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THE NATURE OF ANALYSIS AND SYNTHESIS AND SOME CONDITIONS IN THE CLASSROOM WHICH FACILITATE OR RETARD THESE COGNITIVE PROCESSES, PART II, ANALYSIS, SYNTHESIS, AND ACADEMIC PERFORMANCE.

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*EDUCATIONAL RESEARCH, *RESEARCH METHODOLOGY, *RESEARCH PROBLEMS, *TESTING, FACTOR ANALYSIS, *COGNITIVE PROCESSES, EAST LANSING, MICHIGAN, PERCEPTUAL SYNTHESIS TEST

THIS STUDY WAS CONCERNED WITH THE NATURE AND RELATIONSHIPS AMONG THE COGNITIVE FACTORS, ANALYSIS AND SYNTHESIS, AND THEIR PERSONALITY AND ACADEMIC CORRELATES. ENTERING FRESHMEN AT THE UNIVERSITY OF MICHIGAN WERE TESTED WITH A BATTERY OF NINE TESTS TO OBTAIN THE DATA REQUIRED FOR ANALYSIS. SUSPECTED CONTAMINATION OF THE TEST RESULTS DUE TO COMMUNICATION AMONG SUBJECTS AND THE ORDER OF TESTING WAS INDICATED IN A TEST FOR THE INDEPENDENCE OF OBSERVATIONS. ALTERNATE PROCEDURES INVOLVING FACTOR ANALYSIS WERE THEN EMPLOYED WITH A LITERATURE REVIEW TO FIND DATA SUPPORTING THE HYPOTHESIS AND SUBHYPOTHESES STUDIED. NO EVIDENCE WAS FOUND WHICH INDICATED THAT ANALYSIS AND SYNTHESIS WERE DISCRIMINABLE FACTORS. NEITHER WAS THERE ANY EVIDENCE THAT THESE FACTORS WERE NOT DISCRIMINABLE. EMERGING FROM THE STUDY ARE SUGGESTED PROCEDURES FOR ASSESSING WHETHER TEST RESULTS HAVE BEEN CONTAMINATED BY COMMUNICATION AMONG SUBJECTS OR THE ORDER OF TESTING. IT WAS SUGGESTED THAT ALL STUDIES IN WHICH INDIVIDUAL SUBJECTS ARE TESTED SUCCESSIVELY SHOULD ROUTINELY USE THE TECHNIQUE WHICH REQUIRES CALCULATION OF A CORRELATION COEFFICIENT BETWEEN ORDER-OF-TESTING AND THE SCORES OBTAINED. THE REVIEW OF THE LITERATURE AND FACTOR ANALYSES SUPPORTED THE CONCLUSION THAT THE PERSONALITY VARIABLES, DOGMATISM AND RIGIDITY, ARE SYSTEMATICALLY BUT DIFFERENTIALLY RELATED TO MEASURES OF CONCEPTUAL ANALYSIS AND SYNTHESIS. THERE WAS NO EVIDENCE INDICATING THAT CORRELATIONS BETWEEN ACADEMIC SUCCESS AND ANALYSIS AND SYNTHESIS WERE DIFFERENTIAL. (WN)

ANALYSIS, SYNTHESIS, AND ACADEMIC PERFORMANCE

by

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I. INTRODUCTION

The research to be reported herein is an outgrowth of earlier research by Rokeach and his associates (1960) on the interrelations existing between personality and the cognitive processes. In the course of this earlier research we had succeeded in isolating and measuring two distinct phases of cognitive functioning; namely, the ability to analyze and the ability to synthesize. Analysis was defined, following Witkin (1954, 1962), as the ability to separate item from field. Synthesis was defined as the ability to integrate new items, elements, ideas, or beliefs into new fields, or into new wholes or into new belief systems. It is reasonable to assume that perceptual and conceptual activity in the classroom, in the laboratory, in the examination hall, and in everyday life involve both the processes of analysis and synthesis to the extent that the specific tasks confronting a person require different combinations or degrees of the ability to analyze and the ability to synthesize.

In the earlier research we had developed methods for isolating these two variables and measuring the extent to which perceptual and conceptual activity involve the processes of analysis and synthesis. The Doodlebug Problem, to be described more fully later on in this report, provided us with measures of analysis and synthesis within the framework of solving a complicated conceptual problem. The Witkin Embedded-Figures Test and

our own modification of the Kohs Block Test, which will also be fully described later on, provided us with measures of perceptual analysis and synthesis.

Although this earlier work was not specifically concerned with educational problems, the following questions having particular relevance for education seemed to us to merit further investigation:

1. To what extent is it meaningful to speak of the cognitive ability to analyze and to synthesize?

2. What are the personality correlates of the cognitive ability to analyze and to synthesize?

3. To what extent are analysis and synthesis correlated or independent variables? To the extent that they are independent, they should emerge as separate factors in factor analytic studies.

4. To what extent do current tests of intelligence measure analysis and synthesis?

5. To what extent are analysis and synthesis general rather than specific factors? Is a person who is a good synthesizer in one academic subject area, for example, also likely to be a good synthesizer in another academic subject area?

6. To what extent can cognitive and personality tests of analysis and synthesis predict academic success in various curricula, such as, the physical and social sciences, engineering and business, literature, the fine arts and mathematics?

7. To what extent do objective-type and essay-type examinations test or tap differentially the ability to analyze and to synthesize?

8. To what extent can the processes of analysis and synthesis be related to those of deduction and induction?

Despite the great amount of theoretical and empirical work available in the areas of problem solving (Duncan, 1959; Johnson, 1955), creativity (Anderson, 1959; Barron, 1963; Getzels and Jackson, 1962; Guilford, 1956; MacKinnon, 1962; McNemar, 1964; Rokeach, 1965; Steiner, 1965; Taylor, 1960) and perception (Allport, 1955; Bartley, 1958) there has been virtually no empirical work or theoretical concern with the nature, determinants, correlates, and measurement of processes involved in the ability to analyze and the ability to synthesize. While there are innumerable references in the psychological literature and in the Psychological Abstracts to such topics as productive thinking (Wertheimer, 1945), critical and logical thinking, concrete and abstract thinking (Goldstein and Sheerer, 1941; Harvey, Hunt and Schroder, 1961) and the like, there are only occasional references to the abilities of analysis and synthesis or to the determinants or correlates of individual differences in such abilities.

Two major exceptions should be noted here. Bloom et al. (1956), have recognized the importance of analysis and synthesis in the cognitive domain by including them in the following listing of six major educational objectives:

1. Knowledge
2. Comprehension
3. Application
4. Analysis (analysis of elements, of relationships, of organizational principles)
5. Synthesis (Production of a unique communication, of a plan, or proposed set of operations; derivation of a set of abstract relationships)
6. Evaluation

It is also interesting to note that in a volume edited by Brian Simon on Psychology in the Soviet Union (1957), the variables of analysis and synthesis are mentioned in seven out of 22 chapters written by Soviet psychologists. Russian psychologists seem to be greatly interested in these processes, particularly in applications which may lead to the training of these abilities in children, or to improvements in teaching. Despite such concern, however, it does not appear that the Russians have succeeded any more than we have in increasing their theoretical understanding of these processes, in measuring them, or in applying them to the educational scene.

Conceptual and empirical foundations for the present research

1. Two personality variables -- rigidity and dogmatism -- have been found in our earlier research (Rokeach, 1960), to be differentially correlated with analysis and synthesis in cognition or conception-thinking and in perception. Rigidity refers to the resistance to change of *single* beliefs, or sets, or habits, or to the presence of specific compulsive or obsessive tendencies within the individual. Dogmatism refers, on the other hand, to the resistance to change of *total systems of beliefs*. Whereas rigidity is conceived to be a hypothetical property of a single belief, or habit, or set, or expectancy, which prevents it from changing in the face of objective requirements, dogmatism is conceived to be a property of a total system of beliefs, which prevents the whole system *qua* system from changing. For example, we may speak of a person as being a *dogmatic* advocate of psychoanalysis, Marxism, or Catholicism, but as being *rigid* in tying his shoelaces, brushing his teeth, or preparing for bed. A rat may be said to behave in a rigid (fixated) manner but cannot be said to behave dogmatically. Similarly, a mentally retarded, pedantic child may be said to behave rigidly, but not dogmatically. To say that a person behaves dogmatically implies that he adheres to, espouses, and defends some system or subsystem of beliefs (in religion, politics, or science) such that we gain the impression that the *referent* of his behavior is a whole system of ideas rather than a single idea. Dogmatism would seem to be a system property in the same way that *conversion* or *defection* is a system property. When a person

changes a single attitude or belief (e.g., about Medicare) we do not say that he defects from that attitude and converts to another attitude. However, when he changes a system of ideas to another (e.g., from Catholicism to Unitarianism, or from Communism to some form of anti-Communism), we speak of conversion to and defection from. In the same way, we should speak of a person as adhering to a system in a dogmatic or nondogmatic manner, rather than rigidly or nonrigidly.

Needless to say, the variables of rigidity and dogmatism are conceived to be continuous rather than discrete. In both our earlier research and the present research we have measured the rigidity variable by means of the Gough-Sanford Rigidity Scale and the dogmatism variable by means of the Rokeach Dogmatism Scale. Copies of these two scales will be found in Appendix A and a fuller discussion of the rationale of these two scales will be found in The Open and Closed Mind (Rokeach, 1960).

Subjects scoring high on the Gough-Sanford Rigidity Scale as compared with subjects low in rigidity, have been found by Rokeach, McGovney and Denny (1955) to take significantly longer to analyze, but not to synthesize conceptual problems, as determined by measures of analysis and synthesis on the Doodlebug Problem (a problem to be described more fully later on). Conversely, subjects scoring high on the Rokeach Dogmatism Scale, as compared with subjects scoring low in dogmatism, were found to differ significantly in synthesis, but not in analysis. These findings are theoretically explained by assuming that personality

rigidity, referring as it does to the resistance to change of single beliefs, leads to an inability to analyze; i.e., an inability to separate an item from its field. In short, personality rigidity leads to a failure of the ability to analyze or to break down one or more beliefs within a total configuration of beliefs. Conversely, we assume that the more dogmatic a person (or, synonymously, the more closed his belief system) the greater the difficulty in synthesizing new systems of beliefs because of the resistance to change of (dogmatically held) older systems of beliefs, which are in contradiction to the new system.

2. Evidence from two factor analytic studies by Rokeach and Fruchter (1956) and by Fruchter, Rokeach and Novak (1958) indicate that rigidity and dogmatism (measured by the Gough-Sanford and by the Rokeach measures) are factorially discriminable personality variables. These findings, when considered alongside those described in No. 1 above, suggest that purely cognitive measures of analysis and synthesis (as obtained, e.g., from the Doodlebug Problem) might also turn out to be factorially independent and, furthermore, that the personality factors of rigidity and dogmatism might have something in common with analysis and synthesis at the cognitive level. On the basis of the above stated theoretical considerations and empirical findings, it was hypothesized that measures of personality rigidity and of the cognitive ability to analyze would together form one factor, while a measure of personality dogmatism and the cognitive ability to synthesize would together form another factor, each factor being independent of or at least discriminable from the other.

3. Measures of cognitive analysis and synthesis have been found to correlate around .45. Similarly, personality rigidity and dogmatism correlate around .45. These findings suggest that even if rigidity and analysis should turn out to load on one factor and dogmatism and synthesis on another, that such factors would be correlated rather than independent factors.

4. We have found repeatedly in our research with college-student samples that analysis and synthesis in problem solving and in perception are negligibly related to various tests assumed to measure intelligence. Similarly, negligible correlations are found between various intelligence tests and the personality measures of rigidity and dogmatism.

5. Subjects scoring high on the Dogmatism Scale consistently reveal greater difficulty than those scoring low, not only in synthesizing conceptual systems, but also in synthesizing perceptual systems (Levy and Rokeach, 1960), and aesthetic systems (Mikol, 1960).

6. Also pertinent to the present research is the work of Witkin and his associates (1954, 1962) on field-dependence and independence which he conceptualizes in his more recent work in terms of the more pervasive process of individual differentiation. The "field-dependent" person is a person who, because he is relatively low in individual differentiation, lacks the ability to separate item from field and is thus deficient in the ability to analyze. In the present research we will use the Witkin

Embedded-Figures Test to measure this ability at the level of perceptual functioning.

We regard the findings by Witkin and his associates on field-dependence to be closely related to our own empirical findings on individual differences in rigidity or in the ability to analyze. When these findings are considered alongside our empirical findings on the ability to synthesize, it seems clear that analysis and synthesis are important variables at a "deeper" personality level as well as the cognitive level. We may reasonably assume at the deeper level of personality, the existence of individual differences in resistance to change and in receptivity to new information, which may result in individual differences in the abilities to analyze and to synthesize.

7. Finally, we have been most impressed by Howard Ehrlich's work (1961a, 1961b) on the relation between dogmatism and learning with respect to a course in sociology. Ehrlich found that "low dogmatism subjects who entered the sociology classroom with a higher level of learning, learned more as a result of classroom exposure and retained this information to a significantly greater degree than the more dogmatic subjects" (1961b, p. 283). What is perhaps even more surprising is that Ehrlich found that low dogmatic subjects retained more information about sociology not only at the end of the course but also <u>five months afterwards</u> and <u>five years afterwards</u>. Ehrlich further found that dogmatism "can account for a greater proportion of the variance in the sociology

test scores than OSPE (Ohio State Psychological Examination)" (1961a, p. 149).

These findings of Ehrlich suggested that it might be worthwhile to explore in considerably greater detail the relationship between selected nonintellective variables and academic performance. On the nonintellective side we were not only interested in the dogmatism variable but also in the rigidity variable. On the academic-performance side we were not only interested in Ehrlich's sociology course but in all kinds of academic courses, by students who majored and by students who did not major in them.

A more detailed review and discussion of other studies bearing on the analysis-synthesis distinction, and on Ehrlich's "dogmatism-learning" hypothesis, are reserved for later sections of this report.

II. TESTS, PROCEDURE AND SUBJECTS

All freshmen entering Michigan State University in 1960 and 1961 took various aptitude, academic achievement, and personality tests during Welcome Week. Included in this battery of tests were the following:

1. The Michigan State University English Test. The MSU English Test is a locally constructed test of 35 objective test items developed by Dr. Benjamin B. Hickock in cooperation with the Office of Evaluation Services. It has a reliability of .80. The 1958 edition of this test measures several aspects of English usage, including capitalization, sentence structure, punctuation, grammar, word choice, and the ability to organize.

2. The Michigan State University Reading Test. The MSU Reading Test is designed to measure the ability of students to comprehend ideas expressed in reading passages that are representative of textual materials found in several academic areas. The 1958 edition of this test consists of 42 objective items, and was developed by the Office of Evaluation Services. It has a reliability of .84.

3. The College Qualification Test (CQT). The CQT is a nationally-used test constructed by the Psychological Corporation, Form C, 1957. The CQT Test is broken down into --

a. CQT - Verbal (V)
b. CQT - Information (I)
c. CQT - Numerical (N)
d. CQT - Total (T)

4. The Dogmatism Scale (D). This is a 40-item scale (Form E) originally developed by Rokeach (1956, 1960). The subject agrees or disagrees with each item on a seven-point, Likert-type scale, ranging from -3 to +3, with the zero point excluded in order to prevent the subject from giving a noncommittal answer. In the present research the subjects indicated their response to each item on a specially constructed IBM form (see Appendix A) so that the response could be machine-scored. This scale had been developed on the basis of various theoretical considerations to measure individual differences in openness or closedness of belief systems. As such it attempts to measure individual differences in receptivity to new information and the ability to synthesize or to integrate new information within one's present belief system.

The Dogmatism Scale differs in one important respect from the well-known F Scale. It represents a measure of general authoritarianism, which is independent of ideological content, in contrast to the F Scale, which represents a measure of rightist or fascistic authoritarianism. Evidence for this difference will be found in Rokeach (1956, 1960), in factor analytic studies of the total scale scores by Rokeach and Fruchter (1956), and by Fruchter, Rokeach and Novak (1958), and more recently, in a factor analytic study of D and F Scale items by Kerlinger and Rokeach (1966).

A major methodological criticism which has been leveled at both the F and Dogmatism Scales is that they are contaminated with an acquiescent response set (e.g., Bass, 1955; Christie, Havel and Seidenberg, 1958; Couch and Keniston, 1960; Peabody, 1961). All the items in the D and F Scales are worded in the same direction so that agreement with the items is indicative of authoritarianism or closed-mindedness. It has been suggested by many writers that agreement with items on the D and F Scales may be indicative of an agreement response bias rather than of authoritarianism or closed-mindedness as such since it has been observed that some subjects will also agree with the same statements worded in an opposite direction. One consequence of the many response set studies over the past decade (far too numerous to discuss here) has been an increasing reluctance to use the F or Dogmatism Scales unless it has been corrected for response bias.

Rokeach (1963) has pointed out that there are three possible explanations for the fact that a person may agree with a statement and agree also with its opposite: (1) A person may agree with a scale statement and with its opposite because of an acquiescent response set -- a general tendency to agree with statements regardless of their content. (2) A person may agree with one of the statements because he sees no reason why he shouldn't, and he thus tells the truth. He may agree also with the reverse statement because he sees a good reason why he shouldn't tell the truth, and thus lies. (3) He may genuinely agree with both statements but through an act of "double-think" or compartmentalization he is not

consciously aware of the fact that he holds contradictory beliefs. Many persons in a democratic society have been observed to hold both democratic and undemocratic ideas, a fact which Gunnar Myrdal has pointed out in his classic work, The American Dilemma (1944).

Rokeach has suggested further that the first interpretation of the double agreement phenomenon mentioned above -- acquiescence -- is not able to account for many of the known findings and Rohrer (1965), Block (1965), and Samelson (1964), in recent studies all seem to support this conclusion (though for different reasons); namely, that response style exerts a trivial influence on responses to various attitude and personality tests. Rohrer (1965) after an exhaustive review of 180 studies in the field concludes that:

> "It does not seem possible that the striking unanimity of opinion that various writers have displayed concerning the interpretation of this many studies could be without any foundation whatsoever; and yet, that seems to be the case. The inference that response styles are an important variable in personality inventories is not warranted on the basis of the evidence now available. There is now sufficient evidence to conclude that various measures of response styles are unrelated when they lack common verbal content, from which it follows that there is evidence

that present personality inventories are not interpretable in terms of personality traits such as 'acquiescence' (1965, pp. 150-151)."

5. The Gough-Sanford Rigidity Scale. This is a 22-item scale measuring rigidity -- agreement with items indicating high rigidity. This scale is taken from the California Psychological Inventory where it is labeled F (Flexibility). The items of this scale were intermingled with the items from the Dogmatism Scale and the subjects responded to these items on the same specially constructed IBM form using six alternatives ranging from -3 to +3 (see Appendix A). The two factor analytic studies mentioned above by Rokeach and Fruchter (1956) and by Fruchter, Rokeach and Novak (1958) have shown that while the two variables, dogmatism and rigidity, correlate around .45 with one another they nevertheless form two factorially distinct factors.

A total of 798 freshmen were selected for individual testing with the Doodlebug Problem, a test which provides measures of conceptual analysis and synthesis; with the short form of the Witkin Embedded-Figures Test, a test of perceptual analysis; and with our own modification of the Kohs Block Test, a test of perceptual synthesis.

6. The Denny Doodlebug Problem. This test is individually administered and takes anywhere from a few minutes to a maximum of 30 minutes, depending on the subject. After the subject is seated, the examiner says:

Today you are going to be given a newly devised test of general intelligence. The problem is not a simple one but the solution can be reached by good logical analysis. Here is the problem. Read it over carefully.

(Examiner gives subject a mimeographed sheet which reads as follows):

The conditions

Joe Doodlebug is a strange sort of imaginary bug. He can and cannot do the following things:

1. He can jump in only four different directions -- north, south, east, and west. He cannot jump diagonally (e.g., southeast, northwest, etc.).

2. Once he starts in any direction, i.e., north, south, east, or west, he must jump four times in that same direction before he can switch to another direction.

3. He can only jump -- not crawl, fly, or walk.

4. He can jump very large distances or very small distances -- but not less than one inch per jump.

5. Joe cannot turn around.

The Situation

Joe has been jumping all over the place getting some exercise when his master places a pile of food three feet directly west of him. Joe notices that the pile of food is a little larger than he. As soon as Joe sees all this food he stops dead in his tracks facing north. After all his exercise Joe is very hungry and wants to get the food as quickly as possible. Joe examines the situation and then says, "Darn it, I'll have to jump four times to get the food."

The problem

Joe Doodlebug was a smart bug and he was dead right in his conclusion. Why do you suppose Joe Doodlebug had to take four jumps, no more and no less, to reach the food?

The Doodlebug Problem is quite difficult to solve. With hints from the examiner, the average time to solve, as determined by previous research, is about 22 minutes.

The solution*

At the moment Joe's master placed the food down, Joe had already jumped once to the east. He therefore has to jump sideways three more times to the east and once sideways back to the west, thereby landing on top of the food. He is now in a position to eat the food.

To arrive at this solution the subject must first overcome three currently held beliefs and replace them with three new beliefs, as follows:

1. The facing belief. In our everyday world we assume that one has to turn to face the food if one is to be in a position to eat. In the Doodlebug Problem, Joe cannot turn to face the food but can land on top of it.

2. The direction belief. In our everyday world we can change our direction of movement at will. The subject must come to realize that Joe, even though he is forever trapped facing north, can nevertheless change his direction of movement by jumping sideways and backwards.

3. The movement belief. In the everyday world we may change direction at will. But Joe cannot change his direction at will because once he moves in a particular direction he must make a total of four jumps in that direction before he can change to another direction.

* Needless to say, the solution presented here was not given to the subject.

The total problem solving process can be divided into an analysis and a synthesis phase. In the analysis phase the subject is required to separate three currently held beliefs from his present belief system in which it is embedded and replace them with three new beliefs which are at variance with the older beliefs. But this is not all. Even after the subject is successfully able to accomplish this (with or without the examiner's help) he has not yet solved the problem. He must then organize or synthesize the three newly acquired beliefs into a new system. This is the synthesis phase of problem solving.

(After the subject has read the problem, the examiner continues):

> I'd like to ask you to think aloud as you work the problem so I can let you know whether you are correct or not. You may ask questions as you go along and you may refer to the problem at any time. You may use the scratch paper in any way you wish. Now let's read the problem over together.

The total time allowed is 30 minutes. For the first 15 minutes the subject works continuously regardless of whether he overcomes any of the three beliefs by himself. If he overcomes any belief by himself, the time taken to do so is recorded. At the end of 15 minutes the experimenter asks, "Have you figured it out yet?"

If the problem is not yet solved, the examiner gives hints at the end of 15, 20 and 25 minutes designed to overcome each of the three beliefs. Which hint is given depends upon which belief the subject had previously overcome by himself. But in general the facing belief is given first, the direction belief second, and the movement belief third. Whether or not a solution is reached, the session is terminated 30 minutes after the problem is given to the subject.

In the event that the subject overcomes one belief on his own within the first 15 minutes, he is given the second hint at the end of 15 minutes and the third hint at the end of 20 minutes. In the case where the subject overcomes two beliefs within the first 15 minutes by himself, he is given the third hint at the end of 15 minutes. This procedure is followed for all the subjects without exception.

The hints are given as needed and as follows:

1. The facing belief. "I'm going to give you a hint. Joe does not have to face the food in order to eat it. (Repeat hint.) O.K., I'll give you five minutes more."

2. The direction belief. "I'll give you another hint. Joe can jump sideways and backwards as well as forwards."

3. The movement belief. "Let's read the problem again. (The experimenter and subject reread the problem.) Now here is the last hint. Joe was moving east when the food was presented. (Repeat hint.) You have five more minutes."

At the end of the formal session the subject is given an opportunity to comment freely on his reactions to the experiment. At this time, too, the subject is told the correct solution if he does not already know it, is disabused of the idea that the problem is a test of intelligence, and is asked not to discuss the experiment with others.

Following the procedure described above the following measures are obtained:

Analysis measures

a. Time taken to overcome one belief.

b. Time taken to overcome two beliefs.

c. Time taken to overcome all three beliefs.

Synthesis measures

d. Time taken to solve the problem after first belief is overcome.

e. Time taken to solve the problem after first two beliefs are overcome.

f. Time taken to solve the problem after all three beliefs are overcome.

Analysis and Synthesis

g. Total time to solve the Doodlebug Problem.

7. The Witkin Embedded-Figures Test -- a test for perceptual analysis. The perceptual task used to measure individual differences in perceptual analysis was Witkin's Embedded-Figures Test (1950). The full test is made up of 24 complex figures and the subject is simply instructed to locate a specified simple figure which, he is told, is contained within a specified complex design. (This test is very similar to a test many people will have encountered in their Sunday newspaper supplements wherein a picture of a tree is shown along with the assertion that there are many birds hidden in it, and the invitation to see how many birds the reader can find for himself.)

The Embedded-Figures T used in this study is the short-form version described by Jackson (1956), consisting of 12 instead of the original 24 complex figures, with a 3-minute time limit given to locate each simple figure contained within the more complex figure. Jackson reports that his 12-figure version correlates from .96 to .99 with the longer 24-figure test.

8. The Modified Kohs Block Design Test -- a test for perceptual synthesis

This test is a modification of the Kohs Block Design Test as is found on the Wechsler Adult Intelligence Scale (1955) or the Goldstein-Scheerer Cube Test (1941). In the usual administration of this test the subject is shown a series of printed red-and-white designs of varying complexity and he is asked to reproduce this printed design with a number of cubes, the number varying from four to 16. Each cube has some of its side painted white, some painted red, and some painted half-red and half-white (diagonally).

In our own adaptation of this test, which we will henceforth call the Perceptual Synthesis Test, the subject is shown a printed design and is asked to reproduce it with four blocks. He is then asked to reproduce it (the same design) once again, but this time the design is to be (1) enlarged (built with nine or 16 blocks) and at the same time (2) rotated 90 degrees to the left or right (it must not be built first and then rotated) and at the same time (3) the colors must be interchanged -- red replaces white and white replaces red. All of the subject's activity with the blocks takes place with the printed, colored design placed in front of the subject in its original position. The subject can look at this design all he wants to but is not allowed to move it.

This test is similar in design to the Doodlebug Problem. There are three beliefs or sets which the subject has to first overcome and then

reintegrate -- a size set, a position set, and a color set. By the very nature of the task set for the subject he is not able to deal with these three sets one at a time. He must deal with all of them simultaneously, in an integrative fashion. In contrast with the Witkin Embedded-Figure Test, which calls for the analytic separation of item from field, the Perceptual Synthesis task requires the simultaneous integration of three new items into a new field.

The Perceptual Synthesis Test has six designs and a five-minute time limit is given for each one. In four of them the subject is required to expand the four-block design to a 16-block design; in the remaining two the design is expanded from four to nine blocks.

As already indicated, a total of 798 subjects served as the subjects in the present study. They took the MSU English Test, the MSU Reading Test, the CQT, the Dogmatism and Rigidity Scales during Welcome Week under conditions of group administration to all entering freshmen. Then, over a period of two years subsequent to entering Michigan State University, these subjects were selected for individual testing with the Doodlebug Problem, the Embedded-Figures Test and the Perceptual Synthesis Test. Three hundred twenty-eight of these subjects were tested during the 1960-61 academic year, and 470 were tested during the 1961-62 academic year. The testing took about two hours and the subjects were paid $2 for their time. These subjects were randomly selected from a larger pool of about 2500 entering freshmen from various fields of interest as

expressed by the subjects when they entered Michigan State University. The number of male and female subjects selected is shown in Table 1.

TABLE 1

Breakdown of 798 Subjects by Field of Interest and Sex

Field of Interest	Male	Female	Total
Mathematics, Physical Science, and Statistics	156	9	165
Engineering	145	1	146
Language and Literature	13	107	120
Business Administration	116	6	122
Social Sciences (Philosophy, Foreign Studies, History, Social Sciences, Economics, Political Science, Sociology and Psychology)	64	124	188
No Preference	23	34	57
Total	517	281	798

We had originally planned to select approximately equal numbers of students from the several fields of interest shown in Table 1. But this proved to be impractical due to the fact that many of the subjects we selected to represent these fields of interest changed their major as their interests changed, or changed to "no preference," etc. It should

be obvious, too, that we were not able to get equal numbers of men and women for each field of interest, due to the fact that men and women are differentially attracted to these fields of interest.

The subjects who were randomly selected (within the framework of the breakdown shown in Table 1) were first contacted by letter, and then if necessary by phone, to invite them to the MSU Counseling Center for testing. The subjects were told that this testing was for research purposes only and that they would be paid for their time at the rate of $1 per hour. Approximately 95 per cent of all subjects initially contacted responded, made appointments, and were tested. Substitutions within the same categories (by major and sex) were made for the remaining 5 per cent who were not successfully contacted.

As already indicated these 798 subjects were individually tested with the Doodlebug Problem, the Embedded-Figures Test and the Perceptual Synthesis Test over a two-year period. Over this period a total of 13 examiners were used in all, but the largest majority of our subjects (N = 696 for the Doodlebug and N = 527 for the Perceptual Tests) were tested by Examiners 1, 2, 3 and 4, 1 and 3 being males and 2 and 4 being females. The number of subjects tested on the Doodlebug by these four Examiners is shown in Table 2.

TABLE 2

Number of Subjects Tested on the Doodlebug Problem

by Examiners 1, 2, 3 and 4

Examiner	Males	Females	Total
1	56	41	97
2	165	102	267
3	86	68	154
4	150	28	178
Totals	457	239	696

III. THE ABILITY TO ANALYZE AND THE ABILITY TO SYNTHESIZE

Before presenting the data bearing on the hypothesis that analysis and synthesis are different abilities it is necessary to state at the outset the conclusion we have come to from our analysis of the present data regarding the empirical validity of this hypothesis. The present data, because of unforeseen methodological reasons to be described shortly, can neither confirm nor disconfirm the hypothesis that analysis and synthesis, as operationally measured, are psychologically discriminable personality or cognitive processes.

We could find little or no evidence in this study to support the analysis-synthesis distinction. What evidence we have obtained is clearly inconsistent with our earlier findings and with those obtained by other investigators in the past few years. It was thus necessary to reconcile our findings with those of others and to ascertain whether our negative findings meant that (a) our specific hypotheses were psychologically invalid or whether instead, (b) they could be explained on purely methodological grounds. We therefore conducted several additional studies not originally planned, which were designed to help us choose between alternative (a) and (b). In the course of doing so we obtained additional data regarding sex differences in cognitive functioning, examiner differences in administering cognitive tests, "contamination"

effects, the effects of more simplified ways of scoring the Dogmatism and Rigidity Scales, and regarding results obtained from orthogonal factor analysis, oblique factor analysis, and Guttman's Smallest Space Analysis (Lingoes, 1965). These various findings will be presented and discussed in more or less detail in the various sections which follow.

We have been able to compensate for the unusual methodological problems encountered in our study by drawing on the results which have been, in the meantime, steadily accumulating in other studies regarding the empirical validity of the analysis-synthesis distinction. These studies will be reviewed in some detail in a later section.

A. SEX DIFFERENCES

It is first necessary to draw attention to a variety of sex differences which we discovered in the data. These differences include the Dogmatism Scale, the various measures of analysis and synthesis -- on both the conceptual and perceptual tests -- and the several tests given to all incoming freshmen.

1. Sex differences on dogmatism. Two earlier studies in which the Dogmatism Scale had been used, those by Plant (1958) and by Lehmann and Ikenberry (1959) have demonstrated the presence of sex differences in dogmatism, males scoring significantly higher than females. Table 3 presents their results along with comparable results obtained in the present study showing similar sex differences, and thus confirming the results obtained by Plant (1958) and by Lehmann and Ikenberry (1959).

We are unable to account for these consistent differences except to suggest that they may arise from systematic cultural differences in socialization into sex-roles, females being trained to inhibit dogmatic expressions of beliefs and attitudes, and males being trained to forcefully and aggressively assert such expressions. Another possible explanation is that American males are more anxious because the achievement demands made upon them within a fiercely competitive society lead defensively to a more closed-minded or dogmatic orientation. Earlier

TABLE 3

Sex Differences on Dogmatism Found in Three Different Studies

Sample	Men			Women			t	p
	N	M	S.D.	N	M	S.D.		
Present sample	517	164.14	23.78	281	155.78	23.83	4.72	<.01
MSU - 1959 (From Lehmann and Ikenberry)	1436	168.19	25.36	1310	163.56	25.47	4.77	<.01
San Jose State - 1958 (From Plant)	1007	159.70	25.34	1343	155.32	26.15	4.09	<.01

research has shown sizable correlations between dogmatism and anxiety (Rokeach, 1960; Rokeach and Fruchter, 1956; Fruchter, Rokeach and Novak, 1958) but we have no direct evidence that males are, on the average, more anxious than females.

In contrast to the sex differences in dogmatism we find no consistent differences in rigidity. In the present sample the mean rigidity score for the men is 97.70 and for the women 97.25 (the standard deviations are 23.78 and 23.83 respectively). In the Lehmann-Ikenberry study (1959) a small but significant difference is found on the Inventory of Beliefs, a measure of stereotypy which is similar to the Rigidity Scale, the males being more stereotypic.

2. <u>Sex differences in cognitive functioning</u>. In addition to sex differences in dogmatism we also found systematic sex differences on our various individually-administered tests of cognitive functioning, males being found to be consistently superior to females in cognitive functioning, at least insofar as the measures under consideration are concerned. The results for the Doodlebug, Embedded-Figures and Perceptual Synthesis Tests are shown in Tables 4 and 5.

TABLE 4

Sex Differences in Minutes on the Various Conceptual Measures

Obtained from the Doodlebug Test

(N = 517 Men and 281 Women)

	Men		Women			
Variable	M	S.D.	M	S.D.	t	p*
<u>Analysis Measures</u>						
Time taken to overcome 1 belief	3.81	3.10	4.17	3.26	1.54	N.S.
Time taken to overcome 2 beliefs	7.41	3.61	7.64	3.55	.88	N.S.
Time taken to overcome 3 beliefs	10.90	4.32	11.26	4.10	1.17	N.S.
<u>Synthesis Measures</u>						
Time taken to solve after first belief was overcome	13.99	9.03	16.02	9.91	2.85	.01
Time taken to solve after first 2 beliefs were overcome	10.39	8.27	12.55	9.33	10.29	.01
Time taken to solve after all 3 beliefs were overcome	6.90	7.53	8.93	8.71	3.30	.01
Total time to solve	17.80	9.99	20.19	10.72	3.08	.01

* One-tailed test

TABLE 5

Sex Differences in Minutes on the Various Perceptual Measures

Obtained from the Embedded-Figures Test and the Perceptual Synthesis Test

(N = 517 Men and 281 Women)

	Men		Women			
Variable	M	S.D	M	S.D.	t	p*
Embedded-Figures (Analysis)						
Total Score	9.81	6.92	12.95	7.84	5.63	.001
Figure 1	.76	1.11	.97	1.34	2.57	.01
Figure 2	1.02	1.29	1.25	1.39	2.20	.025
Figure 3	.73	1.21	1.12	1.52	3.71	.001
Figure 4	3.08	1.82	3.63	1.69	4.27	.001
Figure 5	.22	.60	.24	.60	.45	N.S.
Figure 6	.21	.47	.31	.62	2.36	.01
Figure 7	.31	.64	.56	1.00	3.79	.001
Figure 8	1.15	1.28	1.39	1.46	2.31	.025
Figure 9	1.04	1.37	1.68	1.69	5.45	.001
Figure 10	.63	.96	.79	1.13	2.01	.025
Figure 11	.18	.42	.21	.57	.78	N.S.
Figure 12	.48	.84	.80	1.15	4.13	.001
Modified Kohs (Synthesis)						
Total Score	13.99	5.91	18.39	6.03	9.93	.001
Figure 1	2.85	1.43	3.69	1.36	8.24	.001
Figure 2	2.11	1.32	2.95	1.50	7.90	.001
Figure 3	1.83	1.30	2.50	1.48	6.42	.001
Figure 4	2.33	1.47	3.01	1.51	6.15	.001
Figure 5	2.56	1.31	3.29	1.32	7.49	.001
Figure 6	2.30	1.46	2.95	1.53	5.83	.001

* One-tailed test

Considering first the sex differences on the Doodlebug Test, it is seen from Table 4 that the men took a mean of 17.80 minutes to solve the Doodlebug Problem as compared with a mean of 20.19 minutes for the women -- a difference of over two minutes. Similar differences are found without exception on all measures of analysis and synthesis, the men in all cases taking less time than the women. The greater superiority of men over women in problem solving ability is, of course, consistent with other studies reported in the literature. But we hasten to add that the sex differences are significant for the synthesis measures but not for the analysis measures, suggesting that the generally more superior problem solving abilities of men over women reported in the literature may be due to the significantly greater ability of men over women to synthesize rather than to analyze. But the finding is somewhat paradoxical in the sense that these sex differences in synthesizing ability are found despite the fact that men are significantly more dogmatic than wome .

Table 5 shows the mean scores obtained by men and women on the Witkin Embedded-Figures Test, a measure of perceptual analysis and the Modified Kohs Test, a measure of perceptual synthesis. Once again we note that the men are consistently superior to the women on both tasks. Table 5 also shows that the results are consistent for all tasks taken individually without exception as well as for the total scores.

TABLE 6

Sex Differences on Various Achievement Tests

(N = 517 Men and 281 Women)

Variable	Men M	Men S.D.	Women M	Women S.D.	t	p*
English	22.74	5.73	25.84	5.06	7.87	.001
Reading	30.03	6.05	30.88	5.56	2.00	.025
CQT Verbal	49.31	12.78	53.94	11.74	5.16	.001
CQT Information	54.57	8.39	48.45	8.77	6.06	.001
CQT Numerical	37.46	9.35	27.98	9.83	13.24	.001
CQT Total	141.34	24.50	130.37	24.17	6.09	.001

* Two-tailed test

The finding of significant sex differences on the Embedded-Figures Test is, of course, consistent with Witkin's findings. And assuming that the Embedded-Figures Test is a measure of perceptual analysis, the sex differences found here are in contrast to the absence of such differences on conceptual analysis (obtained on the Doodlebug Problem). At the same time it should be noted that the levels of significance are generally higher for the perceptual synthesis tasks than for the perceptual analysis tasks. All the differences on the perceptual synthesis tasks are without

exception, significant beyond the .001 level while this is not so for the perceptual analysis tasks. It may be noted, for example, that on two of the 12 perceptual analysis tasks the differences between men and women do not reach statistically significant levels.

3. Sex differences on other tests. To round out the presentation of results bearing on sex differences, we show in Table 6 the mean scores obtained for men and women on various achievements tests taken upon entering Michigan State University.

Consistent with results from numerous other studies, the women are significantly superior to the men in English, Reading Comprehension and CQT Verbal, the men significantly superior in CQT Information, CQT Numerical and CQT Total. These differences in favor of the men are, of course, consistent with the findings shown in Tables 4 and 5 showing male superiority of cognitive functioning on conceptual and perceptual te[illegible].

From all the preceding it is clear that the two sexes cannot be regarded as one sample but as two distinctly different ones. We will, therefore, report all subsequent data to be presented in this report separately for men and women.

B. EXAMINER DIFFERENCES

We found not only sex differences but, more important and with far more serious implications for our research program, we also found examiner differences on the individually-administered Doodlebug, and Perceptual Synthesis Tests. The battery of cognitive tests required about two hours for each subject and with 798 subjects, required about 1600 hours of individual testing. As already pointed out, such testing was carried out over a two-year period and required the service of a relatively large number of examiners -- eight examiners who were trained to administer all three tests and an additional five who were trained to administer the Embedded-Figures and Perceptual Synthesis Tests. We examined the data for four examiners (two males and two females) who administered the great majority of the tests (the remaining examiners being employed primarily to facilitate the work of these four examiners) in order to ascertain whether differences in performance existed among them. Despite the fact that we trained all examiners to administer the tests in a standardized manner and despite the fact that early in our testing program we conducted quantitative checks to assure that the examiners were not producing significantly different results, we nevertheless found, when all the data had been collected, statistically significant results among the four main examiners. The specific data are shown in Table 7.

TABLE 7

Examiner and Sex Differences in Total Time to Solve the Doodlebug Problem and to Complete the Embedded-Figures and Perceptual Synthesis Tests

	Men			Women		
	N	M	S.D.	N	M	S.D.
A. Total Time to Solve the Doodlebug Problem						
Examiner 1	56	18.87	9.42	41	27.03	11.31
Examiner 2	165	16.94	8.44	102	19.09	10.23
Examiner 3	86	14.64	8.01	68	14.64	6.48
Examiner 4	150	19.17	11.23	28	22.88	11.84
B. Total Time on Embedded-Figures Test						
Examiner 1	56	9.48	6.08	41	14.83	11.63
Examiner 2	165	8.60	5.22	102	12.31	6.99
Examiner 3	86	8.44	4.90	68	12.11	6.67
Examiner 4	150	10.88	7.74	28	14.16	6.96
C. Total Time on Perceptual Synthesis Test						
Examiner 1	56	14.28	5.42	41	19.42	6.53
Examiner 2	165	14.12	6.11	102	18.55	5.99
Examiner 3	86	14.48	6.02	68	18.62	6.26
Examiner 4	150	12.70	5.53	28	16.76	6.25

In order to fully understand the data shown in Table 7 it should first be pointed out that Examiners 1 and 3 are male and Examiners 2 and 4 are female graduate assistants. Of even greater relevance is the fact that Examiner 1 tested subjects between September, 1960 and June, 1961; Examiner 2 tested subjects from January, 1961 to September, 1962; Examiner 3 tested subjects from September, 1961 to June, 1962; and Examiner 4 tested subjects from December, 1961 to August, 1962. In other words, the data shown in Table 7 represent data obtained in temporal sequence -- Examiner 1's data being obtained first and Examiner 4's data being obtained last.

Before considering the differences in means among the four main examiners, let us draw attention once again to the systematic sex differences which can be seen in the data. In the case of Examiner 1, for example, the mean total time taken by his male subjects to solve the Doodlebug Problem is 18.87 minutes and for his female subjects 27.03 minutes -- a difference of over 8 minutes. Similar differences in the same direction are observed in 3 out of 4 examiners, the means for male and female subjects of Examiner 3 being identical. On the Embedded-Figures Test and on the Perceptual Synthesis Test, male subjects perform better than female subjects for each examiner without exception. These results, of course, confirm those shown in Tables 4 and 5.

Considering now the examiner differences separately for males and females, it is seen that the means on total Doodlebug scores range from 14.64

to 27.03 for the female subjects. The mean Doodlebug scores for Examiner 1's female subjects are roughly about twice that of Examiner 3's female subjects -- 27.03 minutes to 14.64 minutes. Analysis of variance reveals that the examiner differences are highly significant.

The comparable examiner differences for the Embedded-Figures Test and for the Perceptual Synthesis Test do not appear to be as marked as those for the Doodlebug Problem. By analysis of variance we learn that the examiner differences are not significant for the Embedded-Figures Test. But the examiner differences for the Perceptual Synthesis Test are significant beyond the .01 level, although these differences are not nearly as large as those obtained for the Doodlebug Problem.

One possible reason for the large variation among examiners on the Doodlebug Problem is that there is a great deal of social communication between examiner and subject in this test. The examiner answers all kinds of questions put to him by the subject, thus confirming or disconfirming the various hypotheses the subject might formulate about the world of Joe Doodlebug. Perhaps the large examiner differences arise then, from the unstandardized manner in which the examiners respond verbally and nonverbally despite our training procedures to the subject's remarks, queries, etc.

If this interpretation is correct, it would also account for the smaller examiner differences found on the perceptual tests. Once these tasks are

set before the subject he is no longer dependent on the examiner, and he can proceed on his own to solve the problems. The data show further that the examiner differences are systematic rather than random. The male subjects of Examiners 2 and 3 solve the Doodlebug Problem faster than do the male subjects of Examiners 1 and 4. The same is true for the female subjects of Examiners 2 and 3 as compared with Examiners 1 and 4. Similar trends are noted with respect to the Embedded-Figures Test. While these consistent trends are not evident with respect to the Perceptual Synthesis Test, we nevertheless felt it reasonable to assume that it was the presence of personality factors in our examiners which was the source of the consistent differences observed.

On the basis of the data presented in Tables 3 through 7 it was clear that the data must be analyzed separately by both sex and examiner. Further analysis of examiner differences shows that not only do the means on the Doodlebug Problem (and on the Embedded-Figures and Perceptual Synthesis Tests) differ from one examiner to the next, but that the relationships among these and other variables also differ.

For these unforeseen reasons we found it necessary to depart from our original research design. Instead of looking for evidence relevant to our main hypotheses regarding the analysis-synthesis distinction in one relatively large mass of data obtained from one sample of subjects, it was necessary to examine our data separately by sex and by examiner.

As already mentioned, we carried out a large number of analyses for the total body of data, separately by sex, by examiner, and by sex and examiner. We found many significant correlations among the various tests but the findings were all negative insofar as the analysis-synthesis distinction was concerned. We found no evidence that our various measures of analysis were factorially discriminable from our various measures of synthesis. We explored and tested many hypotheses which might possibly account for these negative findings and which might help to reconcile these findings with the positive findings obtained in other studies.

We finally concluded, on the basis of the data to be presented in the next section, that the data obtained on the cognitive tests were "contaminated"; that is, that the subjects, unknown to us and contrary to our requests for secrecy, were communicating with one another about the nature of these cognitive tests.

C. A STUDY OF COMMUNICATION AMONG SUBJECTS: TESTS FOR THE INDEPENDENCE OF OBSERVATIONS*

As a result of the consistently negative findings with respect to the hypotheses already mentioned above, we re-examined the data in an attempt to determine the true meaning of the examiner differences. More specifically while these differences could have been due to the effect of the different examiners, another possibility was that the differences were due to the effect of the <u>order</u> in which the subjects took the test.

If the latter were true, implying communication between subjects already examined and prospective subjects, most of the statistical analyses relevant to the factorial nature of analysis and synthesis would be invalid because the observations obtained would not be independent.

If the reader will turn once again to Table 7 he will note that for both male and female subjects the mean "total time to solve the Doodlebug Problem" <u>decreases</u> from Examiners 1 to 3 but increases for Examiner 4. The same trends are observed for the Embedded-Figures Test, except that the decreases in mean scores from Examiner 1 to 3 is not as marked as

* This study was conducted in collaboration with Dr. Rita Zemach of the Statistics Department of Michigan State University, who carried out the varied analyses described herein.

those for the Doodlebug Problem. These particular trends are, however, not evident with respect to the Perceptual Synthesis Test.

If we recall that the data shown for the four examiners are in temporal order of testing it does not appear that the differences among examiners are due to order of testing.

The means for Examiner 4 do not show the decreases observed from Examiners 1 to 3 on the Doodlebug and Embedded-Figures Test. The decreases in means observed on the Perceptual Synthesis Test do not follow any clear-cut temporal order.

For this reason we initially rejected the hypothesis that the examiner differences observed were due to one extent or another, to order effects. But we returned to this hypothesis to examine it more closely when our results consistently produced negative findings in the face of various confirmations of the analysis-synthesis hypothesis obtained in other studies.

Suppose the observed decreases in mean scores were due to examiner differences alone. Then, with the scores arranged in the same order as the tests were administered by the examiners, there should be no tendency for the scores to decrease within the sample of subjects tested by a single examiner.

To test whether this was so, each of the eight sets of subjects, separated by examiner and sex, was divided into first-half and last-half, according to the order in which the cognitive tests were taken. Under the hypothesis that there was no order effect, the mean score for the first half of a particular sample is just as likely to be lower as higher than the mean score for the last half. In addition, the direction of the differences for the eight samples should be independent; that is, should fluctuate randomly. The question of independence of observations might then be answered by testing the null hypothesis that the first-half and second-half means do not differ significantly from one another.

1. <u>The Doodlebug Test-Total Time</u>. Table 8 shows that in every one of the eight samples, mean total time to solve the Doodlebug Problem for the first half is greater than mean time for the last half. Since this result is highly significant (at the .004 level, using a sign test), the hypothesis (that the decreases in mean scores were due to examiner differences alone) may be rejected. We conclude therefore, that the differences in mean scores between the two halves of a sample are not chance fluctuations, but that first-half mean scores tend to be higher than last-half mean scores.

TABLE 8

Comparison of Means of (a) First Half and (b) Last Half of Samples on Total Time to Solve the Doodlebug Problem, by Examiner and Sex

Examiner	Sample	N	$\overline{X}$	S.D.	F	p
1	Male (a)	28	19.60	10.36	.33	--
	Male (b)	28	18.15	8.50		
	Female (a)	21	28.49	11.28	.65	--
	Female (b)	20	25.63	11.43		
2	Male (a)	83	17.02	8.99	.02	--
	Male (b)	82	16.86	7.90		
	Female (a)	51	20.83	11.61	3.00	$<.10$
	Female (b)	51	17.35	8.40		
3	Male (a)	43	15.85	8.44	1.97	--
	Male (b)	43	13.43	7.47		
	Female (a)	34	16.20	7.48	4.10	$<.05$
	Female (b)	34	13.09	4.93		
4	Male (a)	75	23.92	11.62	33.96	$<.0005$
	Male (b)	75	14.22	8.51		
	Female (a)	14	26.05	13.04	1.96	--
	Female (b)	14	19.92	9.91		

Since the effect of the order-difference across the first four examiners is confounded with the effect of examiner differences, no statistical test can be made across examiners. In view of the results of within-examiners differences, however, it is reasonable to assume that the order in which the test was taken influenced the scores of the sample as a whole. The monotonic pattern of decreasing scores for males and females across and within the first three examiners is clearly evident in Table 9.

TABLE 9

Doodlebug Total Time

Decrease Across and Within First Four Examiners

Examiner		Male	Female
1	First half	19.60	28.49
	Last half	18.15	25.63
2	First half	17.02	20.83
	Last half	16.86	17.35
3	First half	15.85	16.20
	Last half	13.43	13.09
4	First half	23.92	26.05
	Last half	14.22	19.92

In addition to the sign test to establish the trend of the scores, analysis of variance tests were run to determine which of the within-sample decreases were statistically significant, even considered apart from the general trend. Table 8, which gives the resulting F scores, indicates successive increases in the significance of the differences in mean scores between first and last half as we proceed from Examiner 1 to 4. We interpret this to be due to the fact that the opportunity for a prospective subject to communicate with a previously examined subject increases with the number of subjects examined. In other words, the data suggest that the probability of communication increases as a function of the number of subjects already examined.

The most significant difference is found for the male sample of Examiner 4, who constitute about 85 percent of the subjects tested by this Examiner. The vast majority of these subjects were engineers (see Table 1) who, because they were tested relatively late in the two-year period, were relatively isolated from those previously tested and at the same time, were apparently in frequent communication with one another. The fact that these subjects were homogeneous and isolated from those previously tested may account for the lack of influence of the first three examiners' subjects on the fourth examiner's subjects.

Examiner 4's male sample of 150 subjects was further broken down into 15 groups of 10 subjects each, arranged in order of testing. Figure 1 clearly shows a decrease in means as a function of order of testing.

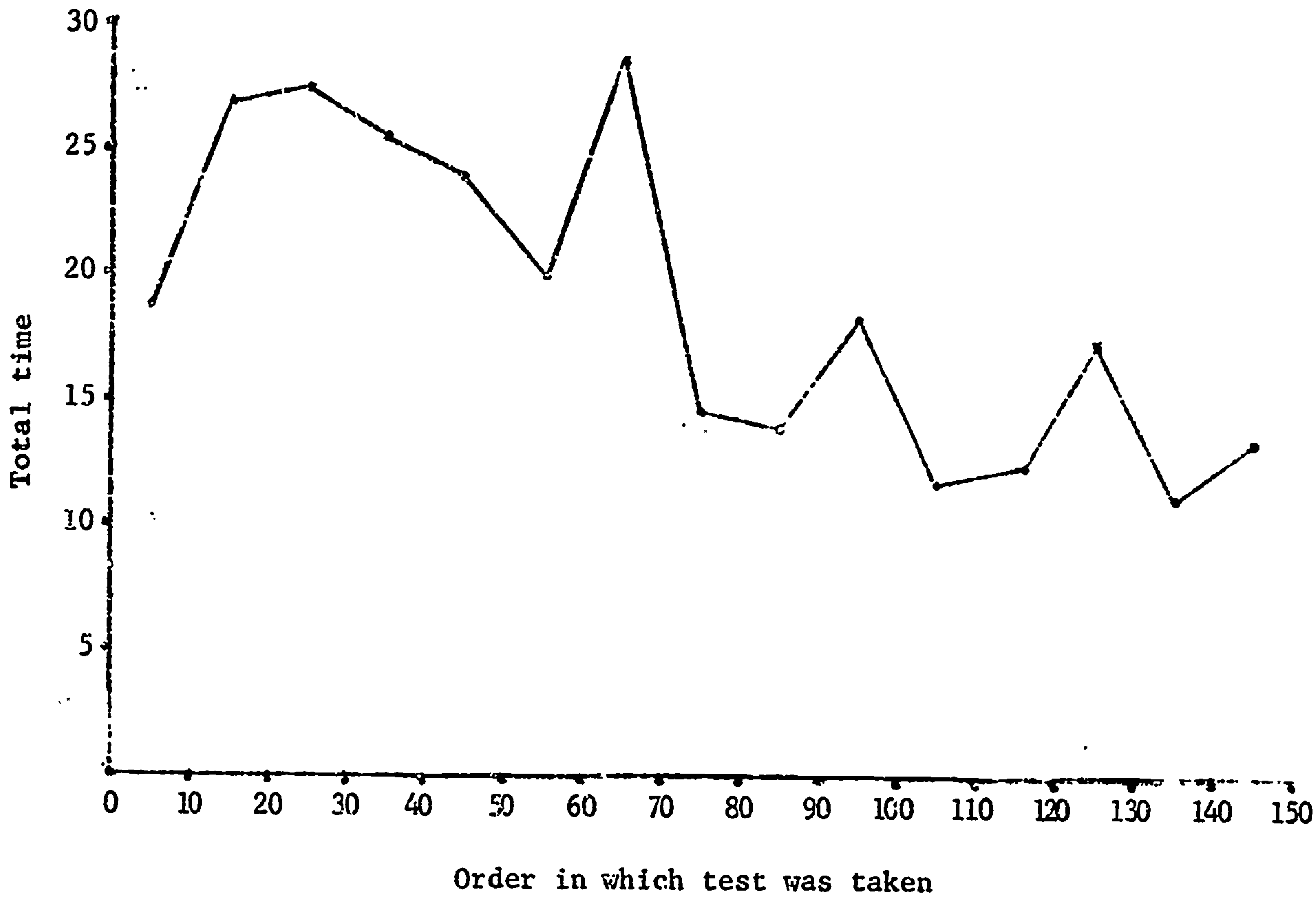

Figure 1. Graph showing time to complete Doodlebug Test for male sample of Examiner 4, with scores ordered with respect to time test was taken (values shown are mean scores for groups of 10).

2. The Conceptual Analysis and Synthesis Scores. The next question we asked was whether the order effects observed for the total time to solve the Doodlebug Problem was due to order effects only on analysis, or only on synthesis, or both. We therefore calculated the mean analysis and synthesis scores (mean time taken to overcome three beliefs, and mean time taken to solve after the third belief was overcome) for first half and second half of samples tested, separately for examiner and sex. The results are shown in Table 10.

An examination of the first-half, last-half mean analysis scores for each examiner reveals that in seven of the eight samples (four male and four female) there is a decrease in mean time. We find this result significant at the .03 level. In the one case of increase (the male sample of Examiner 2) the increase is slight; on the other hand, two of the decreases are significant beyond the .10 level, one significant beyond the .05 level, and one highly significant beyond the .0005 level.

In the case of synthesis, we also find that the tendency for scores to decrease from first- to last-half within samples is significant, with seven of the eight samples showing a decrease. The one increase (male sample of Examiner 1) is negligible. We again point to the highly significant decrease in the male sample of Examiner 4.

3. The Embedded-Figures and Modified Kohs Tests. Comparable analyses were carried out to determine whether order effects existed also for the

TABLE 10

Comparison of Means of (a) First half and (b) Last half of Samples on Analysis and Synthesis (Doodlebug Problem), by Examiner and Sex

		Analysis				Synthesis			
Examiner	Sample	Mean	S.D.	F	p	Mean	S.D.	F	p
1	Male (a) Male (b)	11.57 9.83	3.53 3.05	3.89	.10	8.03 8.32	7.97 8.44	.02	----
	Female (a) Female (b)	10.73 10.37	3.30 3.17	.13	----	17.76 15.26	9.[illegible]6 9.91	.65	----
2	Male (a) Male (b)	11.62 11.78	4.41 3.62	.07	----	5.40 5.07	5.86 5.97	.13	----
	Female (a) Female (b)	11.70 11.26	4.30 3.21	.34	----	9.11 6.09	8.89 7.01	3.62	.10
3	Male (a) Male (b)	11.10 9.11	4.72 4.33	4.14	.05	4.75 4.32	5.56 4.87	.14	----
	Female (a) Female (b)	11.16 9.34	5.30 3.69	2.68	----	5.04 3.74	3.97 2.52	2.60	----
4	Male (a) Male (b)	12.41 7.85	4.09 3.42	54.68	.0005	11.50 6.37	9.09 6.58	15.70	.0005
	Female (a) Female (b)	12.49 10.16	4.16 1.46	3.90	.10	13.56 9.76	9.60 9.58	1.10	----

Witkin Embedded-Figures Test and for the Perceptual Synthesis Test. The results shown in Table 7 show a decrease in mean scores for both males and females across Examiners 1, 2 and 3 for the Embedded-Figures Test, but not for the Perceptual Synthesis Test. The within-examiners comparisons of mean scores for first- and last-half, presented in Tables 11 and 12, show that scores increased within four of the eight samples for the Embedded-Figures Test, and in five of the eight samples for the Perceptual Synthesis Test. Clearly there is no indication of any trend within examiner samples for either test. Furthermore, the one highly significant change in the Perceptual Synthesis scores, for the female sample of Examiner 3, involves an increase. For both tests, the male sample of Examiner 4 shows unmistakable uniformity, in glaring contrast to the Doodlebug scores.

TABLE 11

Comparison of Means of (a) First half and (b) Last half of Samples on Witkin Embedded-Figures Test, by Examiner and Sex

Examiner	Sample	Mean	S.D.	F	p
1	Male (a)	9.13	6.68	.18	----
	Male (b)	9.84	5.52		
	Female (a)	13.65	12.21	.28	----
	Female (b)	15.78	11.26		
2	Male (a)	8.75	5.24	.12	----
	Male (b)	8.46	5.22		
	Female (a)	13.47	6.62	2.86	.10
	Female (b)	11.16	7.21		
3	Male (a)	8.79	4.78	.44	----
	Male (b)	8.09	5.04		
	Female (a)	11.90	6.26	.07	----
	Female (b)	12.33	7.14		
4	Male (a)	10.90	6.72	.00	----
	Male (b)	10.88	8.66		
	Female (a)	13.67	6.93	.04	----
	Female (b)	14.23	7.44		

TABLE 12

Comparison of Means of (a) First half and (b) Last half of Samples on Perceptual Synthesis Test, by Examiner and Sex

Examiner	Sample	Mean	S.D.	F	p
1	Male (a) Male (b)	13.80 14.76	5.20 5.69	.43	---
	Female (a) Female (b)	18.69 20.11	6.26 6.86	.48	---
2	Male (a) Male (b)	13.93 14.32	6.13 6.13	.17	---
	Female (a) Female (b)	18.86 13.25	5.69 6.33	.27	---
3	Male (a) Male (b)	14.74 14.21	5.65 6.42	.17	---
	Female (a) Female (b)	16.47 20.77	6.26 5.56	8.98	.005
4	Male (a) Male (b)	12.83 12.64	5.71 5.36	.04	---
	Female (a) Female (b)	15.36 18.03	5.81 6.65	1.28	---

In order to assess not only whether communication had a significant effect but also how much of an effect, correlations were obtained for each of the eight examiner-by-sex samples, between the order in which the test was taken and the scores for analysis, synthesis, total Doodlebug Test solution, Witkin Embedded-Figures Test and Modified Kohs Test. These results are presented in Table 13. In the case of total time, analysis, and synthesis on the Doodlebug Problem, five of the eight

TABLE 13

Correlation Between Order in Which Subjects Took Tests and Various Test Scores

			Doodlebug Problem				
Examiner	Sample	N	Total Time	Analysis	Synthesis	Witkin	Kohs
1	Male	56	-.04	-.28*	.07	-.05	.03
1	Female	41	-.08	-.11	-.06	.05	.04
2	Male	165	-.06	.01	-.08	-.07	.02
2	Female	162	-.20*	-.13	-.19*	-.27**	-.18
3	Male	86	-.34**	-.36**	-.21*	-.06	.02
3	Female	68	-.30**	-.25*	-.24*	.02	.32**
4	Male	150	-.38**	-.48**	-.27**	-.03	-.02
4	Female	28	-.43*	-.50**	-.36*	-.22	-.04

* $p < .05$
** $p < .01$

correlations are significant beyond the .05 level on each variable. It is seen also that the correlations are significant for all these three variables for Examiners 3 and 4. In all, 15 of the 24 Doodlebug correlations are statistically significant. By contrast, only two out of the 16 correlations obtained for the Embedded-Figures Test and Modified Kohs Test are significant, and these two correlations are in opposite directions.

In view of the results presented above, the conclusion is unavoidable that communication occurred among the subjects at the very least with respect to the Doodlebug Test, and that communication affected the results obtained on analysis, synthesis, and total time to solve the Doodlebug Problem.

One alternative explanation which must be considered is that the examiners became <u>more experienced</u> as they continued to test successive subjects and as a result, subjects' performance improved over time. This explanation seems unlikely for two reasons: (a) it would not account for the observed improvement in problem solving performance on the Doodlebug across Examiner 1 to 3; (b) it would not account for the lack of improvement of performance within and between examiners on the Embedded-Figures Test and on the Perceptual Synthesis Test.

It should be added, however, that while the finding of significant differences in performance related to order, and of significant

correlations between order and performance strongly indicate communication among subjects, the finding of no differences or zero correlations is not necessarily indicative of independence of data or of the absence of communication. It is quite possible, and we suspect it is highly likely, that the subjects communicated with one another not only about the Doodlebug Problem but also about the perceptual tasks. But the Doodlebug Problem is intrinsically more interesting and, it is relatively easy to communicate the specific hints (beliefs) and the solution. It is far more difficult to communicate the solution or aspects of the solution on the various items comprising the Embedded-Figures and Perceptual Synthesis Tests. Thus, even though we did not find evidence of improvement of the perceptual tasks, we are extremely reluctant to conclude that communication among subjects was restricted only to the Doodlebug Problem.

A simple method for assessing independence of data. A wide-spread practice in psychological research with individual subjects, whether it involves the administration of some test or the manipulation of some experimental variable, is to ask the subject before dismissing him, not to discuss the nature of the test or experiment with others. As the subject is pledged to secrecy prior to dismissal, it is often explained to him that the scientific validity of the data obtained hinges on his cooperation in maintaining "security." Many investigators mention in the procedure section of their report that they carried out this essential precaution; they then proceed to discuss their results on the assumption that their subjects did, in fact, cooperate as requested.

The present research is no exception to this wide-spread practice. We too, pledged our subjects to secrecy. We "checked up" on each subject who appeared for testing by being on the lookout for unusual behavior which might indicate that he had seen, heard of, or discussed the tests with others before coming in for testing. We routinely asked the subjects at least once during the testing session if he was in any way familiar with the tests.

In approximately half a dozen instances (out of about 800 subjects) the subject admitted sometime during the testing session, that he had indeed heard of one or more of the tests from others. Needless to say, the data obtained from these subjects were discarded, and new subjects were substituted to take their place. We then proceeded to assume what is undoubtedly assumed in hundreds of other investigations; namely, that except for the data of those few who admitted prior communication, the data for these remaining subjects are independent of such communication and thus valid.

Accepting this assumption implicitly, we proceeded with a variety of analyses designed to test our major hypotheses, and when these hypotheses failed to be confirmed, we proceeded with many other analyses in the hope that these would help us interpret our negative results as indicating either invalid hypotheses or a methodological flaw in the research design.

The results described in this section strongly indicate that the subjects were communicating with one another and that the probability of such communication seemed to increase with time. We discovered this fact only after formulating, testing and discarding many other hypotheses which would help us account for the findings -- a process enormously costly in time and money.

One methodological implication of the present findings is that it is now possible to propose a simple method for testing for communication effects in any body of data obtained from individual subjects who are tested successively. The investigator should:

1. keep a record of the dates his subjects were tested,
2. order the data temporally,
3. correlate the order of testing with the measures obtained in the research.

Lack of independence of observations would be strongly indicated if such correlations are significantly greater than zero. The larger the correlations the less the independence of observations. The larger the increase in correlation as a function of time of testing the larger the increase in interdependance of observations over time.

It is reasonable to expect that subjects who communicate with one another, in violation of requests from the examiner or experimenter, would be motivated to hide this fact, and it is thus necessary to find other ways

of uncovering evidence of such communication. We have here proposed a simple method for assessing such effects requiring nothing more than the calculation of a correlation coefficient between order-of-testing and scores obtained. In view of the simplicity of this method, it would not be unreasonable to suggest that all studies in which individual subjects are tested successively, should routinely report this correlation, in the same way that means, standard deviations and reliabilities are routinely reported. In view of the unexpected findings reported here, the mere assertion by an investigator that his subjects were "pledged to secrecy" (or other words to this effect) should no longer be accepted at face value to mean that independence of observations is assured. Whether a lack of independence of observation is due to communication among subjects, or improvements among examiners, or systematic changes in the subjects being tested is a matter of careful inference, requiring additional data. But regardless of cause, the present method should assess any set of data for independence.

D. RESULTS CONCERNING THE ANALYSIS-SYNTHESIS HYPOTHESIS

As already stated, the data obtained in the present research from the individually-administered cognitive tests do not provide support for the hypothesis that the ability to analyze and the ability to synthesize are discriminably different abilities. In the previous section we have presented data suggesting that the cognitive measures of analysis and synthesis are probably invalid because of communication among subjects, thus providing us with a purely methodological basis for explaining these negative findings. We have presented these methodological findings first, rather than the substantive findings, in order to spare the interested reader from working his way through a large body of data, only to discover in the end that they are at least in part methodologically suspect.

In this section we will describe in more detail the various kinds of analyses carried out to test the analysis-synthesis hypothesis and the results obtained. These results, while negative insofar as the analysis-synthesis hypothesis is concerned, are nevertheless interesting for two reasons: many significant correlations were found among the various tests, and the results throw further light on the way in which communication among subjects may have affected the substantive results.

In line with the data already presented showing sex and examiner differences on the Dogmatism Scale and on the individually-administered cognitive tests, we typically analyzed our data (a) separately for males and females further subdivided by examiner, (b) separately for the total group of males and females, and (c) for the total sample of 798 subjects.

1. CORRELATIONAL DATA

We first looked at the correlations among the various personality (Rigidity and Dogmatism) and cognitive tests (Doodlebug, Embedded-Figures, Modified Kohs) to see if the average correlations _within_ tests assumed to measure analysis, or assumed to measure synthesis, were larger than the average correlations _between_ measures of analysis and synthesis. If our assumptions are valid (see Introduction) we would expect scores on the Rigidity Scale, on the analysis measures of the Doodlebug Problem and on the Embedded-Figures Test to correlate significantly with one another; conversely, we would expect scores on the Dogmatism Scale, on the synthesis measures of the Doodlebug Problem and on the Modified Kohs Test to correlate significantly with one another. Furthermore, we expected to find that the cluster of variables assumed to measure analysis would not correlate significantly or would, at least, correlate less with the cluster of variables assumed to measure synthesis. The data concerning the intercorrelations among the analysis measures are shown in Table 14.

TABLE 14

Correlations Among Various Measures of Analysis

by Sex and Examiner

r between	Examiner 1 Men N=56	Examiner 1 Women 41	Examiner 2 Men 165	Examiner 2 Women 102	Examiner 3 Men 86	Examiner 3 Women 68	Examiner 4 Men 150	Examiner 4 Women 28	All Men 517	All Women 281	All Subjects 798
2,3	.18	-.05	.09	-.08	.04	.10	.08	.14	.07	.02	.05
2,4	.37**	.08	.03	-.07	.07	.09	.21**	-.01	.11*	.04	.09*
2,5	.29*	.08	.00	.02	.23*	.15	.23**	.08	.13**	.11*	.12**
2,38	.06	.14	-.04	.13	-.12	-.04	.19*	.16	.06	.08	.06
3,38	.43**	.21	.12	.26**	.10	.12	.12	.29	.12**	.15**	.14**
4,38	.26*	.32*	.11	.25**	.09	.19	.15	.29	.14**	.21**	.17**
5,38	.20	.38*	.09	.32**	.07	.20	.20*	.39*	.16**	.25**	.20**

Code: 2 = Rigidity Scale
3 = Time taken to overcome one belief (Doodlebug)
4 = Time taken to overcome two beliefs (Doodlebug)
5 = Time taken to overcome three beliefs (Doodlebug)
38 = Witkin Embedded-Figures Test

Levels of Significance: * $p < .05$
** $P < .01$

The following points should be noted in Table 14:

1. Quite a few of the correlations are significant beyond the .05 or .01 levels. Of the 77 correlations shown 29 are significant, 11 beyond the .05 level and 18 beyond the .01 level.*

2. But the results do not seem consistent from one examiner to another or for males and females. Examiner 1, 2, 3 and 4 yield, respectively, 6, 3, 1 and 5 significant correlations and these are not necessarily for the same pairs of variables.

3. In general, the correlations between the personality rigidity (as measured by the Gough-Sanford Rigidity Scale) and the analysis measures on the Doodlebug (the correlations between variable 2 and variables 3, 4 and 5) are lower than the correlations between the Doodlebug measures of analysis (variables 3, 4 and 5) and the Witkin Embedded-Figures Test (variable 38). Similarly, we note consistently low and generally nonsignificant correlations between Rigidity Scale scores

* Not all the intercorrelations among analysis measures are shown in Table 14. We do not show the intercorrelations among those measures on the Doodlebug Problem which are not independent; namely, variables 3, 4 and 5.

and the Embedded-Figures Test. It is difficult to ascertain whether the higher correlations are due to the intrinsically greater relationships among the cognitive variables or to communication effects on the individually-administered cognitive tests.

4. The correlations found for all men considered together (N = 517) and for all women considered together (N = 281) are generally low (though often significant) and the same is true for the correlations obtained for all subjects of both sexes considered as one sample (N = 798). These generally low correlations are in contrast to the many higher correlations found when they are calculated separately by sex and by examiner, confirming our suspicion that the data obtained for all the subjects cannot be treated as coming from one sample.

Table 15 shows the comparable set of intercorrelations by examiner and sex for the various measures which are assumed to measure synthesis. The following points should be especially noted:

1. As was the case with the analysis measures (see Table 14) we again note quite a few significant correlations among the various synthesis measures. A total of 37 out of 77 correlations are significant, 18 beyond the .05 level, and 19 beyond the .01 level.

2. We again note the presence of examiner and sex differences. Examiner 1's subjects show significant correlations between Dogmatism

TABLE 15

Correlations Among Various Measures of Synthesis

by Sex and Examiner

r between	Examiner 1 Men N=56	Examiner 1 Women 41	Examiner 2 Men 165	Examiner 2 Women 102	Examiner 3 Men 86	Examiner 3 Women 68	Examiner 4 Men 150	Examiner 4 Women 28	All Men 517	All Women 281	All Subjects 798
1,8	.33*	.14	.20**	.22*	.21*	.10	.01	.07	.10*	.12*	.09*
1,9	.27*	.11	.21**	.21*	.23*	.12	.00	.12	.10*	.13*	.09*
1,10	.31*	.11	.22**	.17	.21*	.07	-.01	.14	.10*	.11*	.08*
1,39	.07	.09	-.03	.12	-.02	.15	.04	-.06	.02	.10	-.01
8,39	.09	.28	.30**	.26**	.11	.17	.32**	.25	.24**	.21**	.25**
9,39	.08	.22	.29**	.22*	.10	.11	.35**	.31	.24**	.18**	.24**
10,39	.09	.25	.32**	.17	.08	.09	.35**	.32	.24**	.17**	.24**

Code: 1 = Dogmatism Scale
8 = Time taken to solve after 1st belief overcome (Doodlebug)
9 = Time taken to solve after 2nd belief overcome (Doodlebug)
10 = Time taken to solve after 3rd belief overcome (Doodlebug)
39 = Total score [illegible] Perceptual Synthesis Test

Levels of Significance: *$p < .05$
**$p < .01$

Scale scores and the Doodlebug measures of synthesis for men but not for women. This is also true for Examiner 3. But Examiner 2's subjects produce significant correlations for both men and women. And Examiner 4's subjects show no significant correlations involving the Dogmatism Scale for either sex.

3. The data clearly and consistently show, by sex and by examiner, no significant correlations between the Dogmatism Scale scores and the total score on the Perceptual Synthesis Test (between variables 1 and 39). These consistent findings are similar to the findings (Table 14) showing that Rigidity Scale scores are negligibly correlated with Embedded-Figures scores. Again, the interpretation of these findings is equivocal, due to possible communication effects on the cognitive variable but not on the personality variable.

4. Concerning the relationship between conceptual synthesis (variables 8, 9 and 10) and perceptual synthesis (variable 39) we again note examiner and sex differences. For Examiners 1 and 3 we find no significant relations either for men or women samples. For Examiners 2 and 4 we find significant or nearly significant relationships between conceptual and perceptual synthesis for both men and women subjects. Correlations between conceptual and perceptual synthesis are significant for all men, all women, and for the total sample. Again, it is difficult to decide whether these consistently significant relationships arise for substantive or for methodological reasons (communication effects).

5. The conclusion seems inescapable that for the Doodlebug Problem, correlational data are inconsistent from examiner to examiner and from male to female. However, for data not involving the Doodlebug Problem, consistency of results by sex and by examiner is the rule. The inference we draw from these findings is that the inconsistent results obtained for the Doodlebug Problem are a function of communication effects.

When the results of the two preceding tables are considered together (Tables 14 and 15) it is reasonable to conclude that the various measures of analysis seem to be significantly related to one another -- rigidity with conceptual analysis, conceptual analysis with perceptual analysis, but not rigidity with perceptual analysis. A parallel set of conclusions can be made with respect to the various synthesis measures: dogmatism is significantly related with conceptual synthesis, conceptual synthesis with perceptual synthesis, but not dogmatism with perceptual synthesis.

Let us now consider to what extent the various analysis measures are correlated with the various synthesis measures. Table 16 shows the correlations between rigidity and dogmatism, between conceptual analysis and conceptual synthesis, and between perceptual analysis and perceptual synthesis.

TABLE 16

Correlations Between Rigidity and Dogmatism, Between Conceptual Analysis and Conceptual Synthesis, and Between Perceptual Analysis and Synthesis by Examiner and Sex

r between	Examiner 1 Men N=56	Examiner 1 Women 41	Examiner 2 Men 165	Examiner 2 Women 102	Examiner 3 Men 86	Examiner 3 Women 68	Examiner 4 Men 150	Examiner 4 Women 28	All Men 517	All Women 281	All Subjects 798
1,2	.49**	.45**	.50**	.43**	.60**	.53**	.53**	.13	.53**	.42**	.49**
3,8	-.04	.27	.20**	.16	.06	.04	.24**	.01	.16**	.10	.14**
4,9	.15	.38*	.33**	.30**	.20	.16	.43**	.35	.31**	.23**	.28**
5,10	.20	.31*	.43**	.41**	.33**	.30*	.50**	.57**	.38**	.31**	.35**
38,39	.61**	.52**	.59**	.57**	.57**	.55**	.69**	.78**	.56**	.54**	.58**

Code:
1 = Dogmatism Scale
2 = Rigidity Scale
3 = Time taken to overcome one belief (Doodlebug)
4 = Time taken to overcome two beliefs (Doodlebug)
5 = Time taken to overcome three beliefs (Doodlebug)
8 = Time taken to solve after 1st belief overcome (Doodlebug)
9 = Time taken to solve after 2nd belief overcome (Doodlebug)
10 = Time taken to solve after 3rd belief overcome (Doodlebug)
38 = Witkin Embedded-Figures Test
39 = Perceptual Synthesis Test

Levels of Significance: * $p < .05$
** $p < .01$

Table 16 reveals the following:

1. Again, a substantial number of the correlations are significant, considerably more than was the case in considering the correlations among measures of analysis only (Table 14) or measures of synthesis only (Table 15). Forty-two of the 55 correlations shown are significant, three beyond the .05 level, and 39 beyond the .01 level.

2. Moreover, the correlations are generally higher than those shown in Tables 14 and 15.

3. The cross-correlations shown involve one measure of analysis and a second measure of synthesis, but the type of test is always the same. The correlation between 1 and 2 (rigidity and dogmatism) involve two verbal attitude scales of the Likert-type; the correlations between 3 and 8, between 4 and 9, and between 5 and 10, each represent independent measures of conceptual analysis and synthesis obtained from the Doodlebug Problem; the correlation between 38 and 39 involve two perceptual tests. It would appear that the consistently higher correlations shown in Table 16 as compared with those shown in Tables 14 and 15 are due to the fact that the pairs of tests being correlated represent a verbal factor, or a conceptual (reasoning) factor, or a perceptual factor. But note that the correlations between the cognitive tests are generally highest for Examiner 4 and lowest for Examiner 1.

The higher correlations may be due to higher communication effects for Examiner 4's subjects.

4. The reason we had developed three measures of analysis and three measures of synthesis was because we were not sure at exactly what point in the problem-solving process analysis ends and synthesis begins. Because we had no way of being sure we took all three possible measures of analysis and all three possible measures of synthesis. Table 16 reveals with only one exception, that measures 3 and 8 consistently correlate the least with one another, measures 4 and 9 consistently correlate higher with one another, and measures 5 and 10 consistently correlate highest with one another. This trend is evident in all comparisons except one (in the case of the female sample for Examiner 1 there is a slight reversal: 27, 38, 31).

The most likely explanation of the fact that the correlations between 5 and 10 are consistently higher than those between 4 and 9, which are in turn consistently higher than those between 3 and 8, is that variable 5 is the purest measure of analysis and variable 10 the purest measure of synthesis. In support of this interpretation is the finding, shown in Table 14, that variable 5 has generally higher correlations than variables 4 or 3 with other measures of analysis (variables 2 and 38). But we find no comparable evidence in Table 15, that variable 10 is a better measure of conceptual synthesis than variables 9 or 8; indeed, variables 8, 9 and 10 seem to correlate about equally well with other

measures of synthesis. Considering these findings all together and quite aside from the bearing these results may have on the analysis-synthesis hypothesis, it would seem that the best measures of analysis on the Doodlebug Problem is the time taken to overcome all three beliefs and the best measure of synthesis is the time taken to solve after all three beliefs had been overcome.

Shown next in Table 17 are the correlations among various measures of analysis and synthesis* (by examiner and sex) which cut across type of test (in contrast to Table 16 which shows only the analysis-synthesis correlations within test modalities). We note the following results:

1. Again, a large number of the correlations are statistically significant. Of 154 correlations shown, 63 are significant, 19 beyond the .05 level, and 44 beyond the .01 level. That so many of these analysis-synthesis correlations are significant again suggests that the various measures assumed to measure analysis and synthesis do not form distinct clusters, in the factorial sense of the term. Any test assumed to measure analysis seems just as apt to correlate significantly with a test assumed to measure synthesis as with another test of analysis.

*The reader should be reminded that variables 3 + 6, variables 4 + 9, and variables 5 + 10 equal the total time to solve the Doodlebug Problem. Variables 3 and 8, 4 and 9, and 5 and 10 are independent and represent different slices of the total time to solve composed of two periods. See Rokeach, 1960, Chapter 8, for a full discussion of the logic underlying these measures.

TABLE 17

Correlations Between Other Measures of Analysis and Synthesis by Examiner and Sex

r between	Examiner 1 Men N=56	Examiner 1 Women 41	Examiner 2 Men 165	Examiner 2 Women 102	Examiner 3 Men 86	Examiner 3 Women 68	Examiner 4 Men 150	Examiner 4 Women 28	All Men 517	All Women 281	All Subjects 798
1,3	.16	.09	.03	.00	-.01	.07	-.02	.15	.01	-.01	-.01
1,4	.38**	.22	.06	.07	.00	.06	.01	-.01	.05	.00	.02
1,5	.27*	.21	.07	.18	.08	.12	.02	-.06	.05	.06	.04
1,38	.12	.04	-.01	.09	.01	.12	.06	-.15	.05	.02	.00
2,8	.20	.02	.13	.14	.38**	.15	.22**	.25	.18**	.17**	.17**
2,9	.14	-.02	.17*	.15	.41**	.17	.18*	.31	.17**	.17**	.17**
2,10	.16	-.12	.20**	.12	.35**	.14	.17*	.31	.17**	.15**	.16**
2,39	.04	.05	.02	.03	-.08	-.11	.10	.08	.05	.01	.03
3,39	.27*	.09	.29**	.05	.15	-.04	.11	.47*	.21**	.06	.16**
4,39	.29*	.32*	.32**	.20*	.18	.07	.12	.37*	.24**	.15**	.20**
5,39	.23	.21	.29**	.31**	.19	.10	.16*	.37*	.23**	.18**	.22**
8,38	-.05	.38*	.19*	.29**	.07	.16	.31**	.41*	.25**	.35**	.31**
9,38	-.01	.36*	.21**	.30**	.07	.12	.32**	.46*	.25**	.35**	.31**
10,38	.01	.33*	.24**	.28**	.10	.11	.31**	.45*	.26**	.34**	.31**

Code:
1 = Dogmatism Scale
2 = Rigidity Scale
3 = Time taken to overcome one belief (Doodlebug)
4 = Time taken to overcome two beliefs (Doodlebug)
5 = Time taken to overcome three beliefs (Doodlebug)
8 = Time taken to solve after 1st belief overcome (Doodlebug)
9 = Time taken to solve after 2nd belief overcome (Doodlebug)
10 = Time taken to solve after 3rd belief overcome (Doodlebug)
38 = Witkin Embedded-Figures Test
39 = Perceptual Synthesis Test

Levels of Significance: * $p < .05$
** $p < .01$

2. We must again point to examiner differences in the correlations, so many such differences that we can point only to a few of them. For example, the significant correlations between dogmatism and conceptual analysis found for Examiner 1 are not found for the other examiners. Examiner 1 shows significant correlations between conceptual analysis and perceptual synthesis for both sexes. However, for this same examiner correlations between conceptual synthesis and perceptual analysis are insignificant for males and significant for females. Examiner 3 shows no significant correlations between conceptual synthesis and perceptual analysis, either for men or for women, while Examiners 2 and 4 show significant correlations for both men and women. Again, when Doodlebug measures are concerned, the picture is one of instability from examiner to examiner and from male to female subjects. Although the Doodlebug measures do indeed often correlate signifcantly with other variables, the picture is confused by the absence of consistency across examiner and sex.

3. When we look at the correlations which do not involve the Doodlebug Problem we note again a consistency across examiner and sex. The correlations between variables 1 and 38 (Dogmatism and Embedded-Figures) is consistently negligible and nonsignificant. The same is true for variables 2 and 39 (Rigidity and Perceptual Synthesis). These results are consistent with the findings noted earlier in Tables 14, 15 and 16.

Our main reason for presenting these data is to show that while we have found many significant and often sizeable correlations among the various personality and cognitive measures of analysis and synthesis, they are extremely difficult to interpret because of sex and examiner differences, because of communication effects, and further, because of the fact that the measures were obtained from different kinds of tests (verbal, conceptual and perceptual). The fact that we found these various effects unfortunately nullifies the great advantage we had hoped to gain from carrying out a large scale study on the ability to analyze and to synthesize with a relatively large number of subjects.

2. FACTOR ANALYTIC STUDIES

Despite the fact that many of the correlations among the various tests are statistically significant the results presented thus far do not (as we saw, for methodological reasons) lend support to the hypothesis that analysis and synthesis as defined and measured, represent independent variables. But because of the fact that so many of these correlations were, nevertheless, significant and also because the pattern of significant correlations seemed to change for male and female groups tested by different examiners, we deemed it desirable to carry out a number of factor analytic studies in the hope of ascertaining whether any portion of our total body of data supported the analysis-synthesis hypothesis, and to what extent there was consistency of factorial

structure underlying the tests. As before, we carried out separate analyses for the total sample (N = 798), for males only (N = 517), for females only (N = 281), and separately for the male and female subjects of the four main examiners, thus making 11 groups in all. Each of these analyses included the following variables:

1. Rigidity
2. Dogmatism
3. Time to overcome 3 beliefs
4. Time to solve after overcoming 3 beliefs
5. English Usage
6. Reading Comprehension
7. CQT Verbal
8. CQT Information
9. CQT Numerical
10. Embedded-Figures
11. Perceptual Synthesis

It will be noted that only two Doodlebug measures are included in these factor analyses -- time to overcome 3 beliefs (conceptual analysis) and time to solve after overcoming 3 beliefs (conceptual synthesis). These two measures were selected because they are independent and because they seemed to represent, on the basis of previous research and on the basis of the findings discussed in the preceding section, the best single measures of conceptual analysis and synthesis. Once we selected these

two Doodlebug measures we could not include in the factor analyses any other Doodlebug measures of analysis, or of synthesis, or the total time to solve because these measures are not independent of the two we selected.

On the Embedded-Figures Test and on the Perceptual Synthesis Test we considered the total time to solve as the best single measure of perceptual analysis or synthesis, and we excluded all item scores -- again because item scores are not independent of total test scores.

All these 11 analyses were rotated to a four-factor solution by:

a. Orthogonal factor analysis, which involves principle-axis factoring using Guttman communalities followed by Varimax rotation, and

b. Oblique factor analysis, using unity communalities followed by the Quartimax orthogonal rotation method, which is determined by the Wrigley direct method of oblique transformation.*

In addition, we analyzed the same data by the:

c. Guttman-Lingoes Smallest Space Analysis (SSA), using size of correlation as the measure of proximity (Lingoes, 1965).

* Personal communication.

The factor analyses were run on the Michigan State University CD-3600 Computer, employing programs developed by the Computer Institute for Social Science Research. The Smallest Space Analysis was run by the University of Michigan Computer Laboratory.

In sum then, we analyzed 11 correlation matrices (total group, males, females, and the male and female subjects of four examiners) by orthogonal factor analysis, by oblique factor analysis and by the Smallest Space Analysis, making a total of 33 analyses of 11 variables. The results are presented in Appendix B. Tables 1.1 through 11.1 show the 11 correlation matrices; Tables 1.2 through 11.2 show the Varimax rotated factor loadings; Tables 1.3 through 11.3 show the Quartimax factor loadings; and Tables 1.4 through 11.4 show the Guttman-Lingoes (Lingoes, 1965) Smallest Space Analysis solutions. The three types of analyses over the same set of data will be of interest not only because of the comparisons thus provided regarding the underlying structure of the tests, but will also be of interest to the student of factor analysis because they provide comparisons among three methods of ascertaining underlying structure.

An inspection of the 11 sets of orthogonal, oblique, and Smallest Space Analysis solutions shown in Appendix B reveals a remarkable consistency of results. Despite our earlier findings of examiner and sex differences, and of communication effects, the results obtained for all 11 samples of subjects show essentially similar factorial structures.

One factor is typically composed of English Usage, Reading Comprehension, CQT Verbal, CQT Information, and to a generally lesser extent, CQT Numerical. This factor may for descriptive purposes be called a general aptitude factor. A second factor typically consists of the Embedded-Figures Test and our modification of the Kohs Block Test -- the Perceptual Synthesis Test. The CQT Numerical is also typically loaded on this factor, but to a generally lesser extent than the two perceptual tests. It is clear that this factor is primarily a perceptual one. Factor 3 is typically highly loaded with the Gough-Sanford Rigidity Scale and with the Rokeach Dogmatism Scale, both of which are verbal-questionnaire type tests of personality. Finally, Factor 4 loads highest on the analysis and synthesis measures obtained from the Doodlebug Problem -- a problem-solving or conceptual factor.

Excluding from consideration the various aptitude tests which all load together on Factor 1, we obtain three factors as follows:

Factor 2	Factor 3	Factor 4
2a. Embedded-Figures	3a. Rigidity	4a. Conceptual Analysis
2b. Perceptual Synthesis	3b. Dogmatism	4b. Conceptual Synthesis

If our hypothesis regarding analysis and synthesis is a valid one, we would have expected to find that variables 2a, 3a, and 4a would emerge together as one factor, and variables 2b, 3b, and 4b would have emerged together as a second factor. We find no empirical evidence whatever in support of this hypothesis. Instead we find three factors, a perceptual

one, a verbal one, and a conceptual one, with each factor consisting of one assumed measure of analysis and one assumed measure of synthesis.

If we did not know about the communication effects on the cognitive tests, interpretation of the factor analytic and Smallest Space Analysis results, because they are all so remarkably consistent, would be relatively unambiguous. But in view of the findings suggesting a high probability of communication among the subjects, it is difficult to say whether the obtained factors are due to test modality or to communication effects which affect (or do not affect) in common the test scores within one modality, or both. The Dogmatism and Rigidity Scales are both verbal tests, and both were given in groups rather than individually. Thus, neither of these tests could have been affected by communication among the subjects. The analysis and synthesis scores obtained from the Doodlebug Problem are both conceptual measures, and both these measures were shown to be systematically and significantly related to order of testing. The analysis and synthesis scores obtained from the Embedded-Figures Test and the Modified Kohs Test are both perceptual measures, and while we did not find any relationship between these scores and order-of-testing, the possibility of communication among subjects cannot be ruled out, especially in view of the fact that these very same subjects probably communicated with one another about the Doodlebug Problem.

We are thus left with a large array of data, consistent for male and female, from one examiner to another, and from one method of assessing

factorial structure to another. These results are in line with the type of factors discovered by Thurstone (1938), but our analysis-synthesis hypothesis requires data which cut across these factors. It is possible that the factor analytic results would have been quite the same even if the subjects did not communicate with one another. But in view of the evidence suggesting that they did communicate with one another and in view of many findings obtained in a number of other investigations (to be considered shortly), we are extremely reluctant to conclude from the data thus far considered that the analysis-synthesis distinction is untenable. At the same time, the data presented herein provide no evidence whatever that the analysis-synthesis distinction is a tenable one.

3. ESSAY VERSUS OBJECTIVE TESTS AS MEASURES OF THE ABILITY TO ANALYZE AND TO SYNTHESIZE

It will be recalled that we had raised the question earlier whether essay-type and objective-type tests typically employed for examination purposes in academic contexts can be regarded as equivalent measures of academic performance. On the basis of psychological considerations one may conjecture that objective tests of the multiple-choice or true-false variety merely require the student to recognize the correct answer or the most correct answer when presented with a statement or with a set of stated alternatives, while essay-type tests require the student to produce two or more ideas in some integrated, organized, or synthesized

fashion relevant to a formulated examination question. It could thus be hypothesized that good performance on objective-type examinations requires an ability somewhat analogous to the ability to separate item from field, and should thus be significantly correlated with measures assumed to tap analytic ability. On the other hand, it could be hypothesized that essay-type examinations should be more highly related to measures of the ability to synthesize.

Working independently, Christensen (1963) has formulated an identical hypothesis. In a study of the relation between dogmatism and measures of classroom learning in an introductory psychology class, Christensen used essay and multiple-choice tests of the amount learned. "The use of two measures of classroom learning permits check on Rokeach's (1960) finding that the abilities to synthesize and analyze relate differentially to dogmatism. It is necessary, of course, to assume that the essay test was more a measure of ability to synthesize than the multiple-choice test" (p. 76). Christensen found a correlation of .66 for females and a correlation of .47 for males between essay and objective tests. But he found insignificant relationships between either type of test and dogmatism, on the basis of which he concluded: "There is no evidence that dogmatism is .... differentially related to abilities to synthesize and analyze" (p. 76).

A search of the literature* on essay and objective tests yielded a number of studies relevant to this issue. It should first be mentioned that objective tests have generally been found to be more reliable than essay tests. Of 15 studies located in the literature dealing with the relative reliability of essay versus objective tests, 11 of them report higher reliabilities for objective tests (Gates, 1921; Wood, 1924; Wood, 1925; Kinder, 1925; Paterson, 1926; Talbott and Ruch, 1929; Corey, 1930; Eurich, 1931; Sims, 1931; Sims, 1933; and Huddleston, 1954) three of them report approximately equal reliabilities for objective and essay tests covering the same material (Brinkley, 1924; Weaver and Traxler, 1931; and Weidemann and Newens, 1933), and only one study reports higher reliabilities for essay tests as compared with objective tests (Courtney, 1946).

Similarly, objective tests have generally been found to be more valid than essay tests. The external criteria vary from study to study and include one or more of the following measures: grades, intelligence, mental age, teacher's ratings, rating of homework, classroom test scores, and standardized scores on tests for such abilities as reading vocabulary and reading comprehension. Of 20 validity studies located in the literature 13 of them found higher validities for objective tests as compared with essay tests (Gates, 1921; Laird, 1923, McAfee, 1924; Kinder, 1925; Wood, 1925; Wood, 1925; Corey, 1930; Davis and Johnson, 1931; Eurich, 1931;

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* What follows is a highly condensed summary of a more detailed review of the literature on essay and objective tests carried out by Mary Berk (1966). The present authors wish to acknowledge their indebtedness to Mary Berk for her review of this literature.

Gilliland and Misbach, 1933; Courtney, 1946; Cowles and Hubbard, 1952; Huddleston, 1954), four studies report approximately equal validities (Wood, 1924; Brinkley, 1924; Peters and Martz, 1931; Courtney, 1946), and three studies report higher validities for essay than for objective tests (Knight, 1922; Crawford and Raynaldo, 1925; Watson and Crawford, 1930).

If objective tests are more reliable and valid than essay tests, why do educators persist in using essay tests? As long ago as 1930, Long argued for the advantages of the essay test: "It provides an opportunity for revealing reasoning procedures, initiative, originality, and ability in organization of material. This value has not been so evident in other types of tests" (1930, p. 66).

While many educators undoubtedly support this school of thought others would agree with Phillip Vernon:

> "The acquisition and reproduction of information always involves a certain amount of thinking, and no thinking is possible unless a person possesses information to think about. Hence, experiments in which attempts have been made to measure these faculties separately have usually shown them to be highly intercorrelated. It follows, therefore, that even when a new-type test is apparently measuring nothing but information, it is at the same time providing a pretty good measure of more complex types of ability" (1961, p. 224).

The journals and textbooks are full of arguments and studies supporting both sides of the issue. Evidence that essay and objective tests measure the same or similar mental functions come from studies of common variance. Paterson described the logic behind such studies as follows:

> "If the two types are measuring radically different mental functions ('reasoning as opposed to mere information') then their intercorrelations should be considerably lower than the reliability coefficients of either. (But) if the old type correlates as closely with the new type as it does with itself then the two are measuring the same mental functions" (1926, p. 247).

Using this method Courtney (1946), Cowles and Hubbard (1952), Davis and Johnson (1931), Eurich (1931), Huddleston (1954), Sims (1933), Weidemann and Newens (1933), and Wood (1925) all conclude from their findings that essay and objective tests measure different mental functions. Laird (1923) suggested that the objective test is more of an intelligence test while the essay is a better measure of actual achievement. Davis and Johnson's study (1931) seems to lend support to this argument.

But other studies would seem to suggest that essay and objective tests measure identical functions (Gates, 1921; Paterson, 1926; Corey, 1930; Sims, 1931; Weaver and Traxler, 1931). All these studies show that essay and objective tests correlate as highly with one another as their reliabilities would allow.

The old controversy, still unresolved, about whether objective and essay tests measure similar functions has been formulated in terms of whether objective tests measure the ability to memorize while essay tests measure the ability to reason. The present formulation re-casts the problem in terms of analysis versus synthesis rather than memory versus reasoning.

If good performance on objective tests requires more of the ability to analyze than to synthesize, and if good performance on essay tests requires more of the ability to synthesize than to analyze, then the two types of tests should be differentially related to our personality and cognitive measures of analysis and synthesis. To test this hypothesis, we selected 100 subjects who were enrolled in the Fall Quarter of 1961 in Natural Science 181, a University College course taken by all freshmen.*

During the quarter these 100 students took the following essay and objective examinations (consisting of multiple-choice and true-false items):

A. Objective examinations.

1. Objective examination 1
2. Objective examination 2
3. Objective examination 3
4. Objective examination 4 (Midterm)
5. Objective examination 5
6. Objective examination 6
7. Objective examination 7 (Final examination, constructed by Instructor)
8. Objective examination 8 (Final examination, constructed by Department of Evaluation Services)

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* Thirty-four of these 100 subjects were included in our original sample of 798 subjects. The 100 subjects were obtained from four sections taught by Dr. Marvin Solomon of the Natural Science Department, and we wish to acknowledge our indebtedness to Dr. Solomon for his cooperation.

B. Essay examinations.

1. Essay examination covering material included in Objective examinations 1 through 4.

2. Essay examination 2, covering material included in Objective examinations 5, 6 and 7.

Before presenting the data, a word of explanation is in order about the various tests. Objective examinations 1 through 7 were constructed by the instructor. Except for Objective examinations 4 and 7 which were one-hour examinations consisting of 100 multiple-choice questions, the remaining objective examinations were short "quizzes" composed of 25 to 75 questions. Final Objective examination 8 was constructed by the Department of Evaluation Services, which makes up and administers all final examinations in the University College of Michigan State University. It is taken in large auditoriums by several thousand students who are enrolled in the same University College course taught by many instructors in many sections. The time limit is two hours. The reliability of such Natural Science 181 objective examinations, as determined from final examinations given over several years is well over .90.

Essay examinations are typically not given in Natural Science 181. The two essays were given in the present study for purposes of comparison and correlation with the objective examinations and with the various psychological tests.

Essay Examinations 1 and 2 were each taken during a regularly scheduled 50-minute class hour. On Essay Examination 1 the subject answered question 1 and either question 2 or question 3. On Essay Examination 2 the subject answered question 1 and any two of the remaining three questions.

The three questions asked on Essay Examination 1 are:

1. Discuss the nature of explanatory systems by defining and describing the structure of a conceptual system utilizing at the least the following terms: postulate, primitive terms, defined terms, deduction, experimentation, concepts by imagination, concepts by perception. Where applicable utilize cell principle and/or gene theory as examples.

2. If sex makes for greater variation and increasing adaptability among offspring, describe how meiosis and fertilization facilitate this process.

3. Use the hormones of the menstrual cycle to illustrate a cyclic phenomenon. Start the cycle by referring to the follicle stimulating hormone.

The four questions asked on Essay Examination 2 are:

1. Define and describe the structure of a conceptual scheme (theory) utilizing at the least the following terms: primitive terms, defined terms, postulates, postulated or hypothetical entity. In answering this question utilize the gene theory as an example.

2. At first glance sex seems like an unnecessary complication in the process of reproduction. Why is this? What advantage(s) does it really have.

3. Compare and contrast the observed behavior of the chromosomes with the postulated behavior of the genes.

4. Explain why it was over 150 years from Hooke's observation of cells to Schwann's formulation of the Cell Principle.

Reliability of this test was determined by having two other instructors in Natural Science 181 (not including Dr. Marvin Solomon, the instructor of the 100 students in the present study) independently score the essay examinations on a 100-point scale. The correlation between Judges 1 and 2 was .89.

Table 18 shows the intercorrelations obtained among the various objective and essay examinations, and an inspection of the results shown reveals the following:

TABLE 18

Correlation Matrix of 11 Objective and

Essay Examinations in Natural Science 181

N = 100

	Test		Correlations									
		1	2	3	4	5	6	7	8	9	10	11
1.	Objective Exam 1		.49	.42	.44	.29	.45	.19	.51	.29	.25	.44
2.	Objective Exam 2			.41	.51	.47	.47	.15	.48	.33	.43	.56
3.	Objective Exam 3				.39	.30	.37	.43	.46	.25	.25	.43
4.	Objective Exam 4 (Midterm)					.37	.40	.39	.58	.41	.51	.60
5.	Objective Exam 5						.47	.35	.54	.23	.32	.44
6.	Objective Exam 6							.34	.52	.18	.31	.41
7.	Objective Exam 7 Final by Instructor								.76	.09	.25	.66
8.	Objective Exam 8 Final, University College									.34	.44	.66
9.	Essay Exam 1										.30	.67
10.	Essay Exam 2											.71
11.	Essay Exams 1 and 2											

Note: A correlation of .20 is significant, $p < .05$; a correlation of .25 is highly significant, $p < .01$.

1. The correlations in the matrix range from .09 to .76, all being positive. Fifty of the 55 correlations are significant, all but one beyond the .01 level.

2. Perhaps the most important finding is that there is a substantial correlation between Final Objective Test 8 and Essay Examinations 1 and 2 ($r = .66$). This correlation is only slightly smaller than that between the two Objective Finals ($r = .76$).

3. The correlations between the Final Objective Examination given by the University College (variable 8) and the other objective examinations (variables 1 to 7) are of about the same order of magnitude (mean $r = .55$) as the correlations between the Essay Exams 1 and 2 and the eight objective examinations (mean $r = .53$).

The data shown in Table 18 then, seem to suggest that objective and essay tests seem to be measuring the same components of ability; there is no evidence that objective tests are measuring the ability to analyze, and essay tests the ability to synthesize. In view of the relatively sizeable correlations found among the various objective and essay tests, it does not seem likel at the two types of tests would be differentially related to our various psychological measures of analysis and synthesis. The data showing the relationships between the objective and essay examinations on the one hand and the psychological tests on the other, are shown in Table 19. The following should be noted:

TABLE 19

Correlations Between Objective and Essay Final Examinations in Natural Science 181

and Various Psychological Tests

N = 100

Psychological Test	Objective Test 7 Final by Instructor	Objective Test 8 Final, University College	Essay Exams 1 and 2
1. Rigidity	-.22	-.24	-.20
2. Dogmatism	-.18	-.25	-.18
3. Time to overcome 3 beliefs	-.22	-.28	-.23
4. Time to solve after overcoming 3 beliefs	-.14	-.21	-.16
5. English Usage	.32	.26	.26
6. Reading Comprehension	.65	.67	.60
7. CQT Verbal	.55	.58	.41
8. CQT Information	.49	.53	.28
9. CQT Numerical	.36	.34	.21
10. Embedded-Figures	.01	-.09	.02
11. Perceptual Synthesis	-.12	-.21	.04

Note: A correlation of .20 is significant, $p < .05$, a correlation of .25 is highly significant, $p < .01$.

1. Performance on objective and essay examinations in Natural Science 181 correlates consistently highest with Reading Comprehension ($r = .60$ to $.67$); the correlations with Reading Comprehension are equally high for objective and essay examinations.

2. The CQT Tests -- Verbal, Information and Numerical -- all correlate moderately with the Natural Science 181 examination measures. But the CQT measures correlate more highly with the objective than with the essay examinations.

3. Both the Rigidity and Dogmatism Scales correlate significantly or nearly significantly with objective and essay examinations and to about the same extent, but to a considerably lesser extent than is the case for Reading Comprehension or the CQT measures.

4. The same is true for conceptual analysis and synthesis measures (variables 3 and 4), which correlate from -.14 to +.28 with the objective and essay tests. The conceptual analysis measure correlates somewhat higher than the conceptual synthesis measure with the objective and essay examinations, but not significantly so.

5. The only cognitive tests which do not seem to correlate significantly with the Natural Science 181 essay and objective tests are the Embedded-Figures and Perceptual Synthesis Tests.

The full correlation matrix of the 14 variables shown in Table 19 is presented in Table 12.1 of Appendix B. Orthogonal rotations (shown in Table 12.2 of Appendix B) yielded the following five factors:

Factor 1. The tests loading highest on this factor are the three Natural Science 181 essay and objective examinations. Also showing a high loading is Reading Comprehension, confirming our more informal analysis of the correlations shown in Table 19.

Factor 2. The tests loading highest are the two perceptual tests -- the Embedded-Figures and the Perceptual Synthesis Test. The CQT Numerical also shows a high loading on this factor. It is clearly the same factor we have noted before in Tables 1.1 to 11.4 (Appendix B). The only difference from earlier results is that the conceptual synthesis variable (time to solve after overcoming 3 beliefs) also loads moderately on this factor.

Factor 3. The Rigidity-Dogmatism factor, confirming earlier analyses.

Factor 4. The conceptual analysis and conceptual synthesis factor, confirming earlier analyses.

Factor 5. This is also the same factor noted earlier, consisting of English, Reading, and the three CQT measures -- Verbal, Information and Numerical. But it is noted that the two Natural Science 181 objective tests (but not the essay tests) also have moderate loadings on this factor.

The pattern of correlations found between the Natural Science examinations and the remaining variables, and the results of the factor analytic studies point clearly in the same direction; namely, that essay and objective examinations correlate relatively highly with one another, and are thus equally good tests of academic performance, showing similar patterns of relationships with other personality and cognitive variables. There is no evidence in any of the data presented to suggest that objective-type academic performance tests tap the ability to analyze while essay-type academic performance tests tap the ability to synthesize.*

* We also conducted factor analytic studies for the Natural Science sample of 100 by the oblique method and by the Smallest Space Analysis of Lingoes (1965). Additional analyses were done wherein the sample was broken down by sex (Males N = 51; Females N = 49) and by Examiner (Examiner 2, N = 30; Examiner 3, N = 29; Examiner 4, N = 41). Despite the small number of cases involved, the results are substantially the same as those discussed above, with only minor variations. For this reason they are not further discussed.

4. ANALYSIS, SYNTHESIS, AND ACADEMIC APTITUDE

To what extent are the various scores obtained from the various tests employed in the present research a function of or related to academic aptitude? In our earlier work (Rokeach, 1960) we have obtained a partial answer to this question by showing that Dogmatism Scale scores consistently correlate to a negligible extent with various tests of intelligence or academic aptitude. The results of the various factor analyses presented in the preceding section consistently show that various tests which can be assumed to measure academic aptitude; namely, the various College Qualification Tests -- Verbal, Information, Numerical -- virtually always load factorially together, along with Reading Comprehension and English Usage. Furthermore, the data consistently show that the personality and cognitive tests have negligible loadings on this general aptitude factor and instead load on other factors. The specific data are given in the various correlation matrices and factor loadings shown in Appendix B. But a more global picture of the relationship between academic aptitude and the various psychological tests is shown in Table 20.

TABLE 20

Correlations* Between CQT Total and Various Tests

Variable	Total Group N=798	Males N=517	Females N=281	Natural Science 181 N=100
Dogmatism	-.06	-.09	-.11	
Rigidity	-.18	-.22	-.12	
Time taken to overcome 3 beliefs	-.23	-.25	-.17	
Time taken to solve after all beliefs were overcome	-.28	.24	-.30	
Total time to solve Doodlebug Problem	-.31	-.29	-.31	
Embedded-Figures	-.34	-.31	-.31	
Modified Kohs	-.36	-.31	-.34	
Essay Exams 1 and 2				.39
Final Objective (by University College)				.62
Final Objective (by Teacher)				.47

* Note: Virtually all the correlations shown are statistically significant but it is more meaningful to pay attention to the size of the correlations.

It is seen that the Dogmatism Scale correlates close to zero with academic aptitude, as measured by the CQT Totel Test, that the Rigidity Scale correlates to a small extent (but still negligibly), that the cognitive tests correlate in the -.20's and low -.20's (despite communication effects among subjects) and that the essay and objective tests in Natural Science 181 correlate from about .40 to .60. These data are of course, consistent with those shown in Appendix B.

These findings are of primary interest here because they show that the various psychological tests are only moderately related to academic aptitude. Of even more interest is the fact that the two personality tests (rigidity and dogmatism) are negligibly related to academic aptitude and thus the correlations between these two tests and academic performance (to be considered in V.) will not need to be corrected (by partial correlation methods) by holding academic aptitude constant.

IV. A REVIEW OF THE LITERATURE ON THE ABILITY TO ANALYZE AND THE ABILITY TO SYNTHESIZE

As has been shown, the present data are methodologically not suitable for an evaluation of the hypothesis that analysis and synthesis are independent variables. Despite our best efforts, the data obtained from the individually-administered cognitive tests simply do not satisfy the assumption of independence of observations. And while many of the correlations involving these tests were found to be statistically significant, and produced stable factors, their interpretation is highly equivocal in view of the lack of independence of observations.

It should also be pointed out that a test of our major hypothesis necessarily involved a test of a number of sub-hypotheses. For example, with respect to the Dogmatism Scale: Those who score high on the Dogmatism Scale should differ significantly from those who score low on the synthesis measures obtained from the Doodlebug Problem and on the Perceptual Synthesis Test (the Modified Kohs Test), but high- and low-scorers on the Dogmatism Scale should not differ significantly on the analysis measures of the Doodlebug Problem or on the Witkin Embedded-Figures Test.

Similar sub-hypotheses could be constructed regarding high- and low-scorers on the Rigidity Scale, the Doodlebug Problem, the Embedded-

Figures Test, and the Perceptual Synthesis Test. We had hoped in the present study, to test all these sub-hypotheses together within the framework of a single research design but, as has been shown, a serious methodological flaw prevents an objective test of these various hypotheses.

Nevertheless, a number of studies have been reported within the past decade, some published and others as yet unpublished, some carried out at Michigan State University and others carried out elsewhere, which provide data relevant to one or more of the various sub-hypotheses. We propose now to review these studies in some detail in order to ascertain the extent to which they provide data supporting the hypothesis that analysis and synthesis represent more-or-less independent psychological variables.

1. <u>The Rokeach-Fruchter Factor Analyses (1956, 1958)</u>. The rotated factor loadings for dogmatism, rigidity and other variables were determined for two groups: a New York College sample of 207 (Rokeach and Fruchter, 1956) and a Michigan State University sample of 153 (Fruchter, Rokeach and Novak, 1958). These loadings are presented in Tables 20A and 20B.

As can be seen in Tables 20A and 20B in both studies, the Dogmatism Scale has high or moderate loadings on the first factor (anxiety), is independent of the second factor (liberalism-conservatism) and has a substantial loading on the third factor (rigidity-authoritarianism). In contrast, the Rigidity Scale has a negligible loading on the first factor,

a moderate loading on the second factor and its highest loading on the third factor (these trends are especially evident in Table 20B). The two variables are thus seen to be factorially discriminable from one another although by no means independent. The correlations between the dogmatism and rigidity variables are between .45 and .50.

TABLE 20.AB

Rotated Factor Loadings for Dogmatism and Related Concepts

A. New York Colleges Group (N = 207)*

	Variable	I	II	III	h^2
1.	Anxiety	.77	-.25	.27	.727
2.	Paranoia	.72	-.14	.26	.597
3.	Self-rejection	.69	-.29	.37	.698
4.	Dogmatism	.46	.21	.62	.637
5.	Authoritarianism (F Scale)	.27	.48	.66	.737
6.	Rigidity	.23	.32	.71	.652
7.	Ethnocentrism (E Scale)	.21	.59	.47	.614
8.	Conservatism (P.E.C.)	-.07	.69	.19	.523
9.	Left opinionation	.17	-.63	.26	.498
10.	Right opinionation	.03	.85	.19	.765

* From Rokeach and Fruchter (1956)

B. Michigan State University II Group (N = 153)*

	Variable	I	II	III	h^2
1.	Dogmatism	.68	.10	.48	.707
2.	F. Scale	.38	.37	.70	.771
3.	Anxiety	.72	.03	.27	.588
4.	Rigidity	.28	.32	.54	.472
5.	Ethnocentrism	.12	.53	.39	.446
6.	Political-economic Conservatism	.01	.44	.22	.245
7.	Intellectual rejection	.29	.49	.63	.717
8.	Intellectual acceptance	-.02	.60	.10	.373
9.	Opinionation	.35	.53	.13	.426
10.	Right-left score	.12	.61	11	.402

* From Fruchter, Rokeach and Novak (1958)

2. <u>The Rubenowitz (1963) Study</u>. Rubenowitz carried out a factor analysis of a battery of tests which included the Dogmatism and Rigidity Scales. The subjects were 172 psychology students in a Swedish university. Rubenowitz found that both the Dogmatism and Rigidity Scales loaded highly on Factor 1, as follows:

TABLE 21

Variable Loadings on Factor 1*

Variable	Loadings
1. F Scale	.67
2. Dogmatism Scale	.66
3. Opinionation Scale	.56
4. Gough-Sanford Rigidity Scale	.51
5. Socio-economic class	.46
6. Reported leniency of upbringing	.45
7. Conservatism-Liberalism	.38
8. Edwards Intellectual Flexibility (EPPS)	.36

* From Rubenowitz (1963), p. 172

Rubenowitz also reports, however, that the Rigidity Scale has a high loading on Factor 3, while the Dogmatism Scale has a low loading on Factor 3, as follows:

TABLE 22

Variable Loadings on Factor 3*

Variable	Loadings
1. EPPS Task Rigidity	.67
2. Study habits: Rigidity of time scheduling	.47
3. Study habits: General study and work attitude	.44
4. Study habits: Concentration	.41
5. Edwards Intellectu Flexibility (EPPS)	-.46
6. Gough-Sanford Rigidity Scale	-.59
7. Dogmatism Scale	-.13

* From Rubenowitz (1963), p. 172

The Rubenowitz results are consistent with the two factor analytic studies by Rokeach and Fruchter (1956) and by Fruchter, Rokeach and Novak (1958). All of these studies suggest that while the Dogmatism and

Rigidity Scales load together on one factor, they are nevertheless discriminable with respect to another factor, that is, while the two variables are substantially correlated, they nevertheless tap discriminably different dimensions.

In a second factor analysis with 242 army recruits, both the Dogmatism and Rigidity Scales had their highest loadings on Factor 1 (.44 and .50 respectively). The Dogmatism Scale loaded moderately (.33) on Factor 2 and the Rigidity Scale loaded negligibly (.12). And conversely, the Dogmatism Scale loaded negligibly on Factor 4 (.08) while the Rigidity Scale loaded moderately (.33). These findings, while less clear-cut than Rubenowitz's study with university students are nevertheless consistent with the factor analytic results already cited.

3. <u>The Wrightsman and Cook (1963) study</u>. These authors factor analyzed a battery of 73 variables, using 177 women subjects who were attending various colleges in Nashville, Tennessee. Consistent with the Rubenowitz study previously cited, Wrightsman and Cook found that both the Dogmatism and Gough-Sanford Rigidity Scales had their highest loadings on Factor 1. The results are shown in Table 23.

TABLE 23

Variable Loadings on Factor 1*

	Variable	Loadings
1.	Gough-Sanford Rigidity	.74
2.	Wesley Rigidity	.71
3.	Independence of Judgment on Welsh Art Judgment	-.59
4.	Rehfisch Rigidity	.52
5.	Rokeach Dogmatism	.51
6.	Barron Independence of Judgment	-.49
7.	Bass' Social Acquiescence	.47
8.	Guilt Subscale on Buss-Durkee Hostility	.40
9.	Anti-Civil Liberties Scale	.40
10.	Agreement with Consensus on Welsh Art Judgment	.35
11.	Chein's Approval of Middle Class Manners Scale	.31
12.	F Scale	.31

* From Wrightman and Cook (1964).

The Dogmatism Scale has a loading of .29 on Factor 6, a Sociability factor, and it has a loading of .31 on Factor 10, a Response Set factor. But the Gough-Sanford Rigidity Scale has negligible loadings on the other factors extracted (a total of 11). These results suggest that the two scales have loadings on only one major factor and do not seem to support the results of the factor-analytic studies already cited.

4. The Ehrlich-Bauer (1965) study. This study is concerned with the "psychiatric" correlates of dogmatism and rigidity. The subjects were 541 patients admitted to the Columbus Psychiatric Institute and Hospital (an adjunct of the Ohio State University Department of Psychiatry) during a seven-month period in 1961-62. All subjects filled out the Dogmatism and Rigidity Scales soon after admission and these scores were correlated with various other scores attempting to measure various facets of diagnosis, prognosis, treatment and outcome. The results are shown in Table 24.

The authors interpret these results as follows:

> "The results of this exploratory testing program indicate quite clearly that dogmatism in particular is a stable characteristic significantly associated with patient diagnosis, impairment, treatment, and outcome in psychiatric hospitalization. These results obtain independent of the socio-economic characteristics of the patients. Of the 14 psychiatric variables (in Table 24) patient dogmatism scores yield seven significant correlations. The high-dogmatic patients are more likely than the low-dogmatic patients to be diagnosed as functionally psychotic, as having a definite thinking

> disorder, and as having greater social and occupational impairment. Prognosis is poorer for the high-scoring patients and they are more frequently given drug therapy -- and more drugs. Finally, they are retained longer than the low-scoring patients. No significant associations appear with respect to anxiety, paranoid tendencies, ECT, final prognosis, or the degree of personality and symptomatic changes occurring.
>
> .....Patient flexibility (rigidity) scores appeared, in general, to follow the same pattern of relationships as their dogmatism scores but only three correlations achieved significance at or beyond the .05 level; diagnosis, work impairment and drug therapy." (ETC usage was judged a function of age specific diagnosis.)
>
> The combination of patient dogmatism and flexibility scores yield no major change over the original dogmatism correlations which suggested that they were tapping the same underlying dimension."

We have here then, a body of data which would suggest that although dogmatism scores generally correlate more highly than rigidity scores with the various psychiatric measures, the pattern of correlations with these psychiatric measures is similar. These results are at variance, of course, with the differential results obtained with the Dogmatism and Rigidity Scales by Rokeach and Fruchter (1956), by Fruchter, Rokeach and Novak (1958) and by Rubenowitz (1963) but, they are consistent with the results obtained by Wrightsman and Cook (1963).

TABLE 24

The Correlates of Dogmatism and Rigidity in Psychiatric Hospitalization****

Variable	Correlation with Dogmatism	Correlation with Rigidity
Diagnosis and Ratings of Pathology		
Primary Diagnosis (severity)	.29*	.26*
Thinking Disorder (severity)	.26*	.22
Work Impairment	.25*	.23*
Social Impairment	.28**	.15
Paranoid Tendencies	.18	.15
Anxiety Level	.16	.14
Prognosis, Treatment and Outcome		
Initial Prognosis	.30***	.13
Final Prognosis	.16	.16
ECT Usage	.16	.22*
Drug Usage	.28**	.29**
Length of Stay	.30***	.20
Personality Change	.19	.10
Symptomatic Change	.18	.02
Type of release	.12	.07

**** From Ehrlich and Bauer (1965)
*** $p < .001$
** $p < .01$
* $p < .05$

5. <u>The Rokeach, McGovney and Denny (1955) Study</u>. One hundred and nine subjects were given the Dogmatism and the Gough-Sanford Rigidity Scales. From this pool 60 subjects were selected so that 15 subjects were high on both variables, 15 subjects were high on Dogmatism and low on Rigidity, 15 were low on Dogmatism and high on Rigidity, and 15 were low on both variables. These subjects were tested with the Doodlebug Problem.

High- and low-rigid subjects (equated for dogmatism) were found to differ significantly from one another at the .05 level on two measures of analysis: number of beliefs overcome within first 10 minutes, and number of beliefs overcome within the first 15 minutes. But high- and low-dogmatic subjects (equated for rigidity) did not differ significantly on any of the analysis measures, but did differ significantly ($p < .05$) on one of three synthesis measures (time taken to solve problem after 2nd belief was overcome). High- and low-rigid subjects did not differ on any of the three synthesis measures.

6. <u>The Rokeach-Vidulich (1960) Study</u>. Thirty high- and 30 low-scoring subjects on the Dogmatism Scale were selected from a pool of 249 subjects and given the Doodlebug Problem. While there were no significant differences between the high- and low-dogmatic subjects on any of the analysis measures, there were significant differences between the two groups on all of the synthesis measures. There were many other findings in this study which were consistent with the above findings but which will not be cited here, since they are not directly germane to the present review of the analysis-synthesis literature.

7. The Rokeach, Oram, Laffey and Denny (1960) Study. In this study a number of hypotheses were tested which are not directly relevant to the present study, but in the course of testing these hypotheses, data were also obtained relevant to the analysis-synthesis hypothesis. Twenty high- and 20 low-dogmatic subjects were selected from a pool of 600 subjects who were tested with the same version of the Doodlebug Problem as that used in the present research (No Canopy Problem) and also with a somewhat different variation of the Doodlebug Problem called the Canopy Problem. The results showed that high- and low-dogmatic groups did not differ on any of the analysis measures on either of the two Doodlebug problems, but the two groups were found to be significantly different in synthesis, beyond the .05 level for the No Canopy Problem and nearly significant on the Canopy Problem.

8. The Rokeach, Swanson and Denny (1960) Study. To study the effects of past experience in determining when a system is psychologically new or not new, the Doodlebug Problem was converted into a chess-like game called the Chessboard Problem. It was assumed that for chess players the Chessboard Problem would not be psychologically new and hence, that they would more readily synthesize the materials into a problem solution than would nonchess players. The findings clearly confirmed this expectation. It was further hypothesized, on the basis of similar theoretical considerations, that high- and low-dogmatic chess players would not differ from one another in their solution of the Chessboard Problem, but that high- and low-dogmatic persons who do not play chess

would differ. Extremely high- and low-dogmatic subjects were drawn from a pool of 614 introductory psychology students at Michigan State University. There were no differences in solution time (which was equivalent in this instance to synthesis time because there were virtually no individual differences in time to analyze) between nine high- and nine low-dogmatic, chess-playing subjects. But a significant difference beyond the .01 level was found between 14 high- and 14 low-dogmatic subjects who did not play chess. The results are interpreted to mean that the differences in synthesis found between nonchess-playing, high- and low-dogmatic subjects is a function of differences in dogmatism and in past experience, which defines whether a given task is psychologically new or not new, The overall results are in good accord with theoretical expectations.

9. <u>The Fillenbaum-Jackman (1961) Study</u>. The subjects were 49 students selected from a larger pool of 73 students in a summer introductory psychology course at the University of North Carolina. Ten subjects with the highest dogmatism scores, 10 subjects with the lowest dogmatism scores, and 29 subjects with intermediate scores were selected for individual testing with the Doodlebug Problem.

The results found by Fillenbaum and Jackman for the two extreme groups (see Table 25) are clearly in line with theoretical predictions and with the results found in the various Doodlebug studies already cited. The difference between high- and low-dogmatic groups in total time to solve

TABLE 25

Time to Analyze, Synthesize, and Total Time to Solve the Doodlebug Problem by High- and Low-Dogmatic Subjects*

Variable		High Dogmatic Group N = 10	Low Dogmatic Group N = 10	Difference
Analysis:	Time taken to overcome all 3 beliefs	12.25	13.85	-1.60
Synthesis:	Time to solve after 3 beliefs were overcome	15.00	4.40	10.60
Total time to solve		27.25	18.25	9.00

* From Fillenbaum and Jackman (1961)

is statistically significant. This difference is, as can be seen in Table 25, clearly attributable to the differences in synthesis (which is statistically significant) and not to analysis, the latter difference being negligible and statistically not significant.

Furthermore, Fillenbaum and Jackman computed correlations over the whole range of scores on the Dogmatism Scale for all 49 subjects. The correlation between dogmatism and total time to solve the Doodlebug Problem was .37 ($p < .01$) and the correlation between dogmatism and synthesis time (time to solve after all three beliefs were overcome) was .41 ($p < .01$).

Finally, Fillenbaum and Jackman computed the correlations between dogmatism and the Doodlebug measures for the 29 subjects with middle scores on the Dogmatism Scale (that is, by excluding the 10 highest-scoring and the 10 lowest-scoring subjects). The correlation between dogmatism and total time was .25, and between dogmatism and synthesis was .20. "When these coefficients were corrected for curtailment in variability on dogmatism, they took values of .44 and .37 respectively, very close to those obtained when the full sample of 49 subjects was used. Consequently, there is some evidence that the correlation between dogmatism and performance on the Doodlebug Problem while by no means very high, does hold over the range of dogmatism values." (1961, p. 213)

10. The Vidulich (1961) Study. From a pool of 287 introductory psychology students at Louisana State University, 60 subjects were selected: 15 extremely high in dogmatism and in rigidity; 15 extremely high in dogmatism and extremely low in rigidity; 15 extremely high in rigidity and extremely low in dogmatism; and 15 extremely low in both dogmatism and rigidity. This study was a replication of the Rokeach, McGovney and Denny (1955) Study, but with two major variations from the original design: (1) unlike the original study which had a 30-minute time limit, no time limits of any kind were imposed, and (2) no hints of any kind were given to the subject, in contrast to the hints given at specified intervals in the original study.

On three measures of analysis (the number of beliefs overcome in first 15 minutes, the time taken to overcome the first belief, and the time taken to overcome all three beliefs) the high-rigid group differed significantly from the low-rigid group (both groups being equated on dogmatism). But high- and low-dogmatic groups (equated for rigidity) did not differ significantly from one another on the analysis measures. These findings are in accord with theoretical expectations and confirm the earlier findings by Rokeach, McGovney and Denny (1955).

None of the synthesis measures significantly differentiated between high- and low-rigid groups or between high- and low-dogmatic groups. That the synthesis measures did not turn out to significantly differentiate either group from the other was probably due to the fact that there was no time

limit on the problem, thus increasing the variance to such an extent (roughly twice the variance found in the Rokeach, McGovney and Denny Study) that significant differences were extremely difficult to obtain.

11. The Beech (1964) Study. The Rigidity and Dogmatism Scales were administered to 341 students at Michigan State University. The 20 subjects scoring highest and the 20 subjects scoring lowest on the Dogmatism Scale were tested on the Doodlebug Problem, thus providing comparisions of conceptual analysis and synthesis. Each group was further subdivided into two groups of 10 each on the basis of their scores on the Gough-Sanford Rigidity Scale. These subjects were also tested with Johnson's tests of deduction and induction, on the assumption that deduction involves primarily the ability to analyze, and induction, the ability to synthesize.

Beech's findings with respect to analysis and synthesis on the Doodlebug Problem are shown in Table 26.

TABLE 26

Mean Time to Analyze, Synthesize and Total Time to Solve the Doodlebug Problem by High- and Low-Rigid, and High- and Low-Dogmatic Subjects*

Variable	Rigidity			Dogmatism		
	High	Low	Difference	High	Low	Difference
Analysis						
1. Time to overcome 1 belief	9.80	7.43	2.32	9.12	8.17	.95
2. Time to overcome 2 beliefs	15.88	10.92	4.96***	14.00	12.80	1.20
3. Time to overcome 3 beliefs	23.41	18.92	4.49**	22.42	19.91	2.51
Synthesis						
4. Time to solve after 1st belief overcome	20.53	19.84	.69	25.10	15.27	9.83***
5. Time to solve after 2 beliefs were overcome	14.45	16.40	-1.95	20.22	10.63	9.59***
6. Time to solve after 3 beliefs were overcome	6.92	8.40	-1.48	11.80	3.53	8.27***
7. Total time to solve	30.33	27.32		34.21	23.43	

* From Beech (1964)
** $p < .025$
*** $p < .01$

As can be seen from Table 26, Beech found that rigidity was a significant source of variance on the time taken to overcome two beliefs and time taken to overcome three beliefs. He also found a significant difference between high- and low-rigid groups on the number of beliefs overcome by the subject in the first 15 minutes in solving the Doodlebug Problem. But dogmatism was not a significant source of variation on any of the analysis measures. These results are in close accord with theoretical expectations.

Beech found further that dogmatism was and rigidity was not a significant source of variance on the time taken to solve after the first belief was overcome, the time taken to solve after the second belief was overcome, and the time taken to solve after the third belief was overcome.

On various measures of Johnson's induction test, Beech found that low-dogmatic subjects scored significantly higher than high-dogmatic subjects, while high- and low-rigid subjects did not differ in this respect. These results are again in accord with theoretical predictions. But Beech further found that neither rigidity nor dogmatism was a significant source of variance on Johnson's test of deduction. The absence of differences in deduction is not in accord with theoretical predictions.

When Beech's data are considered as a whole, they provide us with perhaps the best confirmation to date of the hypothesized relation between rigidity and dogmatism on one hand, and conceptual analysis and synthesis on the other.

However, one methodological weakness in Beech's study should be mentioned here. Beech did not equate his high- and low-dogmatism groups for rigidity, nor did he equate high- and low-rigidity groups for dogmatism. Since we have repeatedly found significant correlations between rigidity and dogmatism, it seems highly likely that the high- and low-rigidity groups differed in dogmatism as well as in rigidity and conversely, that the high- and low-dogmatism groups differed in rigidity as well as dogmatism. What Beech did instead was to initially select the subjects who were extremely high and extremely low in dogmatism and then form subgroups of high- and low-rigidity within each dogmatism group which were then combined into high- and low-rigidity groups.

This methodological weakness, however, should serve to make it all the more difficult (and all the more unlikely) to confirm the analysis-synthesis hypothesis. In spite of this fact, the Beech study provides us with strong confirmation of our earlier findings.

12. The Conway (1963) Study. The subjects in this study were drawn from an original pool of 742 students enrolled in sophomore education courses (required of all students in the teacher-education sequence) at the State University of Albany in 1962-63. All these students took the Dogmatism Scale in group sessions. Experimental groups were then selected from among those scoring +1 or -1 standard deviation from the group mean on the Dogmatism Scale. Each group was composed of four subjects and three types of groups were studied, half of whom were all male and the other

half all female: (a) four-person groups all of whom scored extremely high on the Dogmatism Scale (b) four-person groups all of whom scored extremely low on the Dogmatism Scale and (c) four-person groups half of whom scored extremely high and half scoring extremely low on the Dogmatism Scale. In this way 24, four-person groups were formed, 12 all-male and 12 all-female groups, one-third all scoring high in dogmatism, one-third all scoring low, and the remaining third mixed (two high and two low in dogmatism).

The four-person groups were given the Doodlebug Problem which had a 40-minute time limit. No hints were given. The purpose of the study was to determine the relative effectiveness of group problem-solving, particularly on the analysis and synthesis phases of problem-solving, as a function of the personality structure of the group members. Conway found that the open and closed four-man (and four-woman) groups differed significantly from one another on total time to solve the Doodlebug Problem, the mixed-groups' results falling inbetween. This difference was clearly attributable to differences in synthesis, the open groups being significantly different from the closed groups on all three measures of synthesis (time taken to solve the problem after the first belief, after the second belief, and after all three beliefs were overcome). Again, the mixed groups' results fell inbetween. But the three types of groups did not differ significantly from one another on the analysis measures (time taken to overcome one belief, or two beliefs, or all three beliefs).

These results are in complete accord with theoretical expectations and with previous findings, suggesting that the results found earlier in individual problem-solving tasks can be extended to group problem-solving tasks as well.

But it is to be noted, the hypotheses tested by Conway concern only theoretically-expected differences between groups high and low in dogmatism; namely, expected differences in synthesis, and no expected differences in analysis. Conway's research was not concerned with the rigidity variable.

13. The Hoppe (1962) Study. The purpose of this research was to determine the facilitative or interfering effect of group versus individual performance on analysis, synthesis and on total problem-solving behavior. Comparisions were made between individuals, groups of two, and groups of three in their ability to solve the Doodlebug Problem. There were 40 subjects who were tested individually, 34 subjects who were tested in 17 groups of two, and 51 subjects who were tested in 17 groups of three. Predictions were made on the basis of the Lorge-Solomon model which predicts the probability of improvement in problem-solving as a function of group size, by chance alone. Improvement in groups is expected on no other ground than that as more individuals are added to a group there is an increasing probability that one or more members of the group will come up with one or more aspects of the solution.

> "The results showed groups of three to be superior to individuals and groups of two in analysis, synthesis and solving of the problem. Groups of two were not significantly different from individuals. The Lorge-Solomon model considerably over-predicted the performance of groups of two in analysis, synthesis and solution of the Doodlebug Problem. This indicates the presence of interference in groups of this size. The predictions of the performance of groups of three was accurate except for the synthesis phase of problem solving. In this phase groups of three performed more poorly than predicted by the Lorge-Solomon model suggesting interference....
>
> The strong interference present in groups of two seemed to be due to one person, regardless of his problem-solving ability, dominating the solution to the problem." (Hoppe, 1962, p. 2)

The main bearing which these results have on the analysis-synthesis issue under consideration is that in groups of three there is group interference on synthesis but not on analysis. Hoppe has thus isolated a variable -- group size -- which seems to have a differential effect on analysis and on synthesis, thus suggesting that the two processes are empirically found to behave differentially as a function of group size.

14. The Levy-Rokeach (1960) Study of Perceptual Analysis and Perceptual Synthesis. The subjects, 17 extremely high scorers and 16 extremely low scorers on the Dogmatism Scale, selected from a pool of 400 subjects at Michigan State University were individually tested with a short form of the Witkin Embedded-Figures Test and the Modified Kohs Test (the same tests as those employed herein). No differences between high- and low-dogmatic subjects were found with respect to the Embedded-Figures Test,

but significant differences were found on the Modified Kohs Test (Perceptual Synthesis Test).

15. The Huberman (1961) Study. This study is based on 17 subjects scoring extremely high, 17 subjects scoring in the middle, and 17 subjects scoring extremely low on the Dogmatism Scale. The 51 subjects were drawn from a larger pool of 187 students at the University of British Columbia. The subjects were individually tested with the Witkin Embedded-Figures Test and a four-item Perceptual Synthesis Test. Huberman found the following:

a. In support of our earlier findings, significant differences were found between high- and low-dogmatic subjects on the Perceptual Synthesis Test.

b. Contrary to our earlier and present findings to the effect that there are no differences between high- and low-dogmatic subjects on the Witkin Embedded-Figures Test, this study also yielded significant differences between high- and low-dogmatic subjects on the Perceptual Analysis Test -- the Embedded-Figures Test.

c. Middle scorers on the Dogmatism Scale behaved in general, in a manner which was similar to the high scorers on the Dogmatism Scale.

In short, the Dogmatism Scale correlated significantly not only with perceptual synthesis (in accord with our hypothesis) but also with perceptual analysis (not in accord with our hypothesis). Since Huberman did not include the Rigidity Scale in his study, no information is available on the relationships between this variable and perceptual analysis and synthesis.

16. The Coppinger, Bortner and Saucer (1963) Study. In a factor analytic study of deficit behavior, the authors factor analyzed 42 variables which included the Dogmatism Scale and the Gottschaldt Embedded-Figures Test employed by Witkin. While neither of these two variables loaded highly on any of the nine factors extracted by oblique rotation, these two variables nevertheless had their highest loadings on the first factor, as shown in Table 27.

TABLE 27

Variables Having Factor Loadings on the First Factor*

Variable	Factor Loading
Total Beta	.768
Beta - Test 2	.751
Beta - Test 6	.747
Beta - Test 5	.689
Beta - Test 4	.631
Ohio Literacy	.511
Bender Mental Health	.360
Gottschaldt	.330
Beta - Test 1	.327
Famous Sayings - Conventional Mores	.303
Dogmatism	-.280

* From Coppinger, Bortner, and Saucer (1961)

The authors label this a "Direction Following Intelligence" factor and while the Dogmatism and Gottschaldt have very small loadings on this factor, the fact remains that these loadings are the highest found for these two variables on any of the nine factors extracted. These data then, provide at least weak support for the hypothesis that the Dogmatism and Embedded-Figures Test seem to be testing something in common, and thus seem to disconfirm our hypothesis that they do not share anything in common.

17. <u>The Goodman (1955) Study</u>. Beverly Goodman gave the Embedded-Figures Test to a group of college students who also solved the water jar Einstellung Problems (Luchins, 1942; Rokeach, 1948). Two measures of performance were employed, one measuring the degree of susceptibility to establish a set or Einstellung, the other reflecting the degree of ability to overcome an established set. The first measure did not correlate significantly with the Embedded-Figures Test, but the second measure -- capacity to overcome set -- correlated .65 with the Embedded-Figures Test.

These results are, of course, consistent with the present hypothesis; namely, that there should be a significant relation between perceptual analysis, assumed to be measured by the Embedded-Figures Test, and conceptual analysis, assumed in this case to be measured by the Luchins Einstellung Test.

18. The McCaulley (1964) Study. In a large scale study, Mary H. McCaulley gave a large number of tests to 152 male and 199 female undergraduate students in introductory psychology at a large urban university. Among the many tests administered were the Dogmatism Scale and the Thurstone-Jeffery Concealed-Figures Test, a test highly similar to Witkin's Embedded-Figures Test, which is assumed to measure perceptual analysis. The correlation between Dogmatism and Concealed Figures is .00 for women and -.01 for men. These results are consistent with theoretical predictions.

19. The Hallkamp-Marr (1965) Study. To study the relationship between dogmatism and field-dependency, the authors gave the Dogmatism Scale and the Rod and Frame Test to 38 male Catholics. The correlation between the two tests was .09. "This finding is consistent with Levy and Rokeach's results..." and "...support Rokeach's position that field-dependency and dogmatism are actually emphasizing two distinct aspects of perception. Whereas field-dependency assesses the ability to separate the item from the field (perceptual analysis), dogmatism instead emphasizes the ability to build up or integrate the items into a new field (perceptual synthesis)." (1965, p. 1047)

We have reviewed above all the studies (19 of them) we have been able to locate which are relevant to the analysis-synthesis hypothesis. Not

included are the research findings of the present study. Table 28 summarizes the main findings of these studies with respect to the following four subhypotheses:

A1. Low-rigid subjects will perform better on analysis than high-rigid subjects, but

2. there will be no differences between high- and low-rigid subjects on synthesis.

B1. Low-dogmatic subjects will perform better on synthesis than high-dogmatic subjects, but

2. there will be no differences between high- and low-dogmatic subjects on analysis.

TABLE 28

Summary of 19 Studies Bearing on the Analysis-Synthesis Hypothesis

Study	Rigidity: Hyp. A1: Analysis	Rigidity: Hyp. A2: Synthesis	Dogmatism: Hyp. B1: Analysis	Dogmatism: Hyp. B2: Synthesis	Comments
1. Rokeach-Fruchter factor analyses	not tested	not tested	not tested	not tested	Both factor analyses show that while dogmatism and rigidity are significantly correlated, they are nevertheless factorially discriminable.
2. Rubenowitz factor analyses	not tested	not tested	not tested	not tested	Both factor analyses clearly show that the Dogmatism and Rigidity Scales are significantly correlated. At least one of these analyses shows that the two variables are nevertheless factorially discriminable.
3. Wrightsman-Cook factor analysis	not tested	not tested	not tested	not tested	Dogmatism and rigidity emerge together on Factor 1. The two variables are to a small extent factorially discriminable in that dogmatism has small loadings on two factors while rigidity has negligible loadings on all factors. But support for hypothesis is weak.

Table 28 -- continued

	Study	Rigidity		Dogmatism		Comments
		Hyp. A1: Analysis	Hyp. A2: Synthesis	Hyp. B1: Analysis	Hyp. B2: Synthesis	
4.	Ehrlich-Bauer study	not tested	not tested	not tested	not tested	Both dogmatism and rigidity show similar patterns of correlations with various psychiatric variables. But dogmatism has significant correlations with more of the variables than does rigidity.
5.	Rokeach, McGovney and Denny study (Doodlebug study)	+	+	+	+	The rigidity groups are equated for dogmatism; the dogmatism groups are equated for rigidity.
6	Rokeach-Vidulich study (Doodlebug study)	not tested	not tested	+	+	High- and low-dogmatic groups were not equated for rigidity.
7.	Rokeach, Oram, Laffey and Denny study (Doodlebug study)	not tested	not tested	+	+	High- and low-dogmatic groups were not equated for rigidity.
8.	Rokeach, Swanson and Denny study (Doodlebug study)	not tested	not tested	not tested	+	High- and low-dogmatic subjects not equated for rigidity.

Table 28 -- continued

Study	Rigidity: Hyp. A1: Analysis	Rigidity: Hyp. A2: Synthesis	Dogmatism: Hyp. B1: Analysis	Dogmatism: Hyp. B2: Synthesis	Comments
9. Fillenbaum-Jackman study (Doodlebug study)	not tested	not tested	+	+	High- and low-dogmatic subjects not equated for rigidity.
10. Vidulich study (Doodlebug study)	+	+	+	-	The fact that no time limit was imposed on problems enormously increased the variance on the synthesis measures and this may account for lack of support of Hyp. B2.
11. Beech study a. (Doodlebug study)	+	+	+	+	High- and low-dogmatic groups were each further subdivided into high- and low-rigid groups. Thus extreme groups formed on each variable only partially equated on the other variable.
b. Induction-Deduction study with Johnson apparatus	-	+	+	+	
12. Conway study (Group study with Doodlebug)	not tested	not tested	+	+	High- and low-dogmatic subjects not equated for rigidity.

Table 28 -- continued

Study	Rigidity: Hyp. A1: Analysis	Rigidity: Hyp. A2: Synthesis	Dogmatism: Hyp. B1: Analysis	Dogmatism: Hyp. B2: Synthesis	Comments
13. Hoppe study (Groups 1, 2 and 3 on Doodlebug)	not tested	not tested	not tested	not tested	Group size shows differential effects on analysis and synthesis, thus suggesting they might be different processes.
14. Levy, Rokeach study (Perceptual analysis and synthesis)	not tested	not tested	+	+	High- and low-dogmatic subjects not equated for rigidity.
15. Huberman study (Perceptual analysis and synthesis)	not tested	not tested	-	+	a. High- and low-dogmatic subjects not equated for rigidity. b. High- and low-dogmatic subjects differ significantly on Embedded-Figures Test, thus failing to support Hyp. B1.
16. Coppinger, Bortner and Saucer study (Perceptual analysis)	not tested	not tested	-	not tested	The fact that the Dogmatism and Embedded-Figures Test load together on one factor is inconsistent with Hyp. B1.

Table 28 -- continued

	Study	Rigidity		Dogmatism		Comments
		Hyp. A1: Analysis	Hyp. A2: Synthesis	Hyp. B1: Analysis	Hyp. B2: Synthesis	
17.	Goodman study (Perceptual analysis and Einstellung)	not tested	not tested	not tested	not tested	The fact that there is a significant relation between Embedded-Figures and Einstellung suggests that the ability to analyze is a general characteristic of the person.
18.	McCaulley study (Perceptual analysis)	not tested	not tested	+	not tested	The fact that there is no correlation between Hidden Figures Test and Dogmatism is consistent with Hyp. B1.
19.	Hellkamp-Marr study (Perceptual analysis)	not tested	not tested	+	not tested	The fact that there is no correlation between the Rod and Frame Test and Dogmatism is consistent with Hyp. B1.

Let us try to carefully evaluate the bearing of the 19 studies described in Table 28 on the analysis-synthesis hypothesis.

1. Of a total of 32 separate tests of one or more of the four hypotheses, 28 of them support the hypotheses and only four fail to support the hypotheses. On the Doodlebug Problem the ratio is 20:1; on the perceptual tasks, the ratio is 5:2; and on the induction-deduction task the ratio is 3:1.

2. Studies 1, 2 and 3 involve five factor analyses in which the Rigidity and Dogmatism Scales are represented in a battery of tests. All five factor analyses show that rigidity and dogmatism are positively correlated and load together on a common factor. But at least three of these five analyses also show that these two variables load differentially on other factors: the two variables are factorially discriminable.

3. Study 4 (the Ehrlich-Bauer Study) shows that both rigidity and dogmatism correlate significantly with various psychiatric measures and that the pattern of correlations between these psychiatric measures is essentially the same with rigidity and dogmatism. At the same time the data show that dogmatism generally correlates higher and more significantly than does rigidity with these psychiatric measures. This suggests either that the Dogmatism Scale is simply a more valid test of whatever it is the Rigidity Scale is testing, or that the Dogmatism Scale is tapping

something over and above whatever is being tapped by the Rigidity Scale. It is difficult to say from the data at hand which is the more likely alternative.

4. Studies 5 through 12 (a total of eight studies) are directly concerned with the analysis-synthesis hypothesis, in whole or in part, in relation to problem-solving, and more specifically in relation to solving the Doodlebug Problem.

a. Studies 5, 10 and 11 were designed to test all four subhypotheses: that persons high and low in rigidity will differ in analysis (Hypothesis A1) but not in synthesis (Hypothesis A2); that persons high and low in dogmatism will not differ in analysis (Hypothesis B1) but will differ in synthesis (Hypothesis B2). In Studies 5 and 10, high- and low-rigid groups are initially equated for dogmatism, and conversely, high- and low-dogmatic groups are initially equated for rigidity. In Study 11, extremely high- and low-dogmatism groups are simply further subdivided in terms of high- and low-rigidity, but the high-dogmatic group cannot be said to be equated on rigidity with the low-dogmatic group, or vice-versa.

With respect to performance on the Doodlebug Problem, Study 5 (Rokeach, McGovney and Denny) and Study 11 (Beech) test all four subhypotheses and the results support all four. With

respect to Study 10 (Vidulich) the results support Hypotheses A1, A2 and B1, but not B2. The latter can readily be accounted for (and thus discounted) on the ground that there was no time limit imposed on the subjects and thus that the expected differences in synthesis did not emerge because the variance was enormously increased.

Attention should further be drawn to Beech's findings (Study 11) that high- and low-dogmatic subjects are significantly different, but high- and low-rigid subjects are not significantly different on an inductive reasoning task, which is again in accord with theoretical expectations. But there are no significant differences in a deductive reasoning task either between high- and low-dogmatic groups (theoretically expected) or between high- and low-rigid groups (not theoretically expected). Thus, on the Johnson tests Beech found support for three out of the four analysis-synthesis hypotheses. When these are considered in relation to Beech's Doodlebug findings, there is support for seven out of eight hypotheses.

b. Studies 6, 7, 8, 9 and 12 (five studies) all have in common the fact that they test for differences between high- and low-dogmatic subjects on conceptual analysis and synthesis, and are not concerned with the hypothesized differences between high- and low-rigidity. The results of all these studies without exception, are consistent with theoretical predictions.

It is also of interest to note that two of these studies (the Fillenbaum-Jackman study and the Conway study) were conducted by investigators in other universities. Both these studies are in good agreement with studies done by Rokeach and collaborators at Michigan State University.

When Studies 5 through 12 are considered all together we find that all of them test Hypotheses B1 and B2 (with the exception of Study 8 which tests only B2). All but one of these studies (Study 10) provide data supporting Hypotheses B1 and B2. The number of studies which test Hypotheses A1 and A2 are considerably less (only Studies 5, 10 and 11 do so) and even though the findings of these studies generally favor Hypotheses A1 and A2 we cannot consider these Hypotheses as firmly established as Hypotheses B1 and B2.

But a question may be raised about these generally positive findings with respect to Hypotheses B1 and B2. Since most of the studies cited involve comparisons between high- and low-dogmatic subjects who were not equated for rigidity, and since we repeatedly found significant correlations between rigidity and dogmatism, we could reasonably expect to find that high- and low-dogmatic groups would not only differ in synthesis but also in analysis. A closer inspection of the data from these various studies shows that high- and low-dogmatic groups do

consistently differ in analysis, but the differences are generally small and are statistically not significant.

5. Study 13 also involves the Doodlebug Problem but does not involve a direct test of the four subhypotheses under consideration. In this study the question being asked is whether differential effects on analysis and synthesis can be observed as a function of certain independent variables. Differential effects are indeed found: In groups composed of three individuals, Hoppe finds a significant interfering effect on synthesis but not on analysis of problem-solving. This finding then suggests that it is fruitful to consider analysis and synthesis as discriminable processes and that certain independent variables can produce differential effects on analysis and synthesis.

6. Studies 14 and 15 are the only two studies which have tested the hypothesized differences between high- and low-dogmatic subjects with respect to perceptual analysis and perceptual synthesis. Both these studies are in agreement with respect to perceptual synthesis: high- and low-dogmatic subjects differ significantly on the Perceptual Synthesis Test. But the two studies are contradictory with respect to differences between high- and low-dogmatic subjects on the Embedded-Figures Test. Study 14 reports no significant differences as theoretically expected. Study 15 reports significant differences against theoretical expectations, and so does Study 16 which shows the Dogmatism and Concealed-Figures Test loading together on one factor.

Study 17 suggests that perceptual analysis as measured by the Embedded-Figures Test, is significantly related to the ability to break a conceptual set as measured by the Luchins water-jar technique. Studies 18 and 19 show no significant relationships as expected between the Dogmatism Scale and the Concealed-Figures Test, thus supporting the Levy-Rokeach Study (Study 14) and contradicting the Huberman (Study 15), and Coppinger, Bortner and Saucer Studies (Study 16).

When all the above studies are considered together we are forced to the following conclusions:

a. The presence of significant differences between high- and low-dogmatic subjects with respect to conceptual synthesis, and the absence of significant differences between high- and low-dogmatic subjects with respect to conceptual analysis has been replicated many times, both at Michigan State University and elsewhere. These findings may thus be considered as being well-established.

b. The presence of significant differences between high- and low-rigid subjects with respect to conceptual analysis and not with respect to conceptual synthesis has also been confirmed in three studies, two conducted at Michigan State University and one elsewhere. These findings may therefore, also be considered as well-established.

c. No such consensus is found with respect to the measures of perceptual analysis and synthesis. While significant differences have indeed been found between dogmatism and rigidity on the one hand and measures of perceptual analysis and synthesis on the other, they do not consistently conform to theoretical expectations.

d. We thus conclude that the available data clearly support the hypothesis that Rigidity and Dogmatism Scale scores are systematically but differentially related to measures of conceptual analysis and synthesis as measured by the Doodlebug Problem. But the available data have not firmly established comparable relations between personality and perceptual measures of analysis and synthesis.

V. NON-INTELLECTIVE AND INTELLECTIVE CORRELATES OF ACADEMIC SUCCESS

It is reasonable to suppose that psychologically valid tests of the ability to analyze and the ability to synthesize would have important practical applications to the field of education, particularly in predicting academic success and failure in general and in predicting differential success and failure in various curricula which might require different degrees of the ability to analyze and to synthesize.

While the research data presented in earlier sections of this report fail to provide evidence for the hypothesis that analysis and synthesis represent discriminably different abilities, we have seen that there is considerable support for this hypothesis in the various studies reviewed in the preceding chapter. It seems reasonably clear from these studies that the Dogmatism and Rigidity Scales, while positively correlated, are factorially distinct, are differentially related to conceptual analysis and synthesis as measured by the Doodlebug Problem, and are differentially related to inductive reasoning. It is also clear that these relationships cannot be accounted for as arising from differences in intelligence or general aptitude because the Dogmatism Scale is found to correlate close to zero with such measures, and the Rigidity Scale, while significantly related to such measures, is correlated with them only to a very small extent.

We will now turn to consider to what extent the ability to analyze and to synthesize as operationally measured by our personality and cognitive tests are related to various indices of academic performance. Since the individually-administered Doodlebug tests of analysis and synthesis were found to be methodologically suspect, we will consider here the results obtained for the group-administered Rigidity and Dogmatism Scales as measures of personality analysis and synthesis, and the individually-administered Witkin and Modified Kohs Tests as measures of perceptual analysis and synthesis.

But before presenting these results, let us first review what is already known about various intellective and nonintellective correlates of academic success and more specifically, about the relationship between the particular psychological tests we have here employed, and academic success. Our task of reviewing the literature has been made considerably easier by virtue of the fact that David E. Lavin has in the past year published his - The Prediction of Academic Performance (1965) - which includes a comprehensive review of research findings in this area. Most relevant here is his Chapter 4 on - "Intellective Factors as Predictors" - and his Chapter 5 on - "Personality Factors as Predictors."

In summarizing the results of various studies on the relation between intellective tests and academic success at the college level, Lavin writes that the correlations - "average about .50 with a range of about .30 to .70... Some studies use one of the standard intelligence tests, other use tests intended

specifically as predictors of school performance such as the Scholastic Aptitude Test developed by Educational Testing Service" (1965, p. 51).

As for the relation between various personality (nonintellective) tests and academic achievement Lavin concludes that - "Many of the relationships.... are tenuous at best, and it is undoubtedly true that the state of knowledge regarding the relation between personality variables and achievement is still so tentative that it cannot be used confidently for practical purposes, such as college admissions" (1945, p. 101). "In most cases these relationships are quite weak, and.... the findings are often inconsistent. Essentially, we think that the literature presents a somewhat disappointing picture. Yet we do not conclude that personality variables are simply not very useful as predictors. The current disappointing state of affairs may be more a reflection upon how personality variables have been used rather than upon their absolute usefulness" (1965, p. 111).

A number of studies have been reported on the relation between Dogmatism Scale scores and academic success. Since the Dogmatism Scale is a personality test we would not expect it, in the light of the research findings reviewed by Lavin, to correlate consistently or markedly with academic success. The earliest studies on this issue are those by Ehrlich (1961a, 1961b) who reported correlations between the Dogmatism Scale and an introductory sociology test composed of 40 true-false items wherein half the items tested for empirical generalizations and the other

half tested for an understanding of definitions. The sociology test was given at Time 1, the first week of the academic quarter; at Time 2, 10 weeks later during the last week of the academic quarter; at Time 3, five months later; and at Time 4, five years later. Ehrlich reported correlations between Dogmatism Scale scores and the sociology test at Times 1, 2, 3 and 4 to be, respectively -.30 (N = 100), -.52 (N = 100), -.54 (N = 57) and -.43 (N = 65). All these correlations are statistically significant. When academic aptitude as measured by the Ohio State Psychological Examination was held constant, these correlations remain essentially the same (r = -.24, -.48, -.49 and -.44, respectively). Moreover, Ehrlich found the correlation between dogmatism and sociology test grades was greater than the correlation between academic aptitude and the sociology test. Ehrlich concluded from these data that -- "the basic hypothesis that dogmatism would be inversely related to the degree of learning in a classroom situation, and that such a relationship would be independent of academic aptitude have been confirmed" (1961b, p. 286). Low-dogmatic subjects would thus seem to know more to begin with, learn more, and remember more of what they learn than high-dogmatic subjects.

Another study yielding positive findings is that of Frumkin (1961) who gave the Dogmatism Scale to 135 students in his sociology class. He then compared the 17 highest and 17 lowest scorers on the term sociology grade. The former mean was 168 and the latter mean 187, the difference being significant beyond the .01 level. Discussing this finding, Frumkin

concluded: "it often becomes the primary task of the sociology instructor to help the student to unlearn these myths which dominate his conception of human nature so that he might be free to gain objective knowledge about man's behavior and nature. Very ethnocentric, biased, dogmatic individuals generally have a difficult time doing well in sociology courses." (1961, pp. 400-401).

The preceding two studies both involve sociology courses. Three other studies involve psychology courses. In an unpublished study at Michigan State University, we have found a correlation of -.35 between Dogmatism Scale scores and scores on a final multiple-choice examination in introductory psychology with 76 subjects. This correlation is significant beyond the .01 level.

Christensen (1963) however, obtained negative results. Using 177 female and 49 male subjects at the University of Alberta, he found nonsignificant correlations between dogmatism, essay and multiple-choice tests measuring the learning of introductory psychology at the end of the term, the correlations ranging from -.11 to +.16. Costin (1966) in an attempt to resolve the contradictory findings of Ehrlich and Christensen, gave a 75-item, multiple-choice psychology test at the beginning and end of the semester to 67 subjects (27 men, 40 women) taking an introductory psychology course. Like Ehrlich, Costin's examination covered basic concepts, definitions, principles and applications of principles in various areas of introductory psychology. Like Christensen, Costin found no

significant relation between dogmatism and test score. Both studies, however, found no significant relation between dogmatism and scholastic aptitude as measured by the American Council on Educ. cion Test and by the College Ability Test (SCAT). It should be noted however, that Costin did find small negative correlations of -.23 with the precourse test and -.19 with the postcourse test, these correlations not being statistically significant. When scholastic ability was held constant these correlations drop to -.21 and -.15.

It is thus seen that the evidence is contradictory. Two studies involving sociology and one study involving psychology yield positive findings. Two other studies involving psychology yield negative findings.

Research by Lehmann and Dressel (1962) and by Lehmann and Ikenberry (1959) provide us with additional information regarding the relationships between measures of dogmatism and performance in various academic courses. Their findings will be discussed in more detail when we present the comparable data from the present research.

Our aim in the present study was to assess more systematically the relation between personality, and perceptual tests of analysis and synthesis and academic success and failure. More specifically, we were interested in determining the differential predictive power of our various tests of analysis and synthesis for students of varying academic interests with respect to success in specific college courses and with respect to various

overall measures of academic success and failure. The 798 students were classified at the time they left Michigan State University, either as a result of graduation or drop-out prior to graduation, into the following categories: those majoring in (1) humanities, (2) social science, (3) business, (4) engineering, (5) natural science and (6) education.*

For each of these six groups, which were further subdivided by sex, we calculated product-moment correlations between our four psychological measures (Rigidity, Dogmatism, Embedded-Figures, and Modified Kohs) and various indices of academic performance -- terms in school, grade point average in major, overall grade point average, and grades in many specific courses. We selected for special consideration specific courses in various subject matters in which we had at least an N of 20. For comparison purposes we also calculated the correlation coefficients between various measures of aptitude (CQT, English Usage and Reading Comprehension) and academic performance measures. The specific measures of academic performance are as follows:**

* Forty-eight of the 798 students dropped out of school before declaring their major. These subjects are not included among these six categories.

** Descriptions of the course content of specific courses are presented in Appendix C.

1. Terms in school
2. Grade Point Average in major
3. Overall Grade Point Average
4. American Thought and Language 111
5. American Thought and Language 112
6. American Thought and Language 113
7. Natural Science 181
8. Natural Science 182
9. Natural Science 183
10. Social Science 231
11. Social Science 232
12. Social Science 233
13. Humanities 241
14. Humanities 242
15. Humanities 243
16. Chemistry 111
17. Chemistry 112
18. Chemistry 113
19. Economics 200
20. English 206
21. English 207
22. English 208
23. History 222
24. History 223
25. History 224
26. Mathematics 111
27. Mathematics 112
28. Mathematics 113
29. Philosophy 137
30. Political Science 200
31. Political Science 201
32. Psychology 151
33. Psychology 225
34. Sociology 241
35. Sociology 251
36. Statistics 121

Two major and general hypothesis tested in the present research are that if analysis and synthesis are indeed discriminably different abilities – (1) they should be significantly related to various specific and global measures of academic success and (2) they should be differentially related to various specific measures of academic success.

Before presenting the data relevant to these hypothesis let us first see if our six curriculum groups differ with respect to rigidity, dogmatism, Embedded-Figures and Modified Kohs. The results are shown in Table 29 and it should first be noted that the usual sex differences are apparent: males score consistently higher than females on the Dogmatism Scale; males score consistently lower than females (and are thus superior to females) on the Embedded-Figures and Modified Kohs Tests.

TABLE 29

Means and Standard Deviations on Various Analysis and Synthesis Measures for Total Group, for Males and Females, and for Males and Females Majoring in Various Curricula

Major	Sex	N	Personality				Perceptual			
			Rigidity		Dogmatism		Analysis		Synthesis	
			M	S.D.	M	S.D.	M	S.D.	M	S.D.
Humanities	M	37	96.68	14.34	158.30	23.87	10.10	5.32	14.95	6.67
	F	48	95.63	12.74	150.10	24.06	12.23	7.11	18.47	5.85
Social Science	M	84	95.77	13.07	164.85	25.32	10.73	7.48	14.11	5.36
	F	55	96.51	14.09	156.36	25.20	15.02	9.84	20.49	6.68
Business	M	175	98.41	13.85	165.30	23.02	10.56	6.70	15.31	6.46
	F	12	95.92	8.25	156.75	23.60	13.86	8.87	20.00	6.20
Engineering	M	52	98.48	12.97	162.73	23.18	7.65	4.01	11.43	4.56
	F	---	---	---	---	---	---	---	---	---
Natural Science	M	88	97.63	12.80	164.86	23.93	8.30	4.91	12.33	5.00
	F	23	99.00	16.16	153.48	20.66	11.12	6.43	15.57	5.45
Education	M	53	97.75	12.18	164.83	22.62	10.61	10.18	14.43	5.91
	F	123	97.89	13.85	157.07	23.56	12.55	7.20	17.70	5.29
No Preference	M	28	99.11	15.60	161.54	27.32	9.25	7.71	13.11	5.19
	F	20	98.10	12.70	161.95	24.71	12.98	7.72	18.91	7.82

As for differences among curricular majors, analysis of variance tests reveal no significant differences among these groups on rigidity, or on dogmatism for either sex. Nor are the perceptual analysis results for females significant. But the perceptual analysis results for males are significant beyond the .05 level ($F = 2.34$ with 6 and 510 degrees of freedom), the perceptual synthesis results for males are significant beyond the .01 level ($F = 4.77$ with 6 and 510 degrees of freedom), and the perceptual synthesis results for females are significant beyond the .025 level ($F = 2.96$ with 5 and 275 degrees of freedom).

More specifically, we find that with respect to the Embedded-Figures Test male Engineers are most superior and male Social Science and Education majors are most inferior; with respect to the Modified Kohs, male Engineers are once again most superior but male Business majors most inferior. Comparing females on the Modified Kohs we note that it is the female Natural Science majors who are best and the female Social Science majors who are worst.

When all the results shown in Table 29 are considered it is evident that while some of the differences among curricular groups are significant, they are generally small in magnitude and not consistent from one variable to the other.

The main results bearing on the relation between academic performance, analysis and synthesis, and academic ability are shown in Tables 30 to 43, and we now turn to a detailed consideration of these results.

An inspection of the overall results for the total group of subjects shows that the correlations between the various measures of academic performance and the personality and cognitive tests of analysis and synthesis are generally low. The range of correlations between the 36 measures of academic performance (which includes global measures as well as measures obtained from specific courses) and rigidity is +.12 to -.19; between academic performance and dogmatism is +.10 to -.24; between academic performance and the Embedded-Figures Test is +.19 to -.33; and between academic performance and the Modified Kohs is +.19 to -.39. Relatively few of these correlations are statistically significant (10, 13, 12 and 11, respectively, out of the 36 correlations are significant beyond the .05 level).

Most relevant to our hypothesis is the finding that the correlations between academic performance and rigidity are on the whole, similar to those between academic performance and dogmatism. A similar statement can be made with respect to the measures of perceptual analysis and synthesis. There seems to be no differential pattern of findings with respect to analysis and synthesis, the magnitude of the correlations with academic performance being approximately the same with our measures of analysis and synthesis.

In contrast to the generally low correlations between academic performance and our psychological tests, the correlations between academic performance and the various measures of academic aptitude (CQT, CQT-Verbal, CQT-Information, CQT-Numerical, English, and Reading Comprehension) are generally much higher, and most of these are statistically significant. (Similar results will be evident in all the other breakdowns shown in the succeeding tables, by sex, and by major and sex.) To be noted especially are the generally consistent correlations between the various ability tests and the 12 University College courses (American Thought and Language, Social Science, Natural Science, and Humanities), which are virtually all significant beyond the .01 level.

It should be noted further that while our psychological tests correlate between -.05 and -.15 with the global measures of academic performance (G.P.A. in Major and overall G.P.A.), they correlate between .14 and .44 with the various academic ability tests.

Similar patterns of findings are observed for the males and females (Tables 31 and 32). For males, the correlations between the psychological tests and the global measures of academic performance range between -.04 and -.16 while those between the academic ability tests and the global measures range between .15 and .45; for females, the former set of correlations range between .00 and -.27 while the latter set of correlations range between .26 and .48.

TABLE 30

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability for All Subjects

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	798	.01	-.01	-.05	-.08*	.20**	.11**	.20**	.17**	.12**	.13**
G.P.A. in Major	656	-.05	-.13**	-.13**	-.08*	.27**	.26**	.20**	.14**	.33**	.28**
G.P.A.	795	-.13**	-.10*	-.15**	-.09*	.42**	.39**	.33**	.24**	.44**	.41**
ATL 111	766	-.14**	-.16**	-.11**	-.08*	.49**	.56**	.36**	.17**	.51**	.55**
ATL 112	739	-.11**	-.12**	-.10*	-.05	.45**	.53**	.33**	.15**	.44**	.48**
ATL 113	697	-.15**	-.17**	-.05	-.02	.37**	.52**	.25**	.04	.44**	.45**
NS 181	741	-.11**	-.12**	-.24**	-.24**	.52**	.36**	.45**	.40**	.42**	.47**
NS 182	707	-.09*	-.09*	-.23**	-.23**	.48**	.36**	.42**	.34**	.29**	.37**
NS 183	639	-.06	-.09*	-.33**	-.39**	.52**	.19**	.47**	.59**	.23**	.34**
SS 231	658	-.12**	-.12**	-.04	-.04	.43**	.41**	.35**	.22**	.35**	.43**
SS 232	613	-.09*	-.04	-.05	-.12**	.47**	.40**	.38**	.29**	.27**	.41**
SS 233	573	-.10*	-.05	-.03	-.08	.43**	.37**	.38**	.22**	.28**	.39**
Hum 241	639	-.07	-.06	-.05	-.03	.34**	.36**	.28**	.12**	.28**	.38**
Hum 242	595	-.07	-.03	-.03	-.05	.38**	.42**	.33**	.09*	.29**	.38**
Hum 243	570	-.05	-.07	-.01	.01	.38**	.43**	.31**	.10*	.32**	.43**
Chemistry 111	213	-.07	-.13	-.24**	-.17*	.37**	.25**	.33**	.38**	.35**	.27**
Chemistry 112	159	.12	-.05	-.22**	-.14	.32**	.19*	.39**	.26**	.26**	.20*
Chemistry 113	65	.04	.00	.19	.05	.15	.06	.19	.15	.13	.13
Economics 200	315	-.03	-.13*	-.13*	-.16**	.37**	.24**	.27**	.36**	.36**	.33**
English 206	111	.01	.06	-.08	-.06	.26**	.21*	.20*	.21*	.19*	.10
English 207	91	.01	.03	.00	.16	.12	.17	.03	.07	.11	.18
English 208	88	-.18	-.01	-.03	.19	.16	.12	.02	.10	.21*	.24*
History 222	146	-.02	.11	.00	-.10	.35**	.21**	.32**	.29**	.08	.13
History 223	123	-.01	-.03	-.02	-.12	.28**	.21*	.29**	.17*	.15	.20*
History 224	111	.03	-.04	-.01	-.05	.33**	.13	.38**	.31**	.06	.15

Table 30 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Mathematics 111	147	-.09	-.14	.00	.08	.21**	.14	.14	.31**	.20*	.11
Mathematics 112	137	-.10	-.16	-.14	-.08	.37**	.32**	.29**	.36**	.32**	.27**
Mathematics 113	98	-.15	-.05	-.02	-.01	.30**	.26**	.24*	.23*	.15	.10
Philosophy 137	122	-.14	-.10	-.06	-.04	.27**	.17*	.10	.29**	.37**	.11
Pol. Science 200	73	-.04	.10	-.01	-.10	.20	.39**	.08	-.05	.08	.28*
Pol. Science 201	33	-.18	.07	-.19	-.18	.26	.23	.21	.18	.18	.26
Psychology 151	442	-.09*	-.09*	-.16**	-.12**	.42**	.31**	.36**	.29**	.28**	.36**
Psychology 225	159	-.14	-.17*	-.17*	-.15	.45**	.29**	.42**	.38**	.37**	.34**
Sociology 241	182	-.01	-.16*	.00	.00	.13*	.23**	.07	-.03	.31**	.26**
Sociology 251	119	.07	.03	-.04	-.08	.24*	.15	.25**	.15	.14	.30**
Statistics 121	30	-.19	-.24	-.17	-.10	.15	.10	.12	.14	.16	-.07

* p<.05
** p<.01

TABLE 31

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability for All Males

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	517	.01	-.02	-.03	-.04	.17**	.12**	.15**	.14**	.17**	.15**
G.P.A. in Major	418	-.04	-.16**	-.11*	-.10*	.27**	.23**	.25**	.15**	.29**	.26**
G.P.A.	515	-.13**	-.16**	-.13**	-.12**	.45**	.39**	.38**	.30**	.43**	.43**
ATL 111	496	-.15**	-.15**	-.10*	-.12**	.57**	.57**	.46**	.30**	.49**	.55**
ATL 112	473	-.10*	-.10*	-.11*	-.08	.50**	.55**	.37**	.22**	.43**	.47**
ATL 113	440	-.13**	-.14**	-.08	-.05	.46**	.50**	.38**	.16**	.40**	.45**
NS 181	469	-.13**	-.15**	-.24**	-.24**	.56**	.40**	.51**	.44**	.47**	.48**
NS 182	440	-.12*	-.12*	-.19**	-.19**	.49**	.42**	.42**	.32**	.30**	.38**
NS 183	399	-.06	-.17**	-.30**	-.31**	.52**	.29**	.42**	.57**	.35**	.39**
SS 231	425	-.15**	-.15**	-.04	-.08	.47**	.40**	.43**	.29**	.34**	.42**
SS 232	392	-.10*	-.06	.00	-.06	.48**	.43**	.39**	.29**	.27**	.43**
SS 233	372	-.05	-.06	-.02	-.08	.41**	.37**	.38**	.21**	.31**	.41**
Hum 241	409	-.09	-.11*	-.04	-.04	.36**	.38**	.31**	.13**	.28**	.38**
Hum 242	384	-.11*	-.11*	-.06	-.06	.37**	.42**	.32**	.08	.27**	.38**
Hum 243	364	-.04	-.10*	.01	.01	.37**	.43**	.30**	.09	.27**	.41**
Chemistry 111	212	-.07	-.13	-.24**	-.17*	.37**	.25**	.33**	.39**	.35**	.27**
Chemistry 112	158	.12	-.05	-.22**	-.14	.32**	.19*	.39**	.26**	.26**	.20*
Chemistry 113	65	.04	.00	.19	.05	.15	.06	.19	.15	.13	.13
Economics 200	276	-.06	-.17**	-.11*	-.11*	.35**	.25**	.25**	.34**	.43**	.36**
English 206	30	-.08	-.04	-.24	-.11	.24	.26	.14	.15	.12	.14
English 207	21	.27	-.06	-.07	.18	-.09	-.01	-.04	-.21	-.14	-.07
History 222	68	-.21	-.14	.03	-.03	.42**	.34**	.43**	.24*	.09	.32**

Table 31 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
History 223	57	-.07	.03	-.03	-.08	.16	.15	.28*	-.01	.09	.22
History 224	54	-.12	-.32*	.09	.17	.27*	.19	.37**	.12	.05	.15
Mathematics 111	146	-.08	-.14	.00	.07	.22**	.15	.16*	.31**	.21**	.12
Mathematics 112	136	-.10	-.15	-.14	-.08	.38**	.33**	.31**	.36**	.32**	.27**
Mathematics 113	98	-.15	-.05	-.02	-.01	.30**	.26**	.24*	.23*	.15	.10
Philosophy 137	55	-.03	-.10	.13	.08	.24	.31*	.13	.07	.42**	.10
Pol. Science 200	47	-.04	.06	-.07	.07	.21	.48**	.00	.07	.09	.39**
Pol. Science 201	23	-.39	-.11	-.15	.04	.21	.25	.25	-.03	-.01	.20
Psychology 151	286	-.13*	-.10	-.16**	-.13*	.37**	.31**	.33**	.25**	.35**	.36**
Psychology 225	76	-.25*	-.19	-.07	-.20	.51**	.46**	.44**	.38**	.48**	.47**
Sociology 241	121	.00	-.10	.00	.07	.05	.09	.06	-.06	.19*	.19*
Sociology 251	58	.02	.06	-.02	.02	.29*	.24	.27*	.20	.07	.35**
Statistics 121	29	-.19	-.28	-.17	-.10	.18	.12	.13	.16	.18	-.05

* p<.05
** p<.01

It is appropriate now to compare the correlations obtained here between the Dogmatism Scale scores and the 12 University College courses with those reported by Lehmann and Ikenberry (1959) and by Lehmann and Dressel (1963). It is seen from Table 33 that all but two of the correlations are negative (the higher the Dogmatism score, the lower the academic grade). The correlations obtained in the two studies seem highly similar even though those obtained in the present study are consistently slightly smaller.

TABLE 32

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability for All Females

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	281	.00	-.03	-.07	-.12*	.25**	.12*	.29**	.22**	.09	.11
G.P.A. in Major	238	-.05	.00	-.23**	-.16*	.37**	.27**	.26**	.33**	.37**	.31**
G.P.A.	280	-.01	.00	-.27**	-.19**	.48**	.36**	.41**	.39**	.41**	.37**
ATL 111	270	-.14*	-.11	-.26**	-.21**	.51**	.51**	.44**	.25**	.50**	.54**
ATL 112	266	-.13*	-.10	-.17**	-.16**	.51**	.47**	.45**	.27**	.43**	.47**
ATL 113	257	-.19**	-.15**	-.16*	-.13*	.47**	.47**	.38**	.25**	.40**	.45**
NS 181	272	-.06	-.09	-.25**	-.27**	.46**	.32**	.39**	.39**	.42**	.47**
NS 182	267	-.05	-.05	-.29**	-.29**	.47**	.30**	.43**	.40**	.32**	.35**
NS 183	240	-.05	-.10	-.29**	-.37**	.46**	.21**	.40**	.43**	.33**	.37**
SS 231	233	-.07	-.02	-.12	-.09	.49**	.40**	.41**	.36**	.32**	.43**
SS 232	221	-.06	-.03	-.13	-.21**	.47**	.40**	.38**	.32**	.32**	.38**
SS 233	201	-.19**	-.03	-.04	-.10	.48**	.37**	.43**	.33**	.25**	.35**
Hum 241	230	-.02	.08	-.11	-.07	.37**	.30**	.35**	.23**	.25**	.37**
Hum 242	211	.00	.14*	-.04	-.11	.47**	.39**	.48**	.24**	.29**	.37**
Hum 243	206	-.05	-.04	-.10	-.10	.50**	.42**	.47**	.28**	.36**	.44**
Economics 200	39	.18	.07	-.13	-.34*	.43**	.31	.35*	.36*	.20	.21
English 206	81	.03	.06	-.02	-.01	.25*	.20	.18	.20	.25*	.08
English 207	70	-.06	.07	.00	.13	.21	.22	.08	.21	.18	.28*
English 208	69	-.22	.06	-.12	.13	.25*	.28*	.09	.21	.13	.28*
History 222	78	.15	.20	.03	-.11	.29**	.19	.21	.27*	.18	-.01
History 223	66	.03	-.07	-.01	-.18	.38**	.25*	.32**	.35**	.20	.18
History 224	57	.21	.19	-.08	-.27*	.38**	.10	.39**	.47**	.10	.19

Table 32 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Philosophy 137	67	-.2[illegible]	-.13	-.22	-.07	.27*	.10	.01	.43**	.45**	.20
Pol. Science 200	26	-.02	.25	.16	-.47*	.23	.24	.25	.02	.05	.00
Psychology 151	156	-.02	-.09	-.14	-.07	.50**	.36**	.43**	.39**	.20*	.39**
Psychology 225	83	-.07	-.20	-.22*	-.08	.38**	.14	.39**	.36**	.33**	.20
Sociology 241	61	-.05	-.17	-.07	-.30*	.30*	.36**	.16	.18	.40**	.31*
Sociology 251	61	.11	.02	-.04	-.11	.14	.09	.18	.05	.29*	.26*

* $p<.05$
** $p<.01$

TABLE 33

Correlations Between Dogmatism and 12 University College Course Grades from Two Studies

	From Present Study		From Lehmann et al	
	Males	Females	Males	Females
ATL* 111	-.15	-.11	-.19	-.17
ATL 112	-.10	-.10	-.22	-.13
ATL 113	-.14	-.15	-.15	-.08
NS 181	-.15	-.09	-.18	-.09
NS 182	-.12	-.05	-.28	-.04
NS 183	-.17	-.10	-.20	-.19
SS 231	-.15	-.02	-.13	-.16
SS 232	-.06	-.03	-.10	-.17
SS 233	-.06	-.03	-.10	-.13
Hum 241	-.11	.08	-.11	-.10
Hum 242	-.11	.14	-.10	-.09
Hum 243	-.10	-.04	-.12	-.12

* This course was previously called Communication Skills and is so identified in the Lehmann reports.

The results considered thus far are for all the males and females considered separately and together, regardless of major. Let us now consider to what extent the findings obtained for the men and women majoring in the various curricula are similar to and different from those considered thus far. The pertinent results are shown in Tables 34 to 43, and the following should be especially noted:

1. Male Social Science Majors (Table 34). The psychological variable which is most predictive of academic success (of the four under consideration) is Witkin's Embedded-Figures Test. Eleven of the 22 correlations with this test are significant and the magnitude of many of these correlations is generally higher than those shown for the total group (Table 30) or for the males (Table 31) and females (Table 32). The range of correlations with the various measures of academic performance is from -.02 to -.44. The Embedded-Figures Test "holds up" especially as a consistent predictor of the ATL and Natural Science courses. To be noted also is that it correlates -.26 with introductory sociology (Sociology 241), -.35 with social psychology (Sociology 251), -.27 with introductory psychology (Psychology 151), -.36 with general chemistry (111), and -.35 with introductory economics (200). Finally, the Embedded-Figures Test correlates significantly with Terms in School (-.22) and with the overall grade point average (-.26).

TABLE 34

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Social Science Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	84	-.01	-.02	-.22*	-.12	.19	.13	.22*	.12	.17	.19
G.P.A. in Major	79	-.14	-.27*	-.12	-.11	.27*	.23*	.28*	.16	.27*	.30**
G.P.A.	84	-.12	-.14	-.26*	-.20	.43**	.39**	.42**	.24*	.29**	.41**
ATL 111	80	-.25*	-.27*	-.32**	-.34**	.59**	.53**	.53**	.41**	.48**	.51**
ATL 112	78	-.19	-.17	-.31**	-.26*	.57**	.59**	.50**	.29**	.49**	.48**
ATL 113	76	-.21	-.17	-.26*	-.32**	.45**	.44**	.40**	.25*	.38**	.38**
NS 181	80	-.17	-.20	-.36*	-.28**	.51*	.39**	.37**	.40**	.51**	.51**
NS 182	77	-.26*	-.30**	-.32**	-.29**	.52**	.50**	.48**	.28*	.36**	.45**
NS 183	72	-.06	-.19	-.44**	-.37**	.53**	.38**	.43**	.54**	.35**	.49**
SS 231	73	-.22	-.20	-.14	-.18	.35**	.34**	.39**	.11	.16	.35**
SS 232	68	-.07	.07	-.09	-.09	.47**	.38**	.46**	.33**	.13	.32**
SS 233	63	-.01	.11	-.18	-.12	.32**	.23	.33**	.25*	.17	.14
Hum 241	73	-.12	-.23*	-.08	-.17	.39**	.44**	.41**	.05	.21	.32**
Hum 242	68	-.27*	-.31**	-.07	-.03	.36**	.45**	.36**	.00	.18	.28*
Hum 243	66	-.15	-.23	-.02	.02	.42**	.52**	.39**	.03	.22	.44**
Chemistry 111	30	.19	.18	-.36*	-.33	.14	.09	.07	.03	.34	.17
Economics 200	37	.09	-.10	-.35*	-.26	.42**	.33*	.29	.44**	.59**	.42**
Pol. Science 200	25	-.32	-.35	-.15	-.15	.31	.38	.29	.11	.45*	.41*
Psychology 151	70	-.31**	-.21	-.27*	-.16	.41**	.45**	.36**	.13	.25*	.36**
Psychology 225	36	-.22	-.25	-.19	-.20	.47**	.36*	.41*	.38*	.45**	.34*

Table 34 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Sociology 241	26	-.05	-.09	-.26	-.24	.36	.40*	.43*	.05	.39*	.52**
Sociology 251	24	.28	.05	-.35	-.22	.21	-.03	.25	.34	.06	.21

* $p . .05$
** $p < .01$

The pattern of correlations just described also describes the relationships between the Modified Kohs Test and the various indices of academic performance, except that these correlations are slightly lower. The correlations between the Modified Kohs and ATL and Natural Science are about as high as those involving the Embedded-Figures. But the correlations with sociology, psychology, chemistry and economics are a bit lower and fail to reach statistical significance. The correlation with G.P.A. is -.20 which is not significant.

Turning now to the rigidity and dogmatism correlations we note that these are generally of lower magnitude than the correlations with the perceptual tests. Both rigidity and dogmatism correlate significantly with American Thought and Language 111, Natural Science 182, and Humanities 242. The rigidity variable correlates significantly with Psychology 151, and the dogmatism variable correlates significantly with Humanities 241 and G.P.A. in Major.

On the whole it is evident that the results for rigidity and dogmatism parallel one another, as do the results for perceptual analysis and synthesis. At the same time it is clear that the psychological tests under consideration are "respectably" related to some but not all measures of academic performance.

2. Female Social Science Majors (Table 35). The results for female social science majors show not even one significant relation between academic performance and rigidity, only two significant relations with

TABLE 35

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Social Science Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	55	.02	-.01	-.10	-.11	.39**	.18	.35**	.38**	.08	.06
G.P.A. in Major	44	-.07	.00	-.24	-.24	.41**	.40**	.23	.29	.37*	.50**
G.P.A.	55	.00	-.13	-.30*	-.42**	.63**	.48**	.45**	.53**	.51**	.56**
ATL 111	55	-.06	-.15	-.35**	-.44**	.61**	.61**	.48**	.32**	.50**	.53**
ATL 112	54	.00	-.16	-.28*	-.26*	.56**	.54**	.43**	.31*	.59**	.44**
ATL 113	50	.09	-.11	-.15	-.33*	.49**	.44**	.25	.36**	.44**	.40**
NS 181	53	.01	-.05	-.02	-.41**	.40**	.23	.33*	.36**	.38**	.33*
NS 182	52	-.05	.15	-.35**	-.43**	.58**	.36**	.47**	.50**	.52**	.46**
NS 183	42	.09	.12	-.25	-.60**	.56**	.33*	.46**	.45**	.36*	.62**
SS 231	49	-.08	-.07	-.14	-.25	.52**	.46**	.36*	.36*	.35*	.48**
SS 232	46	.00	-.14	-.20	-.40**	.51**	.44**	.38**	.35*	.34*	.38**
SS 233	43	.11	-.18	.02	-.32*	.61**	.49**	.48**	.41**	.23	.24
Hum 241	44	.05	.11	.06	-.24	.35*	.18	.23	.35*	.22	.37*
Hum 242	40	-.08	.06	-.10	-.46**	.54**	.33*	.47**	.43**	.37*	.38*
Hum 243	39	-.18	-.18	-.18	-.54**	.62**	.42**	.49**	.53**	.36*	.47**
Psychology 151	46	.17	.07	-.33*	-.36*	.60**	.41**	.46**	.49**	.21	.53**
Psychology 225	32	-.03	.13	-.15	-.22	.55**	.25	.50**	.51**	.39*	.45**
Sociology 241	29	-.27	-.41*	-.12	-.45*	-.21	.04	.18	.24	.55**	.41*
Sociology 251	28	-.07	-.43*	-.07	-.21	.17	.02	.19	.18	.30	.42*

* p<.05
** p<.01

dogmatism (both involving correlations over -.40 with sociology) and five significant correlations with Embedded-Figures. But 13 out of the 19 correlations with the Modified Kohs are statistically significant. Moreover, the general magnitude of these correlations is considerably higher than those shown in the preceding tables, the range of correlations varying from -.11 to -.60. Nine out of these 19 correlations are over .40. Finally, it should be noted that the Modified Kohs correlates -.42 with G.P.A.

There is some suggestion in the data that the analysis and synthesis results do not altogether parallel one another as was the case in the preceding tables. Quite a few of the correlations involving perceptual synthesis are sizeable and significant while this is not the case for perceptual analysis. This is especially true for the correlations with American Thought and Language 113, Natural Science 181 and 183, Social Science 232 and 233, Humanities 242 and 243, and Sociology 241. With respect to the two sociology courses we note especially that dogmatism correlates considerably higher than rigidity, and perceptual synthesis correlates higher than perceptual analysis. These results are consistent with theoretical expectations and are in line with Ehrlich's and Frumkin's findings, which have been previously discussed.

When the results for both the male and female social science majors are considered together, it is seen that the results are qualitatively

different from those obtained for all the males and females considered separately and together.

3. Male Natural Science Majors (Table 36). A yet different pattern of findings is evident for this group. This time it is the Dogmatism Scale which yields the highest correlations with the various academic performance measures, nine of the 22 correlations being significant in contrast to only one of 22 correlations with rigidity. The dogmatism correlations with American Thought and Language are between -.18 and -.25; with Natural Science the correlations are between -.28 and -.42; with Social Science 231 the correlation is -.31; with Psychology 151 the correlation is -.45 and with Chemistry 111 the correlation is -.38. With the global G.P.A. measure, dogmatism correlates -.36.

Only five of the 22 correlations with perceptual analysis and not one of the correlations with perceptual synthesis are significant. Embedded-Figures correlates -.33 with G.P.A. which is close to the result obtained with dogmatism.

It is thus clear that rigidity and dogmatism correlate differentially with academic performance but these results are not as theoretically expected since it is not paralleled by higher correlations between perceptual synthesis and academic performance. Rather, it is the Embedded-Figures Test which seems to be the better predictor of academic success.

TABLE 36

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Natural Science Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	88	.06	-.18	-.19	-.15	.06	-.06	.11	.18	.09	.20
G.P.A. in Major	68	-.07	-.23	-.23	-.23	.34**	.27*	.40**	.22	.32**	.26*
G.P.A.	87	-.20	-.36**	-.33**	-.17	.52**	.40**	.49**	.46**	.43**	.51**
ATL 111	85	-.13	-.18	-.39**	-.15	.62**	.57**	.52**	.48**	.52**	.53**
ATL 112	81	-.17	-.23*	-.19	-.03	.59**	.58**	.42**	.44**	.55**	.52**
ATL 113	69	-.19	-.25*	-.28*	-.03	.63**	.58**	.55**	.37**	.58**	.63**
NS 181	69	-.22	-.42**	-.24*	-.15	.58**	.42**	.63**	.48**	.41**	.42**
NS 182	62	-.12	-.33**	-.14	.05	.41**	.39**	.44**	.19	.30*	.30*
NS 183	55	-.05	-.28*	-.13	-.24	.54**	.48**	.51**	.35**	.46**	.46**
SS 231	65	-.17	-.31**	-.02	-.09	.59**	.55**	.44**	.45**	.49**	.38**
SS 232	58	-.09	-.02	-.12	-.11	.64**	.60**	.50**	.45**	.44**	.55**
SS 233	57	-.15	-.12	.01	-.09	.53**	.54**	.42**	.31*	.56**	.62**
Hum 241	67	-.11	-.23	-.05	-.03	.52**	.46**	.43**	.46**	.33**	.42**
Hum 242	61	-.05	-.05	-.19	-.01	.45**	.50**	.34**	.22	.36**	.47**
Hum 243	57	-.08	-.05	-.09	.01	.64**	.66**	.46**	.37**	.55**	.64**
Chemistry 111	50	-.02	-.38**	-.27*	-.04	.21	.10	.21	.30*	.22	.20
Chemistry 112	43	.31*	-.03	-.17	.01	.19	.07	.26	.28	.18	-.01
Chemistry 113	34	.08	.03	.13	.08	.11	.15	.12	-.08	.03	.19
Economics 200	23	.02	-.09	-.18	-.13	.36	.34	.25	.33	.50*	.33

Table 36 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Mathematics 111	22	-.22	-.26	.10	-.03	.30	.16	.25	.43*	.18	.17
Mathematics 112	22	-.13	-.16	-.12	-.28	.40	.25	.44*	.36	.13	.28
Psychology 151	38	-.19	-.45**	-.08	.04	.59**	.50**	.53**	.44**	.38*	.25

* $p<.05$
** $p<.01$

4. Female Natural Science Majors (Table 37). The results just considered for the males are consistent with those obtained for the female Natural Science majors (which unfortunately consists of far fewer cases and thus shows few findings reaching statistical significance). The range of correlations with rigidity is +.23 to -.34 while the range of correlations with dogmatism is from -.06 to -.41. Dogmatism correlates -.34 with G.P.A. while rigidity correlates only -.08 with G.P.A., a result consistent with the findings for males. Similarly, the Embedded-Figures Test but not the Modified Kohs Test yields sizeable correlations with academic performance. With American Thought and Language 112, the correlation is -.61; with Natural Science 181 the correlation is -.57 and with G.P.A. in Major and with overall G.P.A., the correlations are -.49 and -.55 respectively.

TABLE 37

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Natural Science Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	23	.08	-.20	-.34	-.32	.33	.05	.45*	.51*	.19	.34
G.P.A. in Major	21	.03	-.39	-.49*	-.17	.49*	.41	.44*	.45*	.26	.45*
G.P.A.	23	-.08	-.34	-.55**	-.28	.80**	.65**	.75**	.72**	.37	.59**
ATL 111	22	-.15	-.35	-.31	-.20	.73**	.70**	.67**	.50*	.36	.63**
ATL 112	22	.12	-.28	-.61**	-.31	.81**	.71**	.73**	.70**	.49*	.66**
ATL 113	22	-.25	-.33	-.34	-.28	.73**	.68**	.60**	.62**	.49*	.65**
NS 181	23	.16	-.29	-.57**	-.21	.66**	.53**	.61**	.64**	.21	.59**
NS 182	23	.07	-.20	-.40	-.29	.76**	.62**	.67**	.72**	.31	.50**
NS 183	19	.00	-.13	-.32	-.11	.74**	.61**	.69**	.67**	.23	.65**
SS 231	20	.23	-.13	-.43	-.14	.66**	.63**	.63**	.44*	.23	.57**
SS 232	19	.01	-.22	-.25	.04	.60**	.67**	.52*	.31	.26	.46*
SS 233	16	-.34	-.24	-.18	-.09	.72**	.64**	.68**	.54*	.30	.63**
Hum 241	20	.14	-.24	-.15	.06	.63**	.54*	.71**	.42	.23	.46*
Hum 242	18	.06	-.06	-.12	.22	.66**	.56*	.67**	.52*	.14	.37
Hum 243	18	-.16	-.41	-.12	.33	.38	.33	.42	.27	.19	.37

* $p<.05$
** $p<.01$

5. Male and Female Humanities Majors (Tables 38 and 39). The results for both these groups show that both rigidity and dogmatism uniformly fail to correlate significantly with any of the academic performance measures. Of a total of 62 correlations involved, only one reaches statistical significance ($r = .39$ between rigidity and American Thought and Language 113 for females). The correlations with perceptual analysis and synthesis are also uniformly not significant, except for the consistent significant correlations for both males and females, between the Natural Science courses and perceptual analysis and synthesis. For males, the correlations are from -.35 to -.55 between the Natural Science courses and perceptual analysis, and are from -.43 to -.57 between the Natural Science courses and perceptual synthesis. For females the comparable correlations with perceptual analysis range from -.22 to -.39, and with perceptual synthesis they range from -.30 to -.47. For males, the correla ns between the two perceptual tests and G.P.A. are -.25 and -.19, and exactly the same results are obtained for the females.

It is thus seen that for both male and female Humanities majors, the results for rigidity are parallel to those for dogmatism, and the results for perceptual analysis are parallel to those for perceptual synthesis. It is also seen that perceptual analysis and synthesis are better predictors of certain indices of academic performance than are rigidity and dogmatism, a result similar to that observed for the Social Science majors but not similar to that observed for the Natural Science majors.

TABLE 38

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Humanities Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	37	-.19	-.14	-.21	-.14	.48**	.44**	.38*	.42**	.42**	.20
G.P.A. in Major	32	-.09	-.19	-.25	-.26	.55**	.60**	.50**	.31	.55**	.33
G.P.A.	37	-.15	-.03	-.25	-.19	.65**	.67**	.55**	.45**	.58**	.39*
ATL 111	34	-.11	-.15	-.22	-.17	.80**	.85**	.63**	.60**	.66**	.70**
ATL 112	29	-.09	.14	-.31	-.31	.72**	.68**	.68**	.53**	.63**	.67**
ATL 113	28	-.26	.01	-.26	-.10	.66**	.63**	.69**	.42*	.40*	.52**
NS 181	32	-.11	-.05	-.35*	-.43*	.85**	.79**	.70**	.78**	.63**	.71**
NS 182	26	-.13	.04	-.39*	-.55**	.71**	.70**	.72**	.47*	.54**	.54**
NS 183	22	-.18	-.21	-.55**	-.57**	.86**	.73**	.72**	.86**	.64**	.58**
SS 231	24	-.15	-.07	.13	-.05	.60**	.59**	.59**	.40*	.44*	.47*
SS 232	23	-.05	.15	-.11	-.23	.70**	.69**	.66**	.50*	.39	.68**
SS 233	19	-.22	.03	-.36	-.50*	.73**	.74**	.78**	.40	.48*	.73**
Hum 241	26	-.15	.05	-.17	-.19	.58**	.56**	.55**	.47*	.54**	.41*
Hum 242	23	.09	.12	-.22	-.37	.68**	.67**	.72**	.44*	.35	.55**
Hum 243	19	.13	.24	.19	.08	.36	.42	.37	.17	.11	.22

* $p < .05$
** $p < .01$

TABLE 39

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Humanities Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	48	-.06	.03	.12	-.04	.03	.00	.07	.01	.14	.02
G.P.A. in Major	45	.02	-.06	-.06	-.06	.36*	.27	.25	.32*	.25	.22
G.P.A.	47	-.03	.00	-.25	-.19	.50**	.31*	.47**	.42**	.32*	.42**
ATL 111	46	-.21	-.14	-.02	-.02	.31*	.37**	.26	.08	.31*	.51**
ATL 112	46	-.17	-.06	-.02	.00	.33*	.30*	.35*	.15	.07	.35*
ATL 113	45	-.39**	-.21	-.07	-.04	.39**	.41**	.19	.26	.35*	.46**
NS 181	46	-.06	-.08	-.28*	-.30*	.47**	.38**	.38**	.35*	.53**	.61**
NS 182	45	-.19	-.23	-.22	-.39**	.29*	.11	.28	.31*	.22	.32*
NS 183	40	-.15	-.05	-.39**	-.47**	.55**	.27	.54**	.51**	.28	.39*
SS 231	32	-.14	.02	.14	.22	.43*	.37*	.22	.38*	.33	.51**
SS 232	29	.07	.09	-.01	-.04	.34	.25	.22	.33	.39*	.46*
SS 233	25	-.36	-.01	-.03	-.12	.19	.14	.21	.15	.09	.30
Hum 241	33	-.12	-.05	-.16	-.06	.41*	.32	.43*	.30	.14	.42*
Hum 242	28	.03	-.12	-.01	-.05	.44*	.33	.56**	.26	.35	.52**
Hum 243	28	-.05	.00	-.03	-.06	.55**	.54**	.42*	.39*	.51**	.62**
Psychology 151	23	-.20	.14	-.25	-.03	.48*	.31	.47*	.43*	-.02	.22

* $p < .05$
** $p < .01$

6. Male and Female Education Majors (Tables 40 and 41). For the males, not one of the correlations of academic performance with rigidity or with dogmatism or with perceptual synthesis are statistically significant. For the females, similar findings are obtained with only a scattered few of these correlations being statistically significant. For both male and female Education majors, only the perceptual analysis measures correlate consistently with certain academic performance measures -- with the Natural Science courses and with G.P.A. in Major ($r = -.27$ for males and $-.26$ for females). These results differ from those presented for the Humanities majors in that only the perceptual analysis measures yield significant correlations with the Education majors, while both perceptual analysis and synthesis measures yield significant correlations in the case of the Humanities majors.

7. Male Business Majors (Table 42). The correlations between academic performance and rigidity, dogmatism and perceptual analysis are uniformly low and nonsignificant. The only consistent findings are the three significant correlations between perceptual synthesis and the three Natural Science courses.

8. Male Engineering Majors (Table 43). The correlations are uniformly low and nonsignificant for all four variables -- rigidity, dogmatism, perceptual analysis and perceptual synthesis.

TABLE 40

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Education Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	53	.12	.02	-.03	.09	.17	.13	.09	.14	.21	.00
G.P.A. in Major	50	-.28*	-.16	-.27*	-.09	-.01	.01	-.04	.00	.20	.18
G.P.A.	53	-.16	-.13	-.09	-.01	.25	.28*	.12	.12	.36**	.31*
ATL 111	50	-.16	-.11	.01	-.03	.26	.57**	.05	-.14	.37**	.51**
ATL 112	49	-.23	-.20	-.23	-.19	.43**	.59**	.14	.09	.49**	.49**
ATL 113	47	-.18	-.27	-.10	-.02	.22	.54**	.00	-.13	.45**	.45**
NS 181	44	-.08	.02	-.35*	-.06	.36*	.15	.38*	.29*	.37*	.30*
NS 182	45	-.09	-.05	-.17	.08	.50**	.41**	.34*	.29*	.22	.38**
NS 183	45	.06	-.02	-.36*	-.15	.34*	-.01	.27	.51**	.09	.12
SS 231	46	-.14	-.08	-.17	-.04	.34*	.31*	.26	.16	.30*	.39**
SS 232	44	.01	-.21	-.02	.16	.29*	.50**	.10	-.08	.18	.41**
SS 233	43	-.03	-.03	-.07	.07	.18	.31*	.16	-.09	.35*	.43**
Hum 241	48	-.06	-.05	-.20	-.05	.10	.27	.20	-.23	.21	.28
Hum 242	46	-.03	.01	-.08	.17	.27	.46**	.21	-.08	.36*	.22
Hum 243	46	-.04	-.09	.18	.21	.00	.22	.00	-.24	.14	.21
History 222	21	-.38	-.17	.09	-.01	.37	.27	.39	.24	-.01	.19
Psychology 151	21	.06	.21	-.34	-.27	.35	.26	.34	.18	.53*	.33

* $p < .05$
** $p < .01$

TABLE 41

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Education Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	123	-.11	.01	-.10	.00	.18	.13	.20*	.10	.03	.14
G.P.A. in Major	118	-.11	.01	-.26**	-.17*	.40**	.24**	.34**	.38**	.43**	.29**
G.P.A.	123	-.10	.05	-.17*	.00	.43**	.30**	.38**	.34**	.42**	.37**
ATL 111	119	-.13	-.04	-.21*	-.16	.50**	.49**	.42**	.26**	.53**	.52**
ATL 112	118	-.25**	-.02	-.09	-.02	.50**	.51**	.40**	.21*	.52**	.57**
ATL 113	115	-.20*	-.08	-.15	.01	.42**	.47**	.38**	.11	.42**	.42**
NS 181	121	-.15	-.06	-.24**	-.10	.44**	.31**	.38**	.34**	.41**	.50**
NS 182	121	-.04	-.01	-.28**	-.14	.42**	.27**	.37**	.34**	.28**	.27**
NS 183	116	-.07	-.10	-.26**	-.21*	.41**	.15	.36**	.47**	.37**	.27**
SS 231	113	-.13	.06	-.18*	-.01	.44**	.36**	.39**	.28**	.33**	.38**
SS 232	110	-.15	.05	-.10	-.13	.45**	.39**	.37**	.29**	.32**	.37**
SS 233	108	-.19*	.08	-.03	.08	.44**	.33**	.40**	.29**	.25**	.37**
Hum 241	117	-.05	.19*	-.10	.06	.33**	.32**	.28**	.15	.30**	.36**
Hum 242	114	.01	.18*	-.05	-.04	.47**	.42**	.46**	.21*	.34**	.37**
Hum 243	114	.00	.17	-.06	.06	.49**	.45**	.47**	.19*	.40**	.41**
English 206	47	.08	.02	.05	-.02	.24	.26	.12	.15	.28	.16
English 207	43	-.11	-.07	.00	.09	.25	.26	.10	.22	.22	.29
English 208	48	-.26	.06	-.11	.12	.24	.30	.08	.18	.18	.31

Table 41 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
History 222	49	.11	.09	.06	-.16	.21	.15	.11	.22	.25	-.09
History 223	37	-.06	.18	.06	-.11	.18	.11	.07	.24	.16	-.04
History 224	35	.04	-.09	-.25	-.34*	.28	-.01	.27	.46**	.10	.18
Philosophy 137	36	-.11	.16	-.26	-.03	.14	-.19	-.02	.45**	.31	.02
Psychology 151	53	-.03	-.13	.01	.16	.37**	.27*	.34*	.21	.32*	.31*
Psychology 225	30	.12	-.32	-.18	.29	.09	-.03	.20	.06	.30	.07
Sociology 241	20	.32	.05	.04	-.25	.47*	.57**	.29	.16	.29	.03
Sociology 251	24	.41*	.27	-.32	-.26	.39	.12	.36	.30	.65**	.20

* $p < .05$
** $p < .01$

TABLE 42

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Business Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-Q	English	Reading Comprehension
Terms in School	175	.04	.04	.05	-.01	.15*	.07	.07	.20**	.17*	.09
G.P.A. in Major	150	.05	-.07	.06	.06	.15	.16*	.11	.08	.21**	.22**
G.P.A.	174	-.06	-.17*	.01	-.02	.33**	.25**	.19*	.28**	.36**	.38**
ATL 111	173	-.06	-.05	.07	-.04	.49**	.45**	.36**	.28**	.44**	.47**
ATL 112	168	.05	-.02	.00	-.02	.40**	.40**	.29**	.19*	.29**	.33**
ATL 113	162	-.03	-.09	-.11	.07	.33**	.39**	.27**	.04	.29**	.32**
NS 181	170	-.06	-.11	-.15	-.22**	.49**	.35**	.37**	.41**	.36**	.45**
NS 182	165	-.01	-.02	-.14	-.25**	.41**	.31**	.26**	.35**	.21**	.30**
NS 183	156	-.09	-.19*	-.18*	-.27**	.40**	.17*	.26**	.49**	.31**	.33**
SS 231	160	-.10	-.09	.07	.03	.34**	.22**	.31**	.24**	.24**	.37**
SS 232	153	-.12	-.12	.13	.01	.34**	.26**	.25**	.24**	.17*	.30**
SS 233	151	-.04	-.11	.16*	.04	.29**	.27**	.25**	.11	.13	.33**
Hum 241	149	-.01	-.01	.11	.09	.13	.19*	-.01	.06	.12	.25**
Hum 242	144	-.09	-.04	.05	-.04	.19*	.28**	.09	.00	.11	.26**
Hum 243	141	.03	-.05	-.01	.03	.25**	.29**	.16*	.05	.16*	.33**
Economics 200	148	-.08	-.30*	.09	-.03	.16*	.09	.05	.21**	.31**	.25**
Chemistry 111	44	-.23	-.11	-.13	.01	.36*	.29	.27	.34*	.19	-.09
Chemistry 112	32	.31	-.02	-.15	-.02	-.03	-.15	.09	.07	-.03	-.14

Table 42 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Mathematics 111	43	-.15	-.15	-.24	-.27	.13	-.07	.11	.43**	.13	-.08
Mathematics 112	36	-.13	-.03	-.20	-.02	.07	-.05	.14	.14	.09	-.14
Mathematics 113	22	-.59**	-.18	.11	.12	.23	.03	.37	.19	.13	-.23
Psychology 151	123	.01	-.03	.00	-.03	.17*	.10	.11	.19*	.31**	.26**
Sociology 241	77	-.03	-.16	.08	.12	-.06	-.02	-.05	-.07	.13	.09
Statistics 121	25	-.18	-.30	-.17	-.04	.16	-.11	.10	.17	.16	-.07

* p<.05
** p<.01

TABLE 43

Correlations Between Academic Performance, Analysis and Synthesis, and Academic Ability

for Male Engineering Majors

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N	English	Reading Comprehension
Terms in School	52	.10	.10	.07	-.18	.21	.21	.21	.04	.01	.01
G.P.A. in Major	38	-.05	-.17	-.23	-.30	.44**	.41*	.40*	.25	.45**	.43**
G.P.A.	52	.07	-.08	-.05	-.24	.50**	.47**	.42**	.32*	.42**	.39**
ATL 111	52	-.22	-.27*	.04	-.04	.58**	.59**	.43**	.36**	.59**	.57**
ATL 112	48	-.05	-.10	.00	.05	.48**	.56**	.31*	.21	.35*	.55**
ATL 113	43	.02	-.05	-.10	-.09	.57**	.59**	.37*	.39**	.45**	.52**
NS 181	48	-.14	-.16	.12	-.19	.47**	.35*	.53**	.24	.45**	.43**
NS 182	44	-.03	-.04	-.01	-.03	.50**	.51**	.41**	.20	.30*	.42**
NS 183	35	.23	.19	-.10	-.03	.43**	.42**	.39*	.10	.09	.51**
SS 231	40	-.17	-.20	-.15	-.20	.67**	.58**	.58**	.48**	.59**	.66**
SS 232	36	-.27	-.11	.08	-.02	.53**	.52**	.43**	.38*	.47**	.67**
SS 233	33	-.18	-.19	-.13	.01	.55**	.50**	.53**	.30	.40*	.56**
Hum 241	37	-.09	-.22	.00	-.01	.42**	.43**	.43**	.09	.46**	.58**
Hum 242	36	-.36*	-.47**	-.11	-.01	.43**	.38*	.44**	.20	.51**	.64**
Hum 243	32	-.13	-.25	-.05	.08	.48**	.44*	.41*	.31	.47**	.50**
Economics 200	34	.01	-.12	.07	-.10	.46**	.44*	.42*	.27	.54**	.45**
Chemistry 111	49	-.05	-.10	-.14	-.17	.54**	.49**	.49**	.31*	.41**	.46**
Chemistry 112	41	.10	.02	-.36*	-.29	.50**	.39**	.54**	.30*	.44**	.36*
Mathematics 111	40	-.11	-.18	.22	.33*	.26	.23	.19	.29	.30*	.20
Mathematics 112	43	.08	-.13	.07	-.03	.48**	.47**	.30*	.50**	.35*	.32*
Mathematics 113	39	.09	.15	-.31	-.19	.38*	.43**	.20	.29	.18	.21

* p<.05
** p<.01

In view of the complexity of the findings presented for the male and female majors in the various curricula, let us try to summarize them in some way in order to permit the reader to grasp them in some global way. In Table 44 we show for the various subgroups the percent of correlations between the four psychological tests and the various indices of academic performance which reach statistical significance beyond the .05 level of confidence.

If we look first at the results obtained for the six types of majors, it is seen that the results differ markedly from one major to the next. Considering first those obtained from the Engineers, it is obvious that the number of significant correlations obtained from majors in Engineering is close to chance. On the average, only about six percent of all the correlations obtained reach the .05 level of significance. Only five percent of the correlations between academic performance and rigidity are significant, and the comparable figures for dogmatism, perceptual analysis and perceptual synthesis are 10, five, and five percent, respectively.

The results obtained from the Business majors are not much better than those obtained from the Engineering majors. Only four, 13, eight, and 13 percent of the correlations for rigidity, dogmatism, perceptual analysis and perceptual synthesis respectively, reach statistical significance, averaging out to about 10 percent of all the correlations.

For the Education majors, we find a similar picture except for the perceptual analysis correlations; 18 percent of the correlations obtained from the males and 27 percent of the correlations obtained from the females reach statistical significance.

TABLE 44

Percent of Correlations between Academic Performance Measures and Rigidity, Dogmatism, Perceptual Analysis and Perceptual Synthesis Reaching Statistical Significance Beyond .05 Level

Major		Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	Mean Percent
Social Science	Male	.18	.23	.50	.27	.30
	Female	.00	.10	.26	.68	.26
Natural Science	Male	.05	.41	.23	.00	.17
	Female	.00	.09	.27	.00	.07
Humanities	Male	.00	.00	.20	.27	.12
	Female	.06	.00	.13	.19	.10
Education	Male	.06	.00	.18	.00	.06
	Female	.15	.08	.27	.12	.16
Business	Male	.04	.13	.08	.13	.10
	Female	--	--	--	--	--
Engineering	Male	.05	.10	.05	.05	.06
	Female	--	--	--	--	--
Mean Percent	Male	.06	.15	.21	.12	.14
	Female	.05	.05	.23	.25	.15

For the Humanities majors, the number of significant correlations with rigidity and dogmatism are at or close to zero while perceptual analysis and perceptual synthesis yield results considerably better than that which would be expected by chance. In the former case, 20 percent of the male group's correlations and 13 percent of the female group's correlations reach significance. In the latter case, the comparable figures are 27 and 19 percent.

For the Natural Science majors, rigidity and perceptual synthesis yields virtually no significant correlations with academic performance, and this is also true for the dogmatism variable in the case of female majors. But 41 percent of the male group's correlations between dogmatism and academic performance are significant. And 23 and 27 percent of the male and female group's correlations between perceptual analysis and academic performance are significant.

Finally, it is seen that the highest yield of significant correlations are obtained with the Social Science majors. For the males it is especially noteworthy that 50 percent of the correlations between perceptual analysis and academic performance are significant, and for the females 68 percent of the correlations between perceptual synthesis and academic performance are significant.

It is thus clear from Table 44 that the correlations obtained between the various psychological tests and academic performance differs from

one major to another. As far as we know, this is the only study which has reported differential results for majors on the relation between personality and academic success, and such differential results should be followed up in future research. Why should the results be so different for Engineering and Business majors on the one hand, and Social Science and Natural Science majors on the other? At this moment, we must simply confess we do not know and a first order of business of further research, is to determine whether these results are replicable. If they are replicable, further theory and research could then be profitably directed to an analysis of the social and personal conditions which might possibly account for the differential findings.

If we now go down the columns of Table 44 we can get some idea about the differential predictive power of the four psychological tests under consideration. In general, the rigidity variable is seen to be a uniformly poor predictor of academic performance. The best results obtained with the Rigidity Scale is for the male Social Science majors and the female Education majors, but on the average only about five percent of the correlations between rigidity and academic success turn out to be significant. The Dogmatism Scale also turns out to be a poor predictor with two notable exceptions -- for the Natural Science males (wherein 41 percent of the correlations are significant) and for the Social Science males (wherein 23 percent are significant).

The Embedded-Figures and Modified Kohs Tests are clearly seen to be better predictors of academic success than the Rigidity and Dogmatism Scales. On the average, about 20 percent of all the correlations obtained with these tests vis a vis academic success are significant beyond the .05 level. Is this due to the fact that these tests are perhaps more classifiable as ability rather than personality tests? We will come back to this question shortly. For the present, let it be noted that it is sometimes the Embedded-Figures Test and sometimes the Modified Kohs Test which is the better predictor, and the reasons why this is so is far from clear. Again, it may be suggested that the findings seem promising enough to merit further research in order to at least see if they are replicable.

We find no evidence that the four psychological tests purporting to measure analysis and synthesis are better predictors of academic success for males or for females. In this respect our findings are in line with Lavin's conclusions on this point.

A final question which may be raised is whether one or more of the four psychological tests consistently predict certain measures of academic success and not others. With six groups of majors and with male and female groups available in four of these six groups, we had a total of 10 different groups for whom we calculated correlations between the various measures of academic performance and the four psychological tests. For the 12 University College courses and for the three global measures of

academic success, correlations were available for all 10 of these groups. But for the other courses correlations were available for only some of these 10 groups. The relevant results are shown in Table 45.

TABLE 45

Number of Times Rigidity, Dogmatism, Perceptual Analysis and Perceptual Synthesis Correlated Significantly Beyond .05 Level with Various Measures of Academic Success

Academic Performance Score	Number of Groups Tested	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis
Terms in School	10	0	0	1	0
G.P.A. in Major	10	1	1	3	1
G.P.A.	10	0	2	5	1
ATL 111	10	1	2	4	2
ATL 112	10	1	1	3	2
ATL 113	10	2	1	2	2
NS 181	10	0	1	7	5
NS 182	10	1	2	4	5
NS 183	10	0	2	6	6
SS 231	10	0	1	1	0
SS 232	10	0	0	0	1
SS 233	10	1	0	1	2
Hum 241	10	0	2	0	0
Hum 242	10	2	3	0	1
Hum 243	10	0	0	0	1
Chemistry 111	4	0	1	2	0
Chemistry 112	3	1	0	1	0
Chemistry 113	1	0	0	0	0
English 206	1	0	0	0	0
English 207	1	0	0	0	0
English 208	1	0	0	0	0
Economics 200	4	0	1	1	0
History 222	2	0	0	0	0
History 223	1	0	0	0	0
History 224	1	0	0	0	1

Table 45 -- continued

Academic Performance Score	Number of Groups Tested	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis
Mathematics 111	3	0	0	0	1
Mathematics 112	3	0	0	0	0
Mathematics 113	2	1	0	0	0
Philosophy 137	1	0	0	0	0
Pol. Science 200	1	0	0	0	0
Psychology 151	7	1	1	2	1
Psychology 225	3	0	0	0	0
Sociology 241	4	0	1	0	1
Sociology 251	3	1	1	0	0
Statistics 121	1	0	0	0	0

1. The Rigidity Scale. As already noted, the Rigidity Scale is the poorest predictor of academic success in the various courses. It correlates significantly with American Thought and Language 111 in only one of the 10 groups, with American Thought and Language 112 only in one of the 10 groups, and with American Thought and Language 113 in only two of the 10 groups. The rigidity scores' predictive power with respect to all other courses would seem to be even poorer than with respect to American Thought and Language. The only other results worthy of note is that the Rigidity Scale correlates significantly with Humanities 242 in two of the 10 groups.

2. The Dogmatism Scale. Scores on this variable seem to predict success in a number of courses: American Thought and Language (with four of 30 correlations being significant), Natural Science (with five of 30 being significant), Humanities (with five of 30 correlations being significant).

The correlation between dogmatism and Sociology 241 (Introductory Sociology) is significant in one out of four groups, and the correlation between this variable and Sociology 251 (Social Psychology) is found to be significant in one out of three groups. We thus see that the significant results reported by Ehrlich (1961a; 1961b) and Frumkin (1961) with respect to the relation between dogmatism and Sociology are replicated in two of seven groups.

As for the relation between dogmatism and Psychology 151 (Introductory Psychology) we note a significant relation only once in seven groups. No significant correlations are found with respect to Psychology 225 (Psychology of Personality) in any of the three groups for whom data were available.

The dogmatism variable also yields occasional significant correlations with General Chemistry (111) and Introductory Economics (200).

As for the global measures of academic success, it may be noted that we find a significant correlation between dogmatism and G.P.A. in Major in one of 10 groups, and significant correlations with overall G.P.A. in two of the 10 groups for whom data were available.

3. Perceptual Analysis (Witkin Embedded-Figures Test). In general, this test yields more significant correlations with various specific and global measures of academic success than do the other three psychological tests. Reaching statistical significance are nine of 30 correlations with American Thought and Language, 17 of 30 correlations with Natural Science, two of seven correlations with Psychology 151, three of eight correlations with Chemistry, one of four correlations with Economics, but only two of 30 correlations with Social Science. Not reaching significance are the correlations between the Embedded-Figures and Humanities, Philosophy, History, Political Science, Sociology, English, Statistics, or Mathematics.

As for the global measures, one of the 10 correlations between Embedded-Figures and Terms in School is significant, as are three out of 10 correlations with G.P.A. in Major, and five out of 10 correlations with overall G.P.A. The reader will note that the number of significant correlations with the global measures of academic success is considerably greater for Embedded-Figures than for rigidity, dogmatism, and perceptual synthesis.

4. Perceptual Synthesis (Modified Kohs Test). Like the Embedded-Figures Test, the Modified Kohs Test yields a number of significant correlations with American Thought and Language (six out of 30) and with Natural Science (16 out of 30). It also yields occasional significant correlations with Social Science, Humanities, History, Sociology, Psychology and Mathematics. And only one of the 10 correlations with G.P.A. in Major and also with G.P.A. are significant.

When all the results shown in Table 45 are considered together, it is obvious that the order of predictive power of the four psychological tests are not the same. Embedded-Figures is best, followed by Modified Kohs, dogmatism, and finally rigidity. The criterion measure which is best predicted is clearly Natural Science and, second, American Thought and Language.

It is not at all clear why the pattern of correlations found differs for the four psychological tests and for the specific and global measures of

academic success. The results can do no more than to suggest that we do find differential patterns of correlations between personality and academic success measures and that there is therefore, a great deal more which can be profitably learned from further research.

Let us now turn from the nonintellective correlates to consider in more detail the findings on the intellective correlates of academic success. These results are also shown in Tables 31 to 43 and in contrast to the inconsistent findings obtained with respect to the nonintellective variables, we find that most of the correlations with academic success, on both the measures obtained in specific courses and on the global measures are significant. In order to gain some overall idea about the differential predictive efficiency of the intellective measures, we have calculated for each of these six measures the percent of correlations with academic performance reaching statistical significance beyond the .05 level. The results are shown in Table 46, which is comparable to the results shown in Table 44 for the nonintellective measures.

It is obvious that far more of the correlations between intellective and academic success measures are statistically significant. For all the males considered together, from 63 to 77 percent of the correlations are significant; for all females considered together, from 68 to 89 percent of the correlations are significant.

But again it may be noted that the intellective measures are differentially predictive for different types of majors. The intellective measures seem to be least predictive for Education and Business majors. For male Education majors, the percent of significant correlations between academic success and the six intellective measures ranges from 12 to 53 percent; for female Education majors, the range is from 54 to 62 percent. For male Business majors, the number of significant correlations ranges from 46 to 67 percent. By contrast, the number of significant correlations for the Social Science majors ranges from 50 to 89 percent.

We thus see that the intellective measures, like the nonintellective measures, do not seem to uniformly predict for students of varying major interests. Why this should be so is again a problem which should be investigated in future research.

TABLE 46

Percent of Correlations between Academic Performance Measures and CQT-Total, CQT-Verbal, CQT-Information, CQT-Numerical, English and Reading Comprehension Reaching Statistical Significance Beyond .05 Level

Major		CQT-T	CQT-V	CQT-I	CQT-N	English	Reading
Social Science	Male	.77	.77	.82	.50	.59	.82
	Female	.89	.68	.74	.84	.74	.89
Natural Science	Male	.68	.68	.73	.64	.73	.64
	Female	.87	.80	.93	.80	.13	.80
Humanities	Male	.93	.93	.93	.80	.80	.80
	Female	.81	.44	.50	.50	.38	.75
Education	Male	.35	.53	.12	.18	.53	.53
	Female	.62	.58	.62	.54	.62	.58
Business	Male	.67	.58	.46	.54	.58	.67
	Female	---	---	---	---	---	---
Engineering	Male	.90	.90	.86	.38	.86	.86
	Female	---	---	---	---	---	---
Total Groups	Male	.74	.71	.77	.63	.67	.71
	Female	.89	.68	.71	.79	.71	.68

Let us now consider what is perhaps the most interesting findings shown in Table 46. If we ask which of the six tests is most consistently and highly correlated with academic success we would expect to find that it is general academic aptitutde, as measured by CQT - Total (which is a test combining the Verbal, Information, and Numerical subtests of CQT). But this does not appear to be the case. All six intellective tests seem to yield approximately equal numbers of significant correlations with the various indices of academic success, and no one test seems to be clearly superior to any other. When all males are considered together, we find that 74 percent of all the correlations between CQT - Total and academic success are significant. But the proportions are about equally high for CQT - Verbal (71 percent) and CQT - Information (77 percent) and it is only slightly lower for CQT - Numerical (63 percent). Moreover, the percent of significant correlations with English (67 percent) and with Reading Comprehension (71 percent) is only slightly lower than with CQT - Total. When all the females are considered together, the proportion of significant correlations with CQT - Total is higher than for any of the other five intellective tests, but there is not much difference between the three CQT subtests (Verbal, Information, and Numerical) on the one hand and English and Reading Comprehension on the other.

We are therefore led to raise the question whether it is general academic aptitude which is so highly predictive of academic success (in this study as well as in numerous other studies reported in the literature) or

whether it is the more highly specific academic abilities measured by the English Usage and Reading Comprehension Tests. The latter are teachable, intellective skills, undoubtedly highly loaded on a general verbal factor, but far more specific; the former are general ability factors which come closer to measuring what many would call intelligence. It makes a big difference, both conceptually and practically, whether we say that it is a general aptitude or a general verbal ability or a specific skill which is highly predictive of academic success because a specific verbal skill is more easy to teach and thus more capable of being remedied than deficiencies in general intellectual or general verbal ability.

In order to ascertain to what extent it is general academic aptitude or general verbal ability rather than specific aptitude, which is predictive of academic success, we calculated the correlations between the various indices of academic success and the four CQT measures holding English constant, holding Reading Comprehension constant and holding both English and Reading Comprehension constant. We also determined the correlations between various indices of academic success and the four psychological tests (Rigidity, Dogmatism, Perceptual Analysis and Perceptual Synthesis) holding English, Reading Comprehension and both English and Reading Comprehension constant. We calculated the three partial correlations between academic success measures on the one hand and the CQT and psychological measures on the other separately by

major and sex (ten subgroups), thus resulting in 30 tables. These are presented in Appendix D.

It is not practicable to discuss in detail the large volume of data shown in these many tables. It will perhaps suffice to say here that as we compare the zero-order correlations between the many specific and global indices of academic success and the four CQT measures shown in Tables 30 to 43 with the comparable first-order and second-order partial correlations shown in Tables 13.1 to 22.2 in Appendix D, the latter correlations are generally seen to decrease. Many of these reduced first-order and second-order partial correlations are still statistically significant while many others are no longer significant. At the same time the extent to which these first- and second-order correlations decrease varies for the different subgroups of majors, and varies also for the different indices of academic success.

Since G.P.A. is assumed to be the best single global measure of academic success let us consider in greater detail the zero-order, first-order, and second-order partial correlations obtained between G.P.A. and the four CQT measures, and between G.P.A. and the four psychological tests for males and females majoring in the various subject areas. These results, shown in Table 47, are taken from the various tables in Appendix D:

TABLE 47

Zero-Order Correlations, and First- and Second-Order Partial Correlations

between G.P.A., Analysis and Synthesis, and Academic Ability for Various Majors,

Holding English and Reading Comprehension Constant

Subgroup	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-7	CQT-I	CQT-N
Social Science Males									
Zero-order r	84	-.12	-.14	-.26*	-.20	.43**	.39**	.42**	.24*
English held constant	84	-.05	-.10	-.18	-.11	.33**	.29**	.32**	.12
Reading held constant	84	.01	-.01	-.11	-.08	.19	.16	.20	.05
English and Reading held constant	84	.01	-.01	-.10	-.07	.19	.15	.19	.03
Social Science Females									
Zero-order r	55	.00	-.13	-.30*	-.42**	.63**	.48**	.45**	.53**
English held constant	55	.05	-.11	-.20	-.31*	.52**	.38**	.36**	.41**
Reading held constant	55	.07	-.12	-.09	-.27*	.49**	.31*	.33*	.43**
English and Reading held constant	55	.11	-.11	-.03	-.20	.40**	.24	.26*	.33*
Natural Science Males									
Zero-order r	87	-.20	-.36**	-.33**	-.17	.52**	.40**	.49**	.46**
English held constant	87	-.21*	-.35**	-.25*	-.07	.34**	.20	.35**	.29**
Reading held constant	87	-.09	-.31**	-.25*	-.07	.28**	.11	.30**	.30**
English and Reading held constant	87	-.13	-.32**	-.24*	-.06	.24*	.07	.28**	.27**

Table 47 -- continued

Subgroup	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Natural Science Females									
Zero-order r	23	-.08	-.34	-.55**	-.28	.80**	.65**	.75**	.72**
English held constant	23	.07	-.32	-.51*	-.19	.78**	.58**	.71**	.66**
Reading held constant	23	.08	-.28	-.33	.01	.66**	.40	.64**	.54**
English and Reading held constant	23	.08	-.28	-.34	.01	.69**	.44*	.64**	.54**
Humanities Males									
Zero-order r	37	-.15	-.03	-.25	-.19	.65**	.67**	.55**	.45**
English held constant	37	-.05	.01	-.10	-.02	.40*	.44**	.29	.19
Reading held constant	37	-.07	-.02	-.10	-.05	.59**	.60**	.43**	.30
English and Reading held constant	37	-.06	.01	-.12	-.02	.48**	.49**	.35*	.21
Humanities Females									
Zero-order r	47	-.03	.00	-.25	-.19	.50**	.31*	.47**	.42*
English held constant	47	.02	.07	-.22	-.13	.40**	.15	.40**	.34*
Reading held constant	47	.06	.03	-.21	-.14	.33*	.04	.32*	.35*
English and Reading held constant	47	.06	.06	-.20	-.12	.32*	.00	.32*	.34*
Education Males									
Zero-order r	53	-.16	-.13	-.09	-.01	.25	.28*	.12	.12
English held constant	53	-.11	-.15	.06	.13	.09	.14	.03	.00
Reading held constant	53	-.09	-.10	-.05	.01	.11	.10	.00	.10
English and Reading held constant	53	-.08	-.13	.06	.12	.01	.04	-.03	.01

Table 47 -- continued

Subgroup	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Education Females									
Zero-order r	123	-.10	.05	-.17*	.00	.43**	.30**	.38**	.34**
English held constant	123	-.06	.06	-.01	.10	.25**	.10	.23**	.22*
Reading held constant	123	-.02	.05	-.09	.09	.26**	.08	.21*	.25**
English and Reading held constant	123	-.03	.06	-.01	.13	.18*	-.01	.16	.20*
Business Males									
Zero-order r	174	-.06	-.17*	.01	-.02	.33**	.25**	.19*	.28**
English held constant	174	-.07	-.20**	.06	.05	.18*	.13	.10	.16*
Reading held constant	174	-.04	-.21**	.04	.07	.13	.07	.03	.16*
English and Reading held constant	174	-.05	-.21**	.07	.09	.08	.03	.01	.11
Engineering Males									
Zero-order r	52	.07	-.08	-.05	-.24	.50**	.47**	.42**	.32*
English held constant	52	.04	.03	.03	-.19	.34*	.30*	.28*	.18
Reading held constant	52	.00	.06	.06	-.20	.35**	.32*	.26	.19
English and Reading held constant	52	.05	.07	.07	-.18	.29*	.25	.23	.14

* $p<.05$
** $p<.01$

1. As we proceed from the zero-order to the first-order and second-order partial correlations involving G.P.A., we note a general decrease of correlations for all 10 subgroups.

2. Rigidity. It is clear once again that the Rigidity Scale is the poorest predictor of G.P.A. The zero-order correlations are without exception not significant, and when English and Reading Comprehension are partialled out the correlations are close to zero, ranging from .11 to -.13.

3. Dogmatism. For the Natural Science males and for the Business males the zero-order correlations between G.P.A. and dogmatism are statistically significant and these correlations do not decrease when English and/or Reading Comprehension are held constant. These data would suggest, then, that English and Reading Comprehension do not affect scores on the Dogmatism Scale. In contrast it is seen that they do affect scores on the four CQT measures. When both English and Reading Comprehension are held constant for the Natural Science and Business males, the Dogmatism Scale surpasses all four CQT measures as a predictor of overall G.P.A.

4. Perceptual Analysis (Embedded-Figures Test). In five of the 10 subgroups of majors the zero-order correlations between the Embedded-Figures Test and G.P.A. are statistically significant. Only one of these five correlations is still significant when English and Reading

Comprehension are partialled out. These findings will make sense when we remember that English and Reading Comprehension are substantially correlated with CQT. This finding is, in turn, consistent with the findings reported by Witkin and others, of significant correlations between field dependence and various measures of intelligence.

5. Perceptual Synthesis (Modified Kohs). In only one of the 10 subgroups (Social Science females) is the zero-order correlation between G.P.A. and Modified Kohs statistically significant. But this correlation does not "hold up" when English and Reading Comprehension are held constant. Thus, not one of the second-order correlations are significant.

6. When the four psychological tests of analysis and synthesis are considered all together, it is evident that the only variable which correlates significantly with G.P.A. after English and Reading Comprehension are held constant is the Dogmatism Scale. This occurs however, in only two of the 10 subgroups and in these two groups the dogmatism scores surpass the CQT measures in predicting G.P.A. Why the Dogmatism Scale "holds up" better than all the remaining tests, including the CQT tests, and only for Natural Science and Business males and not for the remaining groups, is not at all clear at this time. Speculation about possible explanations of these results is premature. More important is the need to determine whether these findings are replicable.

7. CQT - Total test. For nine of the 10 subgroups of majors, the zero-order correlations between G.P.A. and CQT are statistically significant. While these correlations generally decline from zero-order to first-order to second-order partial correlations, seven of them are still significant. Even with English and Reading Comprehension held constant, the CQT test seems to "hold up" as a significant predictor of academic success.

At the same time, it should be noted that in six of the 10 groups the correlation between CQT and G.P.A. falls below .30 when English and Reading Comprehension are partialled out. These six groups are primarily male groups (Social Science males, Natural Science males, Education males, Business males, Engineering males, and Education females) and all together include 573 subjects. In contrast, the remaining four groups, in which the second-order partial correlations are over .30, are primarily female groups (Social Science females, Natural Science females, Humanities females, and Humanities males) and all together account for only 162 subjects. In general then, it would seem that by holding English and Reading Comprehension constant, the correlations between G.P.A. and CQT decline considerably for the great majority of subjects, and the decline is considerably greater for males than for females. Again, we are at a loss to account for these findings.

8. CQT - Verbal. As would be expected, the second-order partial correlations between G.P.A. and CQT-Verbal "suffer" most. While all 10

zero-order correlations between G.P.A. and CQT-Verbal are significant, only two of the second-order partial correlations remain significant. This finding strongly suggests that general verbal aptitude is to at least a large extent reducible to the more specific skills involved in English and Reading Comprehension. The second-order correlations between G.P.A. and CQT-Verbal for the 10 subgroups are, in order, -.01, .00, .03, .04, .07, .15, .24, .25, .44 and .49 suggesting that the specific skills in English and Reading Comprehension account to a large extent for whatever it is which is measured by the more general CQT-Verbal scores.

9. The fact that the first- and second-order partial correlations between G.P.A. and all four of the CQT measures generally show decreases, and that the decreases are greatest with CQT-Verbal (when English and Reading Comprehension are partialled out) suggest that to a large extent it is the student's skill in English and his skill in understanding what he reads which may account for the major portion of the common variance in the correlations between G.P.A. and academic aptitude. While it is recognized that our correlational data do not provide us with information about causal relationships, it is reasonable to conjecture that it is just as likely that general aptitude and general verbal ability is dependent on the student's exposure to and training in these specific skills, as to conjecture that the causal relationships is the other way around. In any case, it seems reasonable to suggest that in order to improve educational performance, the educational system

is better equipped to orient itself to effect improvements in the learning of identifiable, specific skills than to effect improvements in more general and hence, less-identifiable, academic aptitudes.

VI. A SIMPLIFIED METHOD FOR SCORING LIKERT-TYPE SCALES

Peabody (1962) reports a positive .46 correlation between the mean score obtained from all Dogmatism items the subjects agree with, and the mean score obtained from all the Dogmatism items the subjects disagree with. Similarly, Korn and Giddan (1964) report a positive .34 correlation between these two variables. The fact that these correlations are both positive rather than zero or negative would strongly suggest that, to at least some extent an extremeness response set may be affecting the Dogmatism Scale scores. Korn and Giddan propose to eliminate the possible operation of such an extremeness response set by eliminating the intensity dimension from the scoring and by considering only the direction dimension. They therefore computed two alternative scores for the Dogmatism Scale -- a Likert score and a more simple score obtained by merely counting the number of Dogmatism items the subjects agree with -- and they then compared the construct validity of these two scores. They found that the correlations obtained between the Dogmatism Scale and other personality and aptitude measures, was unaffected by the two methods of scoring the Dogmatism Scale. They therefore proposed that the more simple method of scoring the Dogmatism Scale is justifiable on both theoretical and practical grounds. Their results are shown in Table 48.

TABLE 48

Correlations of Dogmatism Scores with Aptitude and Personality Measures** in Male Sample (N = 195) (from Korn and Giddan, 1964)

Variable	Likert Score	Agree Score
SAT - Verbal	-.20*	-.23*
SAT - Mathematics	-.11	-.12
Well-being	-.30*	-.24*
Tolerance	-.33*	-.31*
Flexibility	-.36*	-.38*

* $p < .05$
** Taken from C.P.I. The Flexibility Scale is essentially the same as the present Rigidity Scale.

Following the publication of Korn and Giddan's report, we re-scored the Dogmatism and Rigidity Scale responses of our subjects by their simple method (number of items agreed with) and we compared the correlations obtained between the two sets of scores with the other variables of this study. Such data were available for our total sample, for males, for females, and for male and female majors in the various curricula. Since these data are too voluminous to present in detail let us, first, merely report that we have confirmed Korn and Giddan's findings for all samples and subsamples inspected, not only with respect to the Dogmatism Scale but also with respect to the Rigidity Scale.

Since our Male Natural Science subgroup provided us with the best evidence in the present study for the construct validity of the Dogmatism Scale, we present here (Table 49) for more detailed consideration the results obtained for this group. The correlation between the Likert and agree score on the Dogmatism Scale is .92, which agrees closely with Peabody's finding ($r = .93$) and Korn and Giddan's finding ($r = .94$). For the Rigidity Scale, the correlation is .91.

We next note that the correlation between the Likert scores on the Dogmatism and Rigidity Scale is .57, and the correlation between the agree scores on the two scales is .54. The correlation between the Likert-dogmatism score and the agree-rigidity score is .52, and between the agree-dogmatism and Likert-rigidity the correlation is .55. In

TABLE 49

Correlations between Likert and Agree Scores on the Rigidity and Dogmatism Scales and Academic Ability and Performance Measures for Male Natural Science Majors

Variable	N	Rigidity Score		Dogmatism Score	
		Likert	Agree	Likert	Agree
Rigidity - Likert	88	----	.91	.57	.55
Rigidity - Agree	88	.91	----	.52	.54
Dogmatism - Likert	88	.57	.52	----	.92
Dogmatism - Agree	88	.55	.54	.92	----
Embedded-Figures	88	.04	-.01	.04	.04
Modified Kohs	88	-.10	-.14	-.06	-.07
Time to overcome 3 beliefs	88	.24	.21	.06	.05
Time to solve after 3 beliefs overcome	88	.12	.06	.03	-.01
Doodlebug - Total time to solve	88	.19	.13	.05	.01
English	88	-.02	.01	-.12	-.07
Reading Comprehension	88	-.24	-.17	-.19	-.14
CQT - Total score	88	-.22	-.16	-.11	-.11
CQT - Verbal	88	-.25	-.21	-.08	-.11
CQT - Information	88	-.14	-.05	-.11	-.11
CQT - Numerical	88	-.12	-.08	-.12	-.07
Terms in School	88	.06	.10	-.18	-.10
G.P.A. in Major	68	-.07	.00	-.23	-.25
G.P.A.	87	-.20	-.15	-.36	-.39
ATL 111	85	-.13	-.09	-.18	-.16
ATL 112	81	-.17	-.18	-.23	-.27
ATL 113	69	-.19	-.18	-.25	-.25
NS 181	69	-.22	-.13	-.42	-.43
NS 182	62	-.12	-.11	-.33	-.34
NS 183	55	-.05	-.03	-.28	-.34
SS 231	65	-.17	-.14	-.31	-.32
SS 232	58	-.09	-.02	-.02	-.10
SS 233	57	-.15	-.06	-.12	-.15
Hum 241	67	-.11	-.04	-.23	-.24
Hum 242	61	-.05	-.03	-.05	-.07
Hum 243	57	-.08	-.01	-.05	-.08
Chemistry 111	50	.02	.09	-.38	-.34
Chemistry 112	43	.31	.39	.03	.05
Chemistry 113	34	.08	.10	.03	.02
Economics 200	23	.02	.06	-.09	-.03
Mathematics 111	22	-.22	-.21	-.26	-.30
Mathematics 112	22	-.13	-.12	-.16	-.24
Psychology 151	38	-.19	-.13	-.45	-.47

other words, the correlations between the two scales are approximately of the same magnitude no matter which type of score is employed.

If we look next at the two sets of correlations between the Dogmatism Scale and other personality, academic aptitude and academic performance variables, it becomes immediately obvious that the two sets of correlations are approximately of the same size. The Likert-dogmatism score correlates -.36 with G.P.A; the agree-dogmatism score correlates -.39 with G.P.A. The highest correlation found between the Likert-dogmatism score and a criterion variable is -.45 with Psychology 151; the comparable correlation between the agree-dogmatism score and Psychology 151 is -.47. It will moreover be noticed that sometimes the Likert-score correlations are higher and sometimes the agree-score correlations are higher. There seems to be no tendency for one set of correlations to be consistently higher than the other set. In no case are the comparable correlations markedly different from one another and we have not bothered to calculate significance of difference of correlations, because it is evident by simple inspection that they are not.

As for the two methods of scoring the Rigidity Scale, it again appears that they are both about equally good. The correlations of the two Rigidity Scale scores with other variables are generally close, and apparently not significant.

We thus confirm Korn and Giddan's findings with respect to the two alternate methods of scoring the Dogmatism Scale, and on the basis of our findings we can reinforce the merit of their proposal that nothing is lost by way of construct validity in employing the more simple scoring scheme. But in view of the fact that we also obtain similar results with the Rigidity Scale, we can raise the question whether the Korn and Giddan findings should be generalized to all scales using the Likert method of scoring. While it is premature to generalize from the results obtained with only two scales to all scales, it is possible now on the basis of these findings to entertain some serious doubts about whether the more complicated Likert type of scoring is ever more justified. Further research with a variety of Likert scales in which the two scoring methods are systematically pitted against one another, should settle this point conclusively.

VII. SUMMARY AND CONCLUSIONS

In this section we present a summary of the major findings and conclusions reached in this study.

1. Sex differences. A variety of sex differences were found, as follows:

a. Males score significantly higher on the Dogmatism Scale than females, thus confirming results reported by Plant (1958) and by Lehmann and Ikenberry (1959).

b. No consistent sex differences were found on the Rigidity Scale.

c. We found systematic sex differences on the individually-administered tests of cognitive functioning, males being consistently and significantly superior to females on the Doodlebug Problem, the Witkin Embedded-Figures Test and the Modified Kohs Test. The greater superiority of the males on the Doodlebug Problem are attributable to significant differences

in their ability to synthesize and not in their ability to analyze.

d. Women were found to be significantly superior to men on the following achievement or ability tests: English, Reading Comprehension and CQT - Verbal; the men were found to be significantly superior to women on CQT - Information, CQT - Numerical and CQT - Total.

2. Examiner differences on the Doodlebug Problem. We found large and significant examiner differences on all the Doodlebug measures. But these differences were more apparent than real. Closer scrutiny of the data revealed that these differences were probably a function of order-of-testing rather than examiner differences.

3. Communication effects. In all psychological research in which subjects are tested individually, the problem of communication among subjects is always present. To the extent that subjects communicate with one another, independence of observations is not present, thus violating a basic assumption of statistical theory and analysis of data. We have presented herein several methods which test for communication among subjects. We have, furthermore, presented strong evidence indicating that our subjects did indeed communicate with one another.

More specifically we found that when our subjects were arranged in the temporal order in which they were tested:

a. Each examiner's second "batch" of subjects was superior to his first "batch" on the Doodlebug Problem. This was found without exception for the male and female subjects of all four examiners.

b. These communication effects were uniformly observed on all Doodlebug scores -- total time to solve, time to analyze and time to synthesize.

c. Such communication effects were not evident on the Embedded-Figures or on the Modified Kohs Tests, thus suggesting that the intrinsic properties of psychological tests will affect the extent to which their contents will be communicated.

d. We observed temporal effects not only within examiners but also between examiners.

e. The communication effects were found to increase over time. The correlation between order-of-testing and the various Doodlebug measures were greater for subjects tested later in our research program than for subjects

tested earlier. For subjects tested late in our research program, the correlations between order-of-testing and Doodlebug performance ranged from -.27 to -.50.

f. The results suggest that the data we have obtained for 798 subjects tested individually with the Doodlebug Problem are generally invalid because they violate the fundamental assumption of independence of observations. Moreover, the data obtained on the perceptual tests are also somewhat suspect (even though these latter data did not show communication effects), because the same subjects who were tested with the Doodlebug Problem were also tested with the perceptual tests.

g. Perhaps the most important scientific outcome of the present research is our discovery of a general and simple method which may be used by all research workers to test for independence of observations when subjects are tested sequentially. We have herein proposed that in the same way investigators routinely report means, standard deviations, and reliabilities, that they should also routinely report the correlation between order-of-testing and whatever variables are under empirical or experimental investigation. It is safe to assume that significant correlations between order-of-testing and

variables under investigation would indicate nonindependence of observation due to communication among subjects, or due to other unwanted variables.

4. The analysis-synthesis hypothesis. While we found many significant correlations among the various personality and cognitive measures of analysis and synthesis, they are extremely difficult to interpret because of sex and examiner differences, and because of communication effects. No evidence was found from various types of correlational studies that analysis and synthesis are independent or discriminable abilities. Several kinds of factor analytic studies with various groups and subgroups consistently yielded three factors: a conceptual factor, a perceptual factor, and a verbal factor. The Doodlebug measures of analysis and synthesis consistently loaded together on the conceptual factor; the Embedded-Figures and Modified Kohs Test consistently loaded together on the perceptual factor; the Rigidity and Dogmatism Scales consistently loaded together on the verbal factor. The analysis-synthesis hypothesis, however, required data which would cut across these three factors. The data found herein fail to provide any evidence which would suggest that the analysis-synthesis distinction is a tenable one. But it is not possible to ascertain from the present data whether the failure to confirm this hypothesis is due to the fact that the analysis-synthesis hypothesis is psychologically untenable or whether, instead, the failure to confirm is due to communication effects or to other methodological considerations.

5. Essay vs. objective tests as measures of the ability to analyze and to synthesize. Data obtained from subjects taking a Natural Science course suggest that objective and essay tests are measuring the same components of ability; there is no evidence to support the hypothesis that objective tests measure the ability to analyze, and essay tests the ability to synthesize. The intercorrelations between and within essay and objective tests are generally quite sizeable and there is no evidence that they are differentially related to the ability to analyze and the ability to synthesize. In factor analytic studies involving essay and objective examinations and other psychological tests we found four factors, the first three being the same as those found in other studies reported here: a conceptual factor, a perceptual factor, and a verbal factor. The fourth factor is a Natural Science factor with both essay and objective tests loading on this factor. The conclusion drawn from these findings is that essay and objective tests are equally good tests of academic performance, and that both types of tests show essentially similar patterns of relationships with other tests of personality and cognition.

6. Analysis, synthesis, and academic aptitude. We found that the Rigidity and Dogmatism Scales are negligibly related to the CQT tests. The tests of conceptual analysis and synthesis, measured by the Doodlebug Problem, and the tests of perceptual analysis and synthesis, measured by the Embedded-Figures and Modified Kohs Tests are moderately related to measures of general aptitude, as measured by the CQT tests.

The construct validity of the Embedded-Figures Test suffers the most when two correlates of CQT (English and Reading Comprehension) are held constant.

7. <u>Evidence from other studies on the ability to analyze and to synthesize</u>. Nineteen other published and unpublished studies, carried out at Michigan State University and elsewhere, were critically reviewed to ascertain the extent to which they supported the analysis-synthesis hypothesis and, more specifically, one or more of the following four subhypotheses:

A1. Low-rigid subjects will perform better on analysis than high-rigid subjects, but

2. there will be no differences between high- and low-rigid subjects on synthesis.

B1. Low-dogmatic subjects will perform better on synthesis than high-dogmatic subjects, but

2. there will be no differences between high- and low-dogmatic subjects on analysis.

We concluded from an analysis of the results reported by these various studies that the available data clearly support the general hypothesis that responses to the Rigidity and Dogmatism Scales are systematically but differentially related to measures of <u>conceptual</u> analysis and synthesis, as measured by the Doodlebug Problem. But the available data have not firmly established comparable relations between personality and <u>perceptual</u> measures of analysis and synthesis. In other words, we

concluded that subhypotheses A1 and 2, and subhypotheses B1 and 2 above are firmly supported when analysis and synthesis are measured by conceptual tests, but are not firmly supported when analysis and synthesis are measured by perceptual tests. We are presently unable to account for these differential findings.

8. Nonintellective and intellective correlations of academic success.

a. Male and female students majoring in various curricula -- Humanities, Social Science, Natural Science, Business, Engineering, Education and No Preference -- do not differ significantly from one another on rigidity or dogmatism. Nor do females majoring in the various curricula differ significantly from one another on the Embedded-Figures Test. But significant differences among males were found on the Embedded-Figures Test, male Engineers scoring most superior and male Social Science and Education majors scoring most inferior. Male Engineers also were the most superior on the Modified Kohs Test while male Business majors were the most inferior group. On the Modified Kohs, too, significant differences were found among females majoring in the various curricula, Natural Science majors being the most superior and Social Science majors the least superior.

b. When all 798 subjects are considered together, we found that the correlations between various measures of academic success and our nonintellective tests are generally low, even though about a third of them were statistically significant.

c. The magnitude of the correlations with academic success were approximately the same for measures of analysis and synthesis. We thus found no evidence of differential patterns of correlations between academic success and analysis on the one hand and academic success and synthesis on the other.

d. The correlations between academic success and the various measures of academic aptitude (the CQT tests, English and Reading Comprehension) were generally much higher, and most of them were statistically significant. Most noteworthy in this connection is that the various aptitude tests are consistently and significantly correlated with 12 courses taught in the University College.

e. We found similar patterns of correlations for males and females between academic success measures on the

one hand and nonintellective and intellective tests on the other.

f. When the nonintellective correlates of academic success are analyzed separately by major and sex, a somewhat different picture emerges, the findings differing from one major to another. In general, the nonintellective tests proved to be the best predictors of academic success, relatively speaking, for the Social Science and Natural Science majors and they were the poorest predictors for Engineering and Business majors. We are presently unable to account for these differential findings.

g. In general, the Rigidity Scale was the poorest nonintellective predictor of academic success. The Dogmatism Scale also turns out to be a poor predictor but with two notable exceptions -- for the male majors in the Natural Sciences and in the Social Sciences. The Embedded-Figures and Modified Kohs Tests are better predictors of academic success than the Rigidity and Dogmatism Scales, but this finding must be qualified by adding that the former two tests are more highly correlated with CQT.

h. We find no evidence that nonintellective tests are better predictors of academic success for males than for females.

i. The academic criterion measures which are best predicted by nonintellective tests are clearly the three Natural Science courses and then the three American Thought and Language courses taught, all such courses being taught in the University College.

j. When we consider in more detail the correlations between academic success and intellective measures, the picture is considerably different. For all the males considered together, from 63 to 77 percent of the correlations are significant; for all females considered together, from 68 to 89 percent of the correlations are significant.

But the intellective measures also differentially predict academic success for majors in the several curricula. The intellective measures are least predictive of academic success for Education and Business majors.

k. We raised the question as to whether it is general academic aptitude which is so highly predictive of

academic success or whether it is the more highly specific abilities measured by English Usage and Reading Comprehension. We argued that while these specific and general abilities are indeed substantially correlated, it makes a big difference both conceptually and practically which way we pose the problem, because specific verbal aptitudes (English and Reading Comprehension) are more teachable and thus remediable than deficiencies in general academic or general verbal ability.

To answer this question, we correlated the many academic success measures with the various nonintellective and intellective tests holding English and Reading Comprehension constant by the method of partial correlation. When the first- and second-order partial correlations were compared with the zero-order correlations, the latter generally decrease. The extent to which these partial correlations decrease varies for different kinds of majors and for different indices of academic success.

When G.P.A. is considered as the best single index of academic success, the only one of the four nonintellective tests which correlates significantly with G.P.A. after English and Reading Comprehension are held constant is

the Dogmatism Scale. This occurs, however, in only two of 10 subgroups of majors (male majors in Natural Science and Business), and in these two groups the dogmatism scores surpass the CQT measures in predicting G.P.A.

Even with English and Reading Comprehension held constant, the CQT tests "hold up" as significant predictors of academic success. But these correlations are generally smaller in magnitude and most of these correlations are below .30. Moreover, the decline in correlations is considerably greater for males than for females.

As expected, the correlation between G.P.A. and CQT - Verbal suffer most when English and Reading Comprehension are held constant, suggesting along with other findings, that student skill in English and Reading Comprehension account for the major portion of common variance in the correlations between G.P.A. and academic aptitude. It is thus suggested that educational success may perhaps be most effectively improved by concentrating on the improvement of the student's specific skills in English Usage and Reading Comprehension.

9. <u>A simplified method for scoring Likert-type scales</u>. It was found that the construct validity of the Dogmatism and Rigidity Scales remains about the same when Likert scores (involving direction and intensity) on these scales are compared with agree scores (involving only direction). Moreover, the two methods of scoring correlate over .90 with one another. These findings confirm findings by others and would thus suggest that the more simple method of scoring the Dogmatism and Rigidity Scales is defensible and possibly, that the more simple method of scoring all Likert scales is also defensible.

BIBLIOGRAPHY

BIBLIOGRAPHY

Allport, F. H. Theories of perception and the concept of structure. New York: Wiley, 1955.

Anderson, H. H. (Ed.). Creativity. New York: Harper, 1959.

Barron, F. Creativity and psychological health. New York: VanNostrand, 1963.

Bartley, S. H. Perception. New York: Harper, 1958.

Beech, R. P. The influence of dogmatism and rigidity on reasoning. Master's thesis, Michigan State University Library, 1964.

Berk, Mary. Essay and objective tests: A review of the literature. Unpublished paper, 1966.

Bloom, B. S. (Ed.). Taxonomy of educational objectives: The classification of educational goals. (Handbook I: Cognitive Domain). Longman, Green, 1956.

Brinkley, S. G. Values of new type examinations in the high school. Teacher's College Contributions to Education, No. 161. New York: Columbia University, 1924.

Christensen, C. M. A note on dogmatism and learning. Journal of Abnormal and Social Psychology, 1963, 66, 1, 75-76.

Christie, R., Havel, Joan, and Seidenberg, B. Is the F Scale irreversible? Journal of Abnormal and Social Psychology, 1958, 56, 143-159.

Conway, James A. Prob'· .olving in small groups as a function of "open-minded' "closed-minded" behavior: Some implications for development of administrative theory. Ph.D. thesis, State University of New York at Albany, 1963.

Coppinger, N. W., Bortner, R. W. and Saucer, R. T. A factor analysis of psychological deficit. Journal of Genetic Psychology, 1963, 103, 23-43.

Corey, S. M. The correlation between new type and essay examination scores, and the relationship between them and intelligence as measured by Army Alpha. School and Society, 1930, 32, 849-850.

Costin, F. Dogmatism and learning: A follow-up of contradictory findings. Journal of Educational Research (In press, 1966).

Couch, A., and Keniston, K. Yeasayers and naysayers: Agreeing response set as a personality variable. Journal of Abnormal and Social Psychology, 1960, 60, 151-174.

Courtney, D., Bucknam, M. E. and Durrell, D. Multiple choice recall versus oral and written recall. Journal of Educational Research, 1946, 39, 458-461.

Cowles, J. T. and Hubbard, J. P. A comparative study of essay and objective examinations for medical students. Journal of Medical Education, 1952, 27, 14-17.

Crawford, C. C. and Raynaldo, D. A. Some experimental comparisons of true-false tests and traditional examinations. School Review, 1925, 33, 698-706.

Davis, R. A. and Johnson, L. W. Influence of intelligence upon performance in new-type and old-type examinations. Educational Method, 1931, 10, 488-493.

Duncan, C. P. Recent research on human problem solving. Psychological Bulletin, 1959, 56, 397-429.

Ehrlich, H. Dogmatism and learning. Journal of Abnormal and Social Psychology, 1961a, 62, 148-149.

Ehrlich, H. Dogmatism and learning: A five-year follow-up. Psychological Reports, 1961b, 9, 283-286.

Ehrlich, H. and Bauer, Mary Lou. The correlates of dogmatism and flexibility in psychiatric hospitalization. Unpublished paper, 1965.

Eurich, A. C. Four types of examinations compared and evaluated. Journal of Educational Psychology, 1931, 22, 268-278.

Fillenbaum, S. and Jackman, A. Dogmatism and anxiety in relation to problem solving -- an extension of Rokeach's results. Journal of Abnormal and Social Psychology, 1961, 63, 212-214.

Fruchter, B., Rokeach, M. and Novak, E. G. A factorial study of dogmatism, opinionation, and related scales. Psychological Reports, 1958, 4, 19-22.

Frumkin, R. M. Dogmatism, social class, values, and academic achievement in sociology. Journal of Educational Sociology, 1961, 34, 398-403.

Gates, A. I. The true-false test as a measure of achievement in college courses. Journal of Educational Psychology, 1921, 12, 276-287.

Getzels, J. W. and Jackson, P. W. Creativity and intelligence. New York: Wiley, 1962.

Gilliland, A. R. and Misbach, L. E. Relative value of objective-type examinations in general psychology. Journal of Educational Psychology, 1933, 24, 349-361.

Goldstein, K. and Scheerer, M. Abstract and concrete behavior: An experimental study with special tests. Psychological Monographs, 1941, 53, No. 2 (Whole No. 239).

Goodman, Beverley. Study cited in H. Witkin, et al. Psychological differentiation. New York: Wiley, 1962.

Gough, H. C. and Sanford, R. N. Rigidity as a psychological variable. Unpublished manuscript, University of California, Institute of Personality Assessment and Research, 1952.

Guilford, J. P. The structure of intellect. Psychological Bulletin, 1956, 53, 267-293.

Harmon, H. H. Modern factor analysis. Chicago: University of Chicago Press, 1960.

Harvey, O. J., Hunt, D. E. and Schroder, H. M. Conceptual systems and personality organization. New York: Wiley, 1961.

Hellkamp, D. T. and Marr, J. N. Dogmatism and field-dependency. Perceptual and Motor Skills, 1965, 20, 1046-1048.

Hoppe, R. A. Individual and group memorization and problem-solving: A test of the Lorge-Solomon pooling-of-abilities model. Ph.D. thesis, Michigan State University Library, 1962. (Also available in Rokeach, M. The nature of analysis and synthesis and some conditions in the classroom which facilitate or retard these cognitive processes. Part One: Some conditions which affect cognitive behavior. Report of Cooperative Research Project No. 879. East Lansing: Michigan State University, 1963).

Huberman, J. A re-examination of certain aspects of Rokeach's study on dogmatism. Master's thesis, University of British Columbia, 1961.

Huddleston, E. M. Measurement of written ability at the college level: Objective vs. subjective testing techniques. Journal of Experimental Psychology, 1954, 22, 165-213.

Jackson, D. N. A short form of Witkin's embedded-figures test. Journal of Abnormal and Social Psychology, 1956, 53, 254-255.

Johnson, D. M. The psychology of thought and judgment. New York: Harper, 1955.

Kerlinger, F. and Rokeach, M. The factorial nature of the dogmatism and F scales. Journal of Personality and Social Psychology (In press, 1966).

Kinder, J. S. Supplementing our examinations. Education, 1925, 45, 557-566.

Knight, F. B. Data on the true-false test as a device for college examination. Journal of Educational Psychology, 1922, 13, 75-80.

Korn, Harold and Giddan, N. S. Scoring methods and construct validity of the dogmatism scale. Educational and Psychological Measurement, 1964, 24, 867-874.

Laird, D. A. A comparison of the essay and objective-type examinations. Journal of Educational Psychology, 1923, 14, 123-124.

Lang, A. R. Modern methods in written examinations. Boston: Haughton-Mifflin, 1930.

Lavin, David E. The prediction of academic performance. New York: Russell Sage Foundation, 1965.

Lehmann, I. J. and Dressel, P. L. Critical thinking, attitudes, and values in higher education: Final Report of Cooperative Research Project No. 590. East Lansing: Michigan State University, 1962.

Lehmann, I. J. and Ikenberry, S. O. Critical thinking, attitudes, and values in higher education: A preliminary report of research. East Lansing: Michigan State University, 1959.

Levy, J. M. and Rokeach, M. The formation of new perceptual systems. In M. Rokeach, The open and closed mind. New York: Basic Books, 1960.

Lingoes, James C. An IBM-7090 program for Guttman-Lingoes smallest space analysis. Unpublished manuscript, 1965.

Luchins, A. S. Mechanization in problem solving -- the effect of "Einstellung." Psychological Monographs, 1942, 54, No. 6 (Whole No. 248).

MacKinnon, D. W. The nature and nurture of creative talent. American Psychologist, 1962, 17, 484-495.

McAfee, L. O. The reliability of nonstandardized point tests. Elementary School Journal, 1924, 24, 579-585.

McCaulley, Mary H. Dimensions of masculinity-femininity in relation to field dependence, dogmatism, and other estimates of perceptual-cognitive differentiation. Ph.D. dissertation, Temple University, 1964.

McNemar, Q. Lost: Our intelligence? Why? American Psychologist, 1964, 19, 871-882.

Mukal, B. The enjoyment of new musical systems. In M. Rokeach The open and closed mind. New York: Basic Books, 1960.

Myrdal, G. The American dilemma. New York: Harper, 1944.

Paterson, D. G. Do old and new type examinations measure different mental functions? School and Society, 1926, 24, 246-248.

Peabody, D. Attitude content and agreement set is scales of authoritarianism, dogmatism, anti-semitism, and economic conservatism. Journal of Abnormal and Social Psychology, 1961, 63, 1-11.

Peabody, D. Two components in bipolar scales: Direction and extremeness. Psychological Review, 1962, 69, 65-73.

Peters, C. C. and Martz, H. B. A study of the validity of various types of examinations. School and Society, 1931, 33, 336-338.

Plant, W. T. Personality changes associated with a college education. Publication of U.S.O.E., Cooperative Research Branch, Project 348. San Jose: San Jose State College, 1958.

Rorer, L. G. The great response-style myth. Psychological Bulletin, 1965, 63, 129-156.

Rokeach, M. The double agreement phenomenon: Three hypotheses. Psychological Review, 1963, 70, 304-309.

Rokeach, M. Generalized mental rigidity as a factor in ethnocentrism. Journal of Abnormal and Social Psychology, 1948, 43, 259-278.

Rokeach, M. In pursuit of the creative process. In G. Steiner (Ed.). The creative organization. Chicago: University of Chicago Press, 1965.

Rokeach, M. The open and closed mind: Investigations into the nature of belief systems and personality systems. New York: Basic Books, 1960.

Rokeach, M. Political and religious dogmatism: An alternative to the authoritarian personality. Psychological Monographs, 1956, 70, No. 18 (Whole No. 425).

Rokeach, M. and Fruchter, B. A factorial study of dogmatism and related concepts. Journal of Abnormal and Social Psychology, 1956, 53, 356-360.

Rokeach, M., McGovney, W. C. and Denny, M. R. A distinction between dogmatic and rigid thinking. Journal of Abnormal and Social Psychology, 1955, 51, 87-93.

Rokeach, M., Oram, A., Laffey, J. J. and Denny, M. R. On party-line thinking: An experimental analogy. In M. Rokeach, The open and closed mind. New York: Basic Books, 1960.

Rokeach, M., Swanson, T. S. and Denny, M. R. The role of past experience: A comparison between chess-players and non-chess players. In M. Rokeach, The open and closed mind. New York: Basic Books, 1960.

Rokeach, M. and Vidulich, R. N. The formation of new belief systems: The roles of memory and the capacity to entertain. In M. Rokeach, The open and closed mind. New York: Basic Books, 1960.

Rubenowitz, S. Emotional flexibility-rigidity as a comprehensive dimension of mind. Stockholm: Almquist and Wiksell, 1963.

Ruch, G. M. The objective or new-type examination. Chicago: Scott, Foresman, 1929.

Simon, B. (Ed.). Psychology in the Soviet Union. Palo Alto: Stanford University Press, 1957.

Sims, V. M. The objectivity, reliability, and validity of an essay examination graded by rating. Journal of Educational Psychology, 1931, 24, 157-168.

Sims, V. M. Improving the measuring qualities of an essay examination. Journal of Educational Research, 1933, 27, 20-31.

Steiner, G. (Ed.). The creative organization. Chicago: University of Chicago Press, 1965.

Talbott, E. O. and Ruch, G. M. The theory of sampling as applied to examinations. Journal of Educational Research, 1929, 20, 199-206.

Taylor, D. W. Thinking and creativity. Annals of the New York Academy of Sciences, 1960, LXV, 108-127.

Thurstone, L. L. Primary mental abilities. Psychometric Monograph, University of Chicago Press, 1938, 1.

Vernon, P. E. The measurement of abilities. (2nd edition). New York: Philosophical Library, 1961.

Vidulich, R. A re-examination of the distinction between rigid and dogmatic thinking. Unpublished manuscript, 1961.

Watson, D. R. and Crawford, C. C. Four types of tests. High School Teacher, 1930, 6, 282-283.

Weaver, R. B. and Traxler, A. E. Essay examinations and objective tests in United States history in the junior high school. School Review, 1931, 39, 689-695.

Wechsler, D. The Wechsler adult intelligence scale. New York: Psychological Corporation, 1955.

Weidemann, C. C. and Newens, L. F. Does the "compare-and-contrast" essay test measure the same mental functions as the true-false test? Journal of General Psychology, 1933, 9, 430-449.

Wertheimer, M. Productive thinking. New York: Harper, 1945.

Witkin, H. A. Individual differences in ease of perception of embedded-figures. Journal of Personality, 1950, 19, 1-15.

Witkin, H. A. _et al_. _Personality through perception_. New York: Harper, 1954.

Witkin, H. A. _et al_. _Psychological differentiation_. New York: Wiley, 1962.

Wood, B. D. _Measurement in higher education_. New York: World, 1924.

Wood, B. D. The measurement of law school work. _Columbia Law Review_, 1924, 25, 1-16 (cited in Ruch, p. 100).

Wood, E. P. Improving the validity of collegiate achievement tests. _Journal of Educational Psychology_, 1927, 18, 18-25.

Wrightsman, L. S. and Cook, S. W. A factor analysis of 73 personality, attitude, and aptitude variables. Unpublished manuscript, 1964.

APPENDICES

A P P E N D I X   A

THE DOGMATISM SCALE

1. A person who thinks primarily of his own happiness is beneath contempt.

2. The main thing in life is for a person to want to do something important.

3. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.

4. Most people just don't know what's good for them.

5. In times like these, a person must be pretty selfish if he considers primarily his own happiness.

6. A man who does not believe in some great cause has not really lived.

7. I'd like it if I could find someone who would tell me how to solve my personal problems.

8. Of all the different philosophies which exist in this world there is probably only one which is correct.

9. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.

10. In this complicated world of ours the only way we can know what is going on is to rely on leaders or experts who can be trusted.

11. There are a number of persons I have come to hate because of the things they stand for.

12. There is so much to be done and so little time to do it in.

13. It is better to be a dead hero than a live coward.

14. A group which tolerates too much differences of opinion among its own members cannot exist for long.

15. It is only natural that a person should have a much better acquaintance with ideas he believes in than with ideas he opposes.

16. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.

17. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.

18. If a man is to accomplish his mission in life it is sometimes necessary to gamble "all or nothing at all."

19. Most people just don't give a "damn" for others.

20. A person who gets enthusiastic about too many causes is likely to be a pretty "wishy-washy" sort of a person.

21. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.

22. If given the chance I would do something of great benefit to the world.

23. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp than by those in the opposing camp.

24. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.

25. Once I get wound up in a heated discussion I just can't stop.

26. There are two kinds of people in the world: those who are for truth and those who are against the truth.

27. Man on his own is a helpless and miserable creature.

28. The United States and Russia have just about nothing in common.

29. In the history of mankind there have probably been just a handful of really great thinkers.

30. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.

31. The present is all too often full of unhappiness. It is only the future that counts.

32. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.

33. Fundamentally, the world we live in is a pretty lonesome place.

34. It is often desirable to reserve judgment about what's going on until one has had a chance to hear the opinions of those one respects.

35. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.

36. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.

37. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.

38. It is only natural for a person to be rather fearful of the future.

39. My blood boils whenever a person stubbornly refuses to admit he's wrong.

40. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.

THE GOUGH-SANFORD RIGIDITY SCALE*

1. I am often the last one to give up trying to do a thing.

2. There is usually only one best way to solve most problems.

3. I prefer work that requires a great deal of attention to detail.

4. I often become so wrapped up in something I am doing that I find it difficult to turn my attention to other matters.

5. I dislike to change my plans in the midst of an undertaking.

6. I never miss going to church.

7. I usually maintain my own opinions even though many other people may have a different point of view.

8. I find it easy to stick to a certain schedule, once I have started it.

9. I do not enjoy having to adapt myself to new and unusual situations.

10. I prefer to stop and think before I act even on trifling matters.

11. I try to follow a program of life based on duty.

12. I usually find that my own way of attacking a problem is best, even though it doesn't always seem to work in the beginning.

13. I am a methodical person in whatever I do

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* This scale is now included in the California Psychological Inventory, where it is labeled F_x (Flexibility). In the CPI, the items are scored in a reverse direction from that used in this book, so that a high score denotes a nonrigid or flexible individual. Permission to reproduce this scale has been granted by the Consulting Psychologists Press.

14. I think it is usually wise to do things in a conventional way.

15. I always finish tasks I start, even if they are not very important.

16. I often find myself thinking of the same tunes or phrases for days at a time.

17. I have a work and study schedule which I follow carefully.

18. I usually check more than once to be sure that I have locked a door, put out the light, or something of the sort.

19. I have never done anything dangerous for the thrill of it.

20. I believe that promptness is a very important personality characteristic.

21. I am always careful about my manner of dress.

22. I always put on and take off my clothes in the same order.

Name ______________________________ **Scores**

Major ______________________ Student No. __________

Date ______________ Age ________ Sex ________

answer sheet for

PSYCHOLOGY QUESTIONNAIRE

1	+3	+2	+1	−1	−2	−3	26	+3	+2	+1	−1	−2	−3	51	+3	+2	+1	−1	−2	−3
2	+3	+2	+1	−1	−2	−3	27	+3	+2	+1	−1	−2	−3	52	+3	+2	+1	−1	−2	−3
3	+3	+2	+1	−1	−2	−3	28	+3	+2	+1	−1	−2	−3	53	+3	+2	+1	−1	−2	−3
4	+3	+2	+1	−1	−2	−3	29	+3	+2	+1	−1	−2	−3	54	+3	+2	+1	−1	−2	−3
5	+3	+2	+1	−1	−2	−3	30	+3	+2	+1	−1	−2	−3	55	+3	+2	+1	−1	−2	−3
6	+3	+2	+1	−1	−2	−3	31	+3	+2	+1	−1	−2	−3	56	+3	+2	+1	−1	−2	−3
7	+3	+2	+1	−1	−2	−3	32	+3	+2	+1	−1	−2	−3	57	+3	+2	+1	−1	−2	−3
8	+3	+2	+1	−1	−2	−3	33	+3	+2	+1	−1	−2	−3	58	+3	+2	+1	−1	−2	−3
9	+3	+2	+1	−1	−2	−3	34	+3	+2	+1	−1	−2	−3	59	+3	+2	+1	−1	−2	−3
10	+3	+2	+1	−1	−2	−3	35	+3	+2	+1	−1	−2	−3	60	+3	+2	+1	−1	−2	−3
11	+3	+2	+1	−1	−2	−3	36	+3	+2	+1	−1	−2	−3	61	+3	+2	+1	−1	−2	−3
12	+3	+2	+1	−1	−2	−3	37	+3	+2	+1	−1	−2	−3	62	+3	+2	+1	−1	−2	−3
13	+3	+2	+1	−1	−2	−3	38	+3	+2	+1	−1	−2	−3	63	+3	+2	+1	−1	−2	−3
14	+3	+2	+1	−1	−2	−3	39	+3	+2	+1	−1	−2	−3	64	+3	+2	+1	−1	−2	−3
15	+3	+2	+1	−1	−2	−3	40	+3	+2	+1	−1	−2	−3	65	+3	+2	+1	−1	−2	−3
16	+3	+2	+1	−1	−2	−3	41	+3	+2	+1	−1	−2	−3	66	+3	+2	+1	−1	−2	−3
17	+3	+2	+1	−1	−2	−3	42	+3	+2	+1	−1	−2	−3	67	+3	+2	+1	−1	−2	−3
18	+3	+2	+1	−1	−2	−3	43	+3	+2	+1	−1	−2	−3	68	+3	+2	+1	−1	−2	−3
19	+3	+2	+1	−1	−2	−3	44	+3	+2	+1	−1	−2	−3	69	+3	+2	+1	−1	−2	−3
20	+3	+2	+1	−1	−2	−3	45	+3	+2	+1	−1	−2	−3	70	+3	+2	+1	−1	−2	−3
21	+3	+2	+1	−1	−2	−3	46	+3	+2	+1	−1	−2	−3	71	+3	+2	+1	−1	−2	−3
22	+3	+2	+1	−1	−2	−3	47	+3	+2	+1	−1	−2	−3	72	+3	+2	+1	−1	−2	−3
23	+3	+2	+1	−1	−2	−3	48	+3	+2	+1	−1	−2	−3	73	+3	+2	+1	−1	−2	−3
24	+3	+2	+1	−1	−2	−3	49	+3	+2	+1	−1	−2	−3	74	+3	+2	+1	−1	−2	−3
25	+3	+2	+1	−1	−2	−3	50	+3	+2	+1	−1	−2	−3	75	+3	+2	+1	−1	−2	−3

76	+3	+2	+1	−1	−2	−3

Scoring Key

+3 I agree very much
+2 I agree on the whole
+1 I agree a little

−1 I disagree a little
−2 I disagree on the whole
−3 I disagree very much

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APPENDIX B

CORRELATION MATRICES AND THE RESULTS OF FACTOR ANALYSIS

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TABLE 1.1

Correlation Matrix of 11 Variables

Total Sample: N = 798

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.49									
3. Time to overcome 3 beliefs	.04	.12								
4. Time to solve after overcoming 3 beliefs	.08	.16	.35							
5. English	-.11	-.10	-.17	-.14						
6. Reading	-.13	-.20	-.22	-.25	.58					
7. CQT Verbal	-.09	-.20	-.14	-.13	.55	.67				
8. CQT Information	-.13	-.14	-.17	-.23	.36	.56	.52			
9. CQT Numerical	.01	-.06	-.21	-.29	.30	.35	.21	.59		
10. Embedded-Figures	-.01	.06	.18	.29	-.26	-.27	-.18	-.36	-.42	
11. Perceptual Synthesis	-.00	.03	.21	.24	-.15	-.19	-.08	-.34	-.47	.56

TABLE 1.2

Rotated Factor Loadings for 11 Variables -- Varimax

Total Sample: N = 798

Variable	Rotated Factor Loadings 1	2	3	4
1. Rigidity	-.12	-.03	.72	.11
2. Dogmatism	-.05	.03	.73	.02
3. Time to overcome 3 beliefs	-.12	-.11	.04	.65
4. Time to solve after overcoming 3 beliefs	-.09	-.25	.11	.61
5. English	.69	.13	-.06	-.11
6. Reading	.79	.19	-.12	-.17
7. CQT Verbal	.82	.05	-.11	-.05
8. CQT Information	.58	.52	-.05	-.04
9. CQT Numerical	.28	.69	.02	-.13
10. Embedded Figures	-.14	-.68	.01	.18
11. Perceptual Synthesis	-.01	-.74	.00	.16

TABLE 1.3

Primary Pattern: Direct Oblique Solutions

Total Sample: N = 798

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	-.02	-.01	.88	.05
2.	Dogmatism	.00	.06	.83	-.07
3.	Time to overcome 3 beliefs	-.08	.03	-.05	-.88
4.	Time to solve after overcoming 3 beliefs	.15	-.02	.07	-.73
5.	English	-.05	.79	-.02	-.01
6.	Reading	-.01	.85	.04	-.08
7.	CQT Verbal	-.16	.91	.02	.03
8.	CQT Information	.40	.61	-.02	.07
9.	CQT Numerical	.68	.25	-.05	-.02
10.	Embedded Figures	.76	.07	.01	-.03
11.	Perceptual Synthesis	.86	-.08	.02	-.02

TABLE 1.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Total Sample: N = 798

	Variable	Dimension 1	Dimension 2
1.	Rigidity	-2408.8	-173.9
2.	Dogmatism	-1740.5	-257.7
3.	Time to overcome 3 beliefs	271.6	-1339.4
4.	Time to solve after overcoming 3 beliefs	-3.8	-952.5
5.	English	21.4	889.5
6.	Reading	-96.0	504.4
7.	CQT Verbal	-353.1	1015.5
8.	CQT Information	477.2	499.3
9.	CQT Numerical	1104.7	296.3
10.	Embedded Figures	1289.1	-52.2
11.	Perceptual Synthesis	1438.2	-429.3

TABLE 2.1

Correlation Matrix of 11 Variables

Male Sample: N = 518

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.53									
3. Time to overcome 3 beliefs	.05	.14								
4. Time to solve after overcoming 3 beliefs	.10	.17	.37							
5. English	-.08	-.12	-.21	-.19						
6. Reading	-.14	-.21	-.26	-.31	.57					
7. CQT Verbal	-.09	-.24	-.16	-.13	.51	.64				
8. CQT Information	-.07	-.19	-.20	-.21	.45	.58	.59			
9. CQT Numerical	-.06	-.08	-.24	-.27	.46	.42	.29	.52		
10. Embedded-Figures	.05	.07	.16	.24	-.27	-.21	-.15	-.25	-.39	
11. Perceptual Synthesis	.02	.06	.23	.24	-.26	-.22	-.13	-.26	-.40	.57

TABLE 2.2

Rotated Factor Loadings for 11 Variables -- Varimax

Male Sample: N = 518

	Variable	Rotated Factor Loadings 1	2	3	4
1.	Rigidity	-.15	.00	.74	-.12
2.	Dogmatism	-.04	-.03	.74	-.02
3.	Time to overcome 3 beliefs	-.15	-.11	.03	-.64
4.	Time to solve after overcoming 3 beliefs	-.12	-.19	.11	-.64
5.	English	.67	.24	-.02	.11
6.	Reading	.77	.09	-.12	.26
7.	CQT Verbal	.80	-.01	-.13	.04
8.	CQT Information	.73	.21	-.06	.11
9.	CQT Numerical	.47	.51	.01	.19
10.	Embedded Figures	-.13	-.74	.04	-.10
11.	Perceptual Synthesis	-.12	-.73	.00	-.18

TABLE 2.3

Primary Pattern: Direct Oblique Solutions

Male Sample: N = 518

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	-.05	.89	.08	.05
2.	Dogmatism	.08	.84	-.02	-.07
3.	Time to overcome 3 beliefs	.07	-.05	-.09	-.85
4.	Time to solve after overcoming 3 beliefs	.02	.07	.05	-.78
5.	English	.76	-.05	.07	.03
6.	Reading	.83	.04	-.12	-.13
7.	CQT Verbal	.88	.06	-.21	.08
8.	CQT Information	.81	-.01	.03	.03
9.	CQT Numerical	.52	-.07	.42	-.05
10.	Embedded Figures	.11	.15	.84	.05
11.	Perceptual Synthesis	.10	.00	.81	-.05

TABLE 2.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Male Sample: N = 518

Variable	Dimension 1	Dimension 2
1. Rigidity	-2709.3	76.0
2. Dogmatism	-1878.1	209.2
3. Time to overcome 3 beliefs	532.0	1417.4
4. Time to solve after overcoming 3 beliefs	-74.5	1183.5
5. English	393.9	-826.8
6. Reading	-141.7	-344.4
7. CQT Verbal	-353.7	-892.5
8. CQT Information	132.4	-674.1
9. CQT Numerical	805.7	-250.1
10. Embedded Figures	1603.1	-144.6
11. Perceptual Synthesis	1690.3	246.5

TABLE 3.1

Correlation Matrix of 11 Variables

Female Sample: N = 280

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.43									
3. Time to overcome 3 beliefs	.06	.10								
4. Time to solve after overcoming 3 beliefs	.11	.14	.32							
5. English	-.10	-.08	-.15	-.19						
6. Reading	-.11	-.19	-.17	-.20	.52					
7. CQT Verbal	-.05	-.11	-.13	-.21	.53	.65				
8. CQT Information	-.14	-.09	-.12	-.23	.43	.56	.58			
9. CQT Numerical	-.09	-.07	-.16	-.28	.39	.35	.30	.49		
10. Embedded-Figures	.02	.06	.26	.35	-.31	-.28	-.20	-.24	-.29	
11. Perceptual Synthesis	.10	.01	.19	.17	-.24	-.23	-.18	-.29	-.37	.54

TABLE 3.2

Rotated Factor Loadings for 11 Variables -- Varimax

Female Sample: N = 280

	Variable	Rotated Factor Loadings 1	2	3	4
1.	Rigidity	-.08	-.05	.69	.15
2.	Dogmatism	-.05	.09	71	.00
3.	Time to overcome 3 beliefs	-.08	.11	.04	.62
4.	Time to solve after overcoming 3 beliefs	-.16	.16	.11	.64
5.	English	.65	-.21	-.03	-.12
6.	Reading	.77	-.10	-.12	-.14
7.	CQT Verbal	.82	.00	-.02	-.13
8.	CQT Information	.72	-.25	-.10	-.04
9.	CQT Numerical	.44	-.47	-.06	-.11
10.	Embedded Figures	-.16	.63	-.02	.37
11.	Perceptual Synthesis	-.15	.76	.03	.09

TABLE 3.3

Primary Pattern: Direct Oblique Solutions

Female Sample: N = 280

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	.00	.86	.09	.09
2.	Dogmatism	.04	.82	-.12	-.13
3.	Time to overcome 3 beliefs	-.03	-.02	.01	-.83
4.	Time to solve after overcoming 3 beliefs	.07	.06	.09	-.72
5.	English	.73	-.03	.05	.00
6.	Reading	.84	.05	-.10	-.04
7.	CQT Verbal	.90	-.05	-.21	-.04
8.	CQT Information	.80	.03	.07	.08
9.	CQT Numerical	.47	.01	.41	.03
10.	Embedded Figures	.10	-.05	.70	-.24
11.	Perceptual Synthesis	.11	.02	.88	.12

TABLE 3.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Female Sample: N = 280

	Variable	Dimension 1	Dimension 2
1.	Rigidity	2141.6	231.3
2.	Dogmatism	2048.6	-174.7
3.	Time to overcome 3 beliefs	-141.8	-1582.1
4.	Time to solve after overcoming 3 beliefs	56.1	-838.3
5.	English	-543.6	646.2
6.	Reading	-20.7	561.8
7.	CQT Verbal	-278.9	887.4
8.	CQT Information	-288.9	660.4
9.	CQT Numerical	-780.1	350.1
10.	Embedded Figures	-907.8	-513.8
11.	Perceptual Synthesis	-1284.5	-228.3

TABLE 4.1

Correlation Matrix of 11 Variables

Examiner 1, Male Sample: N = 56

	Variable	1	2	3	4	5	6	7	8	9	10
1.	Rigidity										
2.	Dogmatism	.49									
3.	Time to overcome 3 beliefs	.27	.29								
4.	Time to solve after overcoming 3 beliefs	.31	.16	.20							
5.	English	-.16	-.23	-.06	-.28						
6.	Reading	-.24	-.26	-.18	-.32	.62					
7.	CQT Verbal	-.06	-.34	-.06	-.03	.49	.56				
8.	CQT Information	-.07	-.20	-.15	-.23	.41	.61	.55			
9.	CQT Numerical	-.02	-.05	-.09	-.32	.37	.36	.22	.58		
10.	Embedded-Figures	.12	.06	.20	.01	-.12	-.31	-.10	-.21	-.30	
11.	Perceptual Synthesis	.07	.04	.23	.09	-.19	-.42	-.12	-.30	-.47	.61

TABLE 4.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 1, Male Sample: N = 56

	Variable	Rotated Factor Loadings 1	2	3	4
1.	Rigidity	-.29	.70	-.04	-.07
2.	Dogmatism	-.03	.74	.02	.18
3.	Time to overcome 3 beliefs	.01	.51	.29	.11
4.	Time to solve after overcoming 3 beliefs	-.12	.28	-.03	.72
5.	English	.69	-.11	-.03	-.24
6.	Reading	.74	-.22	-.29	-.18
7.	CQT Verbal	.82	-.12	.00	.18
8.	CQT Information	.72	.01	-.24	-.29
9.	CQT Numerical	.40	.15	-.43	-.54
10.	Embedded Figures	-.10	-.12	.78	-.06
11.	Perceptual Synthesis	-.17	.03	.82	.12

TABLE 4.3

Primary Pattern: Direct Oblique Solutions

Examiner 1, Male Sample: N = 56

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	-.09	.81	-.02	.26
2.	Dogmatism	.16	.77	-.07	-.11
3.	Time to overcome 3 beliefs	-.14	.62	.36	.09
4.	Time to solve after overcoming 3 beliefs	.21	.20	-.29	.92
5.	English	.78	.01	-.17	.14
6.	Reading	.78	.13	.14	.02
7.	CQT Verbal	.82	.07	-.10	-.36
8.	CQT Information	.81	-.10	.08	.08
9.	CQT Numerical	.57	-.25	.27	.39
10.	Embedded Figures	.08	.14	.92	-.29
11.	Perceptual Synthesis	.22	.02	.86	-.10

TABLE 4.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 1, Male Sample: N = 56

	Variable	Dimension 1	Dimension 2	Dimension 3
1.	Rigidity	-1890.9	-78.5	-77.4
2.	Dogmatism	-1463.6	438.5	854.3
3.	Time to overcome 3 beliefs	-1036.3	-1563.8	-7.3
4.	Time to solve after overcoming 3 beliefs	-605.1	181.2	-1648.2
5.	English	214.8	1283.6	-165.1
6.	Reading	280.2	468.6	131.5
7.	CQT Verbal	410.9	1243.8	948.3
8.	CQT Information	939.8	574.4	-50.3
9.	CQT Numerical	1210.1	-71.0	-856.5
10.	Embedded-Figures	902.7	-1336.0	827.8
11.	Perceptual Synthesis	1037.5	-1140.6	42.8

TABLE 5.1

Correlation Matrix of 11 Variables

Examiner 1, Female Sample: N = 41

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.45									
3. Time to overcome 3 beliefs	.21	.08								
4. Time to solve after overcoming 3 beliefs	.11	-.02	.31							
5. English	.17	-.05	-.14	-.34						
6. Reading	-.15	-.05	-.49	-.43	.40					
7. CQT Verbal	.04	.07	-.21	-.36	.46	.61				
8. CQT Information	-.16	.08	-.42	-.16	.22	.61	.49			
9. CQT Numerical	.11	.11	-.36	-.49	.21	.34	.18	.48		
10. Embedded-Figures	.04	.14	.38	.33	-.50	-.49	-.30	-.34	-.16	
11. Perceptual Synthesis	.09	.05	.21	.25	-.32	-.33	-.27	-.23	-.32	.52

TABLE 5.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 1, Female Sample: N = 41

Variable	Rotated Factor Loadings 1	2	3	4
1. Rigidity	.10	.72	-.18	-.11
2. Dogmatism	-.15	.81	.13	.07
3. Time to overcome 3 beliefs	-.42	.28	-.09	.49
4. Time to solve after overcoming 3 beliefs	-.13	.01	-.39	.60
5. English	.23	.16	.75	-.02
6. Reading	.73	-.12	.37	-.25
7. CQT Verbal	.70	.16	.41	.03
8. CQT Information	.81	-.02	.03	-.30
9. CQT Numerical	.20	.19	.08	.83
10. Embedded Figures	-.23	.18	-.73	.17
11. Perceptual Synthesis	-.06	.12	-.59	.33

TABLE 5.3

Primary Pattern: Direct Oblique Solutions

Examiner 1, Female Sample: N = 41

Variable	Primary Pattern 1	2	3	4
1. Rigidity	.10	.84	-.18	.07
2. Dogmatism	-.16	.81	.27	-.16
3. Time to overcome 3 beliefs	.31	.25	-.07	.53
4. Time to solve after overcoming 3 beliefs	-.03	-.04	.34	.60
5. English	.23	-.16	.76	-.13
6. Reading	.73	.10	.16	.15
7. CQT Verbal	.82	-.16	.22	-.19
8. CQT Information	.81	-.01	-.20	.23
9. CQT Numerical	.00	-.27	.00	.88
10. Embedded Figures	.15	.17	.71	.09
11. Perceptual Synthesis	-.12	.10	.64	.33

TABLE 5.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 1, Female Sample: N = 61

Variable	Dimension 1	Dimension 2
1. Rigidity	1875.1	465.0
2. Dogmatism	2103.7	-477.2
3. Time to overcome 3 beliefs	231.4	647.8
4. Time to solve after overcoming 3 beliefs	-947.1	245.8
5. English	-825.4	-827.4
6. Reading	-370.2	42.1
7. CQT Verbal	-898.3	-264.8
8. CQT Information	-209.5	509.7
9. CQT Numerical	-778.8	868.6
10. Embedded-Figures	-197.7	-528.4
11. Perceptual Synthesis	16.8	-681.1

TABLE 6.1

Correlation Matrix of 11 Variables

Examiner 2, Male Sample: N = 165

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.50									
3. Time to overcome 3 beliefs	.07	.00								
4. Time to solve after overcoming 3 beliefs	.22	.20	.43							
5. English	-.06	-.14	-.21	-.15						
6. Reading	-.15	-.33	-.32	-.37	.57					
7. CQT Verbal	-.18	-.34	-.24	-.25	.52	.67				
8. CQT Information	-.09	-.27	-.35	-.27	.45	.64	.68			
9. CQT Numerical	-.06	-.08	-.16	-.20	.36	.36	.30	.53		
10. Embedded-Figures	-.01	-.04	.09	.24	-.28	-.19	-.19	-.19	-.23	
11. Perceptual Synthesis	-.03	.02	.29	.32	-.24	-.22	-.19	-.28	-.33	.59

TABLE 6.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 2, Male Sample: N = 165

	Variable	Rotated Factor Loadings 1	2	3	4
1.	Rigidity	-.23	.04	.75	.00
2.	Dogmatism	-.02	.00	.74	-.10
3.	Time to overcome 3 beliefs	-.22	-.06	-.06	-.74
4.	Time to solve after overcoming 3 beliefs	-.13	-.26	.26	-.64
5.	English	.69	.20	-.02	.01
6.	Reading	.77	.05	-.21	.27
7.	CQT Verbal	.78	.03	-.24	.12
8.	CQT Information	.80	.10	-.09	.24
9.	CQT Numerical	.52	.32	.02	.06
10.	Embedded Figures	-.15	-.79	-.02	-.02
11.	Perceptual Synthesis	-.17	-.75	-.04	-.26

TABLE 6.3

Primary Pattern: Direct Oblique Solutions

Examiner 2, Male Sample: N = 165

Variable	Primary Pattern 1	2	3	4
1. Rigidity	-.08	.86	.03	-.08
2. Dogmatism	.20	.81	-.05	.07
3. Time to overcome 3 beliefs	.13	-.20	-.10	-.87
4. Time to solve after overcoming 3 beliefs	-.02	.21	.20	-.73
5. English	.78	-.08	.10	.14
6. Reading	.80	.08	-.09	-.14
7. CQT Verbal	.84	.13	-.10	.01
8. CQT Information	.84	-.03	-.05	-.10
9. CQT Numerical	.58	-.08	.27	.08
10. Embedded Figures	.07	.02	.89	.08
11. Perceptual Synthesis	.07	-.04	.80	-.19

TABLE 6.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 2, Male Sample: N = 165

Variable	Dimension 1	Dimension 2
1. Rigidity	-2146.6	-536.9
2. Dogmatism	-1947.6	303.8
3. Time to overcome 3 beliefs	506.7	-1312.9
4. Time to solve after overcoming 3 beliefs	-76.4	-1064.5
5. English	127.9	1010.6
6. Reading	-269.0	153.1
7. CQT Verbal	-423.5	543.4
8. CQT Information	20.8	353.2
9. CQT Numerical	751.1	867.3
10. Embedded-Figures	1916.8	-14.0
11. Perceptual Synthesis	1539.7	-303.0

TABLE 7.1

Correlation Matrix of 11 Variables

Examiner 2, Female Sample: N = 102

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.43									
3. Time to overcome 3 beliefs	.18	.02								
4. Time to solve after overcoming 3 beliefs	.17	.12	.41							
5. English	-.16	-.08	-.15	-.10						
6. Reading	-.13	-.22	-.11	-.14	.62					
7. CQT Verbal	-.06	-.17	-.11	-.05	.57	.70				
8. CQT Information	-.19	-.27	-.22	-.19	.54	.61	.60			
9. CQT Numerical	-.03	-.14	-.27	-.18	.44	.40	.34	.52		
10. Embedded-Figures	.09	.13	.32	.28	-.31	-.22	-.17	-.17	-.30	
11. Perceptual Synthesis	.12	.03	.31	.17	-.30	-.21	-.13	-.31	-.36	.57

TABLE 7.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 2, Female Sample: N = 102

Variable	Rotated Factor Loadings 1	2	3	4
1. Rigidity	-.15	.02	73	.00
2. Dogmatism	-.04	.06	.70	-.15
3. Time to overcome 3 beliefs	-.09	.25	.02	-.68
4. Time to solve after overcoming 3 beliefs	-.06	.10	.14	-.69
5. English	.73	-.28	-.04	.02
6. Reading	.83	-.08	-.14	.04
7. CQT Verbal	.83	.00	-.06	.00
8. CQT Information	.75	-.11	-.20	.18
9. CQT Numerical	.53	-.34	.01	.23
10. Embedded Figures	-.13	.74	.08	-.20
11. Perceptual Synthesis	-.18	.77	.03	-.15

TABLE 7.3

Primary Pattern: Direct Oblique Solutions

Examiner 2, Female Sample: N = 102

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	-.05	.05	.83	-.10
2.	Dogmatism	.09	.02	.85	.09
3.	Time to overcome 3 beliefs	.05	.11	-.07	-.78
4.	Time to solve after overcoming 3 beliefs	.02	-.12	.06	-.88
5.	English	.77	.16	-.04	.08
6.	Reading	.88	-.08	.04	.02
7.	CQT Verbal	.90	-.16	-.03	.05
8.	CQT Information	.79	-.04	.11	-.10
9.	CQT Numerical	.55	.26	-.10	-.13
10.	Embedded Figures	.04	.82	.06	-.05
11.	Perceptual Synthesis	.09	.87	.01	.05

TABLE 7.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 2, Female Sample: N = 102

	Variable	Dimension 1	Dimension 2	Dimension 3
1.	Rigidity	1109.2	-1736.9	186.2
2.	Dogmatism	480.1	-1921.3	601.8
3.	Time to overcome 3 beliefs	1468.6	806.0	-542.2
4.	Time to solve after overcoming 3 beliefs	1427.4	335.0	-1305.7
5.	English	-1225.5	177.3	39.0
6.	Reading	-1242.2	-215.9	-184.9
7.	CQT Verbal	-1445.1	-320.0	-415.6
8.	CQT Information	-876.6	-73.1	-333.4
9.	CQT Numerical	-845.4	731.8	33.0
10.	Embedded-Figures	833.6	1020.4	986.7
11.	Perceptual Synthesis	315.8	1196.7	934.9

TABLE 8.1

Correlation Matrix of 11 Variables

Examiner 3, Male Sample: N = 86

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.60									
3. Time to overcome 3 beliefs	.08	.23								
4. Time to solve after overcoming 3 beliefs	.21	.35	.33							
5. English	.00	.05	-.17	-.07						
6. Reading	-.25	-.18	-.15	-.21	.56					
7. CQT Verbal	-.13	-.09	-.20	-.17	.52	.60				
8. CQT Information	.04	.02	-.13	-.04	.54	.47	.48			
9. CQT Numerical	-.02	-.01	-.33	-.25	.57	.38	.26	.51		
10. Embedded-Figures	.01	-.12	.07	.10	-.32	-.15	-.23	-.27	-.32	
11. Perceptual Synthesis	-.02	-.08	.19	.08	-.43	-.21	-.26	-.36	-.46	.57

TABLE 8.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 3, Male Sample: N = 86

Variable	Rotated Factor Loadings 1	2	3	4
1. Rigidity	-.02	.75	-.13	-.28
2. Dogmatism	-.07	.80	.02	-.02
3. Time to overcome 3 beliefs	-.11	.06	.05	-.67
4. Time to solve after overcoming 3 beliefs	-.05	.31	.04	-.59
5. English	.74	.10	-.31	.13
6. Reading	.78	-.24	-.03	.09
7. CQT Verbal	.73	-.15	-.10	.06
8. CQT Information	.69	.13	-.24	.11
9. CQT Numerical	.46	.13	-.39	.49
10. Embedded Figures	-.14	.00	.76	.00
11. Perceptual Synthesis	-.23	-.06	.75	-.15

TABLE 8.3

Primary Pattern: Direct Oblique Solutions

Examiner 3, Male Sample: N = 86

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	.00	.93	.15	.09
2.	Dogmatism	-.02	.79	-.06	-.25
3.	Time to overcome 3 beliefs	.15	-.09	-.10	-.84
4.	Time to solve after overcoming 3 beliefs	.04	.27	.01	-.67
5.	English	.80	-.12	.12	.03
6.	Reading	.85	.22	-.15	.08
7.	CQT Verbal	.81	.12	-.09	.08
8.	CQT Information	.78	-.16	.04	.04
9.	CQT Numerical	.51	-.17	.24	-.38
10.	Embedded Figures	.05	.13	.91	.13
11.	Perceptual Synthesis	.19	.00	.79	-.03

TABLE 8.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 3, Male Sample: N = 86

Variable	Dimension 1	Dimension 2
1. Rigidity	-1965.4	554.5
2. Dogmatism	-2102.3	29.6
3. Time to overcome 3 beliefs	-470.1	-1209.9
4. Time to solve after overcoming 3 beliefs	-1125.0	-834.6
5. English	936.9	354.6
6. Reading	5.6	814.9
7. CQT Verbal	210.1	883.0
8. CQT Information	1104.4	674.2
9. CQT Numerical	525.7	-222.1
10. Embedded-Figures	1445.5	-714.8
11. Perceptual Synthesis	1434.7	-329.4

TABLE 9.1

Correlation Matrix of 11 Variables

Examiner 3, Female Sample: N = 68

	Variable	1	2	3	4	5	6	7	8	9	10
1.	Rigidity										
2.	Dogmatism	.53									
3.	Time to overcome 3 beliefs	.12	.15								
4.	Time to solve after overcoming 3 beliefs	.07	.14	.30							
5.	English	-.18	.02	-.25	-.16						
6.	Reading	-.26	-.35	-.16	-.42	.45					
7.	CQT Verbal	-.08	-.13	-.09	-.23	.49	.60				
8.	CQT Information	-.05	.04	.01	-.26	.26	.49	.53			
9.	CQT Numerical	-.19	-.04	-.13	-.18	.38	.40	.22	.40		
10.	Embedded-Figures	.12	-.04	.20	.11	-.29	-.39	-.15	-.24	-.34	
11.	Perceptual Synthesis	.15	-.11	.10	.09	-.26	-.24	-.14	-.23	-.42	.55

TABLE 9.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 3, Female Sample: N = 68

	Variable	Rotated Factor Loadings			
		1	2	3	4
1.	Rigidity	-.08	.81	.15	.14
2.	Dogmatism	-.03	.75	-.20	.02
3.	Time to overcome 3 beliefs	.05	.09	-.15	.71
4.	Time to solve after overcoming 3 beliefs	-.32	.04	.00	.58
5.	English	.46	-.03	.36	-.28
6.	Reading	.71	-.33	.24	-.26
7.	CQT Verbal	.81	-.06	.04	-.11
8.	CQT Information	.73	.06	.22	.06
9.	CQT Numerical	.34	-.11	.57	-.06
10.	Embedded Figures	-.12	.01	-.73	.15
11.	Perceptual Synthesis	-.09	-.01	-.78	.01

TABLE 9.3

Primary Pattern: Direct Oblique Solutions

Examiner 3, Female Sample: N = 68

Variable	Primary Pattern 1	2	3	4
1. Rigidity	-.02	.86	.21	-.11
2. Dogmatism	.07	.88	-.21	.05
3. Time to overcome 3 beliefs	-.17	.01	.10	.89
4. Time to solve after overcoming 3 beliefs	.35	-.08	-.17	.67
5. English	.47	-.04	.28	.19
6. Reading	.72	.24	.09	.12
7. CQT Verbal	.89	-.02	-.13	.01
8. CQT Information	.81	-.15	.09	-.16
9. CQT Numerical	.32	.07	.57	-.05
10. Embedded Figures	.03	-.03	.78	.09
11. Perceptual Synthesis	.00	-.04	.87	-.08

TABLE 9.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 3, Female Sample: N = 68

	Variable	Dimension 1	2	3
1.	Rigidity	-1116.9	-1124.9	541.3
2.	Dogmatism	-1923.0	-494.2	496.6
3.	Time to overcome 3 beliefs	-592.1	30.2	-1689.0
4.	Time to solve after overcoming 3 beliefs	-737.0	1141.7	-649.2
5.	English	749.3	395.7	-351.3
6.	Reading	-198.4	218.5	323.3
7.	CQT Verbal	84.8	1172.1	629.1
8.	CQT Information	725.5	773.3	834.5
9	CQT Numerical	803.1	-380.9	605.0
10.	Embedded-Figures	948.8	-715.2	-628.9
11.	Perceptual Synthesis	1255.9	-1016.3	-111.2

TABLE 10.1

Correlation Matrix of 11 Variables

Examiner 4, Male Sample: N = 150

Variable	1	2	3	4	5	6	7	8	9	10
1. Rigidity										
2. Dogmatism	.53									
3. Time to overcome 3 beliefs	.02	.23								
4. Time to solve after overcoming 3 beliefs	-.01	.17	.50							
5. English	-.18	-.21	-.23	-.26						
6. Reading	-.20	-.22	-.28	-.34	.58					
7. CQT Verbal	-.14	-.33	-.19	-.14	.51	.69				
8. CQT Information	-.14	-.27	-.14	-.21	.39	.57	.60			
9. CQT Numerical	-.10	-.12	-.24	-.35	.52	.50	.36	.49		
10. Embedded-Figures	.06	.19	.20	.31	-.28	-.24	-.21	-.29	-.50	
11. Perceptual Synthesis	.04	.10	.16	.35	-.20	-.19	-.09	-.20	-.42	.69

TABLE 10.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 4, Male Sample: N = 150

	Variable	Rotated Factor Loadings			
		1	2	3	4
1.	Rigidity	-.18	.06	.77	.18
2.	Dogmatism	-.11	.03	.76	-.06
3.	Time to overcome 3 beliefs	-.14	.06	.09	.74
4.	Time to solve after overcoming 3 beliefs	-.16	.27	.00	.72
5.	English	.66	-.18	-.10	-.17
6.	Reading	.81	-.08	-.10	-.24
7.	CQT Verbal	.82	.01	-.17	-.05
8.	CQT Information	.72	-.19	-.12	-.02
9.	CQT Numerical	.55	-.51	.02	-.17
10.	Embedded Figures	-.18	.82	.09	.12
11.	Perceptual Synthesis	-.07	.82	.02	.15

TABLE 10.3

Primary Pattern: Direct Oblique Solutions

Examiner 4, Male Sample: N = 150

Variable	Primary Pattern 1	2	3	4
1. Rigidity	.00	.07	.88	-.13
2. Dogmatism	.06	.03	.84	.15
3. Time to overcome 3 beliefs	.03	-.14	.06	.91
4. Time to solve after overcoming 3 beliefs	.08	.13	-.05	.78
5. English	.73	.01	.01	.06
6. Reading	.86	-.13	-.01	.12
7. CQT Verbal	.89	-.20	.06	-.06
8. CQT Information	.81	.04	.02	-.12
9. CQT Numerical	.60	.41	-.11	.03
10. Embedded Figures	.16	.84	.06	-.01
11. Perceptual Synthesis	.03	.88	.01	.04

TABLE 10.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 4, Male Sample: N = 150

	Variable	Dimension 1	2	3
1.	Rigidity	-1785.7	1111.1	623.4
2.	Dogmatism	-1471.5	909.0	-91.9
3.	Time to overcome 3 beliefs	372.6	863.6	-1498.8
4.	Time to solve after overcoming 3 beliefs	1140.7	716.6	-773.4
5.	English	168.4	-1005.2	-536.0
6.	Reading	-271.9	-811.6	-318.9
7.	CQT Verbal	-781.6	-1141.5	-137.7
8.	CQT Information	-470.7	-1029.5	460.7
9.	CQT Numerical	754.5	-543.6	279.4
10.	Embedded-Figures	986.0	270.8	1040.4
11.	Perceptual Synthesis	1359.2	660.4	952.7

TABLE 11.1

Correlation Matrix of 11 Variables

Examiner 4, Female Sample: N = 28

	Variable	1	2	3	4	5	6	7	8	9	10
1.	Rigidity										
2.	Dogmatism	[illegible]									
3.	Time to overcome 3 beliefs	-.06	.08								
4.	Time to solve after overcoming 3 beliefs	.14	.31	.57							
5.	English	-.02	-.24	-.26	-.28						
6.	Reading	.18	-.00	-.32	-.23	.53					
7.	CQT Verbal	-.08	-.21	-.30	-.28	.54	.50				
8.	CQT Information	-.13	-.28	-.36	-.40	.45	.35	.74			
9.	CQT Numerical	-.17	-.20	-.28	-.25	.40	.39	.44	.52		
10.	Embedded-Figures	-.15	.16	.39	.45	-.17	-.25	-.46	-.44	-.25	
11.	Perceptual Synthesis	-.06	.08	.37	.32	-.04	-.23	-.44	-.35	-.37	.78

TABLE 11.2

Rotated Factor Loadings for 11 Variables -- Varimax

Examiner 4, Female Sample: N = 28

Variable	Rotated Factor Loadings 1	2	3	4
1. Rigidity	.15	-.03	.48	.26
2. Dogmatism	.00	.03	.70	-.06
3. Time to overcome 3 beliefs	.23	-.23	-.07	.71
4. Time to solve after overcoming 3 beliefs	.15	-.22	.25	.77
5. English	-.77	-.13	-.05	-.24
6. Reading	-.72	.07	.33	-.20
7. CQT Verbal	-.75	.41	-.16	-.04
8. CQT Information	-.65	.38	-.33	-.16
9. CQT Numerical	-.58	.27	-.27	-.07
10. Embedded Figures	.17	-.81	-.07	.33
11. Perceptual Synthesis	.13	-.89	-.04	.16

TABLE 11.3

Primary Pattern: Direct Oblique Solutions

Examiner 4, Female Sample: N = 28

	Variable	Primary Pattern 1	2	3	4
1.	Rigidity	.04	.13	-.83	.12
2.	Dogmatism	.11	.16	-.58	-.38
3.	Time to overcome 3 beliefs	.11	-.14	.09	-.74
4.	Time to solve after overcoming 3 beliefs	.02	-.09	-.27	-.82
5.	English	.85	.40	.00	-.14
6.	Reading	.79	.10	.41	-.05
7.	CQT Verbal	.81	-.24	-.05	.14
8.	CQT Information	.69	-.20	-.24	-.01
9.	CQT Numerical	.70	-.13	-.21	.13
10.	Embedded Figures	.11	-.80	.14	-.22
11.	Perceptual Synthesis	.10	-.91	.12	-.02

TABLE 11.4

Coordinates of Smallest Space Analysis: 2-Dimensional Solution

Examiner 4, Female Sample: N = 28

	Variable	Dimension 1	2	3
1.	Rigidity	-2377.5	-31.6	830.4
2.	Dogmatism	-1375.0	33.8	-1303.5
3.	Time to overcome 3 beliefs	787.1	-649.4	-733.8
4.	Time to solve after overcoming 3 beliefs	-235.6	-879.9	-592.5
5.	English	205.3	1315.0	-380.9
6.	Reading	1196.6	1020.0	-64.7
7.	CQT Verbal	531.7	322.6	241.6
8.	CQT Information	-1.4	171.7	75.7
9.	CQT Numerical	-75.0	683.3	856.3
10.	Embedded-Figures	686.7	-1038.9	243.5
11.	Perceptual Synthesis	657.2	-946.6	827.9

TABLE 12.1

Correlation Matrix of Psychological and Cognitive Test Battery and Essay and Objective Tests in Natural Science 181

N = 100

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Rigidity	-	.46	.07	.13	-.09	-.29	-.20	-.23	-.24	.04	-.04	-.20	-.24	-.22
2.	Dogmatism		-	.09	.18	.03	-.34	-.23	-.16	-.09	.08	-.09	-.18	-.25	-.18
3.	Time to overcome 3 beliefs			-	.29	-.24	-.32	-.20	-.20	-.12	.04	.16	-.23	-.28	-.22
4.	Time to solve after overcoming 3 beliefs				-	-.07	-.17	-.03	-.19	-.19	.40	.23	-.16	-.21	-.14
5.	English					-	.36	.34	.24	.26	-.15	-.14	.26	.26	.32
6.	Reading						-	.71	.59	.33	-.03	-.10	.60	.67	.65
7.	CQT Verbal							-	.65	.22	-.03	-.17	.41	.58	.55
8.	CQT Information								-	.51	-.09	-.22	.28	.53	.49
9.	CQT Numerical									-	-.28	-.36	.21	.34	.36
10.	Embedded-Figures										-	.50	.02	-.09	.01
11.	Perceptual Synthesis											-	.04	-.21	-.12
12.	Natural Science Essay - Exams 1 & 2												-	.66	.66
13.	Natural Science Final Objective (University College)													-	.76
14.	Natural Science Objective Test 7 (Instructor)														-

TABLE 12.2

Rotated Factor Loading for 14 Variables

Which Include Natural Science 181

Essay and Objective Tests

N = 100

	Variable	Rotated Factor Loadings				
		1	2	3	4	5
1.	Rigidity	-.12	.04	.68	-.03	.14
2.	Dogmatism	-.11	-.02	.75	.09	.05
3.	Time to overcome 3 beliefs	-.13	.06	.02	.67	.18
4.	Time to solve after overcoming 3 beliefs	-.14	.46	.26	.46	-.14
5.	English	.18	-.12	.14	-.31	-.41
6.	Reading	.54	.01	.27	-.26	-.58
7.	CQT Verbal	.34	.03	-.15	-.13	-.75
8.	CQT Information	.25	-.22	-.19	-.01	-.74
9.	CQT Numerical	.21	-.53	-.13	.14	-.40
10.	Embedded-Figures	.03	.75	.08	.13	-.05
11.	Perceptual Synthesis	-.01	.71	-.17	.08	.21
12.	Natural Science Final Essay	.83	.06	-.10	-.17	-.11
13.	Natural Science Final Objective	.76	-.15	-.16	-.13	-.35
14.	Natural Science Objective Test 7	.79	-.06	-.09	-.05	-.37

A P P E N D I X   C

DESCRIPTION OF THE CONTENT OF 33 COURSES EMPLOYED IN THIS RESEARCH

Description of Various Courses Employed as

Measures of Academic Success

(from Michigan State University Catalog Issue - 1966)

AMERICAN THOUGHT AND LANGUAGE

University College

American Thought and Language 111. (Comm. Skills 111.) Fall, Winter, Spring, Summer. 3(3-1) Satisfactory grade on English proficiency examination or satisfactory grade in Preparatory English.

Training in reading and writing through the use of selected American documents; particular emphasis on structure and development of ideas. Introduction to library use. Weekly writing assignments.

American Thought and Language 112. (Comm. Skills 112.) Fall, Winter, Spring, Summer. 3(3-1) 111. Training in reading and writing through the use of selected American documents; particular emphasis on syntax. Library papers. Weekly writing assignments.

American Thought and Language 113. (Comm. Skills 113.) Fall, Winter, Spring, Summer. 3(3-1) 112. Training in reading and writing through the use of selected American documents; particular emphasis on problems of style. Library papers. Weekly writing assignments.

NATURAL SCIENCE

University College

Natural Science 181. Fall, Winter, Spring, Summer. 4(2-3) Area of reproduction and cell theory to demonstrate function of empirical methods in science. Heredity to exemplify the development and use of theories or conceptual schemes in science. Emphasis on the role of theory in science.

Natural Science 182. Fall, Winter, Spring, Summer. 4(2-3) 181. Consideration of geological processes of the earth and organic evolution. The scientific methods involved and social and cultural consequences of the historical development of areas considered.

Natural Science 183. Fall, Winter, Spring, Summer. 4(2-3) 182. Theories of the solar system considered as an illustration of a succession of scientific explanations. The molecular and atomic theories of matter, and the methods of their development. Emphasis on the social and philosophical preconditions for acceptance of new scientific ideas.

SOCIAL SCIENCE

University College

Social Science 231. Fall, Winter, Spring, Summer. 4(4-0) Basic concepts used in analysis of social behavior. Processes by which new members of group are oriented to prevailing patterns of behavior. Part played by such agencies as the family, school, and church in the development of personality and in the socialization process.

Social Science 232. Fall, Winter, Spring, Summer. 4(4-0) 231. Problem of satisfying human needs and wants. This includes socio-psychological (noneconomic) needs and wants as well as treatment of ways in which resources are allocated and products distributed in response to economic needs and wants. Economic institutions with emphasis on their relationships to other aspects of human behavior.

Social Science 233. Fall, Winter, Spring, Summer. 4(4-0) 232. Problem of regulating and controlling human behavior. Social control functions of informal groups as well as family, church, and school. Controls exerted by the institution of government. Controlling and regulating human behavior on the international level.

HUMANITIES

University College

Humanities 241. Fall, Winter, Spring, Summer. 4(4-0) Sophomores. A field of study in relation to general education; classical background of Western man as seen in Greek pattern of community life, religion, philosophy, literature, and art; Roman contributions as seen in the imperial idea, in concepts of the good life, in architecture and engineering, and in development of law; Christian roots of Western

civilization as seen in its spiritual foundations, the basic teachings of Jesus Christ, and growth of the early Church.

Humanities 242. Fall, Winter, Spring, Summer. 4(4-0) 241. Medieval man in Western Europe; economic life on manor and in towns; political ideas and practices in feudal times, influences from Islam and the East; creation of a Christian synthesis in spirit, thought, education, literature, art, and music; emergence of modern man and modern forces in Western civilization; transition to a dynamic capitalist economy; the development of nation state; humanism as expressed in literature, art, and music; the Protestant Reformation.

Humanities 243. Fall, Winter, Spring, Summer. 4(4-0) 242. Intellectual foundations of the modern world: revolution in science; thought, literature, and art of the Enlightenment. Locke and origins of democratic political theory, the liberal revolutions, romanticism and idealism in philosophy and the arts, impact of the machine, advance of science, nationalism and imperialism; attacks on liberalism from Right and Left; break-up of liberal order; effect of World Wars; rise of collectivism; contemporary spirit in literature and art; contemporary views of the world and man.

CHEMISTRY

College of Natural Science

General Chemistry 111. Fall, Winter. 4(3-3) MTH 111 concurrently. For students in Chemistry, Chemical Engineering, Pre-Medical and others desiring a more comprehensive introduction to chemistry. This course, 112 and 113 constitute a general sequence on fundamental chemical principles.

Laws of chemical combination, gas laws, simple structures of atoms, periodic system, chemical equilibrium, oxidation-reduction, etc. Fundamental principles will be illustrated by discussions of the more important elements, including their occurrence, preparation, and properties.

General Chemistry 112. Winter, Spring. 4(3-3) 111 or approval of department. Continuation of 111.

General Chemistry 113. Fall, Spring. 3(3-0) 112 or approval of department. Continuation of 112.

ECONOMICS

College of Business

Introduction to Economics 200. Fall, Winter, Spring, Summer. 4(4-0) Problem of unemployment; meaning and determination of national income; the multiplier; the accelerator; fiscal policy; deficit spending; monetary policy; banks creation of money; international aspects of the employment problems.

ENGLISH

College of Arts and Letters

Forms of Literature 206. Fall, Winter, Spring, Summer. 3(3-0) Required of majors and minors. Open to Freshmen. Major forms of prose fiction, designed to reveal artistic problems met and solved by these forms. Prepares students for advanced literary study by acquainting them with the conventions of various literary forms, by providing a critical vocabulary and by furnishing experience in reading and writing critical evaluations of outstanding literary works from all historical periods.

Forms of Literature 207. Fall, Winter, Spring, Summer. 3(3-0) Required of majors and minors. Open to Freshmen. Major forms of drama, designed to reveal artistic problems met and solved by these forms.

Forms of Literature 208. Fall, Winter, Spring, Summer. 3(3-0) Required of majors and minors. Open to Freshmen. Major forms of poetry, designed to reveal artistic problems met and solved by these forms.

HISTORY

College of Arts and Letters

History 222. The Growth of American Civilization: Foundations of the Republic. (222A.) Fall, Winter, Spring, Summer. 3(3-0) Extension of European civilization to America, severance of European ties, and beginnings of nationalism.

History 223. The Growth of American Civilization: The Strengthening of Nationality. (222B.) Fall, Winter, Spring, Summer. 3(3-0) Slavery and Manifest Destiny, preservation of the Union, and rise of agrarian and urban conflicts.

History 224. The Growth of American Civilization: America Comes of Age. (222C.) Fall, Winter, Spring, Summer. 3(3-0) The experiment with imperialism, progressive era, nation engulfed in world conflict, growing regulation of domestic economy, global war.

MATHEMATICS

College of Natural Science

Mathematics 111. College Algebra. Fall, Winter, Spring, Summer. 5(5-0) 1½ years of high school algebra, 1 year of high school geometry, satisfactory score in algebra placement examination, trigonometry or 102 or concurrently: Sets and equations, simultaneous equations and matrices, vectors, inequalities, functions and relations, inverse functions, elementary theory of equations, trigonometric equations and identities, polar coordinates, parametric equations, straight line analytic geometry.

Mathematics 112. Analytic Geometry and Calculus I. Fall, Winter, Spring, Summer. 5(5-0) 109 or 111: The sequence 112, 113, 214, 215 is an integrated course in calculus, analytic geometry and differential equations covering derivatives, curve sketching, definite and indefinite integrals, area, volume, transcendental functions, vector analysis, solid geometry, partial differentiation, multiple integrals, infinite series, power series, differential equations.

Mathematics 113. Analytic Geometry and Calculus II. Fall, Winter, Spring, Summer. 5(5-0) 112. A continuation of 112.

PHILOSOPHY

College of Arts and Letters

Philosophy 137. Introduction to the Principles of Right Reason. Fall, Winter, Spring, Summer. 3(3-0) Not open to Seniors or students with credit in 391: Study of critical thinking, concerned with analysis of deductive and inductive arguments, criteria of sound definition, and problems of right reason arising from ambiguity, vagueness, and emotive dimension of language.

POLITICAL SCIENCE

College of Social Science

Political Science 200. Introduction to Political Science. Fall, Winter, Spring, Summer. 5(3-0) Acquaints the student with the theories, methods and concepts of political science. Emphasis is on ideology and interests in the political process.

Political Science 201. Introduction to Political Science. Fall, Winter, Spring, Summer. 5(3-0) 200. Continuation of 200. Emphasis on function of institutions in political systems and individual motivation and behavior in the political process.

PSYCHOLOGY

College of Human Medicine

College of Social Science

Psychology 151. General Psychology. Fall, Winter, Spring, Summer. 4(4-0) Survey of psychological topics including learning motivation, emotions, intelligence, personality, and social relations. Students participate in psychological experiments outside of class for up to 3 to 5 hours a term.

Psychology 225. Psychology of Personality. Fall, Winter, Spring, Summer. 3(3-0) 151 or 200. Application of psychological principles to an introductory understanding of personality and interpersonal adjustments; social motivation, frustration, conflicts, and adjustment mechanisms; theories of adjustment, the assessment of personality, problems of mental hygiene and some theories of psychotherapy.

SOCIOLOGY

College of Human Medicine

College of Social Science

Sociology 241. Introduction to Sociology. Fall, Winter, Spring, Summer. 4(3-0) Sophomores. Introduction to nature of sociological inquiry and to concepts and principles of sociology. Analysis focuses on institutional features of modern society and of structure and dynamics of social organization.

Sociology 251. Introduction to Social Psychology. Fall, Winter, Spring, Summer. 3(3-0) Sophomores or approval of department. Relation of individual to his social environment, with special reference to personality development, communication and role behavior.

STATISTICS

College of Natural Science

Statistics 121. Introduction to Probability. Fall, Winter, Spring. 4(2-2). Three high school units in mathematics including 1½ units in Algebra and satisfactory grade on placement test or 082; 1 unit in Geometry; ½ unit unspecified with trigonometry or Algebra strongly recommended: Sets and algebra of sets. Chance experiments, outcomes and events. Probabilities of events. Conditional probability, independent trials, Bayes' theorem. Introduction to statistical inference relevant to business decision problems.

A P P E N D I X D

PARTIAL CORRELATIONS BETWEEN ACADEMIC PERFORMANCE, ANALYSIS AND SYNTHESIS, AND ACADEMIC ABILITY, FOR VARIOUS MAJORS, HOLDING ENGLISH AND READING COMPREHENSION CONSTANT

TABLE 13.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Social Science Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	84	.03	.01	-.07	.06	.10	.05	.16	.04
G.P.A. in Major	79	-.08	-.24*	-.03	-.02	.13	.11	.16	.04
G.P.A.	84	-.05	-.10	-.18	-.11	.33**	.29**	.32**	.12
ATL 111	80	-.15	-.22*	-.18	-.22*	.43**	.38**	.37**	.25*
ATL 112	78	-.08	-.09	-.16	-.11	.39**	.46**	.32**	.08
ATL 113	76	-.12	-.11	-.15	-.22*	.29**	.31**	.24*	.09
NS 181	80	-.05	-.12	-.23*	-.13	.30**	.18	.28*	.22*
NS 182	77	-.19	-.26*	-.22*	-.19	.40**	.40**	.36**	.14
NS 183	72	.03	-.14	-.36**	-.29*	.42**	.25*	.30**	.45**
SS 231	73	-.18	-.18	-.09	-.13	.32**	.30**	.36**	.36**
SS 232	68	-.04	.09	-.05	-.05	.50**	.36**	.46**	.31**
SS 233	63	.06	.15	-.14	-.07	.28*	.18	.29*	.19
Hum 241	73	-.07	-.19	-.01	-.10	.33**	.39**	.36**	-.06
Hum 242	68	-.23	-.28*	.00	.03	.33**	.42**	.32**	-.10
Hum 243	66	-.10	-.21	.06	.11	.37**	.48**	.33**	-.09
Chemistry 111	30	.30	.26	-.28	-.24	-.09	.10	-.15	.11
Economics 200	37	.30	.01	-.18	-.07	.09	.04	-.03	.23
Pol. Science 200	25	-.31	-.35	-.15	-.15	.36	.41*	.31	.10
Psychology 151	70	-.27*	-.17	-.20	-.08	.33**	.38**	.28*	.02
Psychology 225	36	-.13	-.20	-.03	-.05	.28	.17	.22	.21

Table 13.1 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Sociology 241	26	.05	-.03	-.14	-.12	.17	.26	.29	-.15
Sociology 251	24	.31	.06	-.36	-.21	.22	-.07	.26	.35

* $p < .05$
** $p < .01$

TABLE 13.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Social Science Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	84	.05	.05	-.05	.07	.06	-.01	.13	.02
G.P.A. in Major	79	-.06	-.19	-.01	-.01	.06	.03	.11	.02
G.P.A.	84	.01	-.01	-.11	-.08	.19	.16	.20	.05
ATL 111	80	-.10	-.13	-.14	-.22*	.37**	.29**	.29**	.22*
ATL 112	78	-.04	-.01	-.14	-.13	.36**	.41**	.26*	.07
ATL 113	76	-.10	-.05	-.13	-.23*	.26*	.27*	.20	.08
NS 181	80	-.01	-.03	-.19	-.14	.21	.05	.19	.20
NS 182	77	-.13	-.18	-.16	-.17	.29**	.29**	.26*	.07
NS 183	72	.11	-.02	-.30**	-.26*	.27*	.06	.14	.39**
SS 231	73	-.12	-.09	.01	-.07	.14	.14	.22	-.08
SS 232	68	.03	.20	.05	.02	.37**	.23	.34**	.21
SS 233	63	.06	.17	-.15	-.08	.35**	.20	.33**	.21
Hum 241	73	-.02	-.13	.05	-.07	.24*	.32**	.28*	-.13
Hum 242	68	-.20	-.24*	.05	.06	.25*	.37**	.25*	-.17
Hum 243	66	-.01	-.11	.19	.19	.14	.33**	.13	-.24*
Chemistry 111	30	.26	.26	-.33	-.29	.01	-.04	-.08	.19
Economics 200	37	.25	.04	-.21	-.14	.17	.06	.01	.29
Pol. Science 200	25	-.21	-.25	.02	-.02	-.02	.14	.00	-.12
Psychology 151	70	-.23*	-.10	-.15	-.05	.22	.29**	.17	-.06
Psychology 225	36	-.13	-.16	-.05	-.10	.35*	.18	.25	.25

Table 13.2 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Sociology 241	26	.14	.10	-.06	-.09	-.08	.07	.11	-.28
Sociology 251	24	.38	.13	-.30	-.16	.07	-.25	.15	.28

* $p < .05$
** $p < .01$

TABLE 13.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Social Science Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	84	.06	.04	-.04	.08	.04	-.02	.12	.01
G.P.A. in Major	79	-.05	-.20	.01	.01	.03	.01	.08	-.01
G.P.A.	84	.01	-.01	-.10	-.07	.19	.15	.19	.03
ATL 111	80	-.09	-.14	-.10	-.18	.32**	.26*	.25*	.17
ATL 112	78	-.03	-.02	-.10	-.08	.30**	.39**	.22*	.01
ATL 113	76	-.08	-.06	-.10	-.20	.21	.25*	.17	.03
NS 181	80	.01	-.04	-.16	-.09	.14	.01	.15	.14
NS 182	77	-.13	-.18	-.14	-.15	.27*	.28*	.24*	.05
NS 183	72	.12	-.03	-.30**	-.25*	.26*	.05	.13	.38**
SS 231	73	-.12	-.09	.00	-.09	.16	.15	.24*	-.07
SS 232	68	.03	.20	.04	.00	.42**	.24*	.37**	.23*
SS 233	63	.07	.17	-.13	-.06	.34**	.18	.31*	.19
Hum 241	73	-.02	-.13	.05	-.07	.24*	.32**	.28*	-.14
Hum 242	68	-.20	-.24*	.05	.07	.25*	.37**	.25*	-.18
Hum 243	66	-.02	-.11	.19	.19	.16	.34**	.14	-.24*
Chemistry 111	30	.30	.26	-.30	-.25	-.08	-.09	-.15	.13
Economics 200	37	.33*	.03	-.16	-.06	.04	-.01	-.10	.21
Pol. Science 200	25	-.24	-.25	-.02	-.08	.07	.19	.06	-.06
Psychology 151	70	-.22	-.10	-.14	-.04	.22	.29*	.16	-.07
Psychology 225	36	-.11	-.18	-.01	-.04	.29	.14	.20	.19

Table 13.3 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Sociology 241	26	.15	.10	-.04	-.07	-.11	.05	.10	-.31
Sociology 251	24	.37	.13	-.32	-.18	.10	-.24	.17	.30

* $p<.05$
** $p<.01$

TABLE 14.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Social Science Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	55	.03	.00	-.08	-.09	.40**	.17	.34**	.38**
G.P.A. in Major	44	-.04	.02	-.17	-.14	.29	.31*	.13	.16
G.P.A.	55	.05	-.11	-.20	-.31*	.52**	.38**	.36**	.41**
ATL 111	55	-.01	-.13	-.27*	-.35**	.50**	.54**	.39**	.15
ATL 112	54	.08	-.15	-.17	-.10	.40**	.45**	.32*	.10
ATL 113	50	.15	-.09	-.04	-.22	.37**	.35*	.14	.22
NS 181	53	.05	-.03	.09	-.34*	.28*	.12	.24	.25
NS 182	52	.12	.21	-.27*	-.32*	.46**	.24	.38**	.37**
NS 183	42	.13	.16	-.18	-.55**	.48**	.24	.39**	.36*
SS 231	49	-.05	-.04	-.05	-.16	.43**	.39**	.29*	.25
SS 232	46	.04	-.12	-.12	-.32*	.42**	.37**	.31*	.24
SS 233	43	-.09	-.17	.08	-.27	.58**	.45**	.44**	.35*
Hum 241	44	.07	.13	.12	-.19	.29*	.12	.18	.29*
Hum 242	40	-.05	.10	.00	-.39*	.44**	.24	.41**	.33*
Hum 243	39	-.16	-.17	-.10	-.48**	.54**	.34*	.42**	.45**
Psychology 151	46	.19	.08	-.29*	-.31*	.57**	.37**	.43**	.46**
Psychology 225	32	.02	.17	-.05	-.11	.46**	.14	.43*	.42*
Sociology 241	29	-.26	-.44*	.02	-.35	.06	-.18	.01	.02
Sociology 251	28	-.04	-.44*	.01	-.12	.03	-.09	.11	.06

* $p < .05$
** $p < .01$

TABLE 14.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Social Science Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	55	.03	.00	-.07	-.09	.41**	.17	.35**	.38**
G.P.A. in Major	44	-.02	.02	-.05	-.06	.22	.22	.06	.14
G.P.A.	55	.07	-.12	-.09	-.27*	.49**	.31*	.33*	.43**
ATL 111	55	.00	-.15	-.17	-.31*	.47**	.49**	.37**	.17
ATL 112	54	.06	-.15	-.13	-.12	.43**	.42**	.32*	.19
ATL 113	50	.14	-.10	.02	-.21	.37**	.32*	.13	.26
NS 181	53	.05	-.04	.14	-.33*	.29*	.10	.24	.28*
NS 182	52	.11	.19	-.20	-.31*	.46**	.20	.37**	.41**
NS 183	42	.20	.19	.00	-.50**	.37*	.08	.33*	.32*
SS 231	49	-.03	-.05	.07	-.09	.36**	.32*	.24	.23
SS 232	46	.05	-.13	-.05	-.30*	.39**	.33*	.28	.25
SS 233	43	-.09	-.17	.13	-.26	.58**	.44**	.44**	.36*
Hum 241	44	.09	.14	.25	-.12	.21	.02	.12	.25
Hum 242	40	-.04	.09	.06	-.37*	.43**	.20	.39*	.34*
Hum 243	39	-.15	-.18	.01	-.45**	.50**	.26	.39*	.45**
Psychology 151	46	.26	.11	-.15	-.20	.45**	.23	.34*	.39**
Psychology 225	32	.03	.17	.04	-.06	.43*	.07	.40*	.43*
Sociology 241	29	-.25	-.42*	.05	-.35	.00	-.18	.04	.11
Sociology 251	28	-.03	-.46*	.12	-.06	-.06	-.21	.05	.04

* $p < .05$
** $p < .01$

TABLE 14.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Social Science Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	55	.03	.00	-.07	-.08	.42**	.16	.35**	.38**
G.P.A. in Major	44	.00	.04	-.01	.00	.13	.18	.00	.05
G.P.A.	55	.11	-.11	-.03	-.20	.40**	.24	.26*	.33*
ATL 111	55	.03	-.14	-.12	-.25	.38**	.45**	.31*	.37**
ATL 112	54	.11	-.15	-.06	.00	.30*	.37**	.24	.01
ATL 113	50	.18	-.09	.08	-.14	.27*	.26	.05	.15
NS 181	53	-.08	-.02	.19	-.28*	.20	.03	.18	.20
NS 182	52	.16	.24	-.15	-.24	.35**	.11	.31*	.30*
NS 183	42	.22	.21	.03	-.47**	.32*	.03	.29	.26
SS 231	49	-.02	-.04	.11	-.04	.30*	.28*	.19	.16
SS 232	46	.07	-.12	-.01	-.26	.33*	.29*	.24	.18
SS 233	43	-.08	-.17	.16	-.23	.57**	.42**	.42*	.32*
Hum 241	44	.10	.15	.27	-.10	.18	-.01	.09	.23
Hum 242	40	-.02	.11	.11	-.33*	.37**	.14	.35*	.27
Hum 243	39	-.14	-.17	.05	-.41**	.45**	.22	.35*	.39*
Psychology 151	46	.27	.11	-.14	-.19	.46**	.22	.34*	.39**
Psychology 225	32	.05	.20	.09	.01	.35*	.00	.36*	.36*
Sociology 241	29	-.25	-.46*	.15	-.29	-.22	-.34	-.08	-.07
Sociology 251	28	-.02	-.46*	.16	-.01	-.14	-.27	.00	-.04

* p<.05
** p<.01

TABLE 15.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Natural Science Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	88	.06	-.17	-.17	-.13	.00	-.14	.07	.15
G.P.A. in Major	68	-.07	.20	-.17	-.17	.18	.10	.29*	.05
G.P.A.	87	-.21*	-.35**	-.25*	-.07	.34**	.20	.35**	.29**
ATL 111	85	-.15	-.14	-.32**	-.03	.43**	.37**	.34**	.27*
ATL 112	81	-.20	-.19	-.08	.13	.35**	.37**	.19	.18
ATL 113	69	-.22	-.22	-.19	.14	.40**	.35**	.35**	.06
NS 181	69	-.24*	-.40**	-.16	-.06	.45**	.23*	.53**	.33**
NS 182	62	-.12	-.31*	-.07	.14	.30*	.27*	.35**	.02
NS 183	55	-.05	-.25	-.03	-.15	.35**	.29*	.35**	.13
SS 231	65	-.19	-.29*	.12	.03	.40**	.36**	.25*	.24*
SS 232	58	-.09	.04	-.02	.00	.52**	.47**	.36**	.27*
SS 233	57	-.16	-.06	.17	.06	.26*	.31*	.18	.00
Hum 241	67	-.11	-.20	.03	.06	.43**	.34**	.32**	.35**
Hum 242	61	-.05	.00	-.12	.08	.31*	.37**	.19	.02
Hum 243	57	-.08	.02	.04	.17	.44**	.50**	.24	.08
Chemistry 111	50	.03	-.37**	-.23	.02	.08	-.04	.12	.23
Chemistry 112	43	.32*	-.01	-.13	.05	.10	-.05	.20	.22
Chemistry 113	34	.09	.03	.14	.09	.12	.16	.12	-.11
Economics 200	23	.04	-.03	-.07	-.01	.03	.05	-.01	.06

Table 15.1 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	22	-.22	-.25	.15	.02	.24	.06	.19	.40
Mathematics 112	22	-.13	-.14	-.09	-.26	.43*	.22	.44*	.35
Psychology 151	38	-.20	-.45**	.01	.15	.48**	.37*	.42**	.29

* $p < .05$
** $p < .01$

TABLE 15.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Natural Science Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	88	.11	-.14	-.15	-.11	-.10	-.26*	.00	.10
G.P.A. in Major	68	.00	-.19	-.19	-.19	.23	.14	.32*	.11
G.P.A.	87	-.09	-.31**	-.25*	-.07	.28**	.11	.30**	.30**
ATL 111	85	-.01	-.09	-.33**	-.05	.42**	.34**	.33**	.32**
ATL 112	81	-.06	-.15	-.09	.09	.38**	.37**	.20	.26*
ATL 113	69	-.05	-.17	-.19	.13	.36**	.28*	.32**	.12
NS 181	69	-.14	-.38**	-.16	-.08	.45**	.21	.53**	.36**
NS 182	52	-.05	-.29*	-.08	.12	.30*	.27*	.35**	.06
NS 183	55	.07	-.22	-.34**	-.17	.35**	.27*	.35**	.18
SS 231	65	-.09	-.26*	.07	-.01	.48**	.42**	.30*	.34**
SS 232	58	.06	.10	.00	.00	.45**	.39**	.30*	.26*
SS 233	57	.01	.01	.19	.05	.21	.23	.13	.05
Hum 241	67	-.01	-.16	.05	.07	.36**	.26*	.27*	.33**
Hum 242	61	-.08	.05	-.10	-.09	.21	.28*	.12	.00
Hum 243	57	-.11	.10	.07	.18	.38**	.42**	.19	.12
Chemistry 111	50	.08	-.36**	-.23	.00	.10	-.04	.13	.25
Chemistry 112	43	.32*	-.03	-.18	.00	.27	.11	.31*	.32*
Chemistry 113	34	.14	.07	.18	.13	-.02	.03	.03	-.18
Economics 200	23	.11	-.03	-.11	-.07	.19	.17	.10	.21

Table 15.2 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	22	-.19	-.24	.15	.01	.26	.06	.20	.40
Mathematics 112	22	-.07	-.11	-.06	-.24	.30	.10	.36	.27
Psychology 151	38	-.13	-.43**	-.03	.10	.58**	.[illegible]6**	.48**	.37*

* $p < .05$
** $p < .01$

TABLE 15.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Natural Science Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	88	.13	-.14	-.16	-.12	-.08	-.25*	.02	.13
G.P.A. in Major	68	-.05	-.19	-.17	-.17	.16	.08	.28*	.04
G.P.A.	87	-.13	-.32**	-.24*	-.06	.24*	.07	.28**	.27**
ATL 111	85	-.06	-.10	-.31**	-.02	.36**	.29**	.28**	.25*
ATL 112	81	-.13	-.16	-.06	.14	.29**	.31**	.13	.15
ATL 113	69	-.11	-.18	-.17	.18	.29*	.22	.27*	.01
NS 181	69	-.19	-.38**	-.14	-.05	.41**	.17	.50**	.31**
NS 182	62	-.07	-.29*	-.06	.15	.27*	.24	.32*	.00
NS 183	55	.03	-.23	-.01	-.14	.29*	.22	.31*	.10
SS 231	65	-.17	-.28*	.12	.04	.40**	.36**	.24*	.23
SS 232	58	.04	.10	.02	.02	.44**	.37**	.28*	.24
SS 233	57	-.04	.00	.23	.09	.13	.17	.08	-.06
Hum 241	67	-.02	-.16	.06	.08	.36**	.25*	.26*	.33**
Hum 242	61	.06	.05	-.09	.10	.21	.28*	-.10	-.02
Hum 243	57	.07	.10	.09	.22	.33*	.38**	.14	.04
Chemistry 111	50	.05	-.36**	-.22	.02	.06	-.08	.10	.22
Chemistry 112	43	.28	-.03	-.15	.04	.18	.03	.26	.24
Chemistry 113	34	.17	.07	.16	.11	.04	.08	.06	-.14
Economics 200	23	.04	-.03	-.07	-.01	.04	.06	-.01	.06

Table 15.3 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	22	-.21	-.24	.16	.02	.24	.03	.18	.40
Mathematics 112	22	-.05	-.11	-.07	-.26	.36	.13	.40	.34
Psychology 151	38	-.21	-.46**	.01	.15	.52**	.41*	.44**	.29

* $p < .05$
** $p < .01$

TABLE 16.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability

for Female Natural Science Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	23	.07	-.18	-.30	-.28	.28	-.12	.41*	.48*
G.P.A. in Major	21	.03	-.37	-.45*	-.10	.43*	.33	.38	.39
G.P.A.	23	.07	-.32	-.51*	-.19	.78**	.58**	.71**	.66**
ATL 111	22	-.17	-.33	-.24	-.10	.69**	.67**	.62**	.40
ATL 112	22	.12	-.26	-.57**	-.19	.74**	.58**	.67**	.60**
ATL 113	22	-.30	-.32	-.26	-.16	.63**	.55**	.51*	.50*
NS 181	23	.16	-.27	-.54**	-.15	.70**	.54**	.59**	.62**
NS 182	23	.06	-.18	-.35	-.21	.76**	.59**	.63**	.69**
NS 183	19	-.01	-.11	-.28	-.04	.79**	.65**	.67**	.66**
SS 231	20	.23	-.11	-.39	-.07	.68**	.68**	.60**	.39
SS 232	19	-.01	-.20	-.20	.13	.58**	.71**	.47*	.21
SS 233	16	-.36	-.22	-.12	.01	.71**	.62*	.64*	.48
Hum 241	20	.14	-.22	-.10	.14	.64**	.54*	.69**	.36
Hum 242	18	.05	-.05	-.09	.28	.74**	.65**	.67**	.52*
Hum 243	18	-.16	-.39	-.08	.42	.34	.27	.38	.21

* p<.05
** p<.01

TABLE 16.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Natural Science Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	23	.07	-.14	-.19	-.19	.14	-.28	.33	.40
G.P.A. in Major	21	.03	-.34	-.33	.06	.26	.15	.26	.23
G.P.A.	23	.08	-.28	-.33	.01	.66**	.40	.64**	.54**
ATL 111	22	-.21	-.30	.05	.16	.50*	.46*	.51*	.16
ATL 112	22	.14	-.21	-.40	.01	.65**	.46*	.59**	.48*
ATL 113	22	-.34	-.28	.02	.05	.50*	.42*	.39	.34
NS 181	23	19	-.22	-.36	.12	.42*	.19	.43*	.41*
NS 182	23	.07	-.13	-.17	-.07	.67**	.45*	.55**	.61**
NS 183	19	-.01	-.01	.06	.32	.51*	.29	.54*	.43
SS 231	20	.27	-.03	-.17	.19	.43	.40	.47*	.11
SS 232	19	-.01	-.15	.00	.34	.44	.55*	.36	.01
SS 233	16	-.45	-.16	.25	.31	.49	.35	.52*	.23
Hum 241	20	.15	-.17	.14	.37	.48*	.34	.61**	.18
Hum 242	18	.05	.01	.10	.50*	.61**	.45	.60**	.39
Hum 243	18	-.17	-.37	.10	.63**	.17	.10	.28	.05

* p<.05
** p<.01

TABLE 16.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Natural Science Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	23	.07	-.14	-.19	-.19	.15	-.33	.34	.41*
G.P.A. in Major	21	.03	-.34	-.33	.06	.28	.17	.26	.24
G.P.A.	23	.08	-.28	-.34	.01	.69**	.44*	.64**	.54**
ATL 111	22	-.21	-.30	.06	.16	.54**	.53*	.51*	.16
ATL 112	22	.14	-.21	-.42*	.02	.63**	.43*	.59**	.46*
ATL 113	22	-.35	-.29	.01	.06	.47*	.39	.38	.32
NS 181	23	.20	-.23	-.35	.11	.54**	.34	.46*	.46*
NS 182	23	.07	-.13	-.18	-.06	.71**	.49*	.55**	.61**
NS 183	19	-.01	-.01	.08	.31	.66**	.48*	.59**	.50*
SS 231	20	.28	-.03	-.15	.19	.52**	.55*	.49*	.14
SS 232	19	-.01	-.15	.00	.35	.47*	.64**	.36	.01
SS 233	16	-.45	-.16	.26	.31	.56*	.46	.54*	.25
Hum 241	20	.15	-.17	.15	.37	.53*	.42	.62**	.19
Hum 242	18	.06	.01	.11	.49*	.70**	.58*	.61**	.42
Hum 243	18	-.17	-.37	.11	.63**	.19	.13	.28	.05

* p<.05
** p<.01

TABLE 17.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Humanities Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	37	-.13	-.13	-.10	-.01	.27	.22	.17	.25
G.P.A. in Major	32	.02	-.19	-.11	-.12	.25	.35*	.24	.00
G.P.A.	37	-.05	.01	-.10	-.02	.40*	.44**	.29	.19
ATL 111	34	.02	-.15	-.04	.04	.63**	.72**	.37*	.38*
ATL 112	29	.04	.23	-.17	-.16	.50**	.43*	.47**	.28
ATL 113	28	-.20	.04	-.16	.02	.59**	.54**	.62**	.26
NS 181	32	.02	-.02	-.23	-.33	.73**	.63**	.51**	.66**
NS 182	26	-.03	.09	-.29	-.48*	.56**	.53**	.58**	.25
NS 183	22	-.07	-.21	-.50*	-.51*	.74**	.50*	.53*	.79**
SS 231	24	-.07	-.05	.30	.10	.45*	.43*	.45*	.21
SS 232	23	.03	.18	.00	-.13	.65**	.64**	.58**	.38
SS 233	19	-.15	.06	-.26	-.43	.63**	.66**	.70**	.18
Hum 241	26	-.06	.10	-.02	-.04	.33	.30	.32	.24
Hum 242	23	.17	.16	-.13	-.30	.66**	.65**	.68**	.31
Hum 243	19	.15	.25	.23	.12	.42	.50*	.39	.13

* $p < .05$
** $p < .01$

TABLE 17.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Humanities Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	37	-.15	-.14	-.14	-.07	.51**	.43**	.35*	.38*
G.P.A. in Major	32	-.02	-.19	-.13	-.15	.48**	.55**	.40*	.15
G.P.A.	37	-.07	-.02	-.10	-.05	.59**	.60**	.43**	.30
ATL 111	34	.07	-.16	.12	.15	.60**	.71**	.27	.33
ATL 112	29	.08	.22	-.04	-.08	.45*	.41*	.39*	.23
ATL 113	28	-.17	.03	-.04	.13	.48**	.43*	.54**	.17
NS 181	32	.08	-.04	-.08	-.25	.67**	.59**	.40*	.63**
NS 182	26	.00	.07	-.20	-.44*	.56**	.53**	.57**	.23
NS 183	22	-.06	-.22	-.42*	-.46*	.79**	.56**	.53*	.79**
SS 231	24	-.05	-.06	.41*	.16	.42*	.41*	.42*	.18
SS 232	23	.15	.23	.27	.04	.37	.41*	.35	.18
SS 233	19	-.08	.07	-.08	-.36	.38	.47*	.54*	-.06
Hum 241	26	-.07	.07	.00	-.04	.45*	.42*	.40*	.30
Hum 242	23	.27	.17	.02	-.21	.47*	.48*	.55**	.17
Hum 243	19	.18	.25	.32	.18	.31	.38	.31	.05

* $p<.05$
** $p<.01$

TABLE 17.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Humanities Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	37	-.15	-.13	-.15	-.05	.41*	.30	.28	.31
G.P.A. in Major	32	.01	-.19	-.15	-.14	.35*	.42*	.32	.03
G.P.A.	37	-.06	.01	-.12	-.02	.48**	.49**	.35*	.21
ATL 111	34	.09	-.17	.13	.18	.53**	.66**	.19	.27
ATL 112	29	.10	.25	-.04	-.07	.36	.31	.33	.16
ATL 113	28	-.17	.03	-.04	.13	.50**	.46*	.54**	.16
NS 181	32	.10	-.03	-.08	-.25	.64**	.54**	.36*	.61**
NS 182	26	.01	.09	-.21	-.45*	.51**	.48*	.53**	.17
NS 183	22	-.04	-.22	-.46*	-.48*	.74**	.45*	.48*	.77**
SS 231	24	-.04	-.05	.42*	.18	.39	.38	.39	.14
SS 232	23	.15	.22	.27	.03	.50*	.55**	.40	.23
SS 233	19	-.08	.07	-.08	-.36	.45	.57*	.57*	-.04
Hum 241	26	-.05	.10	.00	-.02	.34	.30	.33	.23
Hum 242	23	.27	.17	.02	-.21	.55**	.57**	.59**	.19
Hum 243	19	.18	.25	.32	.18	.38	.47*	.34	.07

* $p < .05$
** $p < .01$

TABLE 18.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Humanities Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	48	-.04	.06	.14	-.01	-.07	-.11	.02	-.04
G.P.A. in Major	45	.06	.11	-.03	-.01	.27	.15	.17	.25
G.P.A.	47	.02	.07	-.22	-.13	.40**	.15	.40**	.34*
ATL 111	46	-.17	-.09	.01	.04	.16	.24	.17	-.04
ATL 112	46	-.16	-.05	.03	.02	.36*	.32*	.34*	.13
ATL 113	45	-.37**	-.16	-.03	.03	.24	.27	.08	.15
NS 181	46	.02	.04	-.26	-.24	.23	.07	.23	.20
NS 182	45	-.16	-.19	-.20	-.37**	.20	-.03	.22	.26
NS 183	40	-.12	.00	-.38*	-.45**	.50**	.12	.49**	.46**
SS 231	32	-.10	.09	.20	.31	.31	.23	.11	.30
SS 232	29	.13	.19	.04	.04	.14	.01	.09	.21
SS 233	25	-.35	.01	-.02	-.11	.18	.11	.19	.13
Hum 241	33	-.10	-.03	-.14	-.03	.42*	.30	.41*	.28
Hum 242	28	.09	.20	.04	.02	.31	.16	.50**	.15
Hum 243	28	.02	.11	.04	.05	.37*	.33	.30	.25
Psychology 151	23	-.20	.14	-.25	-.03	.61**	.41*	.51*	.47*

* p<.05
** p<.01

TABLE 18.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Humanities Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	48	-.06	.03	.12	-.04	.02	-.02	.07	.01
G.P.A. in Major	45	.07	.07	-.03	.02	.29*	.16	.16	.28
G.P.A.	47	.06	.03	-.21	-.14	.33*	.04	.32*	.35*
ATL 111	46	-.13	-.12	.06	.07	-.01	.04	.01	-.07
ATL 112	46	-.11	-.04	.08	.06	.15	.09	.21	.06
ATL 113	45	-.34*	-.21	-.01	.04	.15	.15	-.05	.16
NS 181	46	.08	-.04	-.25	-.26	.15	-.06	.10	.25
NS 182	45	-.13	-.21	-.19	-.37**	.12	-.15	.14	.25
NS 183	40	-.08	-.02	-.37*	-.46**	.43**	.00	.43**	.46**
SS 231	32	-.04	.06	.26	.35*	.17	.05	-.04	.30
SS 232	29	.18	.14	.07	.03	.08	-.09	-.01	.24
SS 233	25	-.32	.01	.02	-.09	.01	-.09	.07	.08
Hum 241	33	-.04	-.03	-.11	.01	.21	.05	.27	.22
Hum 242	28	.16	.18	.08	.04	.18	-.03	.41*	.15
Hum 243	28	.09	.05	.08	.05	.28	.20	.17	.30
Psychology 151	23	-.16	.16	-.22	.01	.45*	.22	.42*	.40*

* $p < .05$
** $p < .01$

TABLE 18.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Humanities Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	48	-.05	.07	.13	-.02	-.05	-.09	.05	-.04
G.P.A. in Major	45	.07	.11	-.02	.00	.25	.11	.14	.25
G.P.A.	47	.06	.06	-.20	-.12	.32*	.00	.32*	.34*
ATL 111	46	-.12	-.12	.06	.07	.03	.03	.01	-.08
ATL 112	46	-.12	-.07	.07	.04	.23	.16	.23	.11
ATL 113	45	-.34*	-.19	.00	.05	.11	.12	-.06	.13
NS 181	46	.10	.02	-.25	-.24	.05	-.19	.08	.19
NS 182	45	-.13	-.21	-.18	-.37*	.11	-.19	.14	.25
NS 183	40	-.08	-.01	-.36*	-.45**	.43**	-.03	.43**	.46**
SS 231	32	-.04	.07	.26	.36*	.16	.02	-.05	.30
SS 232	29	.19	.19	.07	.06	.01	-.17	-.04	.20
SS 233	25	-.33	-.01	.01	-.10	.05	-.05	.08	.12
Hum 241	33	-.04	-.05	-.11	-.01	.29	.12	.29	.27
Hum 242	28	.17	.20	.09	.05	.16	-.06	.40*	.13
Hum 243	28	.10	.10	.10	.08	.21	.13	.15	.25
Psychology 151	23	-.17	.13	-.23	-.02	.57**	.32	.46*	.47*

* p < .05
** p < .01

TABLE 19.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Education Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	53	.16	.02	.06	.18	.08	.04	.05	.07
G.P.A. in Major	50	-.25	-.17	-.21	-.03	-.12	-.09	-.10	-.07
G.P.A.	53	-.11	-.15	.06	.13	.09	.14	.03	.00
ATL 111	50	-.11	-.14	.19	.11	.10	.49**	-.04	-.30*
ATL 112	49	-.18	-.26	-.05	-.02	.24	.47**	.03	-.08
ATL 113	47	-.12	-.32*	.09	.16	.01	.43**	-.13	-.33*
NS 181	44	-.02	.00	-.24	.08	.23	-.02	.32*	.19
NS 182	45	-.05	-.06	-.09	.17	.46**	.36*	.31*	.24
NS 183	45	.08	-.02	-.35*	-.13	.35*	-.05	.26	.52**
SS 231	46	-.10	-.10	-.06	.07	.23	.21	.20	.07
SS 232	44	.04	-.22	.06	.24	.21	.48**	.06	-.15
SS 233	43	.25	.02	.09	.22	.01	.19	.08	-.24
Hum 241	48	-.02	-.06	-.13	.02	.00	.21	.15	-.33*
Hum 242	46	.09	.00	.08	.33*	.12	.36*	.14	-.23
Hum 243	46	-.02	-.09	.26	.28	-.08	.18	-.03	-.31*
History 222	21	-.39	-.17	.09	-.02	.43*	.30	.40	.26
Psychology 151	21	.18	.22	-.17	-.10	.13	.04	.25	.01

* p<.05
** p<.01

TABLE 19.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Education Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	53	.12	.02	-.04	.09	.21	.18	.10	.14
G.P.A. in Major	50	-.25	-.14	-.26	-.08	-.14	-.16	-.13	-.01
G.P.A.	53	-.09	-.10	-.05	.01	.11	.10	.00	.10
ATL 111	50	-.05	-.07	.10	.01	-.03	.36**	-.13	-.21
ATL 112	49	-.15	-.18	-.19	-.17	.21	.39**	-.07	.06
ATL 113	47	-.09	-.25	-.05	.01	-.04	.37**	-.22	-.19
NS 181	44	-.01	.05	-.33*	.03	.25	-.08	.30*	.28
NS 182	45	.00	-.01	-.13	.12	.37*	.22	.23	.28
NS 183	45	.09	-.01	-.35*	-.14	.34*	-.12	.24	.51**
SS 231	46	-.06	-.05	-.13	-.01	.16	.06	.13	.14
SS 232	44	.12	-.19	-.05	.21	.05	.34*	-.08	-.12
SS 233	43	.30*	.08	.00	.11	-.08	-.03	-.01	-.14
Hum 241	48	.01	-.02	-.17	-.03	-.07	.12	.10	-.27
Hum 242	46	.08	.04	-.05	.19	.19	.44**	.14	-.10
Hum 243	46	.00	-.07	.21	.24	-.15	.11	-.09	-.26
History 222	21	-.36	-.15	.12	.00	.33	.19	.35	.23
Psychology 151	21	.15	.25	-.31	-.26	.21	.05	.24	.16

* p<.05
** p<.01

TABLE 19 3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Education Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	53	.14	.00	.06	.19	.14	.13	.08	.07
G.P.A. in Major	50	-.24	-.16	-.22	-.03	-.20	-.20	-.14	-.06
G.P.A.	53	-.08	-.13	.06	.12	.01	.04	-.03	.01
ATL 111	50	-.04	-.09	.20	.09	-.10	.33*	-.21	-.30*
ATL 112	49	-.13	-.23	-.06	-.05	.10	.34*	-.11	-.06
ATL 113	47	-.07	-.30*	.09	.14	-.17	.32*	-.26	-.33*
NS 181	44	.01	.02	-.25	.07	.17	-.16	.29*	.21
NS 182	45	.01	-.02	-.11	.15	.37*	.21	.22	.28*
NS 183	45	.09	-.01	-.36*	-.13	.34*	-.14	.24	.53**
SS 231	46	-.05	-.07	-.07	.05	.11	.03	.11	.09
SS 232	44	.12	-.19	.06	.23	.05	.34*	-.08	-.13
SS 233	43	.33*	.06	.08	.20	-.17	-.02	-.04	-.23
Hum 241	48	.02	-.03	-.14	.00	-.11	.09	.09	-.32*
Hum 242	46	.11	.01	.08	.33*	.10	.39**	.12	-.22
Hum 243	46	.01	-.08	.26	.27	-.18	.10	-.10	-.30*
History 222	21	-.37	-.15	.09	-.04	.39	.22	.36	.28
Psychology 151	21	.20	.24	-.17	-.12	.07	-.06	.22	.02

* p<.05
** p<.01

TABLE 20.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Education Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	123	-.10	.01	-.09	.00	.20*	.14	.21*	.10
G.P.A. in Major	118	-.08	.02	-.12	-.09	.20*	.01	.16	.27**
G.P.A.	123	-.06	.06	-.01	.10	.25**	.10	.23**	.22*
ATL 111	119	-.09	-.03	-.01	-.04	.28**	.28**	.22*	.08
ATL 112	118	-.23**	.00	.13	.12	.26**	.31**	.20*	.03
ATL 113	115	-.17	-.08	.00	.12	.23*	.32**	.22*	-.05
NS 181	121	-.13	-.06	-.10	-.01	.26**	.11	.22*	.23*
NS 182	121	-.01	.00	-.19*	-.08	.32**	.14	.28**	.26**
NS 183	116	-.04	-.09	-.14	-.14	.25**	-.08	.22*	.38**
SS 231	113	-.11	.08	-.06	.07	.32**	.23*	.27**	.18*
SS 232	110	-.13	.06	.02	-.07	.35**	.27**	.26**	.20*
SS 233	108	-.17	.09	.07	.15	.37**	.24*	.34**	.22*
Hum 241	117	-.02	.21*	.02	.14	.20*	.19*	.16	.05
Hum 242	114	.04	.20*	.09	.04	.35**	.29**	.36**	.10
Hum 243	114	.04	.19*	.10	.17	.33**	.30**	.35**	.05
English 206	47	.11	.03	.18	.04	.09	.13	-.02	.06
English 207	43	-.09	-.07	.09	.14	.16	.17	.00	.16
English 208	48	-.25	.06	-.04	.17	.17	.24	-.01	.13
History 222	49	.14	.10	.17	-.11	.07	.01	-.01	.14
History 223	37	-.05	.18	.13	-.08	.11	.03	.00	.20
History 224	35	.05	-.08	-.23	-.33*	.28	-.07	.25	.45**

Table 20.1 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Philosophy 137	36	-.09	.17	-.17	.04	-.07	-.46**	-.20	.38*
Psychology 151	53	.00	-.12	.14	.25	.24	.12	.22	.11
Psychology 225	30	.15	-.32	-.08	.39*	-.12	-.25	.07	-.06
Sociology 241	20	.37	.06	.17	-.19	.39	.51*	.17	.06
Sociology 251	24	.62**	.38	-.10	-.15	-.01	-.38	.06	.09

* $p < .05$
** $p < .01$

TABLE 20.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Education Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	123	-.08	.01	-.06	.03	.12	.05	.14	.06
G.P.A. in Major	118	-.06	.01	-.21*	-.12	.30**	.07	.21*	.32**
G.P.A.	123	-.02	.05	-.09	.09	.26**	.08	.21*	.25**
ATL 111	119	-.03	-.05	-.10	-.05	.24**	.22*	.15	.12
ATL 112	118	-.16	-.02	.06	.13	.17*	.21*	.07	.05
ATL 113	115	-.12	-.09	-.06	.12	.19*	.28**	.16	-.03
NS 181	121	-.06	-.07	-.14	.01	.15	-.05	.10	.23*
NS 182	121	.02	-.01	-.22*	-.09	.33**	.13	.28**	.28**
NS 183	116	-.02	-.10	-.21*	-.16	.32**	-.05	.25**	.42**
SS 231	113	-.06	.07	-.10	.08	.27**	.16	.21*	.18*
SS 232	110	-.08	.05	-.01	-.06	.29**	.20*	.19*	.20*
SS 233	108	-.12	.09	.07	.18*	.27**	.11	.24**	.19*
Hum 241	117	.03	.20*	-.01	.15	.12	.11	.08	.04
Hum 242	114	.09	.19*	.05	.05	.31**	.24**	.31**	.10
Hum 243	114	.10	.18*	.04	.17	.30**	.26**	.30**	.07
English 206	47	.11	.02	.10	.01	.17	.21	.03	.11
English 207	43	.06	-.07	.07	.16	.08	.09	-.10	.15
English 208	48	-.21	.06	-.04	.21	.04	.12	-.16	.10
History 222	49	.10	.10	.03	-.19	.38**	.29*	.22	.26
History 223	37	-.07	.18	.05	-.13	.29	.19	.13	.27
History 224	35	.08	-.08	-.22	-.31	.22	-.18	.20	.43**

Table 20.2 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Philosophy 1[illegible]7	36	-.11	.16	-.27	-.03	.17	-.28	-.04	.47**
Psychology 151	53	.04	-.13	.09	.25	.23	.09	.19	.13
Psychology 225	30	.13	-.32	-.17	.32	.06	-.11	.21	.04
Sociology 241	20	.34	.05	.05	-.25	.63**	.75**	.34	.16
Sociology 251	24	.47*	.28	-.28	-.23	.36	-.02	.31	.25

* $p < .05$
** $p < .01$

TABLE 20.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Female Education Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	123	-.08	.00	-.08	.02	.15	.07	.16	.07
G.P.A. in Major	118	-.06	.02	-.12	-.08	.19*	-.04	.15	.26
G.P.A.	123	-.03	.06	-.01	.13	.18*	-.01	.16	.20
ATL 111	119	-.03	-.04	.01	.00	.12	.13	.07	.03
ATL 112	118	-.18*	-.01	.17	.19*	.05	.12	.00	-.03
ATL 113	115	-.13	-.09	.02	.16	.11	.22*	.11	-.10
NS 181	121	-.07	-.07	-.09	.04	.08	-.11	.06	.19
NS 182	121	.01	.00	-.18*	-.07	.29**	.08	.24**	.25**
NS 183	116	-.03	-.10	-.14	-.13	.23**	-.15	.20*	.38**
SS 231	113	-.06	.07	-.06	-.11	.23*	.11	.18	.15
SS 232	110	-.09	.05	.04	-.04	.26**	.16	.16	.17
SS 233	108	-.13	.09	.09	.19	.26**	.10	.23*	.18
Hum 241	117	.03	.21*	.03	.17	.07	.07	.05	.13
Hum 242	114	.09	.20*	.11	.08	.27**	.20*	.29**	.06
Hum 243	114	.09	.19*	.12	.21*	.24**	.20*	.26**	.02
English 206	47	.11	.03	.18	.05	.10	.15	-.03	.06
English 207	43	-.06	-.07	.10	.18	.05	.07	-.12	.13
English 208	48	-.21	.06	-.03	.21	.03	.12	-.17	.09
History 222	49	.10	.11	.16	-.15	.28*	.20	.14	.20
History 223	37	-.08	.19	.12	-.10	.23	.13	.08	.23
History 224	35	.08	-.09	-.23	-.31	.24	-.19	.20	.44

Table 20.3 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Philosophy 137	36	-.12	.18	-.18	.02	.04	-.44**	-.14	.42**
Psychology 151	53	.04	-.13	.16	.28*	.17	.03	.15	.09
Psychology 225	30	.13	-.32	-.09	.38*	-.07	-.23	.14	-.04
Sociology 241	20	.35	.07	.17	-.22	.58**	.73**	.29	.09
Sociology 251	24	.60**	.39	-.12	-.19	.15	-.30	.21	.13

* $p < .05$
** $p < .01$

TABLE 21.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Business Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	175	.04	.04	.07	.02	.08	.00	.03	.15*
G.P.A. in Major	150	.05	-.07	.09	.11	.07	.08	.06	-.01
G.P.A.	174	-.07	-.20**	.06	.05	.18*	.13	.10	.16*
ATL 111	173	-.07	-.07	.14	.05	.36**	.34**	.27**	.11
ATL 112	168	.05	-.03	.03	.03	.31**	.33**	.23**	.07
ATL 113	162	-.04	-.10	.15*	.14	.23**	.31**	.21**	-.10
NS 181	170	-.07	-.13	-.11	-.17*	.39**	.24**	.30**	.31**
NS 182	165	-.01	-.03	-.12	-.22**	.36**	.25**	.21**	.30**
NS 183	156	-.09	-.21**	-.15	-.22**	.30**	.06	.19*	.41**
SS 231	160	-.10	-.10	.10	.08	.26**	.14	.26**	.16*
SS 232	153	-.12	-.13	.15	.04	.29**	.21**	.22**	.19*
SS 233	151	-.05	-.11	.17*	.06	.27**	.25**	.23**	.07
Hum 241	149	-.01	-.01	.12	.12	.08	.16*	-.04	.02
Hum 242	144	-.09	-.04	.06	-.02	.16*	.26**	.07	-.05
Hum 243	141	.03	-.05	.01	.06	.20*	.25**	.13	-.01
Chemistry 111	44	-.24	-.12	-.11	.04	.31*	.24	.23	.29*
Chemistry 112	32	.31	-.02	-.16	-.03	-.02	-.15	.11	.10
Economics 200	148	-.08	-.32**	.14	.03	.01	-.03	-.03	.10
Mathematics 111	43	-.16	-.16	-.23	-.25	.07	-.13	.08	.42**
Mathematics 112	36	-.13	-.04	-.19	.00	.02	-.09	.12	.11
Mathematics 113	22	-.60**	-.19	.13	.15	.18	-.03	.35	.15

Table 21.1 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Psychology 151	123	.00	-.04	.05	.03	.03	-.02	.03	.07
Sociology 241	77	-.03	-.17	.10	.14	-.14	-.08	-.08	-.14
Statistics 121	25	-.19	-.31	-.15	-.01	.10	.05	.06	.11

* $p < .05$
** $p < .01$

TABLE 21.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Business Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	175	.05	.04	.06	.01	.12	.03	.04	.18*
G.P.A. in Major	150	.07	-.08	.08	.12	.04	.05	.02	-.01
G.P.A.	174	-.04	-.21**	.04	.07	.13	.07	.03	.16*
ATL 111	173	-.03	-.08	.11	.07	.31**	.28**	.19*	.12
ATL 112	168	.08	-.03	.02	.05	.27**	.29**	.17*	.06
ATL 113	162	-.01	-.11	.14	.15	.18*	.28**	.15	-.10
NS 181	170	-.03	-.14	-.13	-.15*	.31**	.16*	.21**	.29**
NS 182	165	.01	-.04	-.13	-.20**	.30**	.19*	.14	.27**
NS 183	156	-.07	-.21**	-.16*	-.22**	.27**	.01	.13	.41**
SS 231	160	-.07	-.12	.10	.12	.15*	.04	.17*	.11
SS 232	153	-.10	-.14	.15	.08	.21**	.13	.14	.14
SS 233	151	-.02	-.13	.19*	.11	.13	.13	.12	-.02
Hum 241	149	.01	-.02	.13	.16*	-.03	.08	-.14	-.04
Hum 242	144	-.07	-.05	.07	.01	.05	.18*	.02	-.11
Hum 243	141	.06	-.06	.01	.11	.07	.15	.02	-.08
Chemistry 111	44	-.24	-.11	-.14	-.01	.51**	.38*	.35*	.40**
Chemistry 112	32	.31	-.01	-.17	-.05	.07	-.10	.18	.14
Economics 200	148	-.06	-.32**	.12	.02	.02	-.04	-.06	.13
Mathematics 111	43	-.16	-.15	-.25	-.29	.22	-.03	.17	.50**
Mathematics 112	36	-.15	-.03	-.21	-.05	.19	.03	.22	.22
Mathematics 113	22	-.63**	-.18	.10	.07	.47*	.17	.54**	.31

Table 21.2 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Psychology 151	123	.03	-.04	.03	.02	.02	-.04	.00	.10
Sociology 241	77	-.03	-.17	.09	.14	-.14	-.08	-.10	-.12
Statistics 121	25	-.19	-.30	-.17	-.06	.25	.17	.14	.21

* $p < .05$
** $p < .01$

TABLE 21.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Business Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	175	.04	.03	.07	.02	.08	-.01	.02	.15*
G.P.A. in Major	150	.07	-.08	.10	.13	.00	.03	.01	-.05
G.P.A.	174	-.05	-.21**	.07	.09	.08	.03	.01	.11
ATL 111	173	-.05	-.09	.15*	.10	.25**	.24**	.17*	.04
ATL 112	168	.07	-.03	.04	.07	.24**	.27**	.16*	.02
ATL 113	162	-.02	-.11	.16*	.17*	.14	.25**	-.14	-.16*
NS 181	170	-.04	-.15*	-.11	-.13	.28**	.13	.20**	.25**
NS 182	165	.01	-.04	-.12	-.19*	.29**	.18*	.14	.26**
NS 183	156	-.08	-.22**	-.15	-.20*	.23**	-.03	.12	.38**
SS 231	160	-.08	-.12	.11	.13	.14	.03	.17*	.10
SS 232	153	-.10	-.14	.16*	.08	.21**	.13	.14	.13
SS 233	151	-.02	-.13	.19*	.11	.15	.15	.13	-.01
Hum 241	149	.01	-.02	.13	.16*	-.03	.08	-.14	-.04
Hum 242	144	-.07	-.05	.07	.01	.05	.19*	-.02	-.11
Hum 243	141	.06	-.06	.01	.11	.07	.16*	.02	-.09
Chemistry 111	44	-.26	-.11	-.12	.02	.47**	.35*	.34*	.36*
Chemistry 112	32	.31	-.01	-.16	-.05	.06	-.11	.17	.14
Economics 200	148	-.07	-.33**	.15	.05	-.05	-.08	-.08	.07
Mathematics 111	43	-.17	-.15	-.23	-.28	.17	-.07	.15	.48**
Mathematics 112	36	-.16	-.03	-.20	-.03	.14	-.01	.21	.17
Mathematics 113	22	-.67**	-.19	.13	.11	.42*	.12	.54**	.25

Table 21.3 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Psychology 151	123	.02	-.04	.05	.05	-.04	-.08	-.02	.04
Sociology 241	77	-.03	-.17	.10	.15	-.18	-.10	-.10	-.15
Statistics 121	25	-.21	-.31	-.15	-.04	.20	.13	.13	.16

* $p < .05$
** $p < .01$

TABLE 22.1

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Engineering Majors, Holding English Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	52	.10	.10	.07	-.19	.26	.25	.24	.04
G.P.A. in Major	38	.07	-.07	-.17	-.26	.23	.19	.23	.08
G.P.A.	52	.04	.03	.03	-.19	.34*	.30*	.28*	.18
ATL 111	52	-.10	-.16	.18	.06	.34*	.36**	.21	.17
ATL 112	48	.04	-.01	.07	.12	.35*	.46**	.17	.08
ATL 113	43	.16	.07	-.03	-.02	.42**	.45**	.19	.26
NS 181	48	-.03	-.05	.23	-.13	.27	.10	.39**	.07
NS 182	44	.05	.04	.05	.02	.43**	.44**	.32*	.10
NS 183	35	.26	.22	-.09	-.02	.47**	.46**	.40*	.07
SS 231	40	-.03	-.06	-.05	-.14	.48**	.35*	.41**	.33*
SS 232	36	-.18	.01	.19	.07	.35*	.33*	.26	[illegible]
SS 233	33	-.10	-.10	-.06	-.08	.42*	.35*	.42*	.16
Hum 241	37	.02	-.12	.10	.07	.20	.21	[illegible]	-.12
Hum 242	36	-.28	-.41*	-.02	.08	.17	.10	.26	-.01
Hum 243	32	-.02	-.16	.04	.17	.27	.22	.23	.15
Chemistry 111	49	.06	.00	-.07	-.12	.40**	.34*	.36*	.17
Chemistry 112	41	.24	.15	-.32*	-.25	.32*	.17	.42**	.15
Economics 200	34	.18	.02	.04	-.02	.18	.17	.22	.07

Table 22.1 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	40	-.03	-.11	.30	.40*	.10	.06	.06	.19
Mathematics 112	43	.18	-.04	-.01	.03	.36*	.34*	.16	.43**
Mathematics 113	39	.14	.21	-.29	-.17	.36*	.41**	.14	.25

* $p < .05$
** $p < .01$

TABLE 22.2

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Engineering Majors, Holding Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	52	.10	.10	.07	-.19	.28*	.26	.26	.04
G.P.A. in Major	38	.02	-.03	-.14	-.26	.23	.21	.20	.08
G.P.A.	52	.00	.06	.06	-.20	.35**	.32*	.26	.19
ATL 111	52	-.16	-.10	.23	.05	.33*	.37**	.15	.16
ATL 112	48	.05	.12	.18	.16	.17	.33*	-.03	-.03
ATL 113	43	.13	.16	.04	-.01	.35*	.41**	.08	.22
NS 181	48	-.08	.01	.27	-.14	.27	.13	.37**	.07
NS 182	44	.04	.12	.12	.04	.33*	.36*	.22	.03
NS 183	35	.37*	.46**	.04	.05	.14	.16	.13	-.15
SS 231	40	-.09	.05	.04	-.14	.40**	.30*	.31*	.30*
SS 232	36	-.22	.18	.36*	.12	.15	.18	.06	.14
SS 233	33	-.12	.00	.02	.11	.29	.25	.30	.08
Hum 241	37	.00	-.02	.20	.10	.06	.12	.13	-.21
Hum 242	36	-.34*	-.35*	.07	.11	.01	-.01	.10	-.10
Hum 243	32	-.06	-.10	.10	.18	.22	.19	.16	.12
Chemistry 111	49	.03	.07	-.02	-.12	.35*	.30*	.30*	.14
Chemistry 112	41	.17	.17	-.30*	-.25	.37*	.24	.44**	.17
Economics 200	34	.09	.04	.06	-.04	.23	.24	.21	.10

Table 22.2 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	40	-.08	-.12	.29	.37*	.18	.13	.10	.23
Mathematics 112	43	.14	-.02	.01	.02	.39**	.36*	.14	.43**
Mathematics 113	39	.13	.25	-.27	-.17	.34*	.39**	.10	.23

* $p < .05$
** $p < .01$

TABLE 22.3

Partial Correlations between Academic Performance, Analysis and Synthesis, and Academic Ability for Male Engineering Majors, Holding English and Reading Comprehension Constant

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Terms in School	52	.10	.11	.07	-.19	.29*	.27*	.26	.04
G.P.A. in Major	38	.08	-.02	-.14	-.25	.15	.13	.16	.03
G.P.A.	52	.05	.07	.07	-.18	.29*	.25	.23	.14
ATL 111	52	-.10	-.09	.26	.09	.23	.28*	.09	.10
ATL 112	48	.05	.12	.18	.17	.18	.35*	-.03	-.04
ATL 113	43	.17	.18	.04	.01	.31*	.37*	.05	.19
NS 181	48	-.03	.00	.28*	-.12	.20	.03	.34**	.02
NS 182	44	.05	.12	.12	.04	.33*	.37*	.22	.02
NS 183	35	.33*	.47**	.03	.02	.29	.32	.20	-.09
SS 231	40	-.03	.06	.04	-.12	.33*	.22	.27	.25
SS 232	36	-.21	.18	.36*	.13	.13	.16	.04	.13
SS 233	33	-.10	.01	.02	.12	.28	.23	.29	.06
Hum 241	37	.03	-.02	.20	.11	.01	.07	.11	-.25
Hum 242	36	-.32	-.34*	.08	.12	-.06	-.09	.07	-.15
Hum 243	32	-.01	-.09	.10	.20	.15	.12	.12	.08
Chemistry 111	49	.07	.08	-.02	-.11	.31*	.26	.28*	.11
Chemistry 112	41	.24	.19	-.31*	-.24	.30*	.14	.41**	.12
Economics 200	34	.18	.07	.08	-.01	.12	.12	.16	.03

Table 22.3 -- continued

Academic Performance Score	N	Rigidity	Dogmatism	Perceptual Analysis	Perceptual Synthesis	CQT	CQT-V	CQT-I	CQT-N
Mathematics 111	40	-.03	-.11	.30	.41**	.11	.05	.06	.20
Mathematics 112	43	.19	-.01	.01	.04	.34*	.32*	.11	.41**
Mathematics 113	39	.14	.25	-.27	-.16	.34*	.40*	.09	.23

* $p < .05$
** $p < .01$