problem solving task nor did stress conditions significantly affect the

Table 10

Problem Solving Questionnaire Clusters: Reliabilities and Treatment Effects

Cluster	Sess. Cond.	Reliability			Mean				r_{pbi}	
		Coef. Alpha		$r_{1,2}$	Group I		Group II			
		1	2		1	2	1	2		
		NS	S	S	NS	1	2			
<u>Mystery Questionnaire</u>										
Frustrated		.69	.62	.22	4.02	3.17	4.12	3.25	-.04	-.03
Concentrated		.55	.67	.27	6.77	7.33	6.90	7.21	-.04	.05
Enjoyed		.66	.79	.27	3.63	3.46	3.39	3.46	.17	.00
Strategy Change		.54	.58	.31	6.32	5.75	6.18	5.80	.05	-.02
Careful		.59	.61	.04	9.30	9.68	9.51	9.86	-.06	-.05
Deliberate		.66	.73	.31	3.16	2.86	3.10	2.90	.03	-.02
Global		.42	.54	.41	7.81	7.18	7.77	7.09	.01	.03
Notes		.62	.68	.22	2.81	3.33	2.80	3.37	.01	-.02
Systematic		.85	.84	.15	3.02	3.14	3.11	3.07	-.05	.04
Trial and Error		.43	.53	.13	3.09	2.98	2.91	2.80	.11	.12
New Approach		.50	.61	.16	3.42	2.81	3.30	2.93	.08	-.07
Fixated		.48	.48	.31	3.16	2.81	2.98	2.70	.11	.06
<u>Math Questionnaire</u>										
Frustrated		.74	.69	.19	7.96	6.58	8.19	6.77	-.06	-.06
Concentrated		.71	.64	.31	10.95	11.63	11.16	11.70	-.07	-.04
Strategy Change		.79	.84	.03	10.19	8.58	9.90	8.47	.07	.02
Deliberate		.36	.54	.22	8.26	7.02	8.16	6.63	.04	.14
Notes		.83	.85	.19	2.65	3.32	2.58	3.32	.04	.00
Systematic		.73	.61	.31	3.30	3.65	3.28	3.67	.01	.00
New Approach		.70	.72	.36	3.16	3.16	3.39	3.23	-.13	-.04

degree to which subjects reported enjoying working on the problems, the amount of frustration they experienced, or the degree to which they were able to concentrate.

Discussion

The stress conditions were effective in elevating state anxiety to levels as high or higher than those reported by at least one group of researchers using similar treatment conditions. Although treatment conditions were psychologically stressful enough to produce differences between groups in state anxiety, they did not affect most cognitive ability measures of styles, use of problem solving strategies, or problem solving efficiency to a significant degree. It would appear that the intellectual performance of most college students is relatively unaffected by moderate increases in level of anxiety. These conclusions are based on comparisons between group means, and it is possible that some individuals did change strategies and styles as a result of the treatment conditions, while group means remained unaffected. Some styles and strategies are related to problem solving efficiency (as shown in Section III), but the lack of treatment effects in this phase of the study makes it difficult to conclude anything at this point about how systematic changes in these variables may cause changes in problem solving efficiency as conditions vary between stress and nonstress. Correlational data bearing on the relationships between anxiety proneness and use of problem solving strategies will be examined in Section VII. The cluster analyses of the STAI-State Scale and the differential effects of the items that measured tension versus those that measured relaxation suggest that these may not be opposite ends of the same continuum, but separate aspects of the anxiety response. The relaxed items emphasize state of mind (e.g., calm, secure,

self-confident) and most of the tense items refer to body states (e.g., tense, jittery, nervous). Hence, the results of the cluster analyses support a two component model of anxiety reactions.

Style usage as measured by the cognitive ability tests appears to be unaffected by the kinds of stress conditions used in this study and the test-retest reliabilities show that performance on them was fairly consistent. This may be taken as evidence for the stable usage of styles so long as these measures are considered to be valid measures of cognitive styles. The use of styles and strategies within groups across time and their relation to changes in problem solving efficiency across time will be taken up in Section V.

V. PRACTICE EFFECTS ON STATE ANXIETY, ABILITY MEASURES OF COGNITIVE STYLE, PROBLEM SOLVING STRATEGIES, AND PROBLEM SOLVING EFFICIENCY

In this section practice effects will be considered using the same data and design discussed in Section IV in regard to treatment effects. Changes in state anxiety, style scores on the cognitive ability tests, changes in problem solving strategies, and changes in problem solving efficiency will be examined within each group of subjects between Session 1 and Session 2. Although the cognitive ability measures of style were mostly unaffected by differences in treatment conditions, there is still the possibility that they may change as a result of practice. If they do, this will have a bearing on the definition of cognitive styles as stable individual traits. Data from this phase of the analysis will also be examined to see if changes in strategies over time occur which can be tied to changes in problem solving efficiency.

Method

This analysis is much more straight forward than it would have been if there were generalized treatment effects. Separating treatment from practice effects would have been a complicated matter. As it is, except for the few measures for which treatment effects were indicated in Section IV, changes in means will be considered to be pure practice effects.

Group means for all the measures were computed and the Session 1 means were subtracted from the Session 2 means, giving mean difference

scores. Standard deviations of the difference scores were computed, and the mean difference scores were converted to Z scores for testing the significance of changes between sessions.

Results

The mean difference scores and Z scores for the cognitive ability measures of style, measures of problem solving efficiency, state anxiety measured by the STAI-State Scale are presented in Table 11. Since Session 1 means were subtracted from Session 2 means, a negative difference score indicates that scores went down on that measure across sessions and a positive difference score indicates increasing of scores across sessions. Group I went from nonstress to stress conditions across sessions, and Group II went from stress to nonstress so pure treatment effects would be indicated by mean difference scores for each group that are equal in size but opposite in sign. Pure practice effects would be indicated by mean difference scores of the same size and in the same direction for both groups.

Group I did not change significantly in state anxiety going from nonstress to stress conditions. Group II, however, shows a large reduction in anxiety as they went from stress to nonstress conditions. A possible explanation for the difference between the anxiety reactions between the two groups will be suggested in the discussion. Two (Verbal Problems Test, Matching Familiar Figures: Correct) of the other three measures for which treatment effects were found in between groups comparisons (discussed in Section IV) also have mean difference scores of opposite sign. The difference scores for the third measure, Object Uses: % part responses are in the same direction, but one is significantly positive while that for the other group is barely above zero change. For all

Table 11

Mean Difference Scores and Z Scores for Cognitive Ability Measures of Style, Problem Solving Efficiency, and State Anxiety

Measuring Instrument	Mean Difference		Z Score	
	Group I	Group II	Group I	Group II
Verbal Problems	0.18	-0.74	0.45	-1.96*
Hidden Figures	2.97	2.21	7.85***	5.29***
Sign Changes	1.90	2.26	3.85***	4.53***
O.U. total	2.05	2.18	2.72**	3.78***
O.U. % categ.	13.51	20.19	4.98***	6.42***
O.U. % parts	3.46	0.32	2.04*	0.23
MFF: correct	0.28	-0.19	1.74	-1.06
MFF: time	1.45	1.66	6.34***	7.32***
Myst. P. correct	-0.14	-0.07	-1.51	-0.76
Math P. correct	0.00	-0.05	0.00	-0.53
Myst. P. time	0.17	0.81	0.53	2.94
Math P. time	-1.02	-1.28	-6.72***	-8.23***
STAI-State Scale	-0.02	0.50	-0.38	6.72***

* p <.05
 ** p <.01
 *** p <.001

three of these measures the mean difference scores for each group are of unequal size indicating an interaction between treatment and practice effects.

Treatment effects probably played a minor role in the changes that occurred across time on the other measures shown in Table 11. Subjects in both groups improved significantly with practice on the Hidden Figures Test, Sign Changes Test, Object Uses: total and % categories. Both groups took longer in Session 2 on the Matching Familiar Figures Test and less time on the math problem. Group II took more time on the mystery problem in Session 2.

Table 12 presents the group mean difference scores for the problem solving strategies and problem solving anxiety clusters. Virtually every significant change in one group is accompanied by a change in the same direction for the other group. Hence, treatment conditions do not appear to have played a significant part in the changes that took place across sessions on these measures. Going from Session 1 to Session 2, both groups of subjects became less frustrated (less discouraged and worried), and were better able to concentrate. On Session 2 both groups used fewer strategies, but were less likely to use the same hypothesis over and over. On Session 2 both groups were also less deliberate (took less time before beginning), were less global in their approach (more analytic), and more members of each group took notes rather than doing the problems in their heads. More subjects were systematic on the math problems in Session 2 but did not change significantly on this variable for the mystery problem. Fewer used a new approach on the mystery problem in the second Session, but this measure did not change significantly on the math problem. Nor were there signifi-

Table 12

Mean Difference Scores for Problem Solving Questionnaire Clusters

Cluster Name	Mystery Problems		Math Problems	
	Group I	Group II	Group I	Group II
Frustrated	-0.85***	-0.87***	-1.38***	-1.42***
Concentrated	0.56**	0.31	0.68***	0.54**
Enjoyed	-0.17	0.07		
Strategy Change	-0.57**	-0.38*	-1.61***	-1.43***
Careful	0.38	0.35		
Deliberate	-0.30*	-0.20	-1.24***	-1.53***
Global	-0.63**	-0.68***		
Notes	0.52***	0.57***	0.67***	0.74***
Systematic	0.12	-0.04	0.35**	0.39***
Trial and Error	-0.11	-0.11		
New Approach	-0.61**	-0.37**	0.00	-0.16
Fixated	-0.35**	-0.28*		

*p < .05

**p < .01

***p < .001

cant changes in the number of subjects who enjoyed working on the mystery problems, who used a trial and error approach, or who were careful and cautious in their approach.

Discussion

The level of state anxiety in Group I did not show any increase from nonstress to stress conditions. Group II had a marked reduction in anxiety going from stress to nonstress conditions. One possible reason for this discrepancy between the groups is that a certain amount of anxiety may have been caused in Session 1 just because of the novelty of the situation. Group II had this effect plus stress conditions in Session 1 and, hence, a higher mean level of anxiety in that session. In Session 2, the portion of anxiety due to novelty would be predicted to decrease for all subjects since they had been in the situation before and knew more or less what to expect. The finding that both groups were less frustrated and better able to concentrate in the second session suggests that the novelty effects were wearing off. In Session 2 Group I was given a stress treatment that was strong enough to counteract the reduction in anxiety due to the familiarity of the situation. Apparently the stress instructions were less believable in Session 2 or Group I probably would have increased in their level of anxiety over what they experienced in Session 1. Group II received the anxiety reduction due to familiarity with the situation in Session 2 plus the bonus of nonstress conditions, which brought their level of state anxiety even lower.

Practice effects were found for most of the problem solving strategies. This corroborates the suggestion based on low test-retest reliabilities discussed in Section III that they represent cognitive behaviors that are quite changeable. If the cognitive ability measures are

taken as valid indicators of style, then it would appear that with practice on those tests, subjects became more analytical (Hidden Figures Test), more flexible (Sign Changes Test, Object Uses: % categories), and more impulsive (Object Uses: % part responses). If these tests are primarily measuring abilities, however, the improvements in scores could be due to increases in skill with practice. The question of the construct validity of these measures will be taken up in Section VI.

VI. THE CONSTRUCT VALIDITY OF COGNITIVE ABILITY MEASURES OF COGNITIVE STYLES

Up to this point it has been assumed that the cognitive ability measures were valid indicators of cognitive styles. In this section both the convergent and discriminant validity of these measures will be investigated. In Section III it was shown that when the problem solving clusters were grouped together as measures of the styles indicated by their content, only the group of anxiety clusters had inter-correlations indicative of a common trait being shared between them. Those comparisons were made within one method of measurement, the problem solving questionnaire measures. Another important comparison to be made is between the problem solving questionnaire clusters and style measurements made by different methods. The relationships between the problem solving measures, cognitive ability measures, and personality scale measures that have been hypothesized to be indicators of the same styles will be examined in this section in order to check for their convergent validity. In addition, the discriminant validity of the cognitive ability measures of style will be investigated via cluster analysis to see if this method of measurement discriminates between different styles. If discriminant validity is present, cognitive ability measures of different styles should emerge as separate factors.

Method

Table 2 in Section II presents all the measuring instruments used in this study. Several of them have not been involved in the analysis until now because the data from them was not gathered under experimental conditions. Before the subjects were given any instructions as to the nature of the experiment, they were asked to provide some general information about themselves, such as their age and year in college. They were also given four scales to fill out which may be referred to in Appendix A. The first was a 24 item true-false reflectiveness-impulsiveness scale which was made up of items selected from the Impulsiveness Scale (Barratt, 1959), the RI Rigidity Scale (Rehfishch, 1958), the RAPH Scale (Meresko, Rubin, Shontz, and Morrow, 1954), the Wesley Rigidity Scale (Wesley, 1953), and also included a few items written by the experimenter. Second was the Achievement Anxiety Test (AAT) (Alpert and Haber, 1960); the name is misleading, as this is a measure of academic test anxiety. Subjects responded on a five point scale of anxiety reactions in test taking situations that went from "never" to "always". The third scale was a 20 item true-false flexibility-rigidity scale made up of items taken from the same scales as those used by the experimenter in constructing the reflectiveness-impulsiveness scale. The fact that items concerning flexibility and impulsiveness were found on the same scales indicates that there is a good deal of confusion among the authors of these scales as to the difference between these two constructs.

On the same page as the flexibility-rigidity scale were two items written by the experimenter which were not included in that scale. "I get very tense and anxious when I think other people are disapproving of

me" was used as a measure of disapproval anxiety. The other item, "I tend to lack self-confidence in my academic ability" was included so that relationships between this aspect of self-concept and performance could be investigated. The last scale was the trait anxiety form of the State-Trait Anxiety Inventory (STAI) (Spielberger, et. al., 1970). This scale is intended to measure individual differences in general anxiety proneness. It is a four point scale that goes from "almost never" to "almost always" experience certain kinds of anxiety reactions.

The other premeasures used were high school grade point average (GPA) and college entrance examination percentile which were obtained from the University's Evaluation Services. Both are used as indicators of academic ability but GPA is more a measure of academic achievement and college entrance exam percentile is more a measure of academic aptitude. These percentiles were calculated for each class of new students at Michigan State University and are based on scores from the SAT, ACT, and CQT.

The experimental design and procedures used in collecting the other measures of cognitive styles and strategies, the problem solving efficiency measures and the measures of state anxiety, have been discussed in previous sections. Reliabilities, means and point-biserial correlations between groups were computed for the premeasures. Then data from all the measures, pre and experimental, was pooled across groups and sessions and correlations were computed between all measures. Finally, the correlation matrix of all the measures but the problem solving questionnaire clusters was reordered using the ORDER and ARRANGE routines provided in PACKAGE (Hunter and Cohen, 1969). Based on the resulting correlation matrices and similarity coefficients, a primary set of clusters was

formed. Then an oblique multiple groups factor analysis was performed on these clusters. They were revised and factor analyzed several times until they met the three criteria discussed in Section III for unique homogeneous clusters.

Results

Table 13 shows reliabilities, group means, and point-biserial correlations for the premeasures. The split-half and similarity coefficients obtained indicate that the STAI-Trait Scale is very homogeneous, while the Flexibility Scale, AAT, and the Reflectiveness Scale are moderately so. Although subjects were assigned to groups on a random basis, the group means and point-biserial correlations show that in some ways the groups were different. Group I was significantly younger, had spent less time in college, was less reflective, and more flexible as measured by the personality scale measures of style. These group differences did not show up in any discernable way on the other measures in the study.

Correlations between different kinds of measures of the same cognitive styles are presented in Table 14. For flexibility, only the Verbal Problems Test and the Flexibility Scale were significantly related. For reflectiveness, significant correlations were obtained between the Reflectiveness Scale and the Careful cluster and math Systematic. There was also a significant correlation between math Systematic and time on the Matching Familiar Figures Test. The matrix of global style measures did not produce any significant correlations. In summary, there is an obvious lack of generality across the different kinds of measures for each style. These different methods of measurement appear to have little in common as measures of style, hence, they may be said to lack con-

Table 13

Premeasures: Reliabilities and Group Differences

Premeasure	Reliability		Mean		r_{pbi}
	r_{xx}	ϕ	Group I	Group II	
Reflectiveness Scale	.55	.57	70.26	71.77	-.20*
AAT (Test Anxiety)	.57	.64	53.60	53.60	.00
Flexibility Scale	.64	.68	59.32	57.47	.28**
STAI-Trait Scale	.88	.92	47.93	45.63	.13
Academic Self-confidence			1.70	1.53	.18
Disapproval Anxiety			1.72	1.58	.14
High School GPA			3.16	3.02	.16
College Entrance Exam Percentile Score			52.39	53.14	-.01
Year in College			1.28	1.83	-.32***
Age			18.25	18.98	-.27**

Note.-- r_{xx} coefficients are odd-even split half correlations for the Reflectiveness Scale, Flexibility Scale and STAI-Trait Scale. On the AAT the correlation is between the facilitative and debilitative test anxiety items. All are corrected for attenuation with the Spearman-Brown formula.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 14

Correlations Between Cognitive Ability Measures, Personality Scale Measures,
and Problem Solving Questionnaire Measures of Styles and Anxiety

<u>Flexibility</u>		<u>403</u>	<u>409</u>	<u>411</u>	<u>413</u>
Flexibility Scale	403	100			
Verbal Problems	409	19*	100		
Sign Changes	411	-01	17	100	
O. U. % Categories	413	16	-05	-16	100
Myst. New Approach	518	-07	-13	08	-09
" Strategy Chg.	511	-01	-09	-06	05
" Trial & Error	517	-11	-02	09	-08
" Fixated	519	-02	-03	-06	-06
Math New Approach	526	-15	-11	-07	10
" Strategy Chg.	522	-12	-18	-07	03

<u>Reflectiveness</u>		<u>401</u>	<u>415</u>	<u>416</u>	<u>412</u>
Reflective Scale	401	100			
MFF: correct	415	06	100		
MFF: time	416	10	32***	100	
O.U. Total	412	04	-09	-12	100
Myst. Notes	515	-11	17	17	07
" Systematic	516	02	06	13	05
" Deliberate	513	-04	02	-14	01
" Careful	512	21*	01	04	07
Math Notes	524	-08	01	08	18
" Systematic	525	27**	08	21*	15
" Deliberate	523	08	01	09	10

<u>Globalness</u>		<u>410</u>	<u>414</u>
Hidden Figures	410	100	
O.U. % Parts	414	04	100
Myst. Global	515	-10	04
" Deliberate	513	01	10
Math Deliberate	523	-10	04

<u>Anxiety</u>		<u>402</u>	<u>404</u>	<u>407</u>	<u>405</u>	<u>406</u>
AAT (Test Anxiety)	402	100				
STAI-Trait Scale	404	43***	100			
STAI-State Scale	407	25**	48***	100		
Disapproval Anx.	405	10	36***	16	100	
Lack Aca. Self-Conf.	406	32***	41***	20*	13	100
Myst. Frustrated	508	23*	27**	42***	19*	22*
" Concentrated	509	-23*	-21*	-29**	-12	-10
" Enjoyed	510	-01	-02	-28**	-09	-08
Math Frustrated	520	29**	28**	47***	08	27**
" Concentrated	521	-17	-12	-23*	-06	-15

*p < .05, **p < .01, ***p < .001

vergent validity for that purpose.

The results of comparing the different measures of anxiety are sharply contrasting to those just reviewed. A large amount of generality was found among these measures. Here 60 percent of the intercorrelations are statistically significant. These measures show a good deal of evidence for convergent validity, i.e., most appear to be measuring the same trait.

The results of the cluster analysis of the cognitive ability measures of style, problem solving efficiency measures and premeasures are presented by individual clusters in Tables 15 through 19. Each cluster will be discussed briefly. Table 15 presents the eight measures which made up the Ability cluster, so named because its strongest member is a measure of academic ability--College entrance exam percentile. This cluster is considered to be a general measure of academic ability. The three weakest items are the math and mystery problems: correct, and high school GPA. GPA correlates about as well with the Time cluster as with the Ability cluster, but it was placed in the Ability cluster to preserve content homogeneity. The mystery problem correlates as highly with the Object Uses cluster, but it was also kept in the Ability cluster for reasons of content. Three of the cognitive ability style measures, Verbal Problems, Sign Changes, and Hidden Figures, show more variance in common with measures of academic ability than with any other measures. If there is some variance in each that is due to cognitive style, it is probably less than that of the ability component and was not enough to separate them in this analysis.

The six measures that make up the Anxiety cluster are shown in Table 16. All Correlate more highly with this cluster than with any other.

Table 15

Cluster 501: Ability

Coefficient alpha = .65

-
426. College entrance exam percentile
409. Verbal Problems Test
422. Solvable practice problems answered correctly
411. Sign Changes Test
410. Hidden Figures Test
419. Math problems: correct
424. High school grade point average
417. Mystery problems: correct

	426	409	422	411	410	419	424	417	
426	55	57	35	21	31	19	21	17	
409	57	49	27	17	24	24	28	13	
422	35	27	35	23	30	30	13	07	
411	21	17	25	14	16	16	08	11	
410	31	24	30	16	14	-08	11	09	
419	19	24	30	16	-08	06	-07	03	
424	21	28	.13	08	11	-07	05	-01	
501	75	70	59	38	37	24	23	18	Ability
502	-31	-16	-18	-21	-25	05	-12	-09	Anxiety
503	-09	01	04	-15	14	-08	-02	18	Object Uses
504	20	02	17	07	20	02	24	16	Time
505	05	19	03	-01	20	07	-03	01	Flexibility Scale
506	07	08	04	00	14	-02	19	03	Reflectiveness Scale
507	-05	-07	02	06	10	-04	-06	-03	Grade-Age

Table 16

Cluster 502: Anxiety

Coefficient alpha = .67

-
404. Trait Anxiety Scale
402. Test Anxiety Scale
407. State Anxiety Scale: Session 1
406. I tend to lack self-confidence in my academic ability.
408. State Anxiety Scale: Session 2
405. I get very tense and anxious when I think other people are disapproving of me.

	404	402	407	406	408	405	
404	80	43	41	41	36	36	
402	43	24	26	32	13	10	
407	41	26	23	08	28	20	
406	41	32	08	20	24	13	
408	36	13	28	14	17	06	
405	36	10	20	13	06	10	
501	-18	-14	-17	-21	-20	05	Ability
502	90	49	48	45	41	31	Anxiety
503	08	01	18	04	-23	-07	Object Uses
504	-17	01	03	-20	05	-17	Time
505	-20	-20	-02	-10	-22	-22	Flexibility Scale
506	-11	-16	-08	-13	03	-02	Reflectiveness Scale
507	-04	-03	-12	23	-06	-02	Grade-Age

Table 17

Cluster 503: Object Uses

Coefficient alpha = .62

-
413. Object Uses Test: % of total uses in different categories.
412. Object Uses Test: Total number of uses listed.
414. Object Uses Test: % of total uses which required breaking the object into parts.

	413	412	414	
413	69	50	41	
412	50	33	22	
414	41	22	22	
501	00	11	-09	Ability
502	11	-05	-05	Anxiety
503	86	56	45	Object Uses
504	-26	-14	-06	Time
505	16	28	24	Flexibility Scale
506	-04	04	08	Reflectiveness Scale
507	01	07	15	Grade-Age

Table 18

Cluster 504: Time

Coefficient alpha = .62

-
418. Mystery Problems: Time
 416. Matching Familiar Figures Test: Time
 420. Math Problems: Time
 421. Unsolvable practice problems answered
 415. Matching Familiar Figures Test: Correct

	418	416	420	421	415	
418	57	40	34	38	23	
416	40	31	26	11	32	
420	34	26	21	21	13	
421	38	11	21	14	09	
415	23	32	13	09	13	
501	18	14	14	15	19	Ability
502	-16	-02	-06	-12	-01	Anxiety
503	-24	-01	-09	-14	-13	Object Uses
504	77	56	46	37	35	Time
505	01	00	-08	-12	11	Flexibility Scale
506	02	10	19	13	06	Reflectiveness Scale
507	-05	05	-20	-02	-06	Grade-Age

Table 19
Cluster 507: Grade-Age
Coefficient alpha = .85

423. Class in college

425. Age

	423	425	
423	75	74	
425	74	75	
501	-.02	-.01	Ability
502	-.04	.02	Anxiety
503	.14	.06	Object Uses
504	-.05	-.15	Time
505	-.01	-.05	Flexibility Scale
506	.01	.05	Reflectiveness Scale
507	.86	.86	Grade-Age

This cluster can safely be considered to be a measure of the general tendency to experience anxiety reactions or as a measure of anxiety proneness. Note that all but one of the members of this cluster (#405) correlate negatively with the Ability cluster.

The Object Uses cluster, made up of three closely related measures, is shown in Table 17. Although these three measures are closely related both in the way they are mathematically derived and in content, they show lower intercorrelations than might be expected. This indicates that, to a certain extent, each is measuring a different trait. All are uncorrelated with the Ability cluster and are positively correlated with the Flexibility Scale. Exactly what trait the Object Uses Task is measuring is not clear from this data. It may well be an indicator of semantic spontaneous flexibility as suggested by French, et. al. (1963).

Table 18 presents the five measures that make up the Time cluster. They are all positively correlated with the Ability cluster. The content of Unsolvables Practice Problem Answered and Matching Familiar Figures Test: Correct are not obviously homogeneous in content with the other three more direct measures of time. Correctly solving the Matching Familiar Figures Test items is more highly correlated with Time spent than with Ability. This indicates that doing well on this task is more a matter of taking enough time than it is having a special cognitive skill. Since both time and correct for the Matching Familiar Figures Test were most highly related to direct measures of time, there is good reason to believe that it measures a careful or reflective approach. A possible reason why the number of unsolvable practice problems that were answered joined the Time cluster is that subjects who put down an improbable answer to a difficult problem just in case they may be right and

get credit may be more careful and cautious as they work on the kind of tasks used in this study, and being careful and cautious takes more time. Number of unsolvable practice problems answered was correlated .22 with the Careful cluster which measures a careful, cautious approach. The Time cluster is considered as general measure of reflectiveness.

The Reflectiveness Scale and Flexibility Scale each formed a separate cluster. Their correlations with other clusters are shown in Table 20 in Section VII. The Flexibility Scale was most highly correlated with the Object Uses Cluster ($r = .36$) which may well be a measure of cognitive flexibility. The Reflectiveness Scale was correlated most highly with the Time cluster ($r = .20$). These significant correlations are evidence for convergent validity of flexibility and reflectiveness not found previously between unclustered separate measures.

Table 19 presents the Grade-Age cluster whose meaning may be taken at face value. This cluster was not significantly correlated with any others.

Discussion

Intercorrelations between different methods of measurement which were used as indicators of the same cognitive styles were generally found to be very low. When scores were summed across several measures, however, by the formation of a cluster, significant correlations were found between the Reflectiveness Scale and the Time cluster and between the Flexibility Scale and the Object Uses cluster. These correlations may be taken as convergent validity evidence for the existence of these traits. Individual measures did not show strong convergent validity, hence, their utility as single measures of flexibility or reflectiveness is questionable. Evidence for the convergent validity of the global-analytical dimen-

sion was not found. This may be because fewer measures were used to assess this trait than were employed with the others.

The results of the cluster analysis showed that the Verbal Problems Test and the Sign Changes Test that have been used as cognitive flexibility measures and the Hidden Figures Test which has been used as a measure of global-analytic style are more similar to measures of academic ability than measures of cognitive styles. If cognitive styles do play a role in performance on these tasks, it is probably less important than that played by ability. It was hypothesized that the total number of responses on the Object Uses Task might be a measure of impulsivity in the sense of quick nonreflective thinking, that the percent of total uses in different categories was a measure of flexibility, and that the percent of total uses which required the breaking of objects into parts was a measure of analytical thinking. It was no surprise that the three measures combined into one cluster, indicating that there was not enough variance unique to each measure for them to be used separately as indicators of different styles. As one measure, the Object Uses Task is probably an indicator of some aspect of cognitive flexibility. The Matching Familiar Figures Test: time and correct was shown by the cluster analysis to be more closely related to working speed than to any other measure. Although it was a member of the Time cluster and the Time cluster was significantly correlated with the Reflectiveness Scale, neither the Matching Familiar Figures: time or correct scores alone were significantly related to the Reflectiveness Scale. The Matching Familiar Figures Test showed more evidence for construct validity than the other cognitive ability measures of style, but there were still some inconsistencies shown which weaken the confidence that can be placed in it as an

adequate measure of reflectiveness.

After an analysis of the convergent and discriminant validity of the cognitive ability measures, it is concluded that, in general, they cannot be relied upon when used individually as adequate measures of specific cognitive styles. There is some evidence that the Matching Familiar Figures Test measured reflectiveness and that the Object Uses Task measured flexibility. The Hidden Figures Test, Sign Changes Test, and Verbal Problem Test have questionable construct validity as measures of cognitive style.

VII. PROFILE DIFFERENCES BETWEEN HIGH AND LOW ANXIOUS SUBJECTS

When this study was undertaken it was planned that the relationships between anxiety, cognitive styles and strategies, and intellectual performance would be investigated with both experimental and correlational methods. The effects of stressful treatment conditions and practice effects on these variables were examined in Section IV and V. In this section, correlational data is used in looking at the relationships between these variables. The specific question that was proposed for analysis was whether subjects who are more anxiety prone tend to exhibit different patterns of cognitive styles and strategies than subjects who are less anxiety prone. The results of the analyses covered in Sections III and VI have shown that although cognitive styles may exist as individual traits, they were not identified with the methods used in this study. Hence, the relationships discussed here are restricted to measures of anxiety, academic ability, cognitive strategies used on the problem solving tasks, and the personality scale measures of flexibility and reflectiveness.

Method

The data for all subjects was pooled across groups and sessions. Intercorrelations were computed between the 26 major clusters. These included the 12 mystery problem clusters and the seven math problem clusters described in Section III and the seven clusters just described in Section VI. The resulting matrix was investigated for patterns of

relationships which involved large numbers of clusters.

Results

The intercorrelation matrix of the 26 major clusters was divided into two tables. Correlations among the problem solving questionnaire clusters were presented in Table 6; Table 20 shows the remaining portion of the matrix. The two clusters that had the largest number of significant correlations with other clusters were the Anxiety and Ability clusters. The Anxiety cluster was positively related to Frustrated, Strategy Change, and Notes on the math problem only, and negatively correlated with Ability, the Flexibility Scale, Concentrated, Enjoyed and Careful. The Ability cluster was positively associated with Time, Concentrated, Careful and math Systematic, and was negatively related to Anxiety, Frustrated, and Fixated. It was unexpected that Fixated, i.e., sticking with the same hypothesis, would be a function of ability rather than anxiety and that Strategy Change would be a function of anxiety rather than ability. Two distinct profiles emerged from the above relationships in regard to the Anxiety cluster. One profile shows low anxiety proneness with high academic ability, taking ample time on cognitive tasks, and the following problem solving characteristics: carefulness, good concentration, enjoying the problem, not getting frustrated, and not using the same hypothesis over and over again. The other profile shows high tendency toward anxiety, poor performance on measures of academic ability, rigidity as measured by the flexibility-rigidity scale, and the following problem solving characteristics: lack of carefulness, poor concentration, not enjoying working on the problem, getting frustrated, and making several strategy changes.

Several of the clusters were not highly correlated with either Abil-

Table 20
Correlations Among the Twenty Six Major Clusters

		<u>501</u>	<u>502</u>	<u>503</u>	<u>504</u>	<u>505</u>	<u>506</u>	<u>507</u>
Ability	501	100	-37***	01	32***	15	16	-02
Anxiety	502	-37***	100	01	-15	-31***	-18	-01
Object Uses	503	01	01	100	-25**	36***	05	12
Time	504	32***	-15	-25**	100	-03	20*	-11
Flexibility Scale	505	15	-31***	36***	-03	100	-16	-03
Reflectiveness Scale	506	16	-18	05	20*	-16	100	03
Grade-Age	507	-02	-01	12	-11	-03	03	100
<u>Mystery Clusters</u>								
Frustrated		-20*	52***	-08	14	-21*	00	-09
Concentrated		26**	-37***	02	21*	01	23*	-01
Enjoyed		16	-22*	15	05	14	12	-09
Strategy Change		-07	33***	07	-07	-01	-12	-11
Careful		28**	-31***	10	09	06	21*	03
Deliberate		-17	04	01	-17	04	-04	07
Global		-14	01	20*	-08	-03	-12	-08
Notes		08	06	04	35***	07	-11	12
Systematic		06	-16	14	13	15	02	04
Trial and Error		-15	02	-18	-20*	-11	-06	04
New Approach		-03	-07	-07	05	-07	02	14
Fixated		-21*	03	-09	00	02	-07	-03
<u>Math Clusters</u>								
Frustrated		-20*	55***	-08	19*	-28**	-02	04
Concentrated		21*	-29**	-22*	-01	05	22*	-02
Strategy Change		-06	25**	04	28**	-12	05	00
Deliberate		-13	05	08	08	-07	08	01
Notes		14	19*	16	24**	-08	-08	06
Systematic		23*	04	07	23*	-02	27**	-01
New Approach		-08	-05	02	-08	-15	-04	01

*p < .05
 **p < .01
 ***p < .001

ity or Anxiety. Notes was most highly correlated with Time. Trial and Error was negatively related to the Flexibility Scale. New Approach was most strongly correlated with Deliberate. Object Uses was positively related to the Flexibility Scale and Global and negatively related to Time. The Reflectiveness Scale was just below significance in negative correlation with Anxiety. It was positively correlated with Time, Concentrated, Careful, and math Systematic. Grade-Age was not significantly correlated with any other cluster.

Two items that were part of the Anxiety cluster have not been covered elsewhere and will be mentioned briefly here. These correlations are not presented in any of the tables. Lacking self-confidence in academic ability was negatively correlated with Ability ($r = -.21$), Time ($r = -.20$), and Systematic on the mystery problem ($r = -.20$) and was positively related to Anxiety ($r = .45$), Frustrated (mystery $r = .22$, math $r = .27$), and Grade-Age ($r = .23$). Anxiety over disapproval from others was negatively related to Deliberate on the mystery problem ($r = -.21$) and the Flexibility Scale ($r = -.22$) and was correlated positively with Anxiety ($r = .31$), Fixated ($r = .20$), and Notes on the math problem ($r = .20$).

Discussion

The relationships found here between high anxiety proneness and low academic ability have a number of possible explanations. One possibility is that people who actually have low academic ability find their ego or self-esteem threatened every time they are faced with failure experiences in academic situations. There may be external punishments like flunking out of school, not being able to pursue the career of one's choice, etc., associated with poor academic performance

that elicit anxiety reactions in people of low ability. Both of these explanations are based on the assumption that the ability (i.e., potential) of these people is low and, therefore, anxiety reactions to academically stressful situations are the natural and probably unavoidable result.

Another possibility is that some people who have high potential for academic achievement become so anxious when they work on academic tasks that their performance is inhibited and consequently they get lower scores on measures of academic ability than they would if they were not so anxious. That is, although ability plays the largest role in determining academic performance, whatever the level of a person's ability, his performance can be hindered by high levels of anxiety. But how does this happen? The results of this section suggest some possibilities that are consistent with the hypothesis proposed by Wine (1971), that it is the worry component of anxiety that interferes with performance by taking attention away from the task. Subjects who lacked self-confidence in their academic ability tended to spend less time on the tasks in this study and were more easily discouraged and worried (Frustrated cluster). They scored lower on the measures of academic ability and were more prone toward anxiety reactions. This confirms the frequently found relationship between low self-opinions and anxiety proneness (Sarason, 1960) and suggests the possibility that poor performance in these subjects may be due, in part, to a lack of persistence. Also, the strong relationships found here between anxiety proneness, changing strategies, poor concentration, lack of carefulness, and poor academic performance suggests that anxiety reactions may be accompanied by alterations in cognitive functioning that could conceivably be contributing causes to

poor performance. Poor concentration, lack of carefulness, and strategy changes may all be indications of inability to maintain attention toward the task.

VIII. SUMMARY AND CONCLUSIONS

Four general questions were asked in this study: (1) Will the measured anxiety, cognitive styles and strategies, and problem solving efficiency of subjects vary systematically with changes in psychologically stressful conditions? This was asked for two reasons: (a) because cognitive styles have been defined as relatively stable individual traits that should be found consistently across time and in different situations, and (b) because of the possibility that problem solving efficiency may be affected by changes in styles and strategies and these, in turn, may be related to anxiety reactions. Although the treatment conditions used in the experimental phase of this study were psychologically stressful enough to produce differences between groups in state anxiety, they did not affect performance on cognitive ability tests thought to be measures of cognitive styles, problem solving strategies, or problem solving efficiency to a significant degree. Hence, no differences between groups in strategy or style usage or in problem solving efficiency caused by differences in stress conditions were measured.

The results of the cluster analysis of the problem solving questionnaires reported in Section III showed that working carefully and maintaining good concentration were helpful in solving the mystery problem. In Section VII lack of carefulness and poor concentration were found to be characteristics of anxiety prone subjects, and anxiety proneness showed a weak negative relationship ($r = -.09$) with accurately solving

the mystery problem. The size of this correlation is precisely what would be expected if it represents an indirect relationship, thus being a function of the correlation between carefulness or concentration and anxiety proneness (avg. $r = -.34$), times the correlation between carefulness or concentration and accurately solving the problem (avg. $r = .25$). These results suggests that an indirect causal chain was present between anxiety proneness, carefulness and concentration, and problem solving performance.

(2) Will subjects who are measured as more anxiety prone tend to exhibit different patterns of cognitive styles and strategies than less anxiety prone subjects? This question was asked to investigate the possibility that anxiety prone students tend to do poorly on measures of academic ability because they adopt maladaptive styles or strategies when they become anxious which interfere with their performance. The results presented in Section VII showed that high anxiety prone subjects tended to score lower on measures of academic ability, be less flexible as measured by the flexibility-rigidity scale, and exhibited the following problem solving characteristics: lack of carefulness, poor concentration, disliked working on the problem, getting frustrated, and making several strategy changes. Some hypotheses were suggested as to how these characteristics could adversely affect academic performance.

(3) Will subjects be measured as using the same cognitive styles consistently under different experimental conditions and across time? Performance on the cognitive ability tests thought to be measures of style was generally unaffected by changes in treatment conditions. On the other hand, there were changes across time that looked like practice affects on mental ability test. Later it was found that most of these tests more closely resembled measures of ability than measures of styles. The use of problem solving strategies changed over time, but these stra-

tegies do not represent styles as they are commonly defined. So the two kinds of style measures that were used to answer this question about the stability of style usage were found to be invalid as measures of style. Hence, the question of the consistency with which cognitive styles are used cannot be answered with this data.

(4) Will the different measures of cognitive styles be shown to have construct validity? This question was answered negatively in Sections III and VI. Neither the problem solving questionnaire measures of a priori styles nor the cognitive ability measures of style were found to have convergent or discriminant validity as style measures. Some evidence was obtained which indicated that the Matching Familiar Figures Test measured reflectiveness and that the Object Uses Task measured flexibility, but the adequacy of each as single measures of those characteristics is questionable. The Hidden Figures, Sign Changes, and Verbal Problems Tests behaved more like tests of abilities than measures of cognitive styles. In general, the findings indicate that if cognitive styles do exist as individual traits, they are very difficult to identify. If they are to be reliably and validly measured, batteries of tests will probably need to be constructed for each style. Using a single test to assess the use of a cognitive style is likely to be inadequate and may well lead to assumptions about its presence that are entirely unjustified.

Although general cognitive processing characteristics were not found that fit the usual definitions of cognitive styles, a good deal of evidence was obtained which indicates that certain aspects of processing which are more specific in nature than is suggested by the term "style" were identified. These were called cognitive strategies and were found

to have some generality across time and problem types. Until the validity of cognitive style measures are more firmly established, it may be more profitable in research on individual differences in cognitive processing to focus on specific aspects of functioning and to use caution when making assumptions which imply the existence of general processing traits.

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APPENDICES

APPENDIX A: PREMEASURES

Directions:

Listed below are a number of statements concerning attitudes and traits. Read each item and decide whether the statement is true or false as it pertains to you personally. Blacken in 1 for true and 2 for false.

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

T F

1. I am very slow in making up my mind.....	0	1	2	3	4	5	6	7	8	9
2. I rather like the idea of having my meals at odd hours and of going to bed when the mood strikes me.	0	1	2	3	4	5	6	7	8	9
3. I am often the last one to give up trying to do a thing.....	0	1	2	3	4	5	6	7	8	9
4. I prefer work that requires a great deal of attention to detail....	0	1	2	3	4	5	6	7	8	9
5. My friends consider me to be happy-go-lucky.....	0	1	2	3	4	5	6	7	8	9
6. I find it easy to stick to a certain schedule, once I have started on it.	0	1	2	3	4	5	6	7	8	9
7. I don't like to work with slow people.....	0	1	2	3	4	5	6	7	8	9
8. I usually have a ready answer.....	0	1	2	3	4	5	6	7	8	9
9. I like to do things on the spur of the moment.....	0	1	2	3	4	5	6	7	8	9
10. I am a careful person in whatever I do.....	0	1	2	3	4	5	6	7	8	9
11. I usually check more than once to be sure that I have locked a door, have everything I planned to take when I leave the house, etc.	0	1	2	3	4	5	6	7	8	9
12. I am inclined to go from one activity to another without continuing with any one for too long a time.	0	1	2	3	4	5	6	7	8	9
13. I sometimes do dangerous things just for the thrill of it.....	0	1	2	3	4	5	6	7	8	9
14. When reading a newspaper or magazine I skip around alot rather than going through it from beginning to end in a methodical manner.	0	1	2	3	4	5	6	7	8	9
15. I usually dislike to set aside atask that I have undertaken until it is finished.	0	1	2	3	4	5	6	7	8	9
16. My interests tend to change quickly.....	0	1	2	3	4	5	6	7	8	9
17. I like work requiring patience and carefulness.....	0	1	2	3	4	5	6	7	8	9
18. If I had to choose which plays the greatest role in my decision making, I'd say its probably emotions rather than logic.	0	1	2	3	4	5	6	7	8	9
19. I usually think before I leap.....	0	1	2	3	4	5	6	7	8	9
20. I don't like to wait for traffic lights to change.....	0	1	2	3	4	5	6	7	8	9
21. I have less trouble concentrating than other people seem to have...	0	1	2	3	4	5	6	7	8	9
22. I am always on time for social events.....	0	1	2	3	4	5	6	7	8	9
23. In watching games I usually don't yell along with the others.....	0	1	2	3	4	5	6	7	8	9
24. At times I feel I can make up my mind with unusually great ease....	0	1	2	3	4	5	6	7	8	9

Directions:

Listed below are a number of self-descriptive statements. Read each of them and decide whether the statement is true or false as it pertains to you personally. Blacken in 1 for true and 2 for false.

	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9
	0	1	2	3	4	5	6	7	8	9

T F

- | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|---|
| 1. Once I make up my mind about something, it is very hard to..... convince me to change. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2. Sudden unexpected changes of plans are usually upsetting to me..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3. I prefer doing one thing at a time to keeping several projects..... going at once. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4. I like a great deal of variety in my work..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5. I do not like to change my plans in the midst of an undertaking... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6. I often find myself thinking the same tunes or phrases all..... day long. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7. I like to think up puns and plays on words..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 8. I have thought of several good inventions..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9. I dislike having to learn new ways of doing things I already..... know how to do. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10. I always put on and take off my clothes in the same order..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 11. I like work which allows me to work at the same task rather than... having to switch around from one task to another. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 12. When I get stuck working a math problem, I generally keep trying... to solve it for a long time rather than taking a break and coming back to the problem later. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 13. When I am stuck on a math problem I usually try to find a new..... approach rather than continuing with my original strategy. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14. I often think of novel ways to use common objects..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 15. When another person disagrees with me, it is often hard for me..... to see things from their point of view. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 16. When I can't solve a math problem I usually try to forget what..... I have done and start all over from scratch. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 17. My interests probably range over a larger number of areas..... than those of most of my friends. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 18. When I can't get the right answer to a math problem I usually..... try to find my mistake by doing the problem the same way over and over again until I find my error. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 19. I like to think up new jokes..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 20. I often come up with new ways of doing things that others..... haven't thought of. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 21. I get very tense and anxious when I think other people are..... disapproving of me. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 22. I tend to lack self-confidence in my academic ability..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

- 1= almost never
2= sometimes
3= often
4= almost always

1. I feel pleasant.....
2. I tire quickly.....
3. I feel like crying.....
4. I wish I could be as happy as others seem to be.....
5. I am losing out on things because I can't make up my mind.....
soon enough.
6. I feel rested.....
7. I am "calm, cool, and collected".....
8. I feel that difficulties are piling up so that I cannot.....
overcome them.
9. I worry too much over something that really doesn't matter.....
10. I am happy.....
11. I am inclined to take things hard.....
12. I lack self-confidence.....
13. I feel secure.....
14. I try to avoid facing a crisis or difficulty.....
15. I feel blue.....
16. I am content.....
17. Some unimportant thought runs through my mind and bothers me.....
18. I take disappointments so keenly that I can't put them out of.....
my mind.
19. I am a steady person.....
20. I become tense and upset when I think about my present concerns....

[illegible]

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APPENDIX B: INSTRUCTIONS

SECTION II: Problems

The purpose of this study is to learn more about differences in the way people think as they work on problems. Most of the materials you are about to work on are designed to measure what is called "cognitive style." Your work will not be rated as "good" or "bad," rather measures of your performance will be used to separate the participants in this study into groups according to the different ways they like to work on problems. Then these preferences will be correlated with personality traits. You have already filled out some personality questionnaires.

Some people work fast, others prefer to take their time. Some people are global in their approach to problems while others are more analytical. What's best is what is most comfortable for you. We are interested in learning more about people's preferences along these lines.

Some of the problems you are going to work on may seem difficult and others may seem easy. This is to be expected. You will probably be doing better than you feel like you are doing. It is hoped that this explanation has relieved any sense of competition, anxiety, or worries you may have had. We want you to be as relaxed as possible as you go through these materials.

You will be given five minutes to work on some practice problems before we begin.

SECTION III: Measuring Intellectual Abilities

Due to the nature of some of the variables under study, it was not possible to tell you the full purpose of this study until now. Our primary concern is with intelligence. The problems you worked on in Section II were taken from an intelligence test we are developing that will be used with high school students. Students with college-level aptitudes generally find little difficulty with materials designed for use with people of the high school level. That is why the problems were so easy for you.

An important part of intelligence test development has to do with isolating factors which may affect performance on the test. Since there is a large pool of subjects available here at M.S.U., we are using college students to study the relationships between certain personality traits and IQ.

We have developed some intelligence measures for students with college-level aptitudes that are very similar to the problems you have just finished. Thus, the problems you will work on in this section are part of a more advanced test of the same intellectual abilities.

It is crucial that you do your very best on this section, otherwise the results will be invalid. Work quickly, but do not make foolish mistakes. You will have five minutes to do some practice problems before beginning the actual IQ test.

SECTION II: Measuring Intellectual Abilities

We are currently in the process of developing an IQ test that will be used with high school students. An important part of intelligence test development has to do with isolating factors which may affect performance on the test. Since there is a large pool of subjects available here at M.S.U., we are using college students to study the relationships between certain personality traits and performance on this measure of intelligence.

You are about to work on a series of problems that have been established as valid measures of IQ. You have already filled out the personality questionnaires. It is crucial that you do your very best on these problems, otherwise the results of this study will be invalid. Work quickly but do not make foolish mistakes.

You probably have college-level aptitudes, so these problems, which were designed for use with high school students, may not seem very difficult. In fact, most college students find them quite easy. You will be given five minutes to do some practice problems before beginning on the actual IQ test.

WAIT HERE UNTIL TOLD TO GO ON

SECTION:III: Problems

Due to the nature of the variables under study, it was not possible to explain the exact purpose of this experiment until now. These materials were designed to help us learn more about individual differences in the way people work on problems. We are trying to find out if a stressful testing situation will affect people's style or method of approaching problem solving tasks.

In an effort to make you anxious, we told you that you were taking an IQ test and we gave you some unsolvable practice problems. The problems you worked on were not taken from an IQ test. They are designed to measure preferences in thinking styles, not intelligence. Your work will not be rated as "good" or "bad," rather performance measures will be used to separate participants into groups according to the different ways they like to work on problems. Some people work fast, others prefer to take their time. Some people are more global or analytic than others. What's best is what is most comfortable for you. We are interested in learning more about people's preferences along these lines.

Don't worry if you found some of the problems difficult. Most people do much better on them than they feel like they are doing. It is hoped that this explanation will relieve any sense of competition, anxiety, or worries you may have had. We want you to be as relaxed as possible as you go through similar materials in this section. You will be given five minutes to work on some practice problems.

APPENDIX C: PRACTICE PROBLEMS

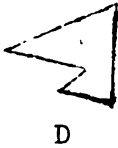
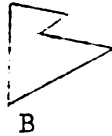
Directions:

Circle your answer or fill in the blank.

1. Holy is to Slob as Cold is to?

A. Born B. Old C. Glow D. Bow

2. Find the one that doesn't belong:



3. Complete the number series:

25, 20, 16, 13, _____

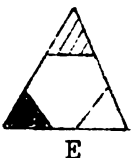
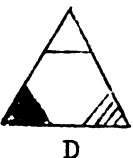
4. Rearrange the letters to make a word:

BACHE _____

5. Complete the letter series:

A, C, F, J, _____

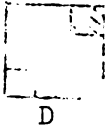
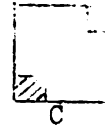
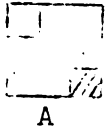
6. Find the one that doesn't belong:



Directions:

Circle your answer or fill in the blank.

1. Find the one that doesn't belong:



2. Rearrange the letters to make a word:

GOHAW _____

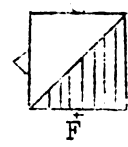
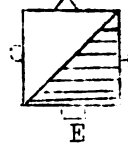
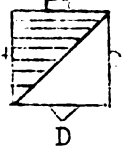
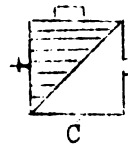
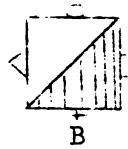
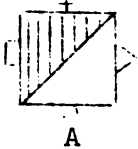
3. Fill in the missing number:

18, 20, ____, 25, 32, 41

- 4.
- Unusual
- is to
- Unprepossessing
- as
- Undulating
- is to?

A. Dubious B. Preponderance C. Congruent D. Continuous E. Roundabout

5. Find the one that doesn't belong:



6. Complete the series of letters:

X, V, S, L, _____

APPENDIX D: COGNITIVE ABILITY MEASURES OF COGNITIVE STYLES

Verbal Problems

Directions:

In this task you are to find the words in the paragraph in the box below which could have the same meanings as each of the numbered words or phrases. When you have found the required word for each numbered item write it in the space provided. Choose only one word for each blank space.

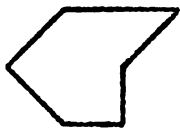
Here is a sample item: unclouded clear
On line 3 in the paragraph below you will see the word "clear" which can mean "unclouded" and therefore it has been written in the space provided.

Now go right ahead, working as quickly as possible. You will have 10 minutes.

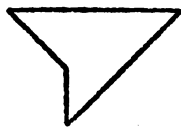
I managed to get into action earlier than usual this morning, dressing by the first beam of sunlight which crept in through my window. When I started off for town, looking very trim in my new outfit, the air was clear and it was silent except for the lonely bark of a dog. Two boys were making their way to the playing field, but otherwise I was quite alone on the street. I ploughed through a mass of leaves at the gate thinking of the errands I must go on. "First, I should go to the bank and draw out some money in case the music store wants cash for the violin bow I ordered, and then I must be back by eleven for there is that meeting to attend..."

- | | | | |
|--|-------|----------------------------------|-------|
| 1. steep slope | _____ | 13. disentangle | _____ |
| 2. piece of timber | _____ | 14. care for | _____ |
| 3. publicize | _____ | 15. deed | _____ |
| 4. law suit | _____ | 16. box | _____ |
| 5. submit | _____ | 17. border of a lake | _____ |
| 6. manner | _____ | 18. lay away | _____ |
| 7. incline | _____ | 19. smile | _____ |
| 8. performing | _____ | 20. part of the body | _____ |
| 9. pages | _____ | 21. prune | _____ |
| 10. sauce to add to
certain dishes | _____ | 22. small sailing
vessel | _____ |
| 11. equip | _____ | 23. application to
a wound | _____ |
| 12. to give material
or moral support
to | _____ | 24. in a flag, the
background | _____ |

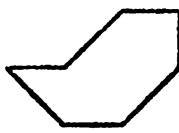
WAIT HERE UNTIL TOLD TO GO ON



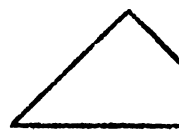
A



B



C

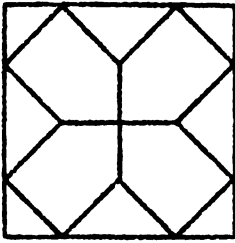


D



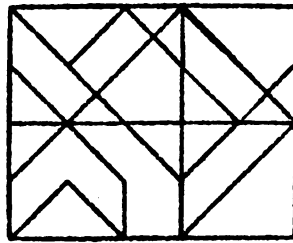
E

1.



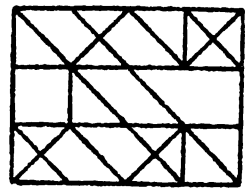
A B C D E

2.



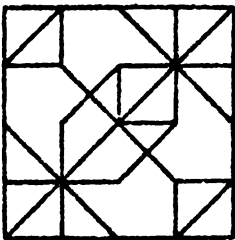
A B C D E

3.



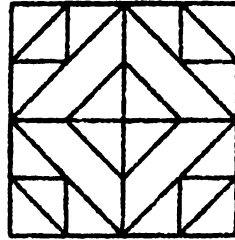
A B C D E

4.



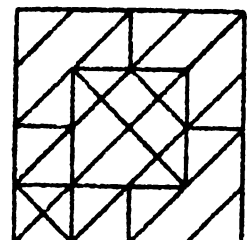
A B C D E

5.



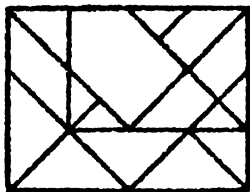
A B C D E

6.



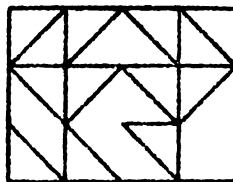
A B C D E

7.



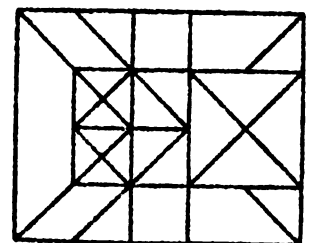
A B C D E

8.



A B C D E

9.



A B C D E

Part 2

1. $8 - 4 =$ _____
2. $6 - 5 =$ _____
3. $5 + 4 - 7 =$ _____
4. $4 - 2 \times 2 =$ _____
5. $5 + 3 - 2 =$ _____
6. $6 + 2 + 3 =$ _____
7. $1 + 3 - 5 + 4 =$ _____
8. $5 \times 5 - 4 + 5 =$ _____
9. $5 + 4 - 5 + 6 =$ _____
10. $3 + 2 + 9 - 7 =$ _____
11. $4 + 4 + 4 - 1 =$ _____
12. $6 + 3 - 2 \times 2 =$ _____
13. $7 + 3 - 5 \times 3 =$ _____
14. $8 + 3 - 1 \times 5 =$ _____
15. $6 + 4 - 4 \times 7 =$ _____

WAIT HERE UNTIL TOLD TO GO ON

Object Uses

Directions:

On the following page is the name of a familiar object. Write down all the different ways you can think of in which the object might be used. Do not hesitate to write down whatever ways you can think of in which the object might be used as long as they are possible uses for the object that is named. You will have 5 minutes.

A CARDBOARD BOX



APPENDIX E: PROBLEM SOLVING TASKS

Malice and Alice

Instructions:

Use the information presented in the following paragraph to answer the questions which follow it. When you have solved this mystery turn the page and record the time.

Here are the facts:

(1) Alice, Alice's brother, her son, and her daughter were involved in a murder. (2) One of the four killed one of the other three. (3) Two of them who are of the same sex were in a bar at the time of the murder. (4) The victim and the killer were together on a deserted beach at the time of the murder. (5) The victim's twin and the killer are of the opposite sex. (6) The victim and the killer are of the same age.

Fill in the blanks: (Alice, brother, son, daughter)

A. The killer was _____

B. The victim was _____

C. The two in the bar were _____ & _____

Murder in the Family

Instructions:

Use the information presented in the following paragraph to answer to questions which follow it. When you have solved this mystery problem, turn the page and record the time.

Here are the facts:

(1) Murder occurred one evening in the home of a married couple and their son and daughter. (2) One member of the family murdered another member, the third member witnessed the crime, and the fourth member was an accessory (an accessory is one who was absent but who contributed to the crime). (3) The accessory and the witness were of opposite sex. (4) The oldest member and the witness were of opposite sex. (5) The youngest member and the victim were of opposite sex. (6) The accessory was older than the victim. (7) The father was the oldest member. (8) The killer was not the youngest member.

Fill in the blanks: (father, mother, son, daughter)

- A. The killer was _____
- B. The victim was _____
- C. The witness was _____
- D. The accessory was _____

The Hotel Room Problem

Three traveling salesmen stopped at a hotel one night and stayed in three separate rooms. They were charged \$10 for each room, so the total bill came to \$30. The next day, however, the desk clerk discovered that a mistake had been made and that the bill should have been only \$25. Accordingly, he gave the bellboy the \$5 to distribute among the three men.

As it happened, the bellboy was not entirely honest. He gave each man only \$1 in return and kept \$2 for himself.

Choose from the calculations on your paper the one which most accurately depicts how the men's money was spent.

- ☐ 1. $30 - 1 = 27 + 2$
- ☐ 2. $30 - 2 = 27 + 1$
- ☐ 3. $1 = 3 - 2$
- ☐ 4. $25 + 2 = 27$
- ☐ 5. $5 - 3 = 2$

The Horse Trading Problem

A farmer went to an auction and bought a horse for \$60. But on his way home he met a neighbor who wanted to buy the horse, so he sold it to him for \$ 70. Later that night the farmer decided he still wanted the horse, so he went over to his neighbor's and bought it back paying \$80. The following day he was offered \$90 for the horse so he sold it.

How did the farmer come out financially in the horse trading business?

- ☐ 1. Lost \$10
- ☐ 2. Broke even
- ☐ 3. Made \$10
- ☐ 4. Made \$20
- ☐ 5. Made \$30

APPENDIX F: PROBLEM SOLVING QUESTIONNAIRES

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

I have worked this problem before and remembered how to solve it..

1. I changed my strategy or approach for solving the problem at..... least once.
2. I changed my strategy or approach for solving the problem..... more than once.
3. My first approach was based on my previous experience with..... similar problems.
4. My first approach was based on what seemed to be the demands of.... this particular problem rather than just using a familiar attack.
5. The first strategy I used was basically trial and error, i.e.,..... I chose a person at random to be the killer, etc., then checked to see if that role for the person fit the facts.
6. My first approach was to list all the facts given about each..... individual or role.
7. My first strategy was to list all possible roles for each of the.... four persons, then systematically eliminate them by checking all the facts .
8. When I discovered that a hypothesis I was trying out ran counter... to the facts, I quickly abandoned it, never to try it again.
9. It seems to me that this problem could have more than one..... correct solution.
10. I found myself trying to use the same hypothesis again and again...
11. I always checked out the facts and clues in the same order..... as they were presented in the problem.
12. I stuck with an unproductive hypothesis for a long time even..... though it didn't seem to be getting me anywhere.
13. I did most of my thinking without the aid of a pencil.....
14. I used pencil and paper to make notes as I worked on the problem...
15. I used a rational systematic approach at all times as I worked..... on the problem.
16. There were times when I abandoned logic and used a non-..... systematic approach.
17. After working for some time, I discovered that I had been..... overlooking some important element of the problem.
18. I was careful and cautious throughout the entire time I worked..... on the problem.
19. Sometimes I checked out hunches that seemed improbable even..... though I knew they would take time and energy.
20. I read the problem several times before deciding how to first..... attack it.
21. I decided on my first approach or strategy immediately after..... reading the problem once.
22. I didn't write down any answers until after I was positive..... that all the facts checked out.

[illegible]

CONTINUED ON NEXT PAGE

T F

- | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--|---|---|---|---|---|---|---|---|---|---|
| 23. More than once, I wrote down an answer that I later changed..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 24. I guessed at some answers before time was up..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 25. I guessed at some answers when time was called..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 26. One thing I did was reading the problem over and over in an.....
effort to get the entire picture. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 27. Each time I got an idea about what rôle a particular person.....
might play, I checked the facts for that person as well as check-
the facts for all the other persons in their new roles. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 28. I tried to visualize the entire problem as a unit..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 29. I concentrated mostly on the details presented in the problem..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 30. I concentrated mostly on the generalizations or assumptions.....
one could make from the facts. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 31. I really didn't expect to get the answers by logical deduction....
I expected them to come as insights from thinking about the
problem. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 32. I had a little trouble deciding which facts were necessary.....
for solving the problem and which were not. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 33. I enjoyed working on this problem..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 34. At times I felt discouraged..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 35. I took this problem as an interesting challenge..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 36. I suspected some trick solution..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 37. I quit working on the problem at least once..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 38. When I first read the problem I didn't think I'd be able to.....
solve it. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 39. There were times when I couldn't seem to think..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 40. I had quite a bit of trouble concentrating..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 41. Sometimes my mind wandered..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 42. At times I worried that I might not be able to get the right.....
answer. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 43. Sometimes I wondered how well the other students were doing.....
on this problem. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 44. After working on the problem a while I began to feel frustrated... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 45. This problem was easy for me to solve..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Listed below are a number of statements that describe the way people may think and feel as they work on math problems like the one you just finished. Read each item and decide whether the statement is true or false as it pertains to you personally. Blacken in 1 for true and 2 for false depending on how you thought or felt as you worked on the problem you have just completed.

T F

I have worked this problem before, and remembered how to solve it...

1. I changed my strategy or approach for solving the problem at..... least once.
2. I changed my strategy or approach for solving the problem more..... than once.
3. My first approach was based on my previous experience with..... similar problems.
4. My first approach was chosen not because I had used it before..... but because it seemed appropriate to use for this specific problem.
5. I worked the problem only once.....
6. I worked the problem more than once, doing it more than one way....
7. I obtained more than one answer before deciding what the..... correct answer was.
8. I worked the problem more than once, the same way each time..... just to check my computational accuracy.
9. I wrote most of my calculations down on paper.....
10. I worked most of my calculations in my head.....
11. I made notes as the problem was read.....
12. I tried to use a rational systematic plan to solve the problem.....
13. I worked the problem with no specific plan in mind.....
14. I thought about the problem briefly before I went to work..... with the actual calculations.
15. I began calculating immediately after the problem was read.....
16. I guessed at the answer before time was up.....
17. I guessed at the answer when time was called.....
18. I tried to visualize the overall picture painted by the..... information given.
19. I forgot about the persons and objects mentioned in the..... problem and figured it with manipulations of numbers.
20. This problem was easy for me to solve.....
21. I enjoyed working on this problem.....
22. At times I felt discouraged.....
23. I took this problem as an interesting challenge.....
24. After working on the problem for a while I began to feel frustrated

T F

25. I suspected some trick solution.....
26. Sometimes I wondered how well the other students were doing.....
on this problem.
27. I quit working on the problem at least once.....
28. At times I worried that I might not be able to get the right.....
answer.
29. When I first read the problem I didn't think I'd be able to.....
solve it.
30. Sometimes my mind wandered.....
31. There were times when I couldn't seem to think.....
32. I had quite a bit of trouble concentrating.....
33. It seems to me that this problem could have more than one.....
correct solution.
34. I changed my answer at least once.....

WAIT HERE UNTIL TOLD TO GO ON

APPENDIX G: REVISED STAI-STATE SCALE

1. I felt calm.....
2. I felt secure.....
3. I was tense.....
4. I was regretful.....
5. I felt at ease.....
6. I felt upset.....
7. I was worrying over possible misfortunes.....
8. I felt rested.....
9. I felt anxious.....
10. I felt comfortable.....
11. I felt self-confident.....
12. I felt nervous.....
13. I was jittery.....
14. I felt "high strung".....
15. I was relaxed.....
16. I felt content.....
17. I was worried.....
18. I felt over-excited and rattled.....
19. I felt joyful.....
20. I felt pleasant.....

[illegible]

APPENDIX H: CLUSTER TABLES

Table H-1

Cluster 509: Mystery Concentrated

-
- 40. I had quite a bit of trouble concentrating.
 - 39. There were times when I couldn't seem to think.
 - 41. Sometimes my mind wandered.
 - 37. I quit working on the problem at least once.

<u>Form A</u>					<u>Form B</u>				
40	39	41	37		40	39	41	37	
40	43	43	31	14	61	51	41	33	
39	43	39	22	20	51	36	26	28	
41	31	22	17	11	41	26	26	25	
37	14	20	11	08	33	28	25	21	
508	-35	-50	-18	-10	-18	-45	-21	-12	Frustrated
509	66	63	41	27	79	60	50	46	Concentrated
510	20	00	33	17	24	07	39	15	Enjoyed
511	-26	-41	-19	-08	-34	-31	-15	-32	Strategy Change
512	34	24	19	08	39	49	32	18	Careful
513	06	02	-10	-11	-20	00	05	-24	Deliberate
514	-15	-32	-11	23	-25	-14	-14	-16	Global
515	-03	-04	32	03	08	05	09	18	Notes
516	25	17	27	16	25	33	21	21	Systematic
517	-04	-07	-25	-06	-24	-09	-03	-04	Trial and Error
518	-11	22	-03	-11	-20	04	-07	-17	New Approach
519	-07	-09	-02	04	-20	-27	-01	-18	Fixated
599	-04	-04	-12	09	05	00	11	00	rpbi

Table H-2

Cluster 510: Mystery Enjoyed

 33. I enjoyed working on this problem.

35. I took this problem as an interesting challenge.

<u>Form A</u>			<u>Form B</u>		
33	35		33	35	
33	52	49	68	66	
35	49	52	66	68	
508	-39	-22	-30	-22	Frustrated
509	38	12	29	30	Concentrated
510	71	71	82	82	Enjoyed
511	-17	-10	-03	10	Strategy Change
512	17	11	20	13	Careful
513	-16	-06	-08	07	Deliberate
514	-04	01	03	05	Global
515	-19	10	15	17	Notes
516	25	16	15	14	Systematic
517	-51	-12	-03	-17	Trial and Error
518	-05	-17	-28	-05	New Approach
519	-02	-16	-09	06	Fixated
599	12	17	02	-02	rpbi

Table H-3

Cluster 511: Mystery Strategy Change

-
2. I changed my strategy or approach for solving the problem more than once.
1. I changed my strategy or approach for solving the problem at least once.
31. I really didn't expect to get the answers by logical deduction; I expected them to come as insights from thinking about the problem.
17. After working for some time I discovered that I had been overlooking some important element of the problem.

	<u>Form A</u>				<u>Form B</u>				
	2	1	31	17	2	1	31	17	
2	48	49	29	12	36	65	05	17	
1	49	36	20	13	65	62	15	25	
31	29	20	18	15	05	15	07	25	
17	12	13	15	06	17	25	25	17	
508	27	28	28	32	25	26	09	31	Frustrated
509	-19	-27	-28	-19	-14	-19	-33	-32	Concentrated
510	-03	-20	-15	00	-16	08	-01	-14	Enjoyed
511	70	60	41	23	60	81	25	41	Strategy Change
512	-32	-21	-49	-33	-29	-27	-22	-34	Careful
513	11	08	26	-07	-04	28	25	19	Deliberate
514	32	14	15	20	14	20	19	22	Global
515	09	22	-06	07	28	10	05	16	Notes
516	-27	-30	-36	-13	-17	-26	-27	-20	Systematic
517	17	18	04	-07	05	-12	-04	13	Trial and Error
518	00	-05	22	-01	-04	08	20	03	New Approach
519	10	-11	-02	06	-21	-24	03	-12	Fixated
599	12	02	-10	09	07	-06	02	-07	rpb1

Table H-4

Cluster 512: Mystery Careful

-
- 24. I guessed at some answers before time was up.
 - 23. More than once I wrote down an answer that I later changed.
 - 12. I stuck with an unproductive hypothesis for a long time even though it didn't seem to be getting me anywhere.
 - 22. I didn't write down any answers until after I was positive that all the facts checked out.
 - 18. I was careful and cautious throughout the entire time I worked on the problem.
 - 19. Sometimes I checked out hunches that seemed improbable even though I knew they would take time and energy.

<u>Form A</u>							<u>Form B</u>						
24	23	12	22	18	19		24	23	12	22	18	19	
24	49	41	29	27	31	12	19	15	17	20	21	25	
23	41	26	24	31	08	06	15	15	11	25	27	11	
12	29	24	23	14	22	14	17	11	22	25	25	26	
22	27	31	14	16	04	15	20	25	25	20	19	13	
18	31	08	22	04	11	13	21	27	25	19	28	24	
19	12	06	14	15	13	06	25	11	26	13	24	19	
508	-38	-12	-28	-19	-18	-21	-41	-32	-40	-25	-38	-23	Frustrated
509	17	05	33	23	24	14	33	07	25	09	43	43	Concentrated
510	12	-11	-02	24	16	14	20	-18	12	17	14	09	Enjoyed
511	-46	-31	-17	-21	-46	-23	-37	-12	-23	05	-45	-36	Strategy Change
512	71	51	47	40	34	25	44	39	47	45	53	44	Careful
513	-03	-10	-03	06	-09	-15	09	14	15	29	01	-01	Deliberate
514	-23	-01	-09	05	-16	-42	-18	08	-06	13	03	-02	Global
415	-01	-02	-21	02	-10	-06	-08	08	09	02	-08	08	Notes
516	24	14	11	26	41	08	48	14	24	17	26	35	Systematic
517	-35	-08	07	-34	-07	-20	-15	-12	-28	01	-18	-24	Trial and Error
518	-06	03	03	-05	-13	-03	03	27	14	20	10	04	New Approach
519	-14	-04	-38	-10	-08	-11	10	25	-24	02	-08	-12	Fixated
599	-09	14	-11	-05	00	-09	02	-03	00	-04	04	-13	r pbi

Table H-5

Cluster 513: Mystery Deliberate

-
20. I read the problem several times before deciding how to first attack it.
- 21. I decided on my first approach or strategy immediately after reading the problem once.

<u>Form A</u>			<u>Form B</u>		
	20	21		20	21
20	52	45	60	57	
21	49	52	57	60	
508	06	03	-05	06	Frustrated
509	-03	-07	-15	-11	Concentrated
510	-03	-19	-03	02	Enjoyed
511	07	21	28	22	Strategy Change
512	-09	-09	24	24	Careful
513	71	71	77	77	Deliberate
514	07	13	22	17	Global
515	09	02	-08	-06	Notes
516	-16	-17	01	-09	Systematic
517	00	13	06	08	Trial and Error
518	03	08	39	36	New Approach
519	09	-06	05	-07	Fixated
599	09	-04	-02	-02	rpb1

Table H-6

Cluster 514: Mystery Global

-
- 29. I concentrated mostly on the details presented in the problem.
26. One thing I did was reading the problem over and over in an effort to get the entire picture.
30. I concentrated mostly on the generalizations or assumptions one could make from the facts.
36. I suspected some trick solution.
28. I tried to visualize the entire problem as a unit.

	<u>Form A</u>					<u>Form B</u>					
	29	26	30	36	28	29	26	30	36	28	
29	24	09	39	07	09	32	07	33	18	35	
26	09	21	19	27	-28	07	11	10	14	14	
30	39	06	11	11	-07	33	10	15	13	03	
36	07	19	11	09	07	18	14	13	12	12	
28	09	27	-07	07	06	35	14	13	12	35	
508	-06	28	12	18	09	-02	08	-03	08	02	Frustrated
509	-21	12	-23	-03	03	-12	-19	-06	-14	-14	Concentrated
510	03	04	-01	-19	08	-15	02	16	-01	09	Enjoyed
511	24	03	18	18	11	01	28	18	11	22	Strategy Change
512	-06	-18	-18	-06	-09	08	-04	03	-12	04	Careful
513	04	18	03	03	-02	00	10	19	14	15	Deliberate
514	49	46	33	30	23	56	33	39	34	59	Global
515	01	12	02	09	20	-08	-12	07	-10	-07	Notes
516	-22	03	-11	03	12	19	-10	01	-04	12	Systematic
517	00	-09	26	07	-17	03	-14	-13	16	-15	Trial and Error
518	20	-02	-03	00	06	-02	18	20	00	13	New Approach
519	-06	26	-03	28	10	-13	07	00	-13	02	Fixated
599	-04	00	00	06	02	04	-13	09	07	02	rpb1

Table H-7

Cluster 515: Mystery Notes

-
14. I used pencil and paper to make notes as I worked on the problem.
- 13. I did most of my thinking without the aid of a pencil.

<u>Form A</u>			<u>Form B</u>		
14	13		14	13	
14	49	45	55	52	
13	45	49	52	55	
508	23	12	-03	03	Frustrated
509	08	11	11	14	Concentrated
510	-04	-05	17	11	Enjoyed
511	13	11	24	17	Strategy Change
512	-06	-13	-01	06	Careful
513	05	05	-15	01	Deliberate
514	31	02	-12	-07	Global
515	69	69	73	73	Notes
516	08	08	-02	06	Systematic
517	-23	03	-24	-09	Trial and Error
518	-12	-13	-09	-11	New Approach
519	07	20	-01	-07	Fixated
599	04	-02	-02	-02	rpbi

Table H-8

Cluster 516: Mystery Systematic

-
15. I used a rational systematic approach at all times as I worked on the problem.
- 16. There were times when I abandoned logic and used a nonsystematic approach.

<u>Form A</u>			<u>Form B</u>		
15	16		15	16	
15	76	74	74	72	
15	74	76	72	74	
508	-18	-22	-33	-36	Frustrated
509	35	40	44	29	Concentrated
510	24	26	20	11	Enjoyed
511	-44	-50	-37	-37	Strategy Change
512	43	37	55	50	Careful
513	-24	-16	03	-11	Deliberate
514	-02	-12	06	08	Global
515	00	20	03	01	Notes
516	87	87	86	86	Systematic
517	-30	-52	-24	-25	Trial and Error
518	-26	-21	-17	-01	New Approach
519	14	22	-06	04	Fixated
599	-04	-05	02	05	r _{pbi}

Table H-9

Cluster 517: Mystery Trial and Error

-
- 6. My first approach was to list all the facts given about each individual role.
5. The first strategy I used was basically trial and error, i. e., I chose a person at random to be the killer, etc., then checked to see if that role for the person fit the facts.

<u>Form A</u>			<u>Form B</u>		
6	5		6	5	
6	32	28	40	36	
5	28	32	36	40	
508	-01	23	01	-17	Frustrated
509	-14	-09	-12	-10	Concentrated
510	-28	-21	-16	00	Enjoyed
511	-09	26	-02	04	Strategy Change
512	-06	-33	-19	-25	Careful
513	-05	15	-06	17	Deliberate
514	-14	18	-15	02	Global
515	-17	-04	-26	-02	Notes
516	-29	-22	-16	-20	Systematic
517	55	55	62	62	Trial and Error
518	05	-27	06	-08	New Approach
519	-21	-07	-15	-08	Fixated
599	02	-08	04	17	r_pbi

Table H-10

Cluster 518: Mystery New Approach

-
- 3. My first approach was based on my previous experience with similar problems.
4. My first approach was based on what seemed to be the demands of this particular problem rather than just using a familiar attack.

<u>Form A</u>		<u>Form B</u>	
3	4	3	4
3	38	47	44
4	34	44	47
508	-21 -08	-04 -19	Frustrated
509	-08 06	-21 01	Concentrated
510	-02 -16	-18 -09	Enjoyed
511	-02 12	21 -03	Strategy Change
512	-12 03	05 33	Careful
513	13 -03	36 30	Deliberate
514	-02 16	20 10	Global
515	-15 -07	-13 -05	Notes
516	-24 -08	-24 10	Systematic
517	07 -31	11 -13	Trial and Error
518	60 60	67 67	New Approach
519	02 15	-02 -11	Fixated
599	00 13	-07 09	rpb1

Table H-11

Cluster 519: Mystery Fixated

-
10. I found myself trying to use the same hypothesis again and again.
- 8. When I discovered that a hypothesis I was trying out ran counter to the facts I quickly abandoned it never to try it again.

<u>Form A</u>			<u>Form B</u>		
10	8		10	8	
10	36	32	36	32	
8	32	36	32	36	
508	26	02	15	-10	Frustrated
509	-07	-01	-23	-20	Concentrated
510	-21	05	01	-03	Enjoyed
511	-01	03	-12	-19	Strategy Change
512	-24	-13	-04	07	Careful
513	-01	04	-04	03	Deliberate
514	20	16	-06	-03	Global
515	08	16	-08	02	Notes
516	18	05	-12	10	Systematic
517	-03	-27	-03	-18	Trial and Error
518	-02	19	-10	-01	New Approach
519	58	58	58	58	Fixated
599	05	13	00	11	r _{pbi}

Table H-12

Mystery Questionnaire Residual Items

- 7. My first strategy was to list all possible roles for each of the four persons, then systematically eliminate them by checking all the facts.
9. It seems to me that this problem could have more than one correct solution.
- 11. I always checked out the facts and clues in the same order as they were presented in the problem.
- 25. I guessed at some answers when time was called.
- 27. Each time I got an idea about what role a particular person might play, I checked the facts for that person as well as checking the facts for all the other persons in their new roles.
32. I had a little trouble deciding which facts were necessary for solving the problem and which were not.
- 38. When I first read the problem I didn't think I'd be able to solve it.

	Form A							Form B						
	7	9	11	25	27	32	38	7	9	11	25	27	32	38
7	100	-10	05	02	05	02	23	21	04	17	00	17	-05	08
9	-10	100	-03	-15	09	-12	09	04	00	08	05	08	-10	-15
11	05	-03	100	16	-02	-01	-03	17	08	03	-06	08	-16	08
25	02	-15	16	100	13	-13	01	00	05	-06	00	-04	-01	05
27	05	09	-02	13	100	-09	01	17	08	08	-04	44	21	02
32	02	-12	-09	-13	-09	100	-28	-05	-10	-16	-01	21	00	04
38	23	09	-03	01	01	-28	100	08	-15	08	05	02	04	01
508	-03	14	-10	-18	01	40	-16	-05	-09	02	-25	-27	-08	-27 Frustrated
509	14	-04	-09	-06	-14	-10	26	-06	-06	-07	20	-17	-12	35 Concentrated
510	10	-03	01	-01	00	-05	11	01	-17	-01	14	-05	13	18 Enjoyed
511	04	12	15	-15	06	33	-16	-05	-19	-01	-15	04	11	-15 Strat. Chng.
512	-21	-17	-01	20	-21	-21	14	04	15	-07	52	05	11	14 Careful
513	-09	13	06	-03	00	02	-26	-21	09	-14	21	-12	18	-34 Deliberate
514	-11	32	-10	-18	18	09	-01	-05	-02	-09	-09	-14	13	-11 Global
515	-07	06	-22	-19	09	-04	-18	-16	-07	15	01	04	-15	06 Notes
516	-07	-13	-14	02	-15	-09	09	00	-06	-09	24	07	06	37 Systematic
517	20	26	-07	-17	-24	-07	-08	-07	-28	-16	03	-05	10	02 Trial & Error
518	-29	01	05	15	10	-10	00	-11	10	14	-07	-06	09	-07 New Approach
519	-35	-14	-04	-07	13	28	-21	-12	04	23	-15	17	-14	-15 Fixated
599	-04	-04	07	-06	10	00	00	00	-19	07	-06	-07	-07	13 r pbi

Table H-13

Cluster 520: Math Frustrated

-
24. After working on the problem for a while I began to feel frustrated.
22. At times I felt discouraged.
28. At times I worried that I might not be able to get the right answer.
- 21. I enjoyed working on this problem.
33. It seems to me that this problem could have more than one correct solution.
26. Sometimes I wondered how well the other students were doing on this problem.

	<u>Form A</u>						<u>Form B</u>						
	24	22	28	21	33	26	24	22	28	21	33	26	
24	69	74	41	36	31	34	70	63	25	43	28	39	
22	74	62	41	36	27	30	63	37	31	40	10	11	
28	41	41	31	32	18	27	25	31	23	09	21	42	
21	36	36	32	22	28	07	43	40	09	15	04	13	
33	31	27	18	28	16	14	28	10	21	04	11	32	
26	34	30	27	07	14	14	39	11	42	13	32	27	
520	84	79	56	47	39	37	84	61	48	39	33	52	Frustrated
521	-63	-61	-32	-39	-08	-40	-56	-51	-39	-12	-29	-33	Concentrated
522	48	48	37	43	45	26	45	40	25	14	11	21	Strategy Change
523	12	11	14	11	01	27	27	19	34	-16	28	38	Deliberate
524	19	14	03	02	19	15	03	-05	-05	-04	-01	05	Notes
525	09	-05	06	-04	09	08	-27	-37	10	-19	04	05	Systematic
526	11	08	11	22	09	-01	13	19	-24	19	08	-04	New Approach
599	-06	-02	-09	09	-06	-12	00	-09	-08	-14	10	-02	r pbi

Table H-14

Cluster 521: Math Concentrated

-
- 32. I had quite a bit of trouble concentrating.
 - 31. There were times when I couldn't seem to think.
 - 30. Sometimes my mind wandered.
 - 27. I quit working on the problem at least once.
 - 29. When I first read the problem I didn't think I'd be able to solve it.
 - 16. I guessed at the answer before time was up.

	<u>Form A</u>							<u>Form B</u>						
	32	31	30	27	29	16		32	31	30	27	29	16	
32	60	50	60	39	29	14		50	45	58	-02	27	30	
31	50	43	33	30	32	25		45	57	32	30	34	25	
30	60	33	38	32	21	16		58	32	38	-03	32	23	
27	39	30	32	27	17	22		-02	30	-03	01	-02	-03	
29	29	32	21	17	15	08		27	34	32	-02	18	16	
16	14	25	16	22	08	08		30	25	23	-03	16	13	
520	-40	-49	-45	-31	-27	-39		-33	-62	-45	-14	-37	-11	Frustrated
521	78	66	62	51	38	29		71	76	61	07	42	36	Concentrated
522	-36	-27	-36	-26	-12	-13		-18	-31	-31	-22	-15	-09	Strategy Change
523	05	12	-11	-32	04	-10		-27	-27	-20	08	-32	19	Deliberate
524	-17	-02	-17	-17	-05	07		-04	-03	-16	15	-01	03	Notes
525	10	27	02	06	41	-04		04	22	11	34	12	06	Systematic
526	-11	-15	-20	-06	-21	07		-08	-17	08	-10	-03	03	New Approach
599	00	-02	00	-04	00	-19		-10	-06	03	-09	16	-10	r _{pbi}

Table H-15

Cluster 522: Math Strategy Change

-
1. I changed my strategy or approach for solving the problem at least once.
- 5. I worked the problem only once.
6. I worked the problem more than once, doing it more than one way.
2. I changed my strategy or approach for solving the problem more than once.
- 20. This problem was easy for me to solve.
7. I obtained more than one answer before deciding what the correct answer was.
34. I changed my answer at least once.

	<u>Form A</u>							<u>Form B</u>						
	1	5	6	2	20	7	34	1	5	6	2	20	7	34
1	69	64	61	70	73	28	21	56	46	67	37	44	49	46
5	64	61	71	46	30	30	28	46	38	65	13	35	49	38
6	61	71	56	40	31	31	25	67	65	63	26	44	54	46
2	70	46	40	43	35	29	12	37	13	26	16	38	31	24
20	73	30	31	35	20	27	09	44	35	44	38	37	46	36
7	28	30	31	29	27	20	25	49	49	54	31	46	60	70
34	21	28	25	12	09	25	09	46	38	46	24	36	70	43
520	49	43	36	44	69	36	28	30	27	30	39	59	30	12 Frustrated
521	-24	-25	-11	-33	-50	-28	-26	-26	-29	-39	-13	-48	-33	-08 Concentrate
522	83	78	75	65	45	45	31	75	62	79	40	61	78	66 Strat. Chng
523	24	11	13	24	-07	-09	-17	22	27	10	20	36	14	05 Deliberate
524	02	05	11	09	15	00	04	06	13	11	-04	21	05	11 Notes
525	13	22	10	-03	-11	-08	-07	05	11	04	10	-11	-30	-13 Systematic
526	23	05	03	14	15	13	08	-08	06	-01	-04	02	08	-01 New Approac
599	07	05	-07	02	-02	09	17	00	09	02	-12	-07	02	13 rpbi

Table H-16

Cluster 523: Math Deliberate

-
18. I tried to visualize the overall picture painted by the information given.
14. I thought about the problem briefly before I went to work with the actual calculations.
- 15. I began calculating immediately after the problem was read.
25. I suspected some trick solution.
- 19. I forgot about the persons and objects mentioned in the problem and figured it with manipulations of numbers.

<u>Form A</u>						<u>Form B</u>					
18	14	15	25	19		18	14	15	25	19	
18	29	26	06	11	18	20	32	12	02	33	
14	26	25	31	08	-08	32	73	66	34	-06	
15	06	31	13	09	-01	12	66	30	16	-01	
25	11	08	09	04	00	02	34	16	08	02	
19	18	-08	-01	00	00	33	-06	-01	02	02	
520	15	-15	12	27	-02	12	10	18	36	17	Frustrated
521	-06	-9	-05	-19	04	-14	-07	-07	-30	-04	Concentrated
522	03	-05	06	11	00	26	12	22	03	03	Strategy Change
523	55	50	36	20	05	44	88	54	27	13	Deliberate
524	-02	-11	13	27	03	-03	17	08	07	07	Notes
525	15	07	05	-07	20	-06	19	04	10	-03	Systematic
526	-02	02	-06	12	00	-02	05	05	11	01	New Approach
599	02	02	-02	07	02	12	09	02	00	17	r _{pbi}

Table H-17

Cluster 524: Math Notes

-
9. I wrote most of my calculations down on paper.
- 10. I worked most of my calculations in my head.

<u>Form A</u>			<u>Form B</u>		
	9	10		9	10
9	73	71	75	74	
10	71	73	74	75	
520	12	24	12	-15	Frustrated
521	-11	-16	-07	03	Concentrated
522	09	10	11	13	Strategy Change
523	13	17	17	11	Deliberate
524	85	85	86	86	Notes
525	11	06	37	33	Systematic
526	10	05	15	08	New Approach
599	09	-02	-02	02	rpb1

Table H-18

Cluster 525: Math Systematic

- 13. I worked the problem with no specific plan in mind.

12. I tried to use a rational systematic plan to solve the problem.

<u>Form A</u>			<u>Form B</u>	
	13	12	13	12
13	60	57	47	43
12	57	60	43	47
520	09	02	-19	-07 Frustrated
521	13	26	24	16 Concentrated
522	07	-01	02	-09 Strategy Change
523	10	27	-05	20 Deliberate
524	13	02	35	20 Notes
525	77	77	67	67 Systematic
526	-43	-26	04	01 New Approach
599	00	02	-08	09 r _{pbi}

Table H-19

Cluster 526: Math New Approach

-
- 3. My first approach was based on my previous experience with similar problems.
4. My first approach was chosen not because I had used it before but because it seemed appropriate to use for this specific problem.

<u>Form A</u>			<u>Form B</u>		
	3	4		3	4
3	56	53	59	56	
4	53	56	56	59	
520	18	08	04	11	Frustrated
521	-18	-12	-07	-07	Concentrated
522	21	08	-05	05	Strategy Change
523	-03	08	04	09	Deliberate
524	15	-02	-05	25	Notes
525	-42	-25	-07	12	Systematic
526	74	74	76	76	New Approach
599	-16	-07	02	-09	r _{pbi}

Table H-20

Math Questionnaire Residual Items

-
8. I worked the problem more than once, the same way each time just to check my computational accuracy.
11. I made notes as the problem was read.
23. I took this problem as an interesting challenge.
- 17. I guessed at the answer when time was called.

<u>Form A</u>					<u>Form B</u>				
8	11	23	17		8	11	23	17	
8	100	-03	-01	01	00	05	07	-14	
11	-03	100	-02	-07	05	02	03	-02	
23	-01	-02	100	-07	07	03	56	14	
17	01	-07	-07	100	-14	-02	14	00	
520	12	09	-20	-07	05	06	-14	-39	Frustrated
521	-03	-15	13	04	01	-05	05	27	Concentrated
522	-02	03	-07	-10	08	06	19	-07	Strategy Change
523	11	27	12	-01	26	-04	18	-13	Deliberate
524	14	23	11	-16	20	24	15	03	Notes
525	18	-10	06	15	05	55	24	34	Systematic
526	08	09	-01	-10	08	-06	-02	-10	New Approach
599	00	-11	11	13	04	-04	17	09	rpb1

Table H-21

Cluster 527: STAI-State Scale, Relaxed Items, Session 1

-
- 15. I was relaxed.
 - 16. I felt content.
 - 5. I felt at ease.
 - 2. I felt secure.
 - 10. I felt comfortable.
 - 1. I felt calm.
 - 20. I felt pleasant.
 - 11. I felt self-confident.
 - 8. I felt rested.
 - 19. I felt joyful.

	15	16	5	2	10	1	20	11	8	19	
15	71	72	64	59	65	57	52	41	58	32	
16	72	61	55	63	53	51	61	50	40	25	
5	64	55	60	59	56	53	48	49	49	31	
2	59	63	59	57	45	63	44	56	40	26	
10	65	53	56	45	51	38	60	40	52	24	
1	57	51	53	63	38	45	40	45	33	30	
20	52	61	48	44	60	40	44	41	18	43	
11	41	50	49	56	40	45	41	38	33	23	
8	58	40	49	40	52	33	18	33	30	18	
19	32	25	31	26	24	30	43	23	18	16	
599	-22	-33	-13	-11	-18	-3	-26	-18	-0	-19	rpb1
527	84	78	77	76	72	67	66	61	55	40	Relaxed Items Sess. 1
528	61	53	59	58	56	59	51	44	33	11	Tense Items Sess. 1
529	41	34	32	23	37	24	24	17	37	29	Relaxed Items Sess. 2
530	19	19	23	25	19	25	- 0	12	21	7	Tense Items Sess. 2

Table H-22

Cluster 528: STAI-State Scale, Tense Items, Session 1

14.	I felt "high strung."										
13.	I was jittery.										
12.	I felt nervous.										
6.	I felt upset.										
3.	I was tense.										
18.	I felt over-excited and rattled.										
17.	I was worried.										
7.	I was worrying over possible misfortunes.										
4.	I was regretful.										
9.	I felt anxious.										
		14	13	12	6	3	18	17	7	4	9
14	68	68	56	71	55	56	61	46	39	30	
13	68	62	64	58	59	50	54	40	36	32	
12	56	64	55	52	70	49	54	32	25	37	
6	71	58	52	54	59	56	40	39	43	18	
3	55	59	70	59	54	50	43	30	26	41	
18	56	50	49	56	50	49	44	46	43	24	
17	61	54	54	40	43	44	43	38	30	30	
7	46	40	32	39	30	46	38	31	52	18	
4	39	36	25	43	26	43	30	52	27	23	
9	30	32	37	18	41	24	30	18	23	16	
599	2	2	-13	-10	-2	-9	-4	-12	-3	4	rpbi
527	52	55	63	60	59	46	46	35	41	19	Relaxed Items Sess. 1
528	82	79	74	74	73	70	66	56	52	40	Tense Items Sess. 1
529	9	25	9	16	18	6	9	4	10	3	Relaxed Items Sess. 2
530	26	40	23	28	29	29	26	13	19	22	Tense Items Sess. 2

Table H-23

Cluster 529: STAI-State Scale, Relaxed Items, Session 2

-
- 1. I felt calm.
 - 10. I felt comfortable.
 - 2. I felt secure.
 - 5. I felt at ease.
 - 16. I felt content.
 - 15. I was relaxed.
 - 8. I felt rested.
 - 20. I felt pleasant.
 - 11. I felt self-confident.
 - 19. I felt joyful.

	1	10	2	5	16	15	8	20	11	19	
1	77	80	88	79	69	69	66	64	65	32	
10	80	78	76	81	68	72	74	67	60	36	
2	88	76	75	80	72	66	68	63	66	27	
5	79	81	80	74	67	70	60	68	59	36	
16	69	68	72	67	70	65	69	69	63	43	
15	69	72	66	70	65	60	62	53	67	22	
8	66	74	68	60	69	62	66	69	60	43	
20	64	67	63	68	69	53	69	64	49	60	
11	65	60	66	59	63	67	60	49	50	17	
19	32	36	27	36	43	22	43	60	17	18	
599	19	13	23	19	21	16	8	11	9	-11	rpb1
527	30	25	30	34	41	33	35	37	42	39	Relaxed Items Sess. 1
528	5	1	11	9	21	15	17	19	21	10	Tense Items Sess. 1
529	88	88	87	86	83	77	81	80	71	43	Relaxed Items Sess. 2
530	51	55	57	61	49	51	48	46	47	12	Tense Items Sess. 2

Table H-24

Cluster 530: STAI-State Scale, Tense Items, Session 2

-
13. I was jittery.
 12. I felt nervous.
 17. I was worried.
 3. I was tense.
 6. I felt upset.
 18. I felt over-excited and rattled.
 14. I felt "high strung."
 4. I was regretful.
 7. I was worrying over possible misfortunes.
 9. I felt anxious.

	13	12	17	3	6	18	14	4	7	9	
13	70	75	59	63	47	58	48	42	38	34	
12	75	69	64	65	52	52	46	37	35	36	
17	59	64	68	61	72	48	46	53	37	20	
3	63	65	61	47	52	35	38	24	22	33	
6	47	52	72	52	48	47	41	46	27	9	
18	58	52	48	35	47	45	41	49	40	14	
14	48	45	46	38	41	41	31	29	19	17	
4	42	37	53	24	46	49	29	30	31	11	
7	38	35	37	22	27	40	19	31	19	13	
9	34	36	20	33	9	14	17	11	13	10	
599	35	41	34	21	15	26	29	22	9	18	rpbi
527	14	13	25	17	34	24	9	17	21	-19	Relaxed Items Sess. 1
528	30	33	31	27	35	24	27	20	13	4	Tense Items Sess. 1
529	48	43	52	42	50	54	16	51	31	3	Relaxed Items Sess. 2
530	84	83	83	69	69	67	56	55	44	31	Tense Items Sess. 2

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