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MATHEMATICAL ABILITY AS A FUNCTION OF PERCEPTUAL FIELD-DEPENDENCY AND CERTAIN PERSONALITY VARIABLES

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MATHEMATICAL ABILITY AS A FUNCTION OF PERCEPTUAL FIELD-DEPENDENCY AND CERTAIN PERSONALITY VARIABLES

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MATHEMATICAL ABILITY AS A FUNCTION OF PERCEPTUAL FIELD-DEPENDENCY AND CERTAIN PERSONALITY VARIABLES

CHAPTER I

INTRODUCTION

Nature of the Problem

The general problem of determining the reasons why some people are more proficient in mathematics than others of seemingly equal intellectual capacity has led to various kinds of speculation. One line of speculation resulted in the hypothesis that the ability to master mathematics is a function of various personality characteristics.

One aim of this study is to determine whether mathematical ability is in fact related to some of the personality factors designated by individuals who have dealt with this problem; further an attempt will be made to relate mathematical ability and the personality characteristics to still another aspect of personality--perceptual field-dependency. A major portion of this study will be devoted to a consideration of the inter-relationships among personality factors, modes of perceiving, and mathematical ability.

In order to understand why one should look for the above relationships, it is helpful to review those articles

which deal with personality-perception relationships and with the relationships between personality factors and mathematical ability.

Importance of the Problem

In the development of psychology as a formal discipline, there was a progression from the study of isolated psychological, sensory processes to the study of man as an interpreting, integrating organism. The early Gestalt or configurational psychologists (36, 37, 41, 96) were not concerned primarily with idiosyncracies in perception. The growth of psychoanalytic psychiatry and the more sensitive diagnostic instruments like the Rorschach test (7, 35, 68) resulted in the placing of more emphasis on subjective, personal interpretation of what is perceived.

Not much less than one nor more than two decades ago, experimental studies of perception and other cognitive functions were concerned only with transient needs of the person such as hunger (38, 74, 75), and reward and punishment (30, 62). Other studies were concerned only with partial aspects of personality functioning such as judgments and attitudes (3, 97), values (14, 61), attitudes in remembering (5, 39, 78, 20), and social factors (43, 79, 80). More recently, there have been studies of intolerance of ambiguity (25), perceptual defense (47), and the authoritarian personality (2). Following these research attempts, or concurrent with them, a number of attempts have been made to evaluate and integrate

the findings of perception and personality (10, 12, 15, 51).

But it remained for Witkin (100) to initiate the first really systematic empirical investigation of the relationship between broad features of the personality and characteristic ways of perceiving. His study differed from previous experimental studies with respect to the inclusiveness of the personality description it attempted. It is one of the first studies to demonstrate an association between major personality variables and a significant, stable feature of the individual's perception. After extensive investigations with many different kinds of people the isolation of a single, complex perceptual function was accomplished.

Witkin's point of view, like this writer's rests on the basic assumption that perception and personality are not separate processes of equal status in the individual. Instead, he sees personality as subsuming perception, thinking, learning, etc. His study attempted to account for perception by relating it to personality variables.

Since this investigation is concerned with the relationships among personality, perception, and mathematical ability it would be appropriate now to review pertinent articles in these areas.

Factors Which Affect Mathematical Performance

Environment. Although little has been said about the personalities of the children who have difficulty learning mathematics, most investigators agree that many children have

such difficulty. For example, Bear (6, p. 139) reported that arithmetic contributed to half the failures of fourth grade children and caused difficulties for over half the pupils of upper grades and high school. Guiler (28) indicated that approximately one-fifth of college entrants lacked sufficient mastery of arithmetic for successful college work.

In order to account for the differences in mathematical ability among students, many writers (6, 13, 28, 34, 46, 77) have emphasized such environmental factors as methods of instruction, academic background, and study habits.

Bear discussed the origins of difficulties in mathematics as stemming from poor readiness experiences, such as counting money, and lack of language development; that is, the child has not yet learned the concept of "most, more, many, same, and equal." He does admit that emotional and social maturity are needed for learning, but these are not stressed. He conceptualized the problem of students in the upper grades as resulting from "incorrect ideas and habits or failure to learn earlier fundamental processes" (6, p. 155).

In short, Bear's point of view, like that of so many educators, seems to emphasize environmental causes for the origin and persistence of mathematical disability. The emphasis is on inadequate learning and experience; the remedy generally offered is more training and practice.

Ability. Some investigators, on the other hand, were more content to stop at the level of statistical description

and merely tried to determine the existence of various general and specific abilities in the intellective functioning of the student (33, 87, 88, 104). Most of these studies concluded that there is no such thing as a special aptitude for mathematics (4, 21, 22, 31, 73).

Dexter (21), in a study involving the administration of a questionnaire and various tests of ability in school subjects, found that on neither elementary, secondary, nor college level was mathematics "erratic" or significantly different from grades in other subjects. She took into account the quality of school, majors, intelligence, and work habits. Her paper was replete with correlational analyses of other studies where mathematics was compared with different school subjects. For the most part, correlations between mathematics and verbal intelligence were moderately high with a range from .39 to .72.

Dexter seemed unsympathetic toward those who considered themselves naturally poor in mathematics, and she wondered if this affords them a gentler alibi than does "general inability" as a student. In the opinion of this writer, she made some good observations concerning what is involved in the study of mathematics. Mathematics requires more exact preparation; bluffing the teacher is more difficult; you can't "rave on" in mathematics.

In short, it was Dexter's opinion that mathematics ability is a general, and not a specific endowment. Thus, for

her, general endowment is what is needed for successful work in mathematics as well as in other subjects.

Judging from the preponderance of foreign articles cited in abstracts of psychological studies during the years 1934-1940, there appeared a trend of thinking quite different from the contentions of the general-factor theorists and of those who spoke of environmental learning factors. These writers (8, 11, 23, 64, 66, 67, 76) pointed to special cases of mathematical genius, superior ability in families and certain racial groups, and hereditary types.

Personality. Only a very small group of psychologists have speculated on the existence of possible personality variables which might be associated with mathematical ability of students in general; however, these psychologists have not put their ideas to empirical test.

Over thirty years ago there were two studies which employed pencial and paper tests to explore possible existing relationships between mathematics and personality. Chambers (19) employed the Pressy X-O Test with 400 cases and found a significant relationship between statements of personality traits and academic success. For girls, Fleming (24) was not able to demonstrate any relationship between achievement in mathematics and temperament as measured by an adaptation of the Downey Will Temperament Scale. The lack of relationship held for both junior and senior high school levels.

Almost a decade later, Parry (54) found that intelligence, as measured by the American College Entrance Test,

played a very small role in predicting mathematics grades of college students when the intelligence measure was used in combination with standardized tests of mathematics. However, he did find that personality, as measured by the Purdue Personality Rating Scale, was a very strong predictor of mathematics marks, and he concluded that it deserves a place with or above some of the standardized tests as a predictor. He obtained a correlation of .52 between first year college mathematics grades and personality. Similarly, he found a correlation of .34 between the Iowa Mathematics Test and personality. Unfortunately, nowhere in his study did he elaborate on what aspect or aspects of personality he was considering. Nor did he inform the reader of the meaning of the score on the personality test. He merely explained that personality is that which is measured by the rating scale which he employed. He did not explain how he scored this test. Inspection of the scale reveals that naively termed items were to be rated without adequate definition of the points along the continuum. Five teachers, five citizens of the hometown of the student, five students, and the student himself contributed to the sixteen ratings of the ten different traits on the scale. Traits were labelled with such terms as "grouchy," "lazy," "helpful," and the like. No satisfactory evidence of the reliability and validity of these scores obtained from the rating scale was given.

Adler (1) drew upon his experience with patients and

indicated that the kind of child who is characteristically passive and sits back waiting for security from others and from the outside will have trouble with mathematics. For this child every other school subject will appear easier than mathematics. Adler stressed that mathematics requires more independence in thinking and reasoning because it is not related easily to other subjects. In this subject the child is left entirely to himself and on his own initiative. Therefore, a pampered, overly dependent child finds mathematics unduly difficult.

Although Adler did not ignore the fact that some theorists had pointed to natural endowment as a requirement for success in mathematics, he was much more emphatic about attitudes. He indicated that if a teacher believed in the concept of a natural talent for mathematics, then he would regard those who seem less gifted as bad and consequently would withdraw his efforts. Adler noted that this was often the case in schools for girls where both teachers and students came to the conclusion that girls were not suited for mathematics and accepted the "fate." This phenomenon of fatalistic belief in the concept of inborn, special aptitudes was also described as relating to boys and to children who pointed to their parents who have been poor in mathematics. Similarly, a success of a boy in this subject may hasten to make his brother give up the contest between the siblings and subsequently experience the deprivation of security that comes

with mastery of numbers.

Like Adler, Bear stated emphatically that in any of the causes of difficulty in dealing with mathematics stem from the attitudes of adults in the youngster's life.

> While parents may at times take failure in arithmetic philosophically and excuse it because "he takes after his mother," or "has no head for figures," they are as likely, especially in the case of reading and spelling to regard it as subnormal or perverse. Invidious comparisons are made with siblings and friends. The child is blamed for not working harder, and in ridicule he is called stupid, lazy, or a fool. Between having difficulty with the subject and the reaction of others to his difficulty, it is small wonder that the learner compensates, rationalizes or accepts himself as inferior, and withal feels that effort to improve is futile (6, pp. 139-140).

Bear's remarks seem to be more an explanation of how a situation is aggravated than of how it develops. In addition, he tended not to see these students as having any special group of personality characteristics, although he did suggest that they have poor self-esteem and feel helpless.

Levy (40), on the other hand, related dependency to overprotection. He concluded that the overprotected child was relatively superior in language skills, such as reading and vocabulary, but not in arithmetic. He explained this difference in abilities in several ways. First of all, he pointed out that the overprotected child had an advantage in language skills because of his close association and identification with the mother. Secondly, the fact that overprotected children do not become members of close-knit peer groups also aids language development. The dynamics of peer groups re-

sult in the development of a language which is unique to group and in resistance to the acceptance of adult-initiated language forms. Since the overprotected child is rather isolated from peer groups, he has no support for resisting adult-initiated language forms. As a result, he accepts the adult language and shows early language proficiency. Levy also observed that mothers who coached their sons with their homework had to leave the arithmetic problems to the child in the more advanced grades because they found the work beyond them. The more aggressive overprotected boy showed least interest in subjects which gave him difficulty, preferring to concentrate his attention on those which came more easily.

For Levy, arithmetic was seen as being the most purely disciplinary of school subjects. Children who were more independent, played with other children, and were sent on errands involving some computation were observed to have more experience with number concepts. This experience would give them an advantage over the overprotected child. Levy felt, however, that the above inferences were only suggestions for the accumulation of further data on this point.

Levy also compared a large group of overprotected children with a large check group of 369 cases from a child guidance institute, a special-school group of 150 juvenile actors and other professior children, and a group of 14 rejected children. Only the group of rejected children showed less retardation in arithmetic than in reading. Of the re-

maining groups, the overprotected showed the highest discrepancy of reading skill and arithmetical ability. Levy did not demonstrate that the performance in mathematics of overprotected children was worse than that of other children; however, he did demonstrate that the performance in mathematics of overprotected children was not as good as was the reading performance of such children.

Plank and Plank (59), in their extensive review of autobiographies of famous persons, revealed some striking similarities to the notions of Levy in their conception of the involvement of the mother as a factor related to difficulty in mathematics. They concluded, "In order to move on into a world of orderly symbols from a world of objects, one has to detach oneself from the most loved object first" (59, p. 286). The "object," in their thinking, was the mother in the family, while the "world of symbols" referred to mathematics. They indicated that men devoted to their mothers (e.g., Sergei Aksakoff, Winston Churchill) found mathematics very difficult; on the other hand, men without strong maternal ties (e.g., A. A. Milne and John Trumbull) found mathematics easy. In summarizing their conceptions, the authors stated:

> There is first of all, the loss of a relationship to the mother and the cathexis of mathematical interest. There is also the role of the guiding older male figure, which we shall see in its great importance in the autobiographies of women. There is finally a tie-up between mathematical prowess and aggression toward authority figures (59, p. 286).

The authors concluded that after severing the dependency ties

with the mother, children display greater competence in mathematics. It was proposed that doing mathematics required manipulation, dissection, and destruction of figures. The authors pointed out that aggression could be harnessed by being turned against abstractions rather than human beings. They concluded, therefore, that one could find expression of aggression with parallel mathematical interest, especially from individuals who develop a desire to "mold the material world to their will." They elaborated this point by discussing such men as Fiorello Laguardia, Chaim Weizman, Abraham Lincoln, and Napoleon Bonaparte who had to fight their way up in life.

These writers saw a more clear and simple pattern emerging from the memories of women mathematicians. The few who had a great interest in mathematics made a strong identification with a masculine figure in their lives. Parallel with this seemed to go a lack of feminine identification or conflict around it. They elaborated this point by discussing such people as Madame Curie and Sonya Kovalevsky. The authors specified that estrangement from both mother and father engendered a flight into abstraction and a complete stagnation in the field of mathematics. They supported this conclusion by discussing observations of other writers who reported cases of lightning calculators who were autistic or schizophrenic. Finally, these investigators indicated the need for more studies in this area:

> Observations of children in school tend to support the impressions gained from a large number of auto-

> biographies. It would be very desirable to collect more clinical material on the emotional concommittants of mathematical interest and ability, both through the study of adults and children in treatment, and especially through the study of children in their educational settings (59, p. 292).

Not only has the problem of emotional factors and mathematics been considered by the psychologist, but it has also been a subject for discussion in the nation's newspapers and magazines. For example, Salvadori (72), a professor of mathematics, wrote an article which disclosed his early hatred for mathematics. Mathematics was described as being a kind of mixture of infallibility, incomprehensibility, and authority to the child who was being taught the subject. He speculated about its relationship to the kind of home from which the child comes. More specifically, he suggested that boys who have trouble identifying with their father's authority or boys who are overprotected by their mothers were likely to have difficulty with this subject.

Rosenfeld (71) suspected that males who were somehow lacking in mature, masculine components of personality would be poor in mathematics ability. Consequently, a preliminary investigation of 119 male college freshmen was conducted; a substantially high correlation of .62 between masculinity and success in mathematics was found. In this study the Terman and Miles Attitude-Interest Test (86) was used since it is a test which validly differentiates between men and women.

One of the few quantitative studies in the area of mathematics and personality was by Cattell (18). In studying

123 ASTP candidates, he analyzed their Army Alpha intelligence test scores and Mathematics Graduate Record Examination scores. He also obtained ratings on 35 personality trait clusters. Cattell discovered that mathematics and verbal skills correlated about .45 with general ability and .40 with character integration. He suggested that mathematics ability was related to surgency (i.e., being cheerful, sociable, quick witted) and, negatively, to the factor of dominance in the person.

Cattell felt that further research would be needed concerning the relations between personality and actual attainment in mathematics skills. He also believed that it would be necessary to determine the extent of these relationships as they might arise through connections with genetic interest and environmental influences.

Unlike Dexter (21), he obtained some unexpected low correlations between intelligence and his two achievement measures, mathematics and verbal abilities. For mathematics, the correlation coefficient was .35, and for verbal ability there was a correlation coefficient of .46. Consequently, it was not surprising for Cattell to find that partialling out of intelligence did not reduce to zero the correlation between these two abilities. Nor did partialling out reduce to zero the correlations of these abilities with the many personality traits which were appreciably related to intelligence.

Cattell had a rather unique finding and interpretation.

He found that mathematics and low dominance of personality were related slightly. He interpreted this to mean

> ...that the individual lacking in social dominance and manifesting the lack of self-confidence which the questionnaire shows to exist on the introspective side of this pattern is both less likely to get out of patience with the rigid, intractable, deliberations of mathematics and more likely to welcome the comforting certainty of the all-embracing system. For the high dominance individual as our correlations show, is notably headstrong and impatient, while the low dominance individual seeks something greater than himself on which he can lean (18, p. 48).

From a somewhat different point of view, it would seem to follow that people who are unassertive and highly "field-dependent," in Witkin's (100) conception, would be better in mathematics. If this is a reasonable translation, then Cattell's opinion would be at variance with the theoretical notions of this paper as well as with the majority of other writers. Cattell stated further that the existence of a relationship between cyclothymia and mathematical ability ran contrary to the clinical observation that schizoid people were good in mathematics. However, he admitted that there was convincing evidence for a preponderance of pyknic body build types among mathematicians. One wonders if Cattell's argument became too vague when he loosely tied together such concepts as "cyclothymia" and "dominance."

All in all, Cattell's findings and theorizing appeared to be in contradiction to some of the theoretical formulations of this paper and of most other writers. It was hoped that this investigation would serve to underline the issues more clearly.

Regardless of Cattell's specific findings, his overall conclusion was that there exists a relationship between ability and personality.

> The general manner in which the profile of loadings found in pure personality research persist in the correlations with abilities, offers, incidentally, additional confirmation of the real existence of the personality factor as functional unities (18, p. 485).

As for more orthodox psychoanalytic literature on this special problem, little has been written, but Plank and Plank (59) referred to several articles involving case studies concerning the unconscious symbolic meaning of certain numbers, and how this meaning may interfere with learning.

Consideration at this point may be given to some of the more recent personality theorists who have attempted to comprehend the development of personality and the ability to think mathematically in terms of a concept of "differentiation."

Development of differentiation. Personality theorists such as Piaget (55), Sullivan (84), and Murphy (49) characterized the earliest years of the child with terms such as "egocentric," "prototaxic," or "undifferentiated." According to Piaget (56) the infant in this stage does not consider himself as one thing among many but only conceives of things in relation to his own actions. Although the child is seen as admitting "the permanence of concrete objects in the world of immediate experience, he really has no idea of the conservation of matter, weight, or movement, nor even any conception

of logical or numerical groups" (56, p. 167). Piaget stated that ability to deal with quantities and mathematical conceptions must await the development of the child into a more mature intelligent individual who has succeeded in "steming the egocentricity," (56, p. 167).

In another paper (58) Piaget discussed and described his various experiments with children and emphasized that social and mental development were very important in the acquisition of mathematical concepts. He stated,

> It is a great mistake to suppose that a child acquires the notion of number and other mathematical concepts just from teaching. On the contrary, to a remarkable degree he develops them himself, independently and spontaneously. When adults try to impose mathematical concepts on a child prematurely, his learning is merely verbal; true understanding of them comes only with his mental growth (38, p. 74).

Rosen (70) agreed with the formulations of Piaget (57) although he tended to translate much of Piaget's terminology into highly orthodox Freudian words. Rosen stated that the true conceptualization of number was quite distinct from the process of the mereverbal reproduction of integers. The three stages of conceptualization were viewed as primarily dependent upon the maturation of the processes of perception. Although Rosen's discussion primarily stemmed from his observations of such special cases as a mathematician in analysis with him, the citing of cases of genius in families, and lightning calculators, it is interesting to note the extent of agreement with Piaget's formulations.

One might infer, therefore, that a more socially and emotionally immature individual, as one of Levy's overprotected children or Piaget's egocentric less differentiated youngsters, would have trouble in coming to terms with the problems presented in doing mathematics. A child who is more dependent, vaguely aware of his surroundings, and passive is not only less likely to show little initiative and zest in everyday social relationships but, as Witkin (102) suspected, he is less likely to be active, curious, and to achieve mastery in academic subjects. Witkin also explained that the passive, dependent child is not prone to learn nonsense syllables since the learning of nonsense takes a great deal of energy as compared with the learning of organized material. The dependent, poorly differentiated child is a child who has trouble distinguishing himself from his surroundings. He is also hampered by anxiety and the impression which he is making, and consequently, does less gathering of information about things around him.

In discussing perception, development, and personality, Witkin described his "field-dependent" perceivers as passive and as probably having an arrested development of personality. These qualities suggested to this writer some similarities to the description of poor mathematics students. Witkin explained the developmental aspect of field-dependency in the following way.

> ...a failure of effort to cope with the environment, with the resulting trend toward passive submission and

> lack of self-differentiation, makes for an "arrest" in development of capacity for active, analytical dealing with the field, manifested in the kind of field-dependent performances observed in our perceptual tasks (100, p. 479).

Theorists such as Witkin, Murphy, and Piaget seem to hold the view that one of the earliest developments in the young child's perception is the ability to experience his body as a separate entity distinct from the environment. As the child grows in experience he is believed to be able to make greater distinctions between stimulation from within and from without. There is, therefore, a strengthening of the boundaries between his body or self and the outer world. With increasing differentiation between the self and the outer world another stage takes place, according to Witkin.

> At a latter point in development we may postulate another stage, in which any item, whether the body or an object in the field, can be separated from the surrounding framework. A process that begins with the ability to differentiate self from environment progresses to ability to differentiate figure from ground in any structure, even against strong ground influence (100, p. 477).

Murphy (50) referred to the inability to differentiate in questionning its possible relationship to mathematics:

> I think we are dealing with a very broad dimension having to do with "failures in differentiation" or what the Germans used to call "splitting power." It would be very important to show whether the failures of differentiation apply more in mathematical than in other work (50).

Rapaport's (63) concepts of selectivity and concentration in his discussion of the simple arithmetic problems on the Wichsler Bellevue Intelligence Scale (95) may also be

akin to the concepts of "differentiation." He described two kinds of concentration but saw them as fulfilling the same functions.

> Both consist in seizing with conscious effort material at the individual's disposal, either in the external or in his internal world. Both are called upon to function selectively, either when externally or internally interfering factors make free receptivity or productivity difficult, or when the complexity of the material to be received or produced requires critical scrutiny and selection not supplied by effortless attention (63, p. 196).

An active orientation to a task and an ability to function selectively in the face of interfering factors seem, then, to be necessary in both mathematical work and in the kind of analytic, independent perceptual performance measured by Witkin. Also implied in Rapaport's theories was the concept of a set or tendency to keep certain mathematical relationships in mind.

Similarly, Rose (69) stated the importance of the quality of perseverance and the preponderant role of determinative tendencies which keep before the mind the end to be attained in the performance of mathematical problems.

There appears to be a kind of self-discipline involved in Rapaport's "concentration" theory and a kind of inner integration, as opposed to poor differentiation, which is required for active, analytic perceiving. These things were suggested by Strunz's (83) study. He examined the extemporaneous compositions of 43 boys, 17 years of age. These essays concerned their attitudes towards mathematics. In them he found the

factor of discipline as a source of pleasure for the subject. Other pupils who felt a repulsion inherent both in the subject and themselves seemed to grasp the immediate meaning, but it was alien and without positive value because their "structural dynamics" appeared to be oriented toward the external world. As Reissman (65), might put it, these students would be called "other directed."

As a consequence of the work of all the aforementioned previous investigators who have dealt with "environmental," "ability," "personality," and "differentiation" factors, there are questions which must be answered, and there is little in the way of clearcut, verified statement which relates personality to mathematical performance. However, suggestions growing out of the observations and theorizing of the majority of authors indicate that there are several personality variables which might be associated with poor mathematics ability. They are: (a) femininity, (b) passivity, (c) aggressiveness of a poorly controlled nature, (d) immaturity, (e) less independence and integration, and (f) less self-esteem.

Witkin's Study

High and low field dependency. The above personality dimensions seem to be very similar to those characteristics associated with Witkin's high and low index perceptual performers:

> ...field-dependent persons tend to be characterized by passivity in dealing with their environment; by unfamiliarity with and fear of their own impulses,

> together with poor control over them; by lack of self-esteem; and by possession of a relatively primitive, undifferentiated body image. Independent or analytically perceptual performers, in contrast, tend to be characterized by activity and independence in relation to their environment; by closer communication with, and better control of their own impulses; and by relatively high self-esteem and more differentiated, mature body image (100, p. 469).

These relationships were found in extensive studies of children, normal adults, and hospitalized psychiatric patients.

If the above parallels between personality variables suspected to be associated with proficiency in mathematics and personality variables known to be associated with extent of field-dependency are more than coincidental or semantically similar, then it should be possible to demonstrate a relationship between mathematics ability (verbal ability held constant) and extent of field-dependency. It would also seem to follow that the various personality indices, already known to be associated with extent of field-dependency, are related to proficiency in mathematics. This, then, is precisely what we wish to determine. Such an undertaking might serve to bring together more closely three areas of psychology--perception, aptitude, and personality.

Since the present study will depend heavily upon Witkin's work, a detailed presentation of his findings will be presented.

Embedded figures test as a device to measure field-dependency. This test, originated by Gottschaldt (26), was employed by Witkin (99, 100) in his studies of extent of field-

dependency. The nature of the task confronting the subject is to separate the item, a simple geometric figure, from the field, a complex geometric figure, which has hidden within it the simple design. It is,

> ...a direct instigation to deal with the field analytically rather than to accept it passively...In fact, the "pressure" exerted on the subject to separate the item from the field is greater in the embedded-figures test than in any of the orientation tests. Here the only acceptable result is the proper identification of the simple figure, and the subject therefore knows whether he has succeeded or failed in overcoming the influences of the field. ...a second important feature of the embedded-figures test is that it involves a unitary perceptual system, concerned only with a field or context, and an item within it, and no need for reference to any standard outside these (100, p. 86).

This test was found to correlate highly with the orientation tests used by Witkin. Thus, dependence on the visual field in the orientation situations is related to difficulty in extracting a hidden item from its complex visual context. Test re-test correlations proved so high as to suggest that this is a stable test. For all ages and types of people, females were more clearly field-dependent than males. Similarly, alcoholics who are usually considered to be basically more passive and feminine were more field-dependent than other hospitalized patients and normal men.

Embedded-figures test and figure drawings. The Figure Drawing Test, like other projective tests, is ambiguous in nature. The subject is merely told to draw a person, and the response to this request is as varied as the number of

people themselves. The figure which is drawn is regarded as a rough representation of the subject's image of himself. This test differs from other projective tests such as the Thematic Apperception Test and Rorshach in that it deals primarily with concept of the body, is graphomotor, and does not have a fixed stimulus. For a more comprehensive discussion of figure drawings the reader is referred to the pioneer work of Machover (44).

The high correlation obtained by Witkin between the Embedded Figures Test and the Figure Drawings signified that a person's ability to keep a visual item separate from its context is related to his attitude toward his own body. The figure drawing measure of an individual's impression of his body in relation to the environment was found to be connected with his method of handling a strictly visual item-in-context problem. The relation between the self and the environment has a bearing on the person's ability to extract an external item from its context.

Field-dependent perceptual performers had drawings which revealed low evaluation of their own body, infantile defenses against anxiety, lack of self-assurance, difficulty in accepting the adult role, passivity coupled with uncontrolled expression of hostility and aggressiveness. Such persons are hypothesized in this study to be poor in mathematics.

Independent perceivers, those who resist the field, were found to have a high degree of narcissistic investment in the body, more sophisticated defenses against anxiety,

greater self-assurance, identification with the "desirable" characteristics of both sexes, strong drives, and manipulative control of their drives. These persons in the present study are hypothesized to be good in mathematics.

Embedded figures test and TAT. The TAT, a popular clinical test, is probably used as often as the Figure Drawing Test in everyday practice. It consists of a series of cards with photographed and sketched pictures which are ambiguous in nature. The subject is instructed to make up a story about the scenes depicted. In the words of Bellak, it is a projective test:

> The TAT is at present regarded as a projective test in that the stories which subjects tell about each of the pictures are considered to be projections--that is, ascriptions of feelings and sentiments, needs or drives of the individual which are elicited by the stimulus materials of the pictures (9, p. 186).

This test is generally expected to provide information about the conscious and unconscious fantasy life of a person, his values, wishes, and attitudes towards others and himself. The TAT differs from the figure drawing and interview techniques in that it deals with fantasy solutions or literary expressions and the like, while the other evaluative techniques give an actual sample of overt behavior.

The person whose perception is characterized by an ability to resist the prevailing field is more apt than a field-dependent person to produce stories on the TAT in which the central characters cope assertively with the environment

and with their own conflicts.

Embedded figures test and interview. The interview has long been employed as a tool for many professions and occupations. It has also been the sole technique of most psychiatrists who practice psychotherapy. Like the projective techniques described in this study, it may be used also in a manner that will allow the subject much freedom to express himself, and consequently reveal various aspects of his personality. Such a use of the interview technique does not belong necessarily to the psychotherapist or psychodiagnostician alone in an actual clinical setting. It may be adapted for research purposes; this is just what Witkin did. In conjunction with the interview, he also used an autobiography and questionnaire to aid in the evaluation of the subjects.

Witkin found that highly field-dependent perceptual performers had the following personality characteristics on the interview and its conjunctive techniques: (a) denial, (b) repression of hostility, (c) passivity, (d) feelings of low self-esteem, (e) anxiety and tenseness.

Those who resisted the field and dealt with it analytically had the following characteristics: (a) self-awareness, (b) open hostility, (c) active natures, (d) compensatory handling of impulses, (e) greater self-assurance.

It was expected, then, that better mathematics students would have more of the interview personality characteristics associated with low field-dependency, while the poorer mathe-

matics students would have more of the interview personality characteristics associated with high field-dependency.

To summarize the basic position or point of view held here, it is suggested that the personality characteristics presumed by various authors to be associated with proficiency in mathematics are essentially the same characteristics which Witkin has found to be present in his less field-dependent perceptual performers. Concretely, it is expected that mathematical ability will be inversely related to perceptual field-dependency; further, relationships between mathematical ability and performance on three personality assessment devices--Figure Drawings, TAT, and Interview--are expected.

CHAPTER II

STATEMENT OF THE PROBLEM

In general, the purpose of this investigation is to study the relationships between mathematical ability and personality. Previous writers have stated that individuals with poor mathematical ability are more feminine and passive than are those with good mathematics ability. It was also suggested that such persons have less control of their impulses, are less independent and integrated, and have less self-esteem than those with better mathematical ability.

Specifically, the purpose of this investigation is to test the following hypothesis. If poorer mathematics performers have personality traits which are similar to those people who are perceptually field-dependent, and if better mathematics performers have personality traits which are similar to those of analytic independent perceivers, then degree of proficiency in mathematics should be related to field-dependency and various personality characteristics measured by the Figure Drawing Test, the TAT, and the Interview-Questionnaire technique. Specifically:

Poorer mathematics performers will be more dependent on the field in the Embedded Figures Test than better mathe-

matics performers.

Poorer mathematics performers will have figure drawings which reflect lower evaluation of their own body, greater lack of sex identification, and less drive, while the contrary will be true for better mathematics performers.

Poorer mathematics performers will depict more frequently the central characters on the TAT as being less assertive, while the contrary will be true for better mathematics performers.

Poorer mathematics performers should have Interview-Questionnaire composite scores representing (a) denial, (b) repressed hostility, (c) passivity, (d) low self-esteem, (e) anxiety and tenseness. Conversely, better mathematics performers should have Interview-Questionnaire composite scores representing (a) self-awareness, (b) open hostility, (c) activity, (d) compensatory handling of inferiority feelings and, (e) self-assuredness.

CHAPTER III

METHOD

Subjects

Since the Embedded Figures Test is more suitable for older children, and because there is greater heterogeneity of ability, interest, and personality below the college level, 100 Ss between the ages of 13 and 15 were tested. The group consisted only of boys because the Embedded Figures Test has been found to be more consistent with males than with females. In addition, most of the theorizing presented in this paper has been concerned with males. These Ss were all students at two city high schools about thirty miles apart in Tulare County, California. Twenty-eight Ss were from Tulare's city high school, and the remainder were from Porterville's city high school. All students were in their first year of high school. They were given the tests described below.

Materials and Their Use

Progressive Arithmetic Test, Intermediate, Form B (PAT)

Originally, the plan was to use the more recent form (93) of the Progressive Achievement Test (94), but the earlier one was selected for this study because of practical reasons.

One of the schools employed in the study had just completed giving this earlier form, and it was not deemed judicious to give this mathematics test over again because of the possibility of obtaining practice effects and increased hostile feelings on the part of the Ss. Both the PAT and the more recent form, the California Achievement Test, are identical in terms of the items used throughout the test, the only real changes being in the use of the format and in the layout of the test booklet. The tests correlate with each other to the extent of .91. In short, the only basic change in the test was the title.

This test was selected because of its exceptionally favorable reviews (16, 17) and because of its unusually wide coverage of mathematical items. It was also considered a desirable test because of its suitability for the age and grade group which was used.

Suggested time limits in the manual were followed, and the exact instructions were employed. The subsections of this test were mathematical reasoning and mathematics fundamentals. The former consisted of number concepts, symbols and rules, numbers and equations, and problems; the latter consisted of addition, substraction, multiplication, and division.

Vocabulary Section of Stanford Binet Intelligence Test, Form L

This test was given to all Ss in order to obtain some estimate of their general, verbal, intellectual level. This test has often been used for such purposes, and is considered

to be an estimate of general intelligence by certain authors (82, 98). The test was administered to groups and the scoring was done in accordance with the instructions and criteria given in the manual (85). Three people, all advanced doctoral students in psychology with at least three years clinical experience, served as judges. Since each item could only be scored with a plus or minus, two-out-of-three agreement constituted the final score for each vocabulary item. The final score was merely the total number of correct items for each subject. Appendix D contains a copy of the vocabulary list used in this study with its inclusive statement of instructions to Ss.

Embedded Figures Test

The Embedded Figures Test has been described in a previous part of this paper (above, p. 22). A more elaborate description of the test with reproductions of all the designs may be found elsewhere (99). The Ss were given the following instructions which parallel Witkin's method of administration:

> I am going to show you a series of colored designs. Each time I show you one of these designs, I want you to describe the overall pattern that you see in it. After you examine each design, I will show you a simpler figure, which is contained in that larger design. You will then be given the larger design again, and your job will be to locate the smaller figure in it. Let us go through one to show you how it is done.

The S was then shown the practice complex design (p-1) for 15 seconds. When it was removed, the complex figure was presented once more with instructions to locate the simple

figure in it. The S was timed in this task, and the score recorded for him was the time taken to locate the simple figure. When he reported that he had found the figure, he was then required to trace it, so that the E could be sure it was the correct one. After the practice trial, the S was given the following additional instructions:

> This is how we will proceed on all trials. I would like to add that in every case the smaller figure will be present in the large design. It will always be in the upright position. There may be several of the smaller figures in the same large design, but you are to look only for the one in the upright position. Work as quickly as you possibly can, since I will be timing you; but be sure that you find the design which is exactly the same as the original figure both in size and proportions. As soon as you have found the figure, tell me at once. If you ever forget what the smaller figure looks like, you may ask to see it again. Are there any questions?

The same presentation procedure was used on 14 test trials. There were four simple figures--A, B, C, and D. The number of complex designs associated with each simple figure were 5, 2, 5, 2 respectively. A random order of presentation was devised for the 14 figures and this order was followed for all Ss. The simple figure to be located was never the same in any two successive trials. Originally, E planned to use all eight simple figures, and, of course, the additional complex figures that went with the respective designs. But, because it would have been impracticable to see Ss for a period of more than an hour, it was necessary to reduce the number of simple figures. Witkin (101) supported the reduction plan. He revealed that he had recently completed an analysis of the

first and second halves of the Embedded Figures Test, and found that the first half of the Embedded Figures Test bore as high a relation to the other tests as did the Embedded Figures Test as a whole. He was, therefore, in agreement with this E concerning the wish to use only the first half of the test. Witkin now uses only half of the Embedded Figures cards in most of his current work.

The Ss score on each trial was the time taken to find the simple figure. A maximum of five minutes was allowed, and if the S failed to locate the figure within that time, his score was recorded as 5'(F). While he searched for the simple figure, he was permitted to re-examine the copy of it as often as he wished. This was deemed necessary because the task would have ceased to be the one intended if the S no longer remembered the structure of the figure for which he was searching. The complex figure was, of course, removed, so that both figures were never seen simultaneously. The S was discouraged from taking more than 10 seconds during each re-examination period. The stop watch was stopped during these periods.

When the S reported his discovery of the simple figure within the complex one, the time was noted, but the stop watch was permitted to continue while he traced it. If this was done correctly, the score recorded for the trial was the time of discovery. But, if the correct figure was not traced, the S continued his search and the time consumed in tracing the incorrect figure was included in the final score. The mean num-

ber of seconds for locating the simple figures in the 14 complex figures constituted the final score for each S.

Figure Drawing Test

A group administration of this test was given. All Ss were given 8 1/2" by 11" white paper and a soft lead pencil. They were instructed to draw a whole person. The examiner then answered any questions which the Ss might have had. After the Ss drew their first figure they were told to number the sheet 1 and to sign their name. Then, they were told to draw a person whose sex was the opposite of that of which they had just completed, number the sheet 2, and sign their names. The E casually circulated among the Ss to answer questions and to see that stick drawings or incomplete drawings were not made.

The scoring on this test was relatively objective. There was little overlap in use of graphic items scored. However, the items scored required some subjective judgment. Therefore, three trained clinicians who were advanced graduate students served as judges. These three experts scored each item independently of each other, and a majority or unanimous decision constituted the final score used for each item. All items had to be scored either plus or minus (i.e., present or absent), and no item was permitted to be left unscored. Prior to the actual scoring of experimental drawings a training period was held, and the judges were trained until they reached a criterion of perfect agreement among themselves on 85% of all the items scored on a figure drawing.

Witkin's short form was used instead of the long form since the short form has a very high correlation with the long form. The first major category of the form was lack-of-body-confidence. It consisted of 21 items which measured lack of body esteem, uncontrolled or primitive expressions of anxiety, and lack of self-assurance. The second major category was lack-of-struggle for sexual identification, which consisted of 8 items. The third category was lack of drive and drive modification, which consisted of 11 items. Thus, there was a total of 40 items on the male scale of the short form. Although the above three major categories could be identified, only a single total score was derived. The definition and scoring criterion for each item may be found in Appendix B. The judges used these items in the manner described by Witkin (100, pp. 518-524). The graphic items have been found to differentiate between high and low field-dependent people. Thus, the presence of an item was likely to be found in highly field-dependent people while the absence was not. Therefore, it was expected that a total score would yield an indirect index of extent of field-dependency.

Thematic Apperception Test

Although 15 cards were employed in Witkin's study, only five cards (1, 2, 3BM, 12M, and 14) were used in this experiment since these cards proved to be highly or moderately discriminating in terms of perceptual performance. Verbal descriptions of these pictures may be found elsewhere (52, p. 18-

20). Originally the plan was to use two other moderately discriminating cards--10 and 13 MF; because of the sexual implications in these two cards, however, it was decided to eliminate them, and thereby to circumvent possible threat to the Ss and poor public relations for the school. These cards were administered to the group in the above listed order. They were exhibited on a screen with the use of an opaque projector. Instructions were informal but emphasized the fact that a story was to be written about what was going on in the picture, what the people might be thinking, saying, or feeling, what led up to it, and what the outcome would be. The Ss wrote their own stories. Although they were assured that spelling and grammar were not important, they were requested to write clearly. Questions by the Ss were handled in a nondirective manner. The tendency of the E was to merely repeat the basic instructions for the TAT.

The TAT was scored in the following manner. Each of the five stories obtained from the Ss was judged by three clinicians of advanced doctoral level status for assertiveness of the central character. The judges were unaware of the other test scores of the Ss and also rated each story independently of each other. Prior to judging, each clinician independently rated all the sample stories given in Witkin's book (100, pp. 535-538, 546-548, 268-273). They then met to discuss any disagreements among themselves or with Witkin's scoring. Such a procedure constituted the training period for the judges. They were trained to a criterion of 85% agreement.

Since each S's score for the TAT as a whole was based on his reactions to five pictures, an estimate of self-assertiveness was possible for all Ss even though the value of this estimate varied with the number of individual ratings on which it was based.

Witkin's three point rating scale was used, with an attempt to employ only the two extreme points of the scale. At one extreme a story was rated as self-assertive or "A" if the principal character showed active coping with the situation and ability to act on his own needs. At the other extreme a story was rated as showing lack of self-assertiveness or "L" if rejection of his own needs or failure to cope with the situation predominated in the central character. Finally, a neutral or "1/2" rating was assigned to stories in which both tendencies were indicated. The clinician was aided in his scoring by referring to Witkin's numerous examples and to a criterion sheet based on Witkin's discussion of criteria for scoring those stories. The statements comprising the TAT criterion guide sheet which the judges used are reported in Appendix E.

TAT stories showing lack of self-assertiveness generally came from Witkin's Ss who were field-dependent in their perception. These persons obtained high scores in the perceptual tasks such as the Embedded Figures Test. A high TAT score, then, was made to represent lack of self-assertiveness. The measure was a lack of self-assertiveness score. This

score was obtained for each S in the following manner: S was given one point for each story in which the principal character was judged as displaying lack of self-assertiveness and half a point for each neutral story in which there was a balance between self-assertiveness and lack of self-assertiveness. The total number of points thus obtained was divided by the total number of instances in which any sort of scoring for self-assertiveness was made, whether self-assertive, unasertive, or neutral. The ratio was converted into a percentage. For example, of the five stories which might have been produced by a particular S, two might have been judged as unassertive, one as neutral, one as self-assertive, and one might not be judged. His lack of self-assertiveness ratio would thus be 2 1/2 divided by 4, or 63%.

In cases where all three judges had different ratings, they were supposed to have met and discussed the protocol. If at least one judge changed his rating after re-examination, then the majority opinion was to have prevailed. If still no agreement was possible after such a meeting, then the particular story was not to be included in the overall TAT score.

Unfortunately, one of the judges had to leave abruptly after having scored all the TAT stories. Although all the ratings were done by the three judges, no meeting was possible Upon having examined the reliability among the judges as they existed at that point, it was decided to re-score all of the total disagreements. This was done by making the final score

as 1/2 because it was presumed that, in effect, the 1/2 rating indicated that the judge had seen both the assertive and unassertive aspects of the story.

Questionnaire-Interview Technique

In order to obtain a more global, qualitative view of the Ss, 25 students were selected with the aid of a table of random numbers (42, pp. 262-264). They were proportioned in accordance with the absolute population numbers from the two schools tested. These Ss were evaluated with the help of a questionnaire which was devised by this writer and included in Appendix C. In addition to this, a personal interview of approximately 40 minutes duration and any additional information which was available in the school records and concerned the behavior of the Ss was used. Also available were observational notes taken by E during the Embedded Figures Test and interview. Using these materials, three judges were requested to make personality ratings on several variables for each S.

Originally, a sentence completion test (32) was to be employed in conjunction with the above evaluative devices. But this technique was omitted because of the shortage of time and the prospect that it would add little to the appraisals.

The interview was conducted somewhat differently from an interview which might take place in a diagnostic or therapeutic setting. In accordance with the principles set forth by Witkin, S was allowed great freedom in discussing his own

symptoms and problems, but at the same time he was questioned about various important areas of adjustment to life such as the following: school experiences, attitudes toward career, religious views, attitudes toward body, and evaluation of self. S's comments were recorded by E in as nearly a verbatim manner as was possible. Finally, that material plus the material from the questionnaire, any relevant information available from school records, and the observational notes from the Embedded Figures Test and the interview were given to the judges for ratings on five personality variables. E had access to the questionnaire filled out by the subject before the interview, and he had already established some sort of relationship with S by prior group and individual testing. Therefore, E was occasionally in a position to utilize his previous knowledge of S in formulating lead questions to be asked when S did not bring up spontaneously those issues which might be significant.

Ratings by judges were made in accordance with the procedure used by Witkin for the interview and related information techniques. Three judges were trained to a criterion of 85% agreement in their ratings of a hypothetical Questionnaire-Interview protocol devised by this writer. This protocol may be found in Appendix C. Five personality variables could be rated, but the judges did not have to rate every S with respect to all five variables if the material yielded insufficient evidence or if judgment of a particular variable

seemed very difficult. The five variables were defined for the judges in exactly the same manner as they had been by Witkin (100, pp. 183-185). The titles of the variables were:

A-1: B-1 Degree of self-awareness. A-1 signified self-awareness and B-1 signified denial.

A-2: B-2 Method of handling hostility. A-2 signified hostility open and impulses expressed and B-2 signified repression of hostility.

A-3: B-3 Activity-passivity. A-3 signified activity and B-3 signified passivity.

A-4: B-4 Method of handling inferiority feelings. A-4 signified compensatory handling of inferiority feelings and B-4 signified low self-esteem.

A-5: B-5 Degree of self-assurance. A-5 signified anxiety, tenseness, and B5 signified self-assuredness.

Complete definitions of the above variables may be found in the Appendix A.

As Witkin noted, "A" variables together and "B" variables together each tend to form a syndrome, at least in the sense of being functionally related to each other. Although many inferences could be made about the unconscious processes of S from such material, the score was based upon judgments speculating about the more "surface" behavior of the Ss. This was in keeping with the spirit of the ratings made by Witkin in his interview procedure.

"A" characteristics were given a negative (-) value and "B" characteristics were given a positive (+) value. The final score for each S was either a plus or minus. That is, the S received a minus score if he had three or more "A's" and a plus score if he had three or more "B's". The instructions

to judges concerning the method of rating the Interview-Questionnaire material may be found in Appendix L.

CHAPTER IV

RESULTS

Intertest Correlations

Table I contains the means, standard deviations, and all intertest correlation coefficients for the following tests: TAT, Figure Drawing Test, Embedded Figures Test, and the eight mathematics subtests. For each of the statistics reported $N = 100$. The .05 level of significance was established as an acceptable criterion for acceptance or rejection of all hypotheses in this study.

The data contained in Table I may be used to evaluate some of the tests as tests; for instance, the consistency among the mathematics tests may be estimated. In this sense, they allow fuller understanding of some of the subsequent analyses. In addition, they serve as the basis for many of the subsequent analyses. The first such analysis appears in Table 2. This table contains the coefficients of correlation for the Vocabulary, Figure Drawing, TAT, and Embedded Figures tests with each of the mathematics tests.

It will be noted from table 2 that vocabulary correlates with the three mathematics scores to the extent of .66, .51, and .63. These findings are in agreement with the find-

Table 1

Correlations between Mathematics Subtests, Personality, Embedded Figures (EF) and Vocabulary (VOC) Tests

Variable	Figure Drawing 1	VOC 2	EF 3	Mathematics Reasoning A 4	B 5	C 6	D 7	Mathematics Fundamentals E 8	F 9	G 10	H 11	TAT 12	Mean	Standard Deviation
1		-18	39	-23	-25	-37	-22	-14	-33	-27	-21	-15	14.1	4.5
2			-41	52	51	46	64	42	33	49	42	04	16.8	4.3
3				-31	-41	-43	-42	-55	-56	-58	-49	-08	61.7	28.5
4					46	40	56	41	43	41	40	-12	11.3	2.4
5						66	55	38	39	44	34	-10	9.7	3.2
6							56	43	53	48	47	-04	6.0	2.1
7								51	44	54	54	-15	9.4	3.0
8									54	54	44	-01	15.2	3.3
9										61	38	02	14.2	4.1
10											67	00	14.7	3.7
11												-05	14.8	4.1
12													53.5	28.1

Table 2

Correlation Coefficients for Each of Three Mathematics Tests and Figure Drawing, TAT, Embedded Figures Test (EF) and Vocabulary Tests

	EF	TAT	Figure Drawings	Vocabulary
Total Mathematics	-.65	-.09	-.34	.63
Mathematics Reasoning	-.49	-.13	-.33	.66
Mathematics Fundamentals	-.68	-.05	-.30	.51

ings of Orleans (53) who reported a correlation coefficient of .54 between the Otis SA Test and teacher's marks given to algebra students in high school. Other investigators have reported a relationship between intelligence quotients and achievement in mathematics. Madsen (45), for example, found that I. Q.'s derived from the Army Alpha were related to passing or failing of algebra courses. Mitchell (48), using the Terman Group Test of Mental Ability, obtained similar findings.

The hypothesis tested in this study (p. 28) contains four predictions each of which specifies a relationship between personality as measured by some technique and mathematical ability. Since mathematical ability has been shown to be related to general intelligence, any demonstrated relationship between mathematical ability and personality may reflect nothing more than a relationship between personality and general intelligence;

therefore, in order to test the hypothesis under consideration, the effects of intelligence should be removed from the results. Table 3 contains the appropriate data for the evaluation of the first three predictions; i.e., table 3 contains the same data as does table 2 with two exceptions: the correlation coefficients are partial correlation coefficients (with verbal intelligence partialled out) and the relationships between Vocabulary and mathematics, of course, do not appear.

Table 3

Intercorrelations of Two Personality Tests, Embedded Figures, (EF), and Three Totalled Mathematics Tests with Vocabulary Partialled Out

	EF	TAT	Figure Drawings
Total Mathematics	-.56*	-.10	-.29*
Mathematics Reasoning	-.32*	-.15	-.29*
Mathematics Fundamentals	-.64*	-.04	-.24*

*Significant.

Test of Predictions

Prediction 1

The first prediction stated that degree of proficiency in mathematics should be related to field-dependency. There-

fore, the poorer mathematics performers were expected to have higher Embedded Figures time scores, and a negative relationship was expected between performances on the mathematics tests and Embedded Figures Test. This prediction was verified. Table 3 indicates that Total Mathematics, Mathematics Reasoning, and Mathematics Fundamentals are respectively correlated with Embedded Figures to the extent of -.56, -.32, and -.64. Since the aforementioned three correlation coefficients are below the .05 level, it may be said that the results for this hypothesis are significant.

Prediction 2

The second prediction stated that degree of proficiency in mathematics should be related to personality characteristics measured on the Figure Drawing Test. The direction expected was negative. Therefore, the poorer mathematics performers were expected to have higher Figure Drawings scores, which reflect lower evaluation of their own body, greater lack of sex identification, and less drive, while the contrary would be true for better mathematics performers. This prediction was verified. Table 3 indicates that Total Mathematics, Mathematics Reasoning, and Mathematics Fundamentals are respectively correlated with Figure Drawings to the extent of -.29, -.29, and -.24. These three correlation coefficients are reliably different from zero.

Prediction 3

The third prediction stated that degree of proficiency in mathematics should be related to personality characteristics measured by the TAT. The direction of the correlation was expected to be negative. Therefore, the poorer mathematics performers were expected to depict more frequently the central characters as being less assertive, while the contrary would be true for the better mathematics performers. This prediction was contradicted. Table 3 indicates that Total Mathematics, Mathematics Reasoning, and Mathematics Fundamentals are respectively correlated with TAT to the extent of -.10, -.15, and -.04. These three correlation coefficients are all low and not significant.

Since the predictions tested by the Embedded Figures Test and Figure Drawing Test were confirmed, and since the prediction tested by the Interview-Questionnaire technique was partially confirmed, the negation of the prediction tested by the TAT raises a question about the adequacy of the TAT in this research. The desirability of raising such a question is enhanced by the fact that the TAT was not related to any of the other variables involved. A full evaluation of the TAT is given below (pp. 59-60).

Prediction 4

The fourth prediction stated that degree of proficiency in mathematics should be related to personality characteristics measured by the Interview-Questionnaire technique. There-

fore, the poorer mathematics performers were expected to have composite scores representing (a) denial, (b) repressed hostility, (c) passivity, (d) low self-esteem, (e) anxiety and tenseness. Conversely, better mathematics performers were expected to have composite scores representing (a) self-awareness, (b) open hostility, (c) activity, (d) compensatory handling of inferiority feelings and, (e) self-assuredness. Thus, the poorer mathematics performers were expected to have more "B" ratings than the better mathematics performers, while the better mathematics performers were anticipated to have more "A" ratings than the poorer mathematics performers. This prediction was verified.

A Chi-square analysis was made of these data obtained from the group of 25 Ss randomly selected from the total population of 100 boys. Tables 4, 5, and 6 show Chi-square values of 3.0, 1.3, and 4.7. Only the Chi-square value of 4.7 was significant. This value permits acceptance of the hypothesis of independence of Interview-Questionnaire ratings and Mathematics Reasoning scores.

The better mathematics performers were arbitrarily differentiated from the poorer ones by separating the two groups at the mean total mathematics score of the 25 S's who were given the Interview-Questionnaire technique. The mean was 96.6 (table 28).

Table 4

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Personality Scores

Total Mathematics	Interview-Questionnaire Rating A	B	Total	Chi-Square
Above Mean	11	4	15	3.0*
Below Mean	3	7	10	

*Not significant. Yates' correction was applied.

Since the Chi-square value of 3.0 (table 4) would occur under the hypothesis of independence with $p > .05$, this hypothesis is not rejected; therefore, the conclusion is drawn that Total Mathematics ability is not related to those personality characteristics measured by the Interview-Questionnaire ratings. Prediction 4, then, is not substantiated, insofar as it might have applied to Total Mathematics.

Following a similar procedure used for separating better mathematics performers from poorer ones with respect to Total Mathematics, the 25 Ss were placed into two groups--those above the mean of Mathematical Fundamentals and those below that mean. The mean was 59.9 (table 28).

Since the Chi-square value of 1.3 (see table 5) would occur under the hypothesis of independence with $p > .05$, this hypothesis is not rejected; therefore, the conclusion is drawn

that Mathematics Fundamentals ability is not related to those personality characteristics measured by the Interview-Questionnaire ratings. Prediction 4, then, is not substantiated as it might have applied to Mathematics Fundamentals.

Finally, the group of 25 Ss were separated at their mean Mathematics Reasoning score which was 36.6 (table 28).

Table 5

Chi-Square Test of Independence of Mathematics Fundamentals Scores and Interview-Questionnaire Personality Scores

Mathematics Fundamentals	Interview-Questionnaire Rating A	B	Total	Chi-Square
Above Mean	10	4	14	1.3*
Below Mean	4	7	11	

*Not significant. Yates' correction was applied.

Since the Chi-square value of 4.7 (table 6) would occur under the hypothesis of independence with $p < .05$, this hypothesis is rejected; therefore, the conclusion is drawn that Mathematics Reasoning ability is related to those personality characteristics measured by the Interview-Questionnaire ratings. Prediction 4, then, receives only partial confirmation.

Table 6

Chi-Square Test of Independence of Mathematics Reasoning Scores and Interview-Questionnaire Personality Scores

Mathematics Reasoning	Interview-Questionnaire Rating		Total	Chi-Square
	A	B		
Above Mean	11	3	14	4.7*
Below Mean	3	8	11	

*Significant. Yates' correction was applied.

In short, only one index of mathematics ability was significantly related to personality characteristics as measured by the Interview-Questionnaire technique. Inspection of table 6 indicates a trend--a greater proportion of the better Mathematics Reasoning performers have "A" characteristics than do poorer Mathematics Reasoning performers.

Up to this point, only total "A" or "B" characteristics have been considered. It now seems advisable to inspect the Interview-Questionnaire variables more closely and to attempt to examine the trends for each of the five component variables versus mathematics ability.

A frequency breakdown for the better and poorer mathematics scorers in each of the five Interview-Questionnaire categories is given in table 7.

Table 7

Frequency Distribution of "A" and "B" Interview-Questionnaire Ratings for Better and Poorer Total Mathematics Scorers

(N = 25)

Interview Variable	Better Mathematics Ss		Poorer Mathematics Ss	
	f	%	f	%
A1 Self-awareness	12	80	3	30
B1 Denial	3	20	7	70
A2 Open Hostility	7	47	4	40
B2 Repressed Hostility	8	53	6	60
A3 Activity	10	67	5	50
B3 Passivity	5	33	5	50
A4 Compensation	13	87	5	50
B4 Low Self-Esteem	2	13	5	50
A5 Self-Assuredness	6	40	3	30
B5 Anxiety, Tenseness	9	60	7	70

*Better mathematics Ss were defined as those whose total mathematics scores were above the mean of the group of 25, while poorer mathematics Ss were those who were below the mean. The Total Mathematics mean for the group of 25 was 96.6 (see table 28).

In order that individual trends for the five interview variables could be better evaluated, five Chi-square tests were run. Tables 8, 9, 10, 11, and 12 report the results. Since only the Chi-square value of 4.34 (table 8) would occur under the hypothesis of independence with $p < .05$, this hypothesis is rejected; therefore, the conclusion is drawn that Total Mathematics ability is related to the per-

sonality characteristic measured by the Interview-Questionnaire variable A1-B1. The conclusion is drawn that, compared with poorer performers on Total Mathematics, a greater proportion of better performers on Total Mathematics show self-awareness and do not use denial as a defense.

Table 8

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Variable A1-B1

Interview Variable	Better Mathematics	Poorer Mathematics	Total	Chi-Square
A1	12	3	15	4.3*
B1	3	7	10	

*Significant. Yates' correction was applied.

Table 9

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Variable A2-B2

Interview Variable	Better Mathematics	Poorer Mathematics	Total	Chi-Square
A2	7	4	11	.11*
B2	8	6	14	

*Not significant.

Table 10

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Variable A3-B3

Interview Variables	Better Mathematics	Poorer Mathematics	Total	Chi-Square
A3	10	5	15	.7*
B3	5	5	10	

*Not significant.

Table 11

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Variables A4-B4

Interview Variables	Better Mathematics	Poorer Mathematics	Total	Chi-Square
A4	13	5	18	2.4*
B4	2	5	7	

*Not significant. Yates' correction was applied.

Table 12

Chi-Square Test of Independence of Total Mathematics Scores and Interview-Questionnaire Variable A5-B5

Interview Variables	Better Mathematics	Poorer Mathematics	Total	Chi-Square
A5	6	3	9	.7*
B5	9	7	16	

*Not significant.

Analyses of the separate Interview-Questionnaire variables, then, as they relate to Total Mathematics performance were not as encouraging as the analyses of the variables taken together in the form of "A or "B" characteristics. Therefore, the conclusions may be drawn that one is dealing with a syndrome in which all the interview variables interact to give a more reliable picture than any single variable taken separately. Attention, however, may be drawn to table 8 which reveals that better Total Mathematics performers had significantly more self-awareness than poorer Total Mathematics performers.

Comparisons with Witkin's Results

One of the purposes of this study was to make a check of Witkin's work by comparing the results of this study with his findings. A reason for making a check of Witkin's re-

sults lies in Postman's (60) challenge of the former's work. It should be noted that attempts to make direct comparisons may be difficult for various general reasons: the difference between Witkin's Ss and the ones used here with respect to age and experience, the nature of the two groups, and the many possible subtle differences between the manner and conditions of testing from one situation to the other. In addition to all of these discrepancies, some basic modifications in the tests themselves were used by this investigator because of certain practical necessities. These modifications have been described in the discussion concerning description and use of the tests.

Comparisons with Witkin's Results

Embedded Figures

This investigator obtained a mean score of 61.7 seconds on the Embedded Figures Test for his group of 100 Ss. Witkin's group of 25 Ss at age 13 yielded a mean of 57.8 (100, p. 124). A *t* test was performed in order to determine whether there was a significant difference between these two means. Since a *t* value of .56 was obtained, which would occur under the null hypothesis with $p > .05$, the hypothesis was accepted; therefore, the conclusion is drawn that there is no significant difference between the means of the two populations in Embedded Figures score.

TAT vs. Embedded Figures

This investigator obtained a mean percentage lack of self-assertiveness score of 53.5 for his 100 Ss. Witkin obtained a comparable score of 52.5 for his 51 Ss. The latter score was computed on the basis of tabular information given in his book (100, p. 276). A test of differences could not be conducted because Witkin's data was insufficient.

Concerning the relationship between TAT and Embedded Figures, a correlation coefficient of .08, with $p > .05$, was obtained in this study. Witkin, on the other hand, reported a correlation coefficient of .36, with $p < .01$, for his group of 51 men. No statistically significant difference was found between the two correlations. Therefore, no clear-cut conclusion can be drawn about comparability of Witkin's results and these of this study.

Procedural differences between Witkin's study and the present study should be noted. Witkin did not have any correlations to report for his younger Ss, but only gave meager tabular results (100, p. 442) which compared the low and high scoring S's on the Embedded Figures Test with their overall TAT scores. There did not appear to be any meaningful differences here. He realized the trouble which would result from the use of the TAT with children and did not give this test to his youngest group. With his older group of 13 year olds, he attempted to analyze the stories in order to supplement the lack of self-assertiveness measure. These other methods

proved unsatisfactory and inconclusive.

It is noted, too, that although this E used the same cards which Witkin employed with his adult group, he employed fewer cards than the latter investigator. Witkin utilized the same cards with his children's group for comparison purposes, but also added two cards to his boys' group in order to facilitate identification with the drawn figures. The additional cards were 8bm and 3bm. In addition to these he also used three other cards (5, 10, and 18gf) from his "common core." The latter cards were not employed in the present study.

Other factors presenting difficulty with the use of the TAT may be enumerated here: (a) group administration, (b) dimly lit room in which it was presented, (c) associations by the Ss that this test is one "bug doctors" use, plus other comments indicating their anxiety, suspicion, and negativism, (d) questionnable use of this test with adolescents, (e) greater possibilities for conscious control and evasion by the S, (f) verbalization abilities or lack of it, (g) possible feeling on the part of the Ss that they are revealing themselves more easily in the act of writing out their fantasies.

TAT vs. Figure Drawing

Again, Witkin had no correlation between TAT and Figure Drawing performance to report for children or adolescents; however, he did report a correlation of .41, $p < .01$, for his

51 adult males on these two tests (100, p. 456). As it might have been expected from this writer's previous comments (pp. 59-60) concerning the problems and difficulties associated with the use of the TAT, only a correlation of .15 $p > .05$, was obtained for the group in this study. The difference between the correlations was not significant. Again, no clear-cut conclusion can be drawn about the comparability of Witkin's results and those of this study. Possible reasons for this lack of conclusiveness have been considered above (pp. 59-60).

Figure Drawings *vs.* Embedded Figures

An average of 14 graphic items present was obtained for the *Ss* in this study. Witkin found an average of 16 items present for his adult males on the same short form of the test. The latter mean was computed from Witkin's table 12.4 (100, p. 251). Similarly, Witkin, using the short scale, less one scoring item, obtained a mean of slightly fewer than 16 graphic items for his small group of 13 year old boys. This latter mean was computed from Witkin's table 19.3 (100, p. 430). It was not possible to determine the extent of differences between his mean and that of the present study since no standard deviation is reported in his study.

As for comparison of correlation coefficients involving Figure Drawing and Embedded Figures results, one finds that both investigators got significant results. Witkin (100, p. 247) obtained an *r* of .62, $p < .01$; this writer obtained an

r of .39, $p < .01$. The difference between the correlation coefficients was not statistically significant. It is concluded, therefore, that the results from the two studies are comparable. Again it is noted that Witkin did not obtain correlations for his small group of 13 year old boys. For the latter group there was only a "Mean Percent Graphic Items" score listed (100, p. 430) for his low, intermediate, and highly field-dependent groups. This tabular listing shows trends in agreement both with his findings for adults and with this study's results involving adolescents.

Interview *vs.* Figure Drawing

Witkin (100, p. 456) obtained a correlation of .60, $p < .01$, between his Interview ratings and Figure Drawing scores of 51 men *Ss*. Table 13 reveals that in this study no statistically significant difference was found between Figure Drawing scores and overall Interview ratings. "Higher" and "Lower" Figure Drawing scores were determined by separating the two groups at their mean which was 13.8 (table 28).

Table 13

Chi-Square Test of Independence of Figure Drawing Scores and Interview Ratings

Figure Drawings	Interview-Questionnaire Ratings			
	A	B	Totals	Chi-Square
Higher Scores	5	6	11	.9*
Lower Scores	9	5	14	

*Not significant.

The results of this part of the study do not support the findings of Witkin that Figure Drawing scores and Interview ratings are related. Several factors may be responsible for this disparity. First of all, different statistical techniques were employed by the two investigators. Secondly, this study did not use the extensive interview and the additional techniques (e.g., autobiographical material and sentence completion tests) which Witkin used. Finally, Witkin obtained his correlation from data collected from 51 adult males. This study employed 25 adolescent males.

Interview vs. Questionnaire

Table 14 compares Witkin's data (100, p. 187) with the findings of this study with respect to the five Interview-Questionnaire variables. Inspection of this table reveals that there is agreement between the results of the two studies with respect to relative greater or lesser percentage of "A" and "B" variables for all but the first category, A1-B1.

Table 14

Comparisons of Witkin's Interview Data with Those of Present Study

Interview Variable	Experimental Data*				Percentage Difference Between Studies
	Witkin		Present Study		
	f	%	f	%	
A1 Self-Awareness	19	41	15	60	19
B1 Denial	27	59	10	40	
A2 Open Hostility	11	37	11	44	7
B2 Repressed Hostility	19	63	14	56	
A3 Activity	19	58	15	60	2
B3 Passivity	14	42	10	40	
A4 Compensation	13	65	18	72	7
B4 Low Self-Esteem	7	35	7	28	
A5 Self-Assuredness	22	48	9	36	12
B5 Anxiety, Tenseness	24	52	16	64	

*Witkin's figures are based on a population of 52 men. The data from this study is based on a population of 25 adolescents which is constantly the same frequency for each of the five variables since judges rated every item. Witkin's N varies because all variables were not rated for all Ss.

In order to see if the variables of the experiments and interview ratings were independent, five Chi-square tests were conducted. The results are reported in tables 15, 16, 17, 18, and 19.

Table 15

Chi-Square Test of Independence of Witkin's Interview Variable A1-B1 and Present Study's Interview Variables A1-B1

	Experiment			
Interview Variable	Witkin	Present Study	Totals	Chi-Square
A1	19	15	34	2.3*
B1	27	10	37	

*Not significant.

Table 16

Chi-Square Test of Independence of Witkin's Interview Variable A2-B2 and Present Study's Interview Variable A2-B2

	Experiment			
Interview Variable	Witkin	Present Study	Totals	Chi-Square
A2	11	11	22	.3*
B2	19	14	33	

*Not significant.

Table 17

Chi-Square Test of Independence of Witkin's Interview Variable A3-B3 and Present Study's Interview Variable A3-B3

	Experiment			
Interview Variable	Witkin	Present Study	Totals	Chi-Square
A3	19	15	34	.0*
B3	14	10	24	

*Not significant.

Table 18

Chi-Square Test of Independence of Witkin's Interview Variable A4-B4 and Present Study's Interview Variable A4-B4

	Experiment			
Interview Variable	Witkin	Present Study	Totals	Chi-Square
A4	13	18	31	.3*
B4	7	7	14	

*Not significant.

Table 19

Chi-Square Test of Independence of Witkin's Interview Variable A5-B5 and Present Study's Interview Variable A5-B5

	Experiment			
Interview Variable	Witkin	Present Study	Totals	Chi-Square
A5	22	9	31	.9*
B5	24	16	40	

*Not Significant.

Since none of the five Chi-square values would occur under the hypothesis of independence, with $p < .05$, the hypotheses are accepted; therefore, the conclusion is drawn that there are no differences between Witkin's study and this one with respect to interview variables. Adolescents in the present study as well as adults in Witkin's study tended, therefore, to show no difference with respect to proportion of interview personality characteristics.

It is almost surprising to find the extent of agreement between the two studies in respect to predominance of "A" or "B". This is especially noteworthy in light of the differences in ages, quantity of material utilized in the formation of judgments, and the fact that the judges in this study were more intent than were Witkin's judges upon rating

all five variables for every subject. In short, variables A1-B1, A2-B2, A3-B3, A4-B4, and A5-B5 suggest that both Witkin's adult men and this study's young men tend to have the following predominant characteristics: (a) repressed hostility, (b) activity, (c) compensatory handling of hostility (d) anxiety and tenseness.

Interview vs. Embedded Figures

A situation similar to that which was found in the Interview versus Figure Drawing results seems to exist with the Interview versus Embedded Figures results. Witkin (100, p. 462) reported a correlation of .46, $p < .01$, between Interview ratings and Embedded Figures scores for his 52 Ss. Likewise, another investigator (27) obtained a correlation of .47, $p < .05$, for 30 Ss. However, table 20 reveals that Interview and Embedded Figures results are unrelated for the present group of 25 adolescent males. The difference between the results of this part of the study and the results from the aforementioned two investigators may have been due to the use of different statistical techniques. Comments made in the above section on Figure Drawing-Interview results also would apply here.

Table 20

Chi-Square Test of Independence of Embedded Figures Time Scores and Interview Ratings

EF**	Interview-Questionnaire Ratings A	B	Totals	Chi-Square
Above Mean**	6	7	13	1.1*
Below Mean	8	4	12	

*Not significant.

**The mean EF score for the group of 25 was 54.0. This mean is reported in table 28.

Interview vs. TAT

Witkin (100, p. 456) obtained a correlation of .24 between the TAT and the Interview. This was not statistically significant. A Chi-square analysis of the results from this study, reported in table 21, also reveals that TAT scores and Interview ratings are unrelated. Table 21 gives the frequencies of high and low TAT lack of self-assertiveness percent scores and "A" and "B" ratings on the Interview. Since both investigators failed to find a relationship between these two evaluative devices, the interpretation that these two methods of appraisal are quite different in terms of what they measure should be given serious consideration; i.e., the TAT cannot be said to measure the more overt, conscious behavior evidenced during the interview and from the questionnaire. In

short, the comparison of Interview versus TAT results agrees with that of Witkin's insofar as both studies failed to show statistically significant relationships between performances on these two evaluative devices.

Table 21

Chi-Square Test of Independence of TAT Scores and Interview Ratings

TAT	Interview Ratings A	B	Totals	Chi-Square
Above Mean**	9	6	15	.2*
Below Mean	5	5	10	

*Not significant.

**The mean TAT score for the 25 subjects was 45.28 (table 28).

Vocabulary vs. Embedded Figures

Witkin actually did not take into account the factor of intelligence in his use of the various personality and perceptual tests. However, there is evidence on this matter from two sources. Thurstone (91) found correlations of .51 and .57 between scores on two Gottschaldt Figures Test situations and Kohs Block Design scores when he evaluated adult subjects. The Kohs test has been used traditionally as a measure of intelligence. Woerner and Levine (103) obtained a correlation of .54, $p < .05$, between the Embedded Figures Test and the ver-

bal part of the Wechsler Intelligence Scale for Children.

In this study a correlation of .41, $p < .01$, was obtained between the Embedded Figures Test and the Binet Vocabulary Test. The similarities of the correlations between these three tests and Embedded Figures may allow one to assume that intelligence is significantly related to perceptual field-dependency. The present results seem to be in rough agreement with the other measures of intelligence when compared to Embedded Figures. Unfortunately, more direct comparisons cannot be made since there are, as yet, no available reports of the relationship between the Binet Vocabulary Test or entire Binet Test and the Embedded Figures Test.

CHAPTER V

DISCUSSION

Limitations of the Study

Certain factors were discussed in appropriate places which had bearing upon the confidence with which the results of this investigation can be considered. It seems desirable that these factors should be summarized and discussed before the theoretical considerations related to the predictions and the conclusions are offerred.

General Restrictions of Scope

This study provided no direct evidence concerning the specific ways in which a field-dependent or independent, analytical mode of perceiving initially arises in the person. It did not indicate how particular ways of perceiving are related to special kinds of coping procedure and self-feelings in the course of psychological development. It would seem, therefore, very important to obtain information concerning these things through longitudinal studies of children.

This investigation attempted to show how a particular mode of perceiving is related to particular ways of adjusting and how these, in turn, might be related to a specific aptitude. Because this study had a correlational design, it is somewhat

limited in providing conclusions. It was not possible to obtain direct evidence concerning the ways in which perception, techniques of adjustment, and mathematical ability develop in relation to each other during the processes of psychological growth.

The Sampling and Representativeness of Sample

The Ss in this study resided in one of the two relatively small towns (population limits 8,000-12,000) in California or in farm areas adjacent to the towns. Since specific cultural, geographic, and socio-economic factors were not evaluated, possible influences of these factors upon the results remain indeterminate. Also, it should be noted that the Ss were selected from a particular age range and educational level. Thus, it is possible that this study contained a non-representative sample with unknown skewness in several areas. In short, generalizations from the results of this study to other groups should be made with proper caution.

The Experimental Instruments

Various comments have been made in appropriate places concerning the tests used and the confidence with which their results could be considered. They are summarized here.

First of all, it should be noted that all comments concerning mathematics performance referred to ability as measured by a test--not to actual school grades in mathematics. The limitations of the mathematics test, itself, insofar as it measures ability would seem to require that generalizations

which are made should be restricted.

Similarly, verbal intelligence was measured by a vocabulary test. There is good reason to use a vocabulary test in reality situations where it is not practical to employ an entire intelligence test, but comparisons of the partial correlations with correlations from other studies or comparisons of the vocabulary results with other intelligence measures used in similar studies require caution.

The TAT and Figure Drawings, like the Vocabulary test, are techniques which are most often administered individually in clinical situations. It is quite possible that the group administration of the personality tests plus the methods of scoring them resulted in the exclusion from consideration of many significant, highly individualistic nuances in personality. Likewise, the individually administered Embedded Figures Test required only a time score, although various comments and associations by the Ss might have enriched our knowledge had they been possible to treat in systematic ways.

Finally, the Interview-Questionnaire technique was used with only 25 Ss. Because of reality demands the personal interview was relatively short in duration and limited in scope, depth, and intensity of rapport between S and E. What effects these limitations may have had upon the results in the study are therefore unknown.

Theoretical Considerations of Results Related to the Hypotheses

Prediction 1

The first hypotheses stated that degree of proficiency in mathematics should be related to field-dependency, as measured by the Embedded Figures Test. There is an inverse relationship between mathematical ability and field-dependency. When considered alone, this finding does not explain anything concerning personality characteristics in individuals. There is, however, good reason to believe that an intellectual factor is required to solve both mathematical problems and embedded figures tasks since vocabulary ability was related significantly to mathematics ability and to field-dependency. The finding of a relationship between mathematics ability and field-dependency when vocabulary was partialled out may be comprehended in terms of the basic theorizing of this paper. That is, the aggressiveness which is involved in the task of separating an item from the field in the Embedded Figures Test and other orientation tests is, perhaps, a personality characteristic which is needed in the solving of mathematical problems.

In short, the hunches of such writers as Plank and Plank (59), who saw aggressiveness as being an important attribute of success in mathematics, seem to be in accord with the findings of this study. This is particularly true if Witkin's conception of what is involved in the performance on the Embedded Figures Test is accepted.

Similarly, the ideas of Piaget (56) and Rosen (70) have been substantiated. These writers stressed the importance of increasing differentiation of the self in the maturational process; further they stressed the importance of maturity for the ability to handle numbers. This substantiation is even more convincing if Witkin's concept is accepted. It states that field-dependent people are actually dependent, immature personalities.

On the other hand, one is readier to question Cattell's (18) interpretations of his own findings. He found on his personality questionnaire that the less dominant, less headstrong individual as measured by his questionnaire achieved higher mathematics scores on the Graduate Record Examination mathematics test. Since Cattell did not validate his personality test against any external criteria, the meaning of "headstrong" is not clear. As a consequence, his results are open to interpretations other than the one he offered.

One risks the possibility of going too far afield in an interpretation of the first hypothesis because we are confined to Witkin's own findings and notions of what is involved in the Embedded Figures task.

Prediction 2

The second hypothesis stated that degree of proficiency in mathematics should be related to personality characteristics measured on the Figure Drawing Test. A significant relationship was found between these two variables. This

relationship existed for all three major mathematics scores--Total Mathematics, Mathematics Reasoning, and Mathematics Fundamentals.

Although a short version of the Figure Drawing Test was used, this test was assumed to provide a global measure of evaluation of one's own body, of sex identification, and of drive or energy level.

Indeed, growing evaluation of one's own body and increasing sex identification are processes which are often considered to be associated with, if not part of, increasing maturity. This writer agrees with Levy (40) in viewing deficiencies in these processes as characterizing the over-protected child.

As far as low drive is concerned, the presence of this factor is implied in the conclusions of Plank and Plank (59) who discovered that the more aggressive people who had to fight their way up in life were the individuals who did best in mathematics. Similarly, they noted that very few women had an interest in mathematics unless they were well identified with their fathers. This would also seem to support this writer's finding in another study (71) that proficiency in mathematics is related to masculinity. Inspection of the test of masculinity used in his study revealed that there was a preponderance of items which represented passive interests on the one hand and more active, aggressive interests on the other hand. The former set of interests reflected femininity while the

latter set reflected masculinity.

In short, the results associated with the second hypothesis appear to have added further support to the theorizing expressed in this paper and to the notions growing out of the works of other investigators (56, 61, 59).

Prediction 3

The third hypothesis stated that the degree of proficiency in mathematics would be related to personality characteristics measured by the TAT. There was no significant relationship between degree of self-assertiveness, as measured by the TAT, and mathematics ability. Possible reasons for the lack of results from the TAT have been offered previously (p. 59). It is interesting to note that this investigator (71) did not obtain significant results with a TAT multiple choice test of "striving" when he correlated these scores against mathematics ability of college students.

One, however, can now look elsewhere at this point. Did the Interview-Questionnaire technique, which was designed so that it could be evaluated in terms of the overt, conscious behavior and activities of the subject, show any relationship to mathematics ability?

Prediction 4

The fourth hypothesis stated that degree of proficiency in mathematics would be related to personality characteristics measured by the Interview-Questionnaire technique. Only one Chi-square test yielded a statistically significant associa-

tion between mathematical ability and the Interview-Questionnaire personality characteristics (table 6). With respect to Mathematics Reasoning, the proportion of good mathematics performers who exhibited "A" characteristics was significantly higher than the proportion of poor Mathematics Reasoning performers who exhibited "A" characteristics. On the whole, then, more of the better performers on Mathematics Reasoning were self-aware, open in hostility, active, self-assurred, and compensatory in the handling of their inferiority feelings than were the poorer performers on Mathematics Reasoning (table 8). Better Total Mathematics performers also had significantly more self-awareness than poorer Total Mathematics performers.

Of course, these results should be accepted with caution because they are based on a small sample. It can be said that Ss with better Mathematics Reasoning scores seem to be characterized by better personality adjustment and ability to cope with life; it also can be said that they tend to be more assertive. These characteristics are in agreement with the theoretical notions of most past writers (18, 40, 59).

Conclusions and General Theoretical Comments

The following discussion is concerned with mathematical ability; but, the results of this study might be applicable to any other field that makes similar demands. The pre-

sent study has arrived at an overall view of the poorer mathematics performer. Compared to the better mathematics performer, he evinces low evaluation of his own body, little struggle for sexual identification, and low drive. In addition, he is likely to employ the defense mechanism of denial and he may show passivity and lack of self-esteem.

Although attempts have been made earlier to deal with each of these characteristics separately it seems advisable now to try to present an over-view of the relationship between personality and mathematical ability.

Of the characteristics associated with the poorer mathematics performers, the role of passivity-activity is the first point for discussion. According to Witkin, passivity

> ...signifies inability to function independently of environmental support, an absence of initiating activity, and a readiness to submit to forces of authority. Activity, on the other hand, involves ability to function with relatively little support from the environment, a capacity for initiating and organizing, and the power to struggle for mastery over social and other environmental forces (100, p. 467).

In the interview situation the poorer mathematics Ss were found, among other syndromal factors, to be more passive than the better mathematics Ss. And in the case of their figure drawings there were indications of weakness of drive and an absence of struggle for adult sexual identification. These three personality characteristics of passivity, weakness of drive, and absence of struggle are all suggestive of reduced activity. The more submissive and passive Ss were found to

be the poorer mathematics performers. In addition, the unfavorable syndromal picture of low drive and low self-esteem was characteristic of the poorer mathematics performer. Additional investigations of fields other than mathematics are indicated so that we might know whether these personality traits are more commonly associated with mathematics than with other fields.

Results from the other interview variable, degree of self-awareness, revealed that poorer mathematics Ss tended to use the mechanism of denial and had relatively little awareness of their own inner life. The supposition may be made that one who has little insight is poorly equipped to control his own impulses. Since he fears them, he shuts them out, as it were, and as a result of doing so, he puts himself at their mercy and is less able to exercise control over these foreign impulses. This is, of course, a simplification of some very complex, psychodynamic theorizing, but it may be presumed that much energy is utilized when denial mechanisms are employed. If this presumption is accepted, it is not unrealistic to visualize the denying person as having less energy available to utilize for concentrative, active working of mathematics problems. Again, this reasoning might apply to other fields, but possibly not to the same degree.

Differences between individuals in terms of self-evaluation were expressed in the Figure Drawings. At one extreme of self-evaluation a relatively undifferentiated and primitive

body image was reflected; the other end represented an integrated, more adult concept of the body. The poorer mathematics Ss proved to have lower self-evaluations than the better mathematics Ss. Of course, this finding may be explained in accordance with the theory that people with low self-esteem will do poorly in many things as a consequence of this defeatist attitude towards themselves. It is possible that Ss could be differentiated with respect to self-evaluation in subjects other than mathematics.

An alternative explanation to the aforementioned simple cause-and-effect idea that people who feel inadequate will perform inadequately was suggested by the ideas of Piaget (57) and Rosen (70), who related the development of the self, or ego, to the acquisition of number skill and mathematical ability. It would appear more probable that both the Piaget-Rosen view and the cause-and-effect idea are operative in the ultimate personality organization of the good or poor mathematics performers.

Inability to separate item from context in the Embedded Figures Test is associated with relative immaturity. This conclusion was made by Witkin after comparing perceptual performances for various ages of children. Similarly, Witkin found that field-dependent performers tend to be submissive to authority, to require environmental support, and to deny inner events. These performers also tended to have difficulty with impulse control and made childish drawings of the human

figure. The presence of such characteristics suggested to Witkin an "arrest" in progress toward emotional maturity. Since the poorer mathematics students tended to have higher Figure Drawing and Embedded Figures scores, it may be said that they were relatively immature. This finding appears to add further strength to the theorizing of Piaget (57), Rosen (70), and Plank and Plank (59).

All in all, it may be said that in addition to this study's confirmation of some of Witkin's basic findings, there has been established some empirical substantiation of the notions derived directly or indirectly from most of the previous theorists (40, 56, 57, 59, 63, 70, 72) who were concerned with the problem of mathematical ability and its relationship to personality.

General Practical Implications

This study was, at least in part, an effort to bring together three areas of psychology. That is, an addition was made to Witkin's already established perception-personality correlates by including a third area, that of aptitude for mathematics. Such efforts to combine and relate those areas which were heretofore considered as relatively separate might also serve to shift the emphasis given by educators. That is, it would seem more useful for teachers to look at difficulties in a subject like mathematics in terms of the kind of personality characteristics a pupil might have. Teachers might then become more interested in and aware of the relative weight of

these characteristics when they are put alongside more customarily used factors like methods of study and of teaching and specific ability. The old tendency to think in terms of discrete units such as personality, ability, perception, and the like might, perhaps, be changed so that these areas would be considered as closely interwoven aspects of the single individual.

Suggestions for Future Research

Before such thinking can really expand and be meaningfully understood, it would seem that there are many more related studies which need to be conducted so that more and more of these aspects can be linked together.

For example, it would seem important to investigate the possible differences between men and women and between boys and girls at various ages to see if the relationships found in this study would hold up. It would also seem desirable to utilize other measures of field-dependency; e.g., those orientation tasks (tilting room-tilting chair, rod and frame) which Witkin used and found significantly correlated with the Embedded Figures Test.

In addition, it would seem worthwhile to seek for further personality variables which possibly might be associated with mathematics ability, such as "reaction toward authority figures." For instance, does rebellion toward authority also go along with a rebellious attitude toward the rigorous rules

of mathematics, as Salvadori (72) hinted it might? We do know that Witkin (100) found field-dependent performers to be submissive to authority.

One might also wish to elaborate on the earlier work of this author (71) and investigate possible differences between more masculine and feminine males in their mathematics ability. This topic would seem to be a more direct follow-up and testing of the autobiographical findings of Plank and Plank (59). Similarly, a potentially fruitful area might involve more direct work concerning identifications with parents or the kinds of relationships a child has with them. These factors, in turn, could be investigated in terms of their relation to mathematical likes and dislikes. This latter suggestion has been cursorily mentioned by various authors (40, 59, 72); however, Murphy (50) was not very optimistic about this line of thinking. One might also wish to ascertain the still remaining "open question" concerning mathematical ability and assertiveness by devising a technique which could measure the latter more directly than does the TAT.

Finally, it would be useful to determine if field-dependency and its related personality variables are also associated with proficiency in other school subjects such as shop work, physical education, typing, sciences, history, etc. Although there does not seem to be much theorizing on the possible existence of personality variables associated with these subjects, it would seem to be an open field for exploratory investigations.

CHAPTER VI

SUMMARY

The purpose of this study was to determine whether mathematical ability is related to some of the personality factors designated by individuals who have dealt with this problem; further, an attempt was made to relate mathematical ability and personality characteristics to still another aspect of personality, perceptual field-dependency. It was predicted that proficiency in mathematics would be related to (a) field-dependency as measured by the Embedded Figures Test, (b) personality characteristics measured by the Figure Drawing Test, (c) personality characteristics measured by the TAT, and (d) personality characteristics measured by the Interview-Questionnaire technique.

The Embedded Figures Test, eight mathematics sections of the Progressive Achievement Test, the Thermatic Apperception Test, the Figure Drawing Test, and the Stanford Binet Vocabulary Test were administered to one hundred first year male high school students. In addition, personal interviews and personality questionnaires were administered to twenty-five students who were selected at random from this sample.

Statistically significant negative correlations were found between perceptual field-dependency as measured by the Embedded Figures Test and mathematics abilities; i.e., the poorer mathematics students were more field-dependent and the better students were more analytic and independent in their perception.

Statistically significant correlations also were found between mathematics ability and a personality syndrome (evaluation of one's own body, extent of sex identification, extent of drive) measured by the Figure Drawing Test; i.e., the poorer mathematics students had drawings reflective of low evaluation of their own body, weak sex identification, and low drive, while the converse was true of the better mathematics students.

The above two findings confirmed the first two predictions. The third prediction was not substantiated; i.e., no significant relationship was found to exist between the TAT measure of self-assertiveness and mathematics ability.

The Interview-Questionnaire technique was used in a test of the fourth major prediction. Only Mathematics Reasoning scores were found to be related significantly to the Interview-Questionnaire ratings. Thus, a significantly greater proportion of the better Mathematics Reasoning performers (compared with the poorer Mathematics Reasoning performers) were characterized by composite "A" ratings. "A" ratings reflect self-awareness, open hostility, activity, compensatory

handling of inferiority feelings, and self-assuredness. When the Interview-Questionnaire variables were considered separately, only the rating of self-awareness-denial was found to be related significantly to Total Mathematics ability.

Additional comparisons were made between the perception-personality findings of Witkin and the results of this study. Differences as well as agreements between the studies were discussed.

The general conclusion drawn is that the poor mathematics students are more field-dependent, less active, and less analytic than are the good mathematics students.

Essential confirmation was made of the ideas which have been expressed by principle authors in this field, and suggestions have been made for further promotion of research in three areas of psychology--perception, personality, and aptitude.

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APPENDICES

Introductory Comments

The following appendices are made up of data obtained from this study in addition to material from other sources.

The Witkin Criteria Sheet used by judges in the rating of Interview-Questionnaire protocols was taken from Witkin's book (100, pp. 185-186) and is quoted in its entirety in Appendix A.

Similarly, Witkin's criteria used by judges in the scoring of figure drawings was taken from Witkin's book (100, pp. 517-524) and only those items which were intended for use with either men or men and women are quoted in Appendix B. However, it should be noted that the numbering system of the items was changed, although the titles have remained the same. Appendix B is reproduced exactly as it was in the original.

Appendix C contains a questionnaire, related information and a "verbatim" interview with hypothetical protocols used by the judges in their practice ratings. In other words, all the "information" given in the case of Harry Smith is fictitious and a product of this investigator's imagination. Only the instructions and questions on the questionnaire were "real" since they were given to all of the 25 Ss who were randomly selected from our population. An effort was made to

make Appendix C similar to the kind of material the judges would have to rate when they would be given the actual data on the 25 Ss.

Appendix D contains the Stanford Binet vocabulary list which was given to all 100 subjects in mimeographed form. This list was taken from the test manual (85, pp. 302-323) and the criteria used in scoring the answers were from the same source.

Appendix E contains the criteria list used by the judges in their rating of TAT stories. The items on this list were based upon remarks made by Witkin (100, pp. 255-280) concerning his method of scoring this test.

All of the remaining appendices are self-explanatory except, perhaps, Appendix L. This contains instructions to the judges in their rating of Interview-Questionnaire material. The instructions were devised by this investigator.

APPENDIX A

Witkin Criteria Sheet Used by Judges in Rating of Interview-Questionnaire

A1-B1: Degree of Awareness of Self

A1: Self-awareness. This refers to the capacity to describe oneself (even if part of the description is inaccurate with respect to specific unconscious determinants of motivation). It involves a certain detachment from and an ability to observe oneself. It implies that "symptoms" of mal-adjustment tend to be felt as ego-alien rather than as ego-syntonic. It involves recognition, based on experience (without necessarily any technical information), that childhood experiences are related to adult attitudes. It indicates a capacity for self-criticism. The characteristic was scored as present if the interview data revealed either full, mature insight; frankness in describing personal problems, without too much awareness of the correct solution; or simply introspectiveness or concern with inner life, even if this was practically unproductive. Concern, however, if it took the form only of suffering was not scored as self-awareness. We realized, of course, that many overideational latent psychotics are full of "insight," which serves mainly to defend the person against recognition of the real dynamics. Borderline psychotics have an unconscious so close to eruption that

they are able to describe primitive fantasies that take years of analysis to uncover in a neurotic personality. The characteristic was treated as a unit, however, whether it occurred in the context of a healthy or unhealthy adjustment. If the individual was accustomed to thinking, "I do this because I have such-and-such inner motives," his interview record was scored A1.

B1: Denial. This characteristic denotes a lack of capacity to observe the self in a detached way. It implies a customary lack of introspectiveness, although the level of suffering may be high. Symptoms are unrecognized, except perhaps as generalized anxiety. Childhood experiences are "forgotten." A bland record indicating "no problems" was scored B1. Difficulty in locating anything about the person that he thought might be criticized or changed was so scored. This last criterion is not to be confused with narcissistic self-satisfaction; it relates, rather, to a blocking or constriction with regard to self-evaluation.

A2-B2: Method of Handling Hostility

A2: Hostility Open. Impulses Expressed. This category indicates the presence of hostility either recognized by the individual or customary acted on directly. It requires that the quantity of hostile feeling in the person be relatively high, and that he should be aware of it or customarily express it directly and purposefully.

Expressing hostile impulses directly should be distinguished from impulsive, uncontrolled "acting out" of hostile impulses, or explosive hostile outbursts. The difference lies in the degree of directed purposefulness in the expression of hostility, or in what might be called a systematic, rather than accidental, "blind" expression of hostility.

B2: Repression of Hostility. This characterizes a personality in which hostility is present (perhaps to an equal degree with an individual scored A2) but is experienced and acted on by the individual mainly in disguised forms--the disguises dictated by guilt and fear. Reaction formations--minor obsessional symptoms, anxiety-hysteric mechanisms (phobic trends), masochistic tendencies--all scored B2. The forces operating in an individual who uses such mechanisms produce acts which bind his hostility and cause its indirect expression. Such an individual might be scored A1, for self-awareness, in spite of his lack of awareness of the correct dynamics of his hostility, because the conflicts created by the opposition of hostility and guilt forces were experienced as "problems" rather than blending into the personality.

A3-B3: Activity-Passivity

A3: Activity. This describes an active attempt on the part of the individual to solve his problems, and active steps toward independence from his family. Job experience,

living away from home, trips from home, active pursuit of special skills, including sports, extracurricular leadership, all scored A3. It should be noted that compulsive personalities often might be scored B2-A3, because reaction formations and compulsions that form the counter-cathexis for hostility might lead to "active" lives.

B3: Passivity. This refers to a more passive attitude toward problems of independence and maturity. Persons in whom masochistic tendencies predominated were scored B3. Persons who were apparently content to accept an easy routine of living (being supported by prospective husbands or wives, sliding into father's business without much exploration of other possibilities), or who held altogether conventional attitudes toward college, religion, and sex, all were scored B3. In other words, B3 is associated with conformity to authorities' expectations. Some conflict of scoring arose when the individual was extremely active in very conventional (socially approved) ways; in such cases the person was scored A3 rather than B3.

A4-B4: Method of Handling Inferiority Feelings

A4: Compensatory Handling of Inferiority Feelings. This indicates a picture in which the individual characteristically compensates for repressed inferiority feelings by the development of a fairly strong narcissistic attitude. Included in this category are persons Rosenzweig (1938) would

characterize as "extrapunitive" (i.e. who characteristically project their guilt). Also included in this category are persons who have ideas of self-reference, projective jealousy (if not quite delusional jealousy), megalomaniacal tendencies, excessive suspiciousness, or feelings of persecution--in short, persons who tend to use some paranoid mechanisms, without, of course, being necessarily in any paranoid state.

B4: Low Self-esteem. The person in this classification "accepts" his inferiorty; that is, he does not characteristically handle his inferiority feelings in a compensatory manner. He has fairly strong feelings of inadequacy, inferiority, and guilt.

A5-B5: Degree of Self-assurance during Interview

A5: Self-assured. This reflects the interviewer's impression of the subject's behavior during the interview. A person was scored "self-assured" if he was apparently relaxed and at ease during the interview.

B5: Anxious; Tense. This again was a judgment based on the subject's behavior during the interview. A person was scored as B5 if he was deferential and apologetic, ill at ease. Body movements, "fidgets," open symptoms of anxiety or tension, such as blushing, halting speech, and difficulty in speaking freely, were regarded as indications of tension.

APPENDIX B

Witkin Criteria Used by Judges in Scoring of Figure Drawings

1. Opposite-sex Drawing Equal in Size to or Smaller Than Self-Sex

(Although it is realistic for males to make the female smaller, and unrealistic for females to make the male smaller, empirically the item suggests depreciative attitude to opposite sex in both males and females.)

2. F in Profile

Scored on opposite sex only. (Profile representation is a turning away. May arise from fear of rejection by or lack of intimacy with women.)

3. Absence of Margins and Encasements

Margins refer, e.g., to cuffs on shirt sleeves or trousers. Encasements may consist of a line around the fingers, toes, or around the hair. Scored on either figure. (Stress on margins and boundaries indicates active controls.)

4. Neck Very Long or Absent

Neck considered long if its length is 10% or more of the length of total figure. Scored on either figure. (In

general the neck, connecting head and body, refers to control problems. Long neck reflects repressive over-controls, absence of neck looseness of control.)

5. Weak Body Posture

Global impression of weakness, depletion, collapse, or "falling apart" (in content or structure). Scored on self-figure. (May or may not occur in context of primitive body type.)

6. Marked Disproportion

Global impression concerning adequacy of proportion in size and placement of major body parts. Specific disproportion of hands and feet in drawings by men and women, are not included in this item, as they reflect special problems. Scored on either figure. (Disproportion reflects disharmony in character and behavior.)

7. Skill Rating of 5 or less on a 9 Point Scale

Scored on either figure. (A high level of interest in and respect for the body are implied in good skill.)

8. Excessive erasures

Scored if either figure has three or more erasures, or if head is erased. (Erasures reflect dissatisfaction, restlessness, need to improve. Head erasures suggest social uneasiness and lack of confidence in organ of control.)

9. Transparency

Scored when any part of the figure "shows through" a superimposed part or through clothing. Scored on either figure. (Indicates lack of judgment with reference to specific feature where it occurs.)

10. Vertical Midline Not Indicated, or Off-Axis

"Midline" refers to explicit indication of body axis. In "simple" drawings, it may be represented by a vertical line in center of trunk; in more "sophisticated" ones by sufficient details (such as rows of buttons, elaborate zipper, long tie, etc.). To represent midline. The midline is "off-axis" if it is not parallel to body. It may be moved to side in profile drawings. Scored on either figure. (Midline interest refers to increased body consciousness. If over-emphasized, the interest may reach pathological proportions.)

11. Continuous Line

Line essentially continuous as if pencil had been rarely lifted from paper in process of drawing outlines of each major body parts. Scored on either figure. (Suggests a holding onto of support, lack of sensitivity, fear of enterprise, lack of living, rhythmic quality.)

12. Reinforcements Absent or Rare

Reinforcement defined as going over line, usually

with heavier pressure. Scored on either figure. (Absent or rarity of reinforcements suggests blandness and passivity of temperament, lack of variability in mood or of over-assertive self-expression.)

13. Consistency Rating of 5 or Less on a 9 Point Scale

Consistency within a single figure refers to consistency in quality, skill amount and balance of detailing in various areas, freedom from combination of childish or animal like elements with mature elements. Consistency of mood or action is included in the score, but variation in line quality is not. Scored on either figure. (Inconsistency indicates poor integration, difficulty in maintaining integration, and impulsiveness.)

14. Excessive Mouth Disturbance

Deviations such as unusual size or shape, persistent erasures, uncontrolled shaking, or omission of mouth when eyes and nose are present. Scored on either figure. (Indicates poorly controlled oral trends, behaviorally expressed in infantile dependence.)

15. Large Head

Scored if length of head is approximately 1/7 of figure. Scored on self-figure only. (Indicates excessive emphasis and reliance on social, ideational, and control

functions, with corresponding under-emphasis on body and impulse life.)

16. Large Eyes

Score based on relation of eyes to rest of face. Scored on self-figure only. (Considered a feminine trait. Indicates curiosity, dependence on visual environment and experience, possible libidinization of visual stimulation.)

17. No Sensuous Mouth

A sensuous one is heavily shaded, full-lipped, very curved. Scored on self-sex only. (Repression, or lack of manifestation of, the more lusty aspects of sexual attitudes.)

18. Ear Emphasis

Ear may be very large, displaced, distorted, detailed, incorporated in head outline, heavily reinforced, erased, or shaded. Scored only when present in both drawings. (Suggests excessive oversensitivity and suspiciousness.)

19. Peculiar or Circle Head

Head misshapen or crude circle. Scored on either figure. (Suggests deviation or "arrested development" in self-concept. Circle head, a normal feature in young children's drawings, is considered immature in adults.)

20. Self-Sex Figure Pleasanter

Ordinarily scored on basis of facial expression. If facial features are omitted in either or both figures, scored on basis of mood expressed in total figure. (A less pleasant expression on opposite-sex figure expresses a negative reaction to the opposite sex, which may take the form of hostility, neglect or indifference.)

21. Opposite Sex More Hostile

Absence of features is also taken as expression of hostility. Does not necessarily overlap with item 20. (Fear of, and hostility toward, opposite sex, which may be dynamically linked with other manifestations of sexual repression.)

22. Hostile or Fearful Expression

Scored on basis of facial expression. Absence of facial features on either sex is also taken as expression of hostility. Scored on either figure. (Item is self-explanatory and represents direct projection of attitude.)

23. Arms Relatively Weak or Omitted

Impression may be conveyed by faint lines, amorphous shape, etc. Scored on male figure only for subjects of both sexes. (Indicates felt inadequacy in contact. A female in ascribing weak arms to drawing of male figure thus minimizes his adequacy.)

24. Short Arms

Normal arm is roughly 2/5 of length of figure. Short arms are defined as less than 1/3 of figure. This item may or may not occur with item 23. Scored on self-sex only. (Reflects frustration or lack of ambition.)

25. Arm or Arm Out or at Side

Scored on either figure. (Arms out express need for contact; arms at side express inactivity.)

26. Hand or Hands not Pointing Toward Body

Basis of scoring self-explanatory. Scored on basis of direction of arm even if hands are omitted. Scored on self-figure only. (Hands pointing to body denotes basic narcissistic orientation in contact.)

27. Foot Blurring, Peculiarity or Omission

Feet blurred, unrealistically shaped, or distorted. Scored on either figure. (Indicated literally insecurity in "footing." For males, the foot is also symbol of adequacy of sex organ.)

28. No Tight Stance

Tight stance defined as legs pressed close together. Scored on either figure when this feature is absent. (Tight stance suggests withdrawal, reserve, or defensiveness in the sexual area; also ambivalence with reference to sexual display.) Thus: Plus - Legs Apart; Minus - Tight Stance.

29. Crude Clothing

Clothing indicated by belts or buttons at most. Does not refer to realistically drawn nudes. Scored on either figure. (Suggests under-developed self-esteem, lack of interest in people, perhaps neglect of social defenses.)

30. No Tie

Scored on male drawing only when a shirt is buttoned up, a hat is indicated, or a business suit is drawn. (Absence of tie suggests timidity in acknowledging this socialized sexual clothing symbol.)

31. Accessories Emphasized More Than Essentials

Figure too "fussy" contains too many ideas or very special items, at the expense of essential parts of figure and clothing. Scored on either figure. (Indicates poor social judgment and balance.)

32. No Dressing to Neckline, No Sport Clothing, No Nudes

No dressing of figure to neck; no sport attire or bathing suit, no nudes. Scored on self-sex only. (Lessened emphasis on social defenses, or on bold self-display.)

33. Meager Sex Characteristics

Basis for judgment was the absence of or minimization of sex characteristics. For drawings of the male figure,

broad shoulders, appropriate hair treatment, clothing, and accessories were considered indicators of masculinity. For drawings of the female figure, breasts, hips, buttocks, as well as coiffure, clothing and accessories, were considered indications of femininity of the figures. Scored on either figure. (Meagerness expresses disinterest in, discouragement with respect to, or fear of accepting mature aspects of the body.)

34. Meager Male-Female Differentiation

May occur with or without item 33. Scored when both figures look "alike." (Reflects failure to recognize opposite sex as different from oneself.)

35. Hair Shading Uncontrolled

Scored when shading is disorderly, lacking in structure, not encased, without coiffure lines. Scored on either figure. (Chaotic hair shading refers to primitive sensuality associated with infantile sexual drives.)

36. Body Shading Uncontrolled

Item similar to 35, but in different area. Scored in either figure. (Indicative or poor handling of or infantile expression of anxiety concerning body.)

37. Absence of Usual Indicators of Masturbatory Guilt

Absence of such features as: hands in pocket or in genital area; rigid, conspicious, or deformed finger;

swelling or reinforcement of hand or hands; pipe or cigarette, pencils, or baseball bat. Scored on self-sex figure only.

38. Absence of Soft Hair on F

Meager, severe, harshly scribbled hair, or complete absence of hair. Scored on F drawing only. (Hair as a secondary sexual characteristic refers to sensual and dependency needs in adulthood. Hair treatment described above suggests that aggression has replaced or dominated passive sensual needs.)

39. F Has Higher Drive

Drive is derived from global impression of all aspects of the drawing, and scored on a nine point scale. Refers mainly to energy level. Scored if numerical rating assigned to M. (Conventionally drive score is higher for M. Reversal of conventional trend suggests passivity and submission.)

40. No Effeminancy on M

Absence of effeminate features such as small feet, small hands, large hips, rouged mouth, fancy hair-do, shoe heels. Scored on self-sex only.

APPENDIX C

A Questionnaire, Related Information, and Interview with Hypothetical Protocols for Judges Practice Ratings

QUESTIONNAIRE

The following questions are being asked in order that we may better understand the likes, dislikes and interests of high school students. Please answer every question and do your best to be accurate. Your answers will be strictly confidential and no parents, teachers, or friends will ever see them. Thanks for your cooperation.

Name: Smith, Harry

Date of birth: Dec. 10, 1940

Weight: 135

Height: 5' 7"

Father Living? yes

Mother Living? yes

Parents divorced? no

Who do you live with? parents

Father's Occupation? salesman

Mother's Occupation? housewife

Number of Brothers? one

Age of each brother: 19

Number of sisters: none

Age of each sister: --

Religion: Methodist

Approximate grade average in all H.S. subjects: B

The subject you like best: P. E.

The subject you like next to best: history

The subject you do best in: history

The subject you like least: English

The subject you like next to least: Orientation

The subject you do worst in: English

What math course are you taking now? Algebra I

What is your approximate grade in it? B

What kind of math gives you the most trouble? problems in Algebra

What kind of math gives you the least trouble? Aarithmetic

List your hobbies and interests: baseball, fishing

What do you generally do in the evening? watch T. V., homework

Are you on any teams? yes Which ones? baseball

Are you or have you been a member of a club, organization? Yes

Which ones? YMCA boys' club

What do you generally do after school? paper route

Are you a leader or follower with other boys? neither one

What kind of teacher do you like? a fair one

What kind of teacher do you dislike? one who yells and has favorites

What do you do when you get angry? keep it to myself

What kind of people do you dislike? show off and braggers

What kind of things make you angry? bullying

What is your biggest fault? lazy

What situations make you most nervous? making a speech in class

If you could have one wish come true, what would it be? to be done with high school and have a good job

Who do you take after most, mother or father? father

Who do you go to for advice on personal matters? mother

What would you like to do as your life's work? be a baseball player

Who is your favorite actor? James Dean Actress? Marilyn Monroe

What sort of person would you vote for as close to your ideal man? smart, good natured

Who is he? my father

What sort of person for your ideal woman? don't know

Who is she? --

If you were an animal what kind would you like to be? a greyhound dog

What do you think of tests like these? I guess they're all right, but I don't see what good they are.

RELATED INFORMATION ON JOHN SMITH

School

Past records indicate John always has been an average or above average student.

Cooperation and willing, but could talk up more in class.

Embedded Figures Test

Tended to work with little trial and error. Occasionally asked for clarification of instructions.

Interview Impression

Very little sign of nervousness. Seemed to be frank and uncomplicated in his replies.

Interview Protocol: John Smith

(School?) Fine, just fine. (Teachers?) O.K. Don't have any trouble with 'em. (Grades important to you?) Yes, I suppose so; I just do my best most of the time. (Get along with students?) O.K. (Get along with brother?) O.K. He's older than me and we don't see each other that much, but we haven't had any real trouble with each other for years. (With parents?) I suppose everything is fine. They're pretty good to me. (Who is the boss?) My father. (Strict?) Only when I deserve it. (How does he punish you?) He hardly ever does except when I don't do something he especially told me to do, then he doesn't let me go out at night.

(Serious illnesses or accidents?) No. (Earliest memory?) When I was about three years old, I can remember my grandmother taking me to the zoo, and one of the animals roared real loud and was jumping around. I got scared and cried. My grandmother gave me some popcorn and ice cream, and I got over it.

(Aspirations?) I'd like to become a big-league ball player, but if I can't make that, I'd like to have my own business and earn a decent income.

(Date?) Do you mean regular, like every week? No, just once in a while. I go to parties, and they have girls there. (Dances?) Sometimes at school, but I don't dance--too hot, so I just listen to the music or talk. (Like to learn how to dance?) I guess so, but there are a lot of other things I'd prefer to do right now.

(Religious?) Not very much, but I do go to church almost every week. (Seasick, car sick, etc.?) No. (Describe self?) What do you mean? (Examiner comments.) Well, I'm about average in most everything, and I am a little shy when I meet new people. (Shy?) Well, I get kinda quiet, and it takes me time to know them. (How come?) I suppose I am afraid that they won't like me. (Like to change self?) Get over the shyness and be more popular.

(Slight twisting of hands observed.)

(Jobs?) Yes, a paper route. (Do with money?) Save it so I can buy a new fishing rod, baseball glove, and things like that. (Trips by yourself?) Yes, hunting, fishing, and camping out in the Sequoias with my buddies.

(How often do you get mad?) Not much. (A little?) Well, I guess so. (At what sort of things?) Well, if somebody picks on another guy who is smaller, or if somebody tries to take something from me without asking. (Fight?) No, I just usually keep it in, but if I get real mad, I will fight back in self-defense. (Blame them much?) No. (Get nervous and don't know why?) No.

(Do you mind being asked all these questions?) No, I figure they could do some good. Will we be able to get some results from all this testing and these questions?

APPENDIX D

Stanford Binet Vocabulary List Given to All Subjects

1. orange
2. envelope
3. straw
4. puddle
5. tap
6. gown
7. eyelash
8. roar
9. muzzle
10. scorch
11. haste
12. lecture
13. Mars
14. skill
15. juggler
16. brunette
17. peculiarity
18. priceless
19. regard

Name: Date:

20. disproportionate
21. shrewd
22. tolerate
23. stave
24. lotus
25. bewail
26. repose
27. mosaic
28. flaunt
29. philanthropy
30. ochre
31. frustrate
32. incrustation
33. milksop
34. harpy
35. ambergris
36. piscatorial
37. depredation
38. perfunctory
39. limpet
40. achromatic
41. causistry
42. homunculus
43. sudorific
44. retroactive
45. parterre

Name: Date:

APPENDIX E

Criteria List for Judges in Rating of TAT Stories

Lack of Self-Assertiveness	Self-Assertiveness
Crushed by circumstances	Maintains integrity of own drives
Feels there is nothing he could do about them	Difficulties (physical environment) not insurmountable
Abrogates own needs to get protection from others	Opposition by others--no appeasing fear, anxiety, interpersonal difference, present
Assertion of own needs at very low level	Flight needed to maintain own direction
Doing something against will	Cherishes own needs more
Depression	Coping is highly competent--success
No direct rebellion against coercion	Other people as ideals, not obstacles
Can't relieve parental pressure	Hardships not minimized
Little hope of getting out of depression, apathy	Characters don't give up
Low level of self-assertion	Capable of making different life for self
Passivity	Anticipation of joy
Help asked for, little expectancy of benefit	Ability and wish to be competent
Conflict accepted, problem not solved by self	Strong need for identification with elder
Looks for outside agencies, luck, father	Receptive, but capable of acting on own
Collapsing, non-plussed	

Rejection of own needs	Does not avoid conflicts, etc.
Failure to cope	Sees possibility of recovery from tragic
	Sees productive in the self-destructive
	Recognition that he has to make up his own mind
	Reasoning may be distorted and out of contact with reality, but capacity to see world through own experience and capacity to struggle remains
	Active coping
	Ability to act on own needs

APPENDIX F

Table 22

Ratings of Five Interview-Questionnaire Variables

(N = 25)

	Interview Variable					
	A1-B1	A2-B2	A3-B3	A4-B4	A5-B5	
S	Rating*					Final Rating
8	A	B	B	A	A	3A
11	A	B	B	A	B	3B
19	A	A	A	A	B	4A
21	B	A	B	A	B	3B
27	B	A	B	A	A	3A
29	A	B	A	A	B	3A
30	A	B	B	B	B	4B
33	B	B	A	B	B	4B
43	B	B	A	A	A	3A
46	A	A	A	A	A	5A
47	A	A	A	A	B	4A
48	A	A	A	A	A	5A
50	B	B	A	A	B	3B
54	B	B	B	B	B	5B
56	A	B	A	A	A	4A

(Table 22 continued on next page.)

Table 22--Continued

S	Interview Variable A1-B1	A2-B2	A3-B3	A4-B4	A5-B5	Final Rating
	Rating*					
62	B	A	A	A	B	3A
69	A	B	A	B	B	3B
70	A	A	A	A	B	4A
74	B	B	B	A	B	4B
79	A	B	B	A	B	3B
80	A	A	B	B	A	3A
82	B	A	B	B	A	3B
86	B	A	A	B	B	3B
92	A	B	A	A	A	4A
98	A	B	A	A	B	3A

*Only majority ratings of judges for each item are given. An "A" rating and a "B" rating are defined fully in Appendix A.

APPENDIX G

Table 23

Progressive Achievement Mathematics Test Raw Scores

S	Mathematics Score										
	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
1	8	8	6	4	16	12	11	11	26	50	76
2	13	15	10	15	19	18	20	19	53	76	129
3	11	8	8	8	12	11	15	20	35	58	93
4	10	13	9	13	20	16	18	20	45	74	119
5	11	6	2	3	14	16	12	9	22	51	73
6	10	5	6	9	13	13	10	8	30	44	74
7	12	9	7	7	17	16	7	12	35	52	87
8*	14	12	7	12	19	15	17	19	45	70	115
9	10	11	8	7	20	18	15	7	36	60	96
10	8	6	3	3	9	10	9	8	20	36	56
11*	13	10	8	12	17	18	17	19	43	71	114
12	14	10	5	13	18	20	18	19	42	75	117
13	12	11	6	8	19	17	17	16	37	69	106
14	11	10	7	12	19	18	19	19	40	75	115
15	8	14	10	8	17	18	15	19	40	69	109

(Table 23 continued on next page.)

Table 23--Continued

	Mathematics Score										
S	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
16	11	11	9	11	19	19	18	16	42	72	114
17	13	6	6	11	13	13	13	15	36	54	90
18	13	5	7	10	19	18	15	13	35	65	100
19*	15	9	6	10	18	18	19	19	40	74	114
20	14	13	9	15	13	18	20	20	51	71	122
21*	10	11	5	8	16	20	19	17	34	72	106
22	10	8	3	4	17	13	15	6	25	51	76
23	10	6	5	9	14	15	15	18	30	62	92
24	11	8	5	12	18	17	12	13	36	60	96
25	8	1	3	4	11	11	13	19	16	54	70
26	13	9	4	12	16	5	16	19	38	56	94
27*	8	6	5	10	16	16	11	15	29	58	87
28	12	9	9	9	13	14	15	14	39	56	95
29*	11	8	7	10	12	12	12	11	36	47	83
30*	5	7	2	4	12	10	12	12	18	46	64
31	6	8	8	7	11	14	10	12	29	47	76
32	13	11	9	14	20	19	15	11	47	65	112
33*	9	6	1	7	16	11	9	11	23	47	70
34	14	13	10	14	20	20	19	20	51	79	130
35	9	5	2	7	15	9	8	9	23	41	64

(Table 23 continued on next page.)

Table 23--Continued

S	Mathematics Score										
	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
36	12	15	7	9	15	18	15	11	43	59	102
37	11	18	6	8	20	19	19	20	33	78	111
38	13	14	9	12	17	15	18	17	48	69	117
39	6	4	5	7	12	6	14	14	22	46	68
40	11	4	4	10	19	12	19	17	29	67	96
41	11	12	7	8	14	9	10	12	38	45	83
42	14	14	8	11	19	16	19	20	47	74	121
43*	10	9	8	10	15	12	18	16	37	61	98
44	11	9	6	7	14	13	15	12	33	54	87
45	9	10	4	11	13	12	14	15	34	54	89
46*	12	14	10	12	17	20	19	20	48	76	124
47*	9	12	8	13	18	20	18	17	42	73	115
48*	18	10	5	11	13	12	13	12	34	50	84
49	8	12	9	10	16	5	15	14	39	50	89
50*	10	9	6	9	13	12	11	10	34	46	80
51	15	11	7	9	17	16	16	16	42	65	107
52	10	3	4	7	12	16	16	15	24	59	83
53	13	14	9	10	20	18	20	20	46	78	124
54*	7	5	2	5	11	13	12	6	19	42	61
55	11	11	6	10	18	18	17	14	38	67	105

(Table 23 continued on next page.)

Table 23--Continued

S	Mathematics Score										
	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
56*	12	13	6	12	19	11	20	20	43	70	113
57	9	11	6	7	13	9	8	16	33	46	79
58	14	14	7	11	17	17	10	8	46	52	98
59	11	12	3	12	14	5	11	15	38	45	83
60	11	7	3	7	16	7	11	9	28	43	71
61	14	8	5	8	16	5	2	15	35	38	73
62*	12	10	6	17	16	17	16	20	39	69	108
63	11	10	5	8	18	8	15	19	34	60	94
64	8	6	2	5	10	10	17	16	21	53	74
65	12	11	7	9	15	14	15	14	39	58	97
66	10	7	5	8	6	11	12	16	30	40	70
67	12	13	8	10	18	15	17	14	43	64	107
68	10	12	3	7	13	9	12	13	32	47	79
69*	12	10	6	10	15	15	15	14	38	59	97
70*	14	14	7	12	15	14	14	11	47	54	101
71	4	6	4	9	15	10	11	7	26	43	69
72	9	3	3	3	12	11	7	11	18	41	59
73	13	7	5	8	17	20	16	15	33	68	101
74*	8	8	4	10	7	8	7	11	30	33	63
75	11	9	7	8	15	18	14	20	35	67	102
76	9	12	6	3	10	8	8	9	30	35	65

(Table 23 continued on next page.)

Table 23--Continued

	Mathematics Score										
S	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
77	15	11	8	15	18	18	18	20	49	74	123
78	13	13	8	14	19	18	19	20	48	76	124
79*	13	14	6	13	20	18	19	19	46	76	122
80*	13	12	7	11	18	18	18	16	43	70	113
81	12	8	6	10	15	15	17	16	30	63	99
82*	11	4	5	5	12	11	16	17	25	56	81
83	13	10	4	10	14	15	16	11	37	56	93
84	14	12	9	14	20	20	20	20	49	80	129
85	11	10	4	9	16	15	16	13	34	60	94
86*	10	10	5	10	10	10	15	13	35	48	83
87	7	5	2	6	9	6	9	4	20	28	48
88	14	8	5	7	13	12	14	11	34	50	84
89	14	11	6	13	20	19	19	19	44	77	121
90	11	13	7	12	15	14	17	18	43	64	107
91	12	10	7	8	12	19	12	11	37	54	91
92*	14	15	7	13	15	20	19	17	49	71	120
93	14	7	6	10	14	10	15	15	37	54	91
94	14	8	4	9	14	15	14	13	35	56	91
95	10	10	7	6	15	16	17	16	33	64	97
96	11	14	7	8	7	14	13	7	40	41	81
97	15	14	8	11	11	15	14	18	48	58	106

(Table 23 continued on next page.)

Table 23--Continued

S	Mathematics Score										
	Subtest								Total**		
	A	B	C	D	E	F	G	H	MR	MF	TM
98*	12	14	6	7	12	13	17	18	39	60	99
99	11	11	7	7	14	18	17	17	36	66	102
100	14	13	8	13	17	19	18	20	48	74	122

**There are three total mathematics scores--MR, which stands for Mathematics Reasoning, MF, which stands for Mathematics Fundamentals, and TM, which stands for Total Mathematics. MR represents a sum of subtests A, B, C, and D. MF represents a sum of subtests E, F, G, and H. TM represents the sum of MR and MF.

*This symbol indicates that the S is one of the group of twenty-five, selected at random, which received the Interview-Questionnaire technique.

APPENDIX H

Table 24

Distribution of Embedded Figures Time Scores (in Seconds) for Fourteen Designs over All Subjects

Design**	Subject 1	2	3	4	5	6	7	8*	9	10
A1	300	2	170	85	22	167	31	40	112	190
B1	32	2	45	15	32	75	8	4	70	115
C4	70	3	144	32	10	7	39	18	15	10
A5	120	13	20	22	24	160	37	27	43	3
C5	207	6	180	17	10	20	50	9	10	217
B2	90	125	8	11	34	7	30	8	75	32
A2	300	25	23	25	172	67	290	45	300	300
C1	87	10	9	10	6	215	92	20	105	6
D2	5	9	9	25	5	17	8	5	33	100
A4	40	3	35	20	7	19	33	5	22	134
C2	25	2	6	4	1/2	110	7	1	38	5
D1	159	30	35	7	71	240	45	87	55	265
C3	30	3	7	90	12	150	90	3	95	10
A3	20	5	139	2	4	74	10	20	6	16
Mean	106.1	17.0	59.3	26.1	29.3	94.9	55.0	20.9	69.9	100.2

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 11*	12	13	14	15	16	17	18
A1	5	80	35	72	205	32	100	290
B1	45	5	17	2	35	3	300	21
C4	35	5	15	2	16	155	300	5
A5	5	58	172	112	10	112	70	55
C5	5	58	104	117	22	20	105	31
B2	5	12	84	62	11	8	140	31
A2	43	7	72	184	55	200	35	210
C1	5	52	188	35	3	13	300	155
D2	30	6	22	15	5	7	20	6
A4	3	35	43	2	7	27	10	18
C2	1	75	6	92	5	25	40	6
D1	15	20	2	4	60	103	72	21
C3	60	38	18	126	3	75	55	50
A3	7	2	76	8	5	35	6	8
Mean	18.9	32.4	61.0	59.5	31.6	58.2	110.9	70.5

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 19*	20	21*	22	23	24	25	26
A1	172	15	185	233	120	92	5	45
B1	90	12	12	48	40	58	25	70
C4	125	6	14	108	25	25	25	45
A5	50	40	8	48	122	25	60	60
C5	55	30	17	8	115	23	20	24
B2	21	5	35	35	30	29	15	22
A2	124	13	12	166	224	300	175	300
C1	20	19	35	93	185	300	60	30
D2	13	5	8	233	10	15	6	300
A4	17	17	13	23	17	9	3	11
C2	5	3	3	43	20	75	1	15
D1	8	10	8	164	36	25	15	35
C3	70	17	18	67	180	4	2	300
A3	8	6	4	6	11	21	1/2	25
Mean	55.6	14.1	26.6	91.1	81.1	71.5	29.5	91.6

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 27*	28	29*	30*	31	32	33*	34	35
A1	25	300	295	170	34	35	160	17	30
B1	3	37	90	12	38	43	28	5	90
C4	7	11	78	8	69	90	95	92	15
A5	50	62	95	30	34	22	112	47	150
C5	15	6	43	95	33	19	120	45	189
B2	8	5	10	12	165	25	40	2	10
A2	45	300	165	240	35	47	300	145	300
C1	3	10	124	120	78	5	258	11	10
D2	10	5	3	23	33	90	42	8	5
A4	10	4	5	7	35	33	17	12	215
C2	1/2	3	23	35	31	5	1	1	10
D1	24	107	115	12	34	16	48	14	18
C3	230	8	190	15	37	4	202	125	19
A3	7	201	40	4	34	2	10	3	76
Mean	31.2	75.6	91.1	55.9	49.3	31.1	102.4	37.6	81.2

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 36	37	38	39	40	41	42	43*	44
A1	157	20	180	23	105	300	74	33	180
B1	10	156	27	300	30	300	180	40	120
C4	3	9	2	25	38	135	5	189	33
A5	16	50	42	300	12	90	20	180	73
C5	13	28	13	300	19	30	10	48	180
B2	5	21	4	85	4	90	8	200	58
A2	85	61	20	45	300	300	10	160	130
C1	21	53	15	240	14	15	19	20	45
D2	9	13	5	20	17	47	9	10	40
A4	4	7	35	5	7	7	8	41	20
C2	5	1/2	1	50	1	5	3	10	30
D1	20	20	20	55	28	45	25	17	50
C3	8	3	7	40	155	12	14	115	23
A3	2	5	12	47	35	11	6	36	28
Mean	25.6	31.9	27.3	109.6	54.6	99.1	27.9	78.5	72.1

(Table 24 continued on next page.)

Table 24--Continued

Design**	Subject 45	46*	47*	48*	49	50*	51	52	53
A1	227	225	78	300	158	300	84	293	5
B1	32	4	85	140	75	300	100	110	3
C4	7	14	15	28	22	292	8	10	1
A5	135	115	18	205	78	3	23	20	14
C5	240	8	9	175	17	65	20	160	2
B2	12	4	18	4	11	206	15	8	3
A2	170	25	88	200	23	4	20	160	137
C1	299	12	4	16	24	87	28	5	46
D2	6	7	16	33	33	12	5	8	13
A4	16	25	4	3	5	5	15	29	2
C2	42	4	4	2	12	2	2	2	5
D1	5	70	45	40	25	7	10	128	29
C3	17	55	20	70	27	175	6	70	157
A3	6	14	3	45	11	10	4	5	1
Mean	86.7	41.6	31.9	90.1	37.2	104.9	24.3	72.0	29.9

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 54*	55	56*	57	58	59	60	61
A1	7	5	8	127	115	300	115	102
B1	55	7	70	112	65	165	33	72
C4	72	23	50	57	7	25	28	63
A5	62	8	56	112	28	27	75	63
C5	65	13	73	72	70	13	30	300
B2	12	5	8	87	1	17	88	90
A2	300	300	300	132	300	158	300	74
C1	6	25	12	57	290	16	23	114
B2	10	8	21	53	18	5	5	143
A4	12	5	27	50	48	7	38	58
C2	8	2	8	60	1/2	17	24	46
D1	35	11	150	58	27	7	88	47
C3	65	35	14	82	147	40	28	46
A3	5	1	7	63	10	13	30	44
Mean	51.0	32.0	57.4	80.1	80.5	57.9	64.6	90.1

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 62*	63	64	65	66	67	68	69*	70*
A1	19	177	190	185	74	120	29	300	40
B1	55	58	215	85	24	105	25	25	15
C4	8	181	132	90	7	28	30	6	2
A5	25	65	60	105	22	70	17	25	8
C5	100	159	108	180	300	110	13	95	8
B2	7	58	69	10	6	8	287	30	4
A2	162	56	300	120	225	22	300	127	30
C1	70	93	115	175	121	42	300	37	1/2
D2	8	173	23	60	12	4	10	12	16
A4	55	180	38	20	240	37	8	128	2
C2	3	54	6	13	54	8	3	8	5
D1	75	100	24	30	2	65	15	35	10
C3	88	48	18	42	272	8	55	300	6
A3	4	69	5	19	276	6	7	42	2
Mean	48.5	104.4	93.1	81.0	116.8	45.2	78.5	83.6	10.6

(Table 24 continued on next page.)

Table 24--Continued

Design**	Subject 71	72	73	74*	75	76	77	78	79*
A1	200	157	300	300	165	83	127	40	8
B1	125	133	265	70	53	83	118	54	142
C4	58	60	43	76	32	48	115	80	1/2
A5	300	50	74	154	33	68	125	44	38
C5	125	49	152	192	173	67	100	27	300
B2	70	44	11	65	24	47	5	7	5
A2	35	78	94	93	280	300	141	99	130
C1	20	119	14	43	91	72	111	134	7
D2	17	45	34	92	29	79	13	10	7
A4	8	47	65	74	5	100	40	8	1/2
C2	21	46	12	79	113	44	5	35	1/2
D1	255	45	3	50	108	120	23	19	1/2
C3	13	182	85	43	15	287	1	35	1
A3	79	54	30	50	6	50	5	2	1
Mean	94.7	79.2	77.2	98.6	80.5	103.4	66.4	42.4	45.9

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 80*	81	82*	83	84	85	86*	87
A1	5	127	108	20	3	3	118	137
B1	61	34	13	40	11	10	40	74
C4	18	136	11	4	4	13	9	57
A5	27	150	18	46	10	9	300	74
C5	10	70	289	190	10	63	300	52
B2	3	20	33	18	12	7	13	50
A2	37	10	85	215	5	130	300	300
C1	31	53	80	56	4	4	88	93
D2	3	4	16	8	1	22	165	48
A4	15	13	18	36	3	8	23	48
C2	11	4	47	15	15	1/2	11	52
D1	159	74	48	22	25	11	57	300
C3	27	32	45	239	2	46	88	122
A3	7	4	4	5	1	3	54	113
Mean	29.6	52.2	58.2	65.2	7.6	23.6	111.9	108.6

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 88	89	90	91	92*	93	94
A1	183	48	104	300	300	11	300
B1	24	270	6	67	8	38	11
C4	64	24	14	90	6	24	34
A5	120	79	39	145	117	59	300
C5	85	14	80	300	32	16	21
B2	65	8	8	39	11	4	22
A2	49	132	115	30	66	259	1
C1	144	26	32	300	16	8	33
D2	50	40	6	6	34	81	12
A4	11	9	5	18	10	45	5
C2	73	24	35	12	50	5	1
D1	30	22	50	17	29	18	20
C3	300	14	25	78	12	24	11
A3	17	10	8	31	11	4	1/2
Mean	86.8	51.4	37.6	102.4	50.1	42.6	55.1

(Table 24 continued on next page.)

Table 24--Continued

De-sign**	Subject 95	96	97	98*	99	100
A1	190	300	139	2	9	41
B1	44	36	43	70	15	51
C4	130	25	253	67	19	6
A5	115	22	134	67	300	48
C5	15	31	67	37	13	12
B2	5	70	7	69	60	19
A2	19	300	16	257	300	58
C1	2	300	269	75	20	2
B2	5	14	29	2	14	4
A4	6	5	7	52	4	75
C2	6	23	4	2	8	2
D1	17	22	3	112	28	77
C3	60	214	68	3	11	1/2
A3	1	88	17	1/2	2	1
Mean	43.9	103.6	75.4	58.2	57.4	28.4

**Letter indicates simple design and number indicates complex designs.

*This symbol indicates that the S is one of the group of twenty-five, selected at random, which received the Interview-Questionnaire technique.

APPENDIX I

Table 25

Consensus Ratings of Five TAT Stories for Each Subject

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
1	A	1/2	L	?	?	50
2	A	A	A	A	A	0
3	A	A	1/2	1/2	1/2	30
4	L	A	1/2	L	L	70
5	L	L	?	?	1/2	83
6	L	L	L	L	A	80
7	L	?	1/2	L	1/2	75
8*	1/2	?	1/2	?	?	50
9	L	L	L	L	?	100
10	L	?	L	?	?	100
11*	L	A	L	1/2	A	50
12	A	1/2	1/2	L	1/2	50
13	L	A	A	?	A	25
14	L	L	L	?	L	100

(Table 25 continued on next page.)

Table 25--Continued

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
15	L	?	L	L	L	100
16	A	1/2	1/2	1/2	A	30
17	A	A	1/2	A	1/2	20
18	L	?	L	?	?	100
19*	A	A	1/2	A	A	10
20	L	L	1/2	?	1/2	75
21*	L	L	L	1/2	1/2	20
22	1/2	L	L	1/2	L	80
23	?	?	1/2	?	1/2	50
24	1/2	1/2	L	A	1/2	50
25	L	1/2	1/2	1/2	1/2	60
26	1/2	1/2	A	A	1/2	30
27*	L	?	L	?	L	100
28	A	A	L	A	A	20
29*	1/2	1/2	L	A	A	40
30*	1/2	A	?	?	1/2	33
31	A	A	A	A	1/2	10
32	1/2	A	1/2	L	1/2	50
33*	L	?	L	?	1/2	50
34	1/2	L	L	1/2	A	60

(Table 25 continued on next page.)

Table 25--Continued

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
35	?	L	L	?	?	100
36	L	L	1/2	L	1/2	80
37	1/2	L	L	?	1/2	75
38	1/2	A	1/2	1/2	L	50
39	?	?	L	L	L	100
40	A	A	L	?	1/2	38
41	A	A	A	1/2	A	10
42	1/2	1/2	1/2	L	L	70
43*	1/2	L	L	1/2	1/2	70
44	L	?	?	?	?	100
45	L	L	L	L	A	80
46*	1/2	?	A	?	?	25
47*	L	1/2	L	?	?	83
48*	A	A	L	L	?	50
49	1/2	?	L	L	?	83
50*	1/2	L	A	1/2	1/2	50
51	A	1/2	L	?	L	63
52	L	L	L	L	L	100
53	L	L	L	1/2	A	70
54*	1/2	A	L	?	1/2	50

(Table 25 continued on next page.)

Table 25--Continued

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
55	A	L	1/2	A	A	30
56*	A	A	L	?	?	33
57	L	1/2	L	?	L	88
58	1/2	A	1/2	1/2	1/2	40
59	A	A	A	A	A	0
60	A	1/2	1/2	1/2	L	50
61	1/2	A	A	A	A	10
62*	A	A	L	1/2	A	30
63	L	1/2	L	L	1/2	80
64	A	1/2	L	?	A	38
65	A	A	1/2	A	A	10
66	L	L	L	L	L	100
67	A	1/2	1/2	L	1/2	50
68	?	?	L	L	L	100
69*	A	A	A	?	A	0
70*	A	L	L	A	L	60
71	L	1/2	L	L	1/2	20
72	A	L	1/2	A	L	50
73	1/2	A	1/2	1/2	1/2	40
74*	L	A	A	L	A	40

(Table 25 continued on next page.)

Table 25--Continued

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
75	L	A	A	1/2	1/2	40
76	A	A	A	1/2	1/2	20
77	L	L	A	A	1/2	50
78	L	A	A	?	1/2	38
79*	1/2	L	A	1/2	1/2	50
80*	A	A	1/2	?	A	13
81	A	A	A	1/2	A	10
82*	1/2	L	A	1/2	L	60
83	L	A	1/2	L	L	70
84	1/2	1/2	L	L	L	80
85	L	L	1/2	A	1/2	60
86*	A	A	L	1/2	A	30
87	?	A	?	L	A	33
88	L	?	A	A	A	25
89	L	A	L	A	A	40
90	1/2	A	1/2	L	A	40
91	A	1/2	A	A	A	10
92*	A	L	1/2	L	1/2	60
93	L	?	L	L	L	100

(Table 25 continued on next page.)

Table 25--Continued

	TAT Story					
	1	3BM	4	14	12	
S	Rating**					Percentage Lack-of Self-Assertiveness
94	L	?	L	?	A	67
95	A	L	L	A	L	60
96	L	?	A	?	L	67
97	L	A	L	L	?	75
98*	L	L	L	?	A	75
99	L	A	L	?	A	50
100	1/2	1/2	1/2	L	1/2	60

**Only final majority ratings by judges for each design are given. An L rating signifies Lack of Self-assertiveness. An A rating signifies Self-assertiveness. A 1/2 rating signifies a Neutral score.

*This symbol indicates that the S is one of the group of twenty-five, selected at random, which received the Interview-Questionnaire technique.

APPENDIX J

Table 26

Distribution of Stanford-Binet Vocabulary Test Scores over All Subjects

S	Total Score*	S	Total Score	S	Total Score
1	9	16	21	31	9
2	18	17	13	32	19
3	14	18	14	33	11
4	20	19	12	34	22
5	17	20	25	35	5
6	14	21	15	36	16
7	16	22	13	37	18
8	21	23	8	38	22
9	21	24	17	39	9
10	5	25	17	40	17
11	19	26	20	41	22
12	20	27	13	42	17
13	18	28	21	43	19
14	21	29	17	44	17
15	16	30	6	45	20
46	20	66	13	86	19

(Table 26 continued on next page.)

Table 26--Continued

S	Total Score*	S	Total Score	S	Total Score
47	22	67	14	87	12
48	17	68	15	88	12
49	20	69	17	89	21
50	18	70	21	90	19
51	19	71	10	91	20
52	16	72	11	92	22
53	24	73	19	93	20
54	16	74	21	94	15
55	17	75	18	95	14
56	26	76	11	96	12
57	12	77	22	97	19
58	21	78	20	98	18
59	20	79	18	99	10
60	18	80	14	100	16
61	15	81	17		
62	22	82	17		
63	19	83	19		
64	12	84	22		
65	13	85	19		

*A majority rating for each vocabulary item constituted at least two out of three agreement by judges. Ratings were either judged as wrong or right. The total score was then, the arithmetic sum of right majority ratings.

APPENDIX K

Table 27

Distribution of Figure Drawing Scores over All Subjects

S	Total Score*	S	Total Score	S	Total Score
1	19	16	16	31	6
2	8	17	15	32	16
3	10	18	7	33	27
4	14	19	10	34	8
5	10	20	18	35	17
6	16	21	5	36	13
7	10	22	21	37	16
8	11	23	10	38	14
9	20	24	19	39	17
10	25	25	20	40	13
11	13	26	24	41	15
12	6	27	21	42	14
13	10	28	16	43	14
14	19	29	16	44	10
15	8	30	19	45	15

(Table 27 continued on next page.)

Table 27--Continued

S	Total Score	S	Total Score	S	Total Score
46	12	63	26	80	9
47	9	64	16	81	15
48	12	65	18	82	11
49	11	66	16	83	12
50	15	67	14	84	7
51	16	68	20	85	16
52	7	69	14	86	11
53	8	70	11	87	19
54	11	71	13	88	19
55	10	72	23	89	14
56	12	73	11	90	11
57	16	74	18	91	15
58	15	75	20	92	13
59	12	76	10	93	13
60	15	77	13	94	15
61	7	78	13	95	15
62	16	79	22	96	11

(Table 27 continued on next page.)

Table 27--Continued

S	Total Score
97	13
98	14
99	11
100	14

*There were 40 Figure Drawing items. At least two out of three agreement by judges as to whether an item was judged present was required for a final score of that item. Total Scores listed in the table were obtained by summation of all final scores which were rated present.

APPENDIX L

Instructions to Judges in Rating of Interview-Questionnaire Material

You will be given information about 25 first year high school males. The information will consist of individual interviews, questionnaires filled out by the Ss and in some cases, where it is available, you will have statements from school records, actual notes taken by the E while the S took the Embedded Figures Test, and also any notes available concerning impression or non-verbal behavior by the S during the interview.

You are requested to form both a global and specific impression of each S from the material and to rate each S on five variables, if at all possible (see definitions of variables below).

Please remember that your ratings should be more concerned with overt manifestations and consciously felt experiences rather than inferences about "unconscious" or "latent" material.

The interviews all follow some sort of rough, general outline, but the interviewer never felt compelled to adhere rigidly to any one precise order or manner of questionning. This plan of interviewing was felt to be a guided kind of in-

terview and more suitable for the purpose of the task and appropriate for the limitations in time as each interview was approximately 35 to 40 minutes in length of time.

You will note that in parentheses there are shortened forms of questions or a few words to suggest the kind of general question or statement made by the interviewer. At times, the parentheses only include the symbol for a question (?) and usually the response of the S makes it possible to assertain the nature of the question asked. Since these interviews were recorded in writing by the interviewer it was not always possible to quote the exact phrasing of the question, but it is safe to assume that the question was usually asked in a general form such as: How are you getting along with your family? At times the question might have been more "direct" such as: Are you having any trouble with your family?

Also in parentheses, there will be occasional notes such as: (S squirms in his chair.) These notes usually refer to behavior which is non-verbal in nature but of possible importance for scoring purposes.

Since we are interested in obtaining an index of present adjustment and functioning of the S, more scoring weight should be given to the material from the interview and questionnaire than to the less systematic and incomplete historical information from school records and behavior on the Embedded Figures Test.

APPENDIX M

Table 28

Mean Scores for TAT, Figure Drawings, Embedded Figures, Total Mathematics over 25 Ss* Who Had the Interview-Questionnaire Technique

Mean					
			Mathematics		
TAT	Figure Drawing	Embedded Figures	Total	Fundamentals	Reasoning
45.28	13.8	54.0	96.6	59.9	36.6

*The 25 Ss may be identified by starred symbols adjacent to their number (which represents their name) on tables 23 (Mathematics), 24 (Embedded Figures), 25 (TAT), and 27 (Figure Drawings).