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# A COMPARATIVE STUDY OF VERBAL ASPECTS OF INTELLECTUAL FUNCTIONING IN ACHIEVING AND LOW-ACHIEVING HIGH SCHOOL STUDENTS

by

Jeanne Ostrow

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of the requirements for the degree of
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Doctoral Committee:

Professor Wm. Clark Trow, Chairman
Associate Professor Finley Carpenter
Professor Anna S. Ellonen
Professor Daniel Katz

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# CHAPTER I

## INTRODUCTION

The writings of Bartlett, Guilford, Vinacke, and Bruner, among others, have compellingly demonstrated the variety of processes involved in "thinking" and "remembering," as well as the variety of approaches used, even by people of the same level of intelligence, in solving problems. Presumably, such differences, whatever their causes, are the basis of the factorial complexities that have been found in analyses of the tasks comprising intelligence tests. It seems plausible that they would also be reflected in the manner in which students learn academic subjects, and that they might be differentially associated with varying levels of achievement among students of equivalent intelligence. On the assumption that responses to standardized intelligence and achievement tests and the relationships of test performance to scholastic performance will yield implications about the nature of underlying thinking and memory processes, it should be possible to obtain evidence on this point.

In the past few years there have been many studies investigating the reasons for atypical scholastic achievement; i.e., of students whose marks are less (or more) than would be expected from their accomplishment on I.Q. or academic achievement tests. Most investigators have assumed

that since these students have the same level of ability as those who achieve according to expectancy, the differences must be accounted for by aspects of personality; including motivation, "cognitive style," emotional disturbance, etc., and/or socio-economic factors.

Yet the fact that tests and school marks correlate only moderately,[1] as a result of both the theory and practice of test construction and variability in marking procedures, necessitates great caution in the definition of what range of marks "should" be expected from given test scores.

In addition, individuals having the same overall test scores may have quite different patterns of correct and incorrect responses to the items and/or subtests. That is, it can be presumed that there is considerable variation in any group having equivalent test scores, in the numerous specific abilities or areas of knowledge being measured by the tests. Because of this, and because we don't know why tests predict or fail to predict academic success accurately, the assumption that individuals who test at the same level should achieve at the same level can be questioned. Might not specific intellectual weaknesses or strengths be associated with deviant achievement? More generally, are there any consistent differences between the various aspects of test performance or the relationships among test scores and school marks of deviant and non-deviant achievers?

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[1]Usually about .5 for I.Q. tests and ranging from about .2 to about .8 for achievement tests (2, 32, 36, 54).

It is likely that the abilities which are necessary for learning an academic subject differ quantitatively or qualitatively or both from the abilities required to perform a test because the tasks involved in these activities are different. Even if the same complex of abilities were required, the proportionate use made of them might vary; e.g., a given ability might be used only slightly in the performance of an I.Q. test, yet it could be a very important ingredient in the mastery of one or more subjects. For this reason, in order to know what range of academic success can be expected from a given I.Q. level (or achievement test score), it is necessary to know whether the same abilities are utilized in the test and in learning all the subjects from which the index of academic success is derived, and whether these abilities are used in the same manner and to the same extent.

One approach to the problem of determining how tests and academic learning are related is by the comparison of test strengths and weaknesses of students who are unusual in some aspect of their academic functioning with those of a control group. If it is found that the experimental group shows a characteristic pattern of test responses which differentiate it from the controls (i.e., internal variations on the test which are consistent from member to member of the group), then specific cause-and-effect relationships can be hypothesized on the basis of what is known about the abilities comprising test and academic performance, augmented

by whatever is known of the causes of the experimental group's distinctness.

The present study compares high school boys whose scholastic achievement is lower than might be expected on the basis of their scores on an achievement test with a control group. Low achievement was arbitrarily defined, but selection criteria were chosen with the intent of making this group comparable to experimental populations of under-achievers or low-achievers in other studies. The groups were compared on an academic achievement test, an individual I.Q. test, and correlations of the subtests of each of these with grades in five school subjects. The study was designed to investigate whether the low-achievers' atypical scholastic functioning reflects deficiencies in ability which could be masked by a test score that averages results on a variety of partial measures.

## CHAPTER II

## THE PROBLEM OF DEFINING ACHIEVEMENT

### Background of the Problem and Survey of Relevant Literature

The majority of investigations of low achievement have been concerned primarily with the personality characteristic and mental health of low or under-achieving students in comparison (not always) with a control group. Unfortunately, the experimental criteria, populations, and procedures have been so varied that few studies are comparable and, not surprisingly, the results have sometimes been contradictory. Most such studies have indicated that under-achievers are emotionally disturbed, have poor motivation for school, and poor social skills (e.g. 5, 24, 25, 34, 40, 41, 43, 47). But the facts that some investigators have found that high-achieving students may also be emotionally disturbed (e.g. 42) and that at least one kind of psychopathology, obsessive-compulsive disturbance, can be associated with superior performance on intellectual tasks (45) indicates that emotional disturbance cannot be assumed to be necessarily a causative factor. Certainly more needs to be known about the specific influences of various emotional states on cognitive, perceptual, and memory processes.

The studies which have been concerned with various

biographical factors, including study habits, family interaction, and socio-economic factors, have yielded more consistent findings, especially in regard to socio-economic factors and study habits, which appear to reflect the student's attitude towards school (6, 9, 14, 16, 20, 23, 33, 52, 53). Many of these studies have amplified the findings of Warner and his associates; however, Udry (51) points out that low scholastic achievement need not be characteristic of low socio-economic status, at least in new communities where class distinctions are not apparent to many of the residents.

Underlying all the studies of achievement is the assumption that whatever test criterion is used, it yields an index of a unitary potential for academic success, the requirements of which are uniform for all subjects. That is, intentionally or not, intelligence is defined as Spearman's 'g' factor. Thus, if people test at the same level relative to others of their age, they should achieve at the same level--with some allowance for errors of measurement and individual differences. If someone has a large discrepancy between his levels of accomplishment on tests and in the classroom it is assumed to be due to personality factors (including attitudes which may be determined by social class background), and it is further assumed that these have in no way influenced his test performance, because that is high.

However, some investigators believe that personality factors have a direct effect on test performance, though not much is known about the mechanisms involved (1, 13, 50, 55).

Perhaps these can be understood only when more is known about the relationships between the neurological and psychological processes of thinking. In any case, memory and thought-association activities are substructures common to attitudes and interests as well as learning--but this gives no clue as to how, in the whole, complex individual, personality and intelligence are related.

The knotty problem of defining intelligence seems to have become even more complicated as factor-analytic studies pile up evidence to demonstrate the complexities even of tests which have not so long ago been accepted as 'pure' measures of unitary abilities. As early as 1935, Alexander (1) demonstrated that the tests which Spearman had tried to construct so that they were as pure measures of 'g' as was possible, when they were combined with various other tests and achievement criteria, showed loadings on additional factors. His study, which was probably the first to demonstrate by factor-analysis the structural relationships between intelligence tests and school achievement, compares the relative proportions of five factors in a number of tests and school subjects. The factors were: Spearman's 'g,' a Verbal factor, a Performance factor, a Factor "X" which he characterized as "persistence" or "the will to succeed," and a Factor "Z," which he considered most probably a number factor, but was puzzled by its correlation with English.

Alexander's purpose was to find a "resolution of the apparent antagonism" between Spearman's Two-factor theory of

intelligence and Thorndike's Unique Traits theory by investigating whether the same factors could be found in performance tests and verbal tests and, if such factors occurred, the nature of their relationships to scholastic and vocational accomplishment. He concluded:

> What we face is variation not merely in intelligence, but variation in each of <u>five</u> independent factors all of which play their part in educational achievement.

Subsequent research, factor-analytic and otherwise, indicates that the problem is even more complex. While the particular tests that Alexander used may have yielded only these factors, analyses of verbal ability (8, 21) and number ability (12) have demonstrated that these are composites of several factors. And analyses of the Wechsler-Bellevue Scale (3, 13) have demonstrated not only the factorial complexity of each subtest, many of which are similar to the ones Alexander used in finding his Performance factor, but that shifts of factorial relationships occur at different ages--to say nothing of the relationships between mental factors (i.e., those which comprise abilities, motivation, etc.) and classroom situation variables. If unitary traits are sought, their combinations and interactions from individual to individual and from situation to situation would presumably have to be charted!

There have been studies factor-analyzing achievement in particular academic subjects (e.g. 56), but studies of a different nature (18, 38) suggest that many more variables exist than have yet been taken into account, and some of them may not be quantifiable in ways that will permit factor-

analysis. In the meantime, it seems reasonable to try to improve prediction--and our understanding of the functioning involved--by systematically comparing people on our present factorially complex but standardized I.Q. and achievement tests in an effort to differentiate the individual's consistent, developmental characteristics from the situational ones. More needs to be known about the entire range of relationships which actually prevail between test accomplishment and academic functioning and why they prevail.

Few studies of academic achievement have been concerned with any aspects of intellectual functioning but I.Q. or achievement test level and grade point average or its equivalent. And there have been few attempts to relate test results to academic performance except for comparisons of (tested) verbal ability versus quantitative, or a Verbal I.Q. versus a Performance I.Q., with grade point average.

However, several investigations have indicated that bright under-achieving students below the college level may have particular weaknesses in the classroom as well as on tests in verbal reasoning (20), arithmetic reasoning and/or mathematical ability (20, 23, 35) or foreign language ability (23). The studies by Gallagher and Lucito (22, 37) and Norman (44) indicate that the intellectually gifted have different hierarchies of WISC and W-B subtests from those of average and retarded populations. The gifted are high on Similarities, Information and Vocabulary, which factor-analytic studies have consistently found to load on the factor usually termed Verbal Comprehension. Average

children, on the other hand, were found not to show outstanding strengths or weaknesses on these subtests (22).

The lower verbal ability of the low-achievers was always assessed by a different means from the criterion test by which they were designated under- or low-achievers (on which they showed no difference from the achievers), and since factor-analyses have demonstrated both verbal ability (8, 21) and these Wechsler-Bellevue subtests to be factorially complex (3, 13), the inconsistencies in the low-achievers' verbal accomplishments (and presumably in other areas as well) may result from differences in their proportions of the factors which comprise the abilities measured by the various tests.

By holding general level of ability constant, at least on the criterion measure, and comparing achievers and low-achievers on other measures of intellectual functioning it should be possible to infer differences in the composition of various specific abilities and skills.

# CHAPTER III

## ASSESSMENT PROCEDURES OF ACHIEVING AND LOW-ACHIEVING STUDENTS

### I. Purpose and Scope

The purpose of the study was to investigate whether high school boys who showed a large discrepancy between their tested scholastic aptitude and their classroom achievement showed any indication on measures other than the criterion of intellectual deficiency which might be causally related to their low achievement.

Since an I.Q. or a composite score on an achievement test is usually an average of scores on different kinds of subtests, each of which in turn reflects several abilities, there is considerable room for variation in the intellectual functioning of people whose total scores are equivalent. Little is presently known about the nature of the specific abilities which comprise test functioning, and even less is known about their relative proportions in an entire test or its parts. Therefore, the significance of possible variations might not be apparent when the test results are considered by themselves, but might clearly differentiate people when the tests are related to an external (non-test) criterion.

The present study was designed both to investigate whether the low-achieving group showed anything characteristic

in its test results by which it could be distinguished from the controls, and/or whether the groups could be distinguished by their test scores in conjunction with the external reference criterion of their school marks. The general hypothesis was that the low-achieving group would show a different pattern of high and low scores on the subtests of an I.Q. test and an achievement test, and a different I.Q. level from those of the control group. Such test differences would imply different combinations in the groups of the abilities underlying the test functioning. These combinations might distinguish them, also, in correlations of their test scores with grades in academic subjects.

The scope of this investigation was limited to an attempt to specify the characteristics which might differentiate the low-achievers from the controls. However, possible explanations, based on evidence provided by other research, were considered.

## II. Population

Two groups of male high school students, designated Achievers and Low-achievers comprised the experimental population. The boys, all sophomores at the beginning of the study, were matched on their Composite Score on the Iowa Test of Educational Development.[1] This test had been administered

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[1]Because there were considerably fewer Achievers than Low-achievers with ITED Composite Scores at or above the 88 percentile, matching had to be approximate in some cases. With the exception of a few who left the school, one who refused to participate, and one who had a broken arm when he was scheduled for the Wechsler-Bellevue, all the sophomores who met these criteria were used. (See Appendix I.)

by the school early in the year. Although the students were not matched for age, most of them were sixteen and seventeen years old (nearest birthday).

Low-achievers (L-A's) were defined as students whose grade point average ranks were at least thirty percentiles below their ranks in relation to the sophomore class on the **Iowa Test of Educational Development. There were forty-three** L-A's. Achievers (A's) were defined as students whose grade point average ranks were within thirty percentiles (above or below) their percentile ranks on the class distribution of scores on the Iowa Test of Educational Development. There were thirty-six A's. The boys are students in a high school of a Chicago suburb which is still fairly new--the high school is only in its eleventh year. It is composed primarily of upper-lower and lower-middle class families with a small proportion at higher levels.

III. Comparisons

A. Test comparisons:

1. The Wechsler-Bellevue Scale, Form I (W-B).
2. The individual subtests of the Iowa Test of Educational Development, Form X-3S, Class Period Version, 1959 edition (ITED). This is a nationally standardized battery of nine scholastic achievement tests which was designed to evaluate both the student's accomplishment in English, mathematics, science and social studies, and his ability to apply his knowledge in tasks requiring

critical thinking and problem-solving in these subject areas. In addition to scores on each test in the battery (referred to here as subtests), a Composite Score is given, which is a weighted average of the scores on tests 1-8 and an index of the general level of a student's educational development. The ninth test, Use of Sources of Information, was not included in the present study because of its specialized nature.

3. Your Educational Plans (YEP): a nationally standardized guidance questionnaire which provides, on the basis of the student's answers, information regarding the socio-economic background and the attitudes towards college and careers of the student and his family.

4. Correlations between subtests of the ITED and W-B and marks in the following subjects: English, mathematics, science, social studies, and foreign language.

B. Additional data:

Health records and elementary school test data were examined, but not treated statistically.

IV. Specific Test Characteristics Investigated

A. Wechsler-Bellevue

1. Differences between mean scores on:

a) Each subtest.

b) Full Scale Weighted Score and I.Q., and percentile rank.

c) Verbal Scale Weighted Score and I.Q.

d) Performance Scale Weighted Score and I.Q.

e) Discrepancy between Verbal and Performance I.Q.'s.

f) The following factors, derived by Cohen (10, 11) from his factor-analyses of the W-B and WAIS:

1) Factor A - The average of weighted scores on the Information, Comprehension, Similarities and Vocabulary subtests.

2) Factor B - The average of weighted scores on the Block Design and Object Assembly subtests.

3) Factor C - The average of weighted scores on the Digit Span and Arithmetic subtests.

4) Factor E - A Digit Symbol specific.

2. Rank-difference correlation of subtest means:

a) Hierarchy of subtest ranks.

b) Coefficient of rank-difference correlation.

It was expected that the L-A's would have a lower mean Full Scale I.Q. than the A's and/or particular deficiencies on verbal subtests.

B. Iowa Test of Educational Development

1. Difference between means on:

a) Subtests 1-8.

b) Amount of scatter, in percentiles, between the

highest and lowest subtest scores.

2. Rank-difference correlation of subtest means:

a) Hierarchy of subtest ranks.

b) Coefficient of rank-difference correlation.

C. Product-moment correlations between marks (means) in each of five subjects and Factors A, B, C and E of the W-B (IV A, above).

D. Product-moment correlations between marks in each of five subjects and various subtests of the ITED[1] as follows:

1. English with subtests:

3--English Usage

5--Interpretation of Social Studies

6--Interpretation of Natural Science

7--Interpretation of Literature

8--Vocabulary.

2. Mathematics with subtests:

3--English Usage

4--Quantitative Thinking

8--Vocabulary.

3. Science with subtests:

2--Background in Natural Science

4--Quantitative Thinking

6--Interpretation of Natural Science.

4. Social Studies with subtests:

1--Background in Social Studies

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[1]For exact titles see Appendix II.

5--Interpretation of Social Studies

8--Vocabulary.

5. Language with subtests:

3--English Usage

4--Quantitative Thinking

5--Interpretation of Social Studies

6--Interpretation of Natural Science

7--Interpretation of Literature.

E. Rank-difference correlation of means of grades in five school subjects:

1. Hierarchy of ranks of English, mathematics, science, social studies and language.

2. Coefficient of rank-difference correlation.

F. A comparison of responses to ten items of the YEP by chi-square.

V. Specific Predictions

The above test characteristics were investigated to determine the extent of quantitative discrepancy between the subtest and Factor scores and I.Q.'s, as well as the degree of similarity between the groups' subtest profiles of high and low scores. The correlations with school marks were intended to give evidence as to whether the groups use the same or different aspects of the abilities represented by the subtest and Factor scores in learning academic subjects. The nature of the aspects used would have to be inferred from the nature of any differences which appeared and from evidence provided by other studies regarding the

factorial composition of the tests. The following specific differences between the groups were predicted:

1. The A's will have a higher Full Scale I.Q. on the W-B than the L-A's.
2. The A's will have a higher Verbal I.Q. than the L-A's.
3. The L-A's will have a greater discrepancy between their Verbal and Performance I.A.'s than will the A's.
4. There will be significant differences between mean scores on at least some of the subtests or factors of the W-B.
5. The A's and L-A's will have different high and low subtest scores on the W-B, so that the rank-difference correlation will be low.
6. On the ITED, the A's will show greater verbal abstract ability as evidenced by higher scores on the following subtests:

   3--English Usage

   5--Interpretation of Social Studies

   6--Interpretation of Natural Science

   7--Interpretation of Literature.
7. There will be a greater range of percentiles between the highest and lowest subtest scores on the ITED for the L-A's than the A's.
8. The A's and L-A's will have different hierarchies of subtest rankings on the ITED, so that the rank-difference correlation will be low.

9. There will be differences between at least some of the correlations of W-B factors with course grades of the A's and L-A's.
10. There will be differences between at least some of the correlations of ITED subtests with course grades of the A's and L-A's.
11. The A's will have a different rank order of school subjects from that of the L-A's, with a consequent low Rho value.
12. The A's will show greater expectancy of college attendance and greater potentiality for it in terms of their own and parental attitudes, and their socio-economic background than will the A's.

## VI. Selection and Classification of the Experimental Population

A cumulative percentile distribution of the grade point averages of the sophomore class was made on the basis of the mid-year calculations (1962). The latter were computed from the students' freshman and first-half sophomore grades. Each student was then ranked by decile. Using information which accompanied the machine-scored test results, comparing the class scores with the national norms, the class's distribution of composite scores of the ITED was also divided into deciles. All boys whose grade point average ranks were three deciles or more below their ITED ranks were designated L-A's. A's were matched as closely as possible by ITED percentile to the L-A's. (See Appendix I.) The students were contacted individually and asked to participate

in the study. All but one participated.

VII. Testing Procedures (W-B)

Each student was given an interview prior to the administration of the W-B, briefly explaining the purpose of the study. He was also asked questions about his background and interests, both to establish rapport and to give the investigator a better picture of him as an individual than could be obtained solely from the test. The entire W-B was administered, after which the boys were given the opportunity to ask questions. These were answered in terms of the purpose that had been outlined to them earlier; i.e., to compare the boys in this school on the subtests on which they were high and low relative to their total score. Later they were given an interpretation of their results in these same terms.

VIII. Other Data

Your Educational Plans.--The YEP questionnaire is administered by the school to incoming freshmen. The results included most of the information which had been obtained by the interview that had been given when the W-B was administered, as well as additional material. Because it is standardized (and the responses had been coded and tabulated) it was used instead of the interview data. However, questionnaires were missing for nine boys, so they were given the questionnaire at the time of the study; about a year and a half later than the others had taken it. A chi-square correlation was done on ten of the YEP items, after the scores

were classified into the categories "college-likely" and "college-unlikely" on the basis of the authors' guide for interpreting the scores. The items which were omitted mostly dealt with the student's and his best friend's marks. It was felt that to include these after having already categorized the groups by grade point average would contaminate the findings. Several other items were omitted after it was determined by inspection that they didn't differentiate the groups.

Health records.--The boys' cumulative health records were examined to determine whether there might be any differences between the groups. In addition, the nurse's records on the A's and L-A's, which noted the date, school period, and nature of complaint of all visits to her, were examined to compare the number of visits and their causes.

Freshman placement cards.--The school has cards for the students giving a summary of the I.Q. and achievement test results from the elementary schools, as well as teachers' comments and recommendations for placement in a slow, average or accelerated program in English, mathematics and science. These were examined, but cards were missing for seventeen of the experimental population, and other cards were incomplete.

The health records and freshman placement cards were examined to investigate whether anything in the boys' histories seemed to be differentially associated with their academic achievement. Frankel (20) found that his underachievers had many more absences than his achievers, and

these seemed to be on an emotional basis. It was originally intended to do a chi-square analysis of these data, but it was apparent from inspection that the health records didn't differentiate the boys, and too much information was missing from the freshman placement cards.

## IX. Statistical Analyses Employed

Comparisons between means were made to determine on which subtests (etc.) the groups showed non-chance quantitative discrepancies. In each comparison, the null hypothesis that there would be no significant differences between means was tested. The two-tailed test of significance for Fisher's t-value was used (17, pp. 151-152). For the correlation of W-B Factors and ITED subtests with grades Pearson product-moment correlations were run. A considerable number of students had no grades in a foreign language or social studies and so had to be eliminated from these correlations. Comparisons between correlations were tested for the significance of differences using Fisher's 'z' transformation (17, pp. 131-132). Again, the null hypothesis of no significant difference between r's was tested, using the two-tailed test of significance.

Rank-difference correlations were computed to determine the degree of similarity in the order of difficulty of subtests and academic subjects. Very different hierarchies of high-to-low subtests would give a low correlation coefficient, which would imply different proportions of the component abilities involved in the subtests (and subjects).

They were evaluated for significance using the two-tailed test (28, pp. 286-287 and p. 549). The responses to the YEP items were converted to the proportion of "college-likely" and "college-unlikely" responses on the basis of the guide offered in the manual (49). These proportions were then summed for each group, and a chi-square computed, using a 2 X 2 contingency table (17, p. 85).

## CHAPTER IV

## COMPARISONS OF ACHIEVERS AND LOW-ACHIEVERS

### Wechsler-Bellevue Test

The A's and L-A's differed in only a few aspects of their test results, but taken together these appear to offer some corroboration of the general hypothesis that the L-A's differ characteristically in their intellectual functioning from the A's. Predictions 4, 5 and 9 were supported; 1, 2 and 3 were not.

Significant differences between means occurred on Digit Symbol, Vocabulary, Factor C, and Full Scale Weighted Score (Table 1). The latter finding, however, is probably spurious, reflecting the somewhat greater age variability of the A's. When the weighted scores were converted to I.Q.'s--i.e., corrected for age--the t-value no longer reached the .05 level of significance. (Cf. Table 1: 16 & 17.)

In addition to score differences, comparison of the rank orders of subtests (Table 2) shows considerable divergence between the groups' hierarchies of strong-to-weak subtests, though the Rho of .678 is significant between the .10 and .02 levels. The evidence is not strong, but neither should it be considered unlikely, that the A's and L-A's sample distinct populations in regard to their proportionate strengths among the abilities measured by the W-B. And this

TABLE 1

DIFFERENCES BETWEEN MEANS ON THE WECHSLER-BELLEVUE

| W-B Variables | Mean of L-A's (N=43) | S.D. | Mean of A's (N=36) | S.D. | t-value |
|---|---|---|---|---|---|
| 1. Information | 11.7 | 1.5 | 12.0 | 1.4 | -.924 |
| 2. Comprehension | 11.4 | 2.0 | 11.8 | 1.9 | -.918 |
| 3. Digit Span | 9.9 | 2.3 | 10.9 | 3.0 | -1.664 |
| 4. Arithmetic | 10.6 | 2.8 | 11.6 | 3.1 | -1.495 |
| 5. Similarities | 13.0 | 1.8 | 13.3 | 1.7 | -.771 |
| 6. Vocabulary | 11.7 | 1.2 | 11.1 | 1.2 | 2.136* |
| 7. Picture Arrangement | 11.7 | 2.8 | 11.1 | 3.1 | .899 |
| 8. Picture Completion | 12.2 | 1.6 | 12.7 | 1.4 | -1.436 |
| 9. Block Design | 13.3 | 1.9 | 14.1 | 1.9 | -1.905 |
| 10. Object Assembly | 12.0 | 2.2 | 12.4 | 1.9 | -.863 |
| 11. Digit Symbol | 11.6 | 2.0 | 12.9 | 2.0 | -2.841** |
| 12. Verbal Scale Weighted Score | 57.1 | 5.1 | 58.9 | 5.4 | -1.526 |
| 13. Verbal I.Q. | 114.0 | 6.6 | 116.3 | 7.0 | -1.494 |
| 14. Performance Scale Weighted Score | 60.9 | 6.0 | 63.2 | 6.2 | -1.675 |
| 15. Performance I.Q. | 114.3 | 8.3 | 117.6 | 8.9 | -1.703 |
| 16. Full Scale Weighted Score | 118.0 | 8.8 | 122.1 | 9.2 | -2.021* |
| 17. Full Scale I.Q. | 116.8 | 6.9 | 119.9 | 7.3 | -1.947 |
| 18. Percentile Rank | 85.0 | 13.0 | 89.3 | 9.2 | -1.665 |
| 19. Difference between V&P I.Q. | 6.7 | 6.1 | 7.4 | 6.5 | -.490 |

TABLE 1--Continued

| W-B Variables | Mean of L-A's (N = 43) | S.D. | Mean of A's (N = 36) | S.D. | t-value |
|---|---|---|---|---|---|
| 20. Factor A (Averages of: Inf, Comp, Sims, and Voc) | 12.0 | 1.2 | 12.1 | 1.0 | -.402 |
| 21. Factor B (Average of BD & OA) | 12.7 | 1.7 | 13.2 | 1.6 | -1.490 |
| 22. Factor C (Average of D Span and Arith) | 10.3 | 1.8 | 11.3 | 2.5 | -2.080* |

*P less than .05 (77 df) **P less than .01 (77 df)

TABLE 2

RANK HIERARCHIES OF MEAN SCORES ON W-B SUBTESTS

| L-A's | A's | Rho = .678* |
|---|---|---|
| 1. Block Design | 1. Block Design | |
| 2. Similarities | 2. Similarities | |
| 3. Picture Completion | 3. Digit Symbol | |
| 4. Object Assembly | 4. Picture Completion | |
| 5. (Information | 5. Object Assembly | |
| 5. (Vocabulary | 6. Information | |
| 5. (Picture Arrangement | 7. Comprehension | |
| 8. Digit Symbol | 8. Arithmetic | |
| 9. Comprehension | 9. (Vocabulary | |
| 10. Arithmetic | 9. (Picture Arrangement | |
| 11. Digit Span | 11. Digit Span | |

*For N = 11: P = .10; Rho = .535; P = .02; Rho = .729 (28 p. 549)

evidence takes on greater importance in light of the differences between the groups' correlations of W-B factors with school subjects (Table 3). Nine out of twenty differences were significant, six beyond the .01 level, which indicates that the groups are probably applying different components of the abilities measured by the W-B to the tasks involved in learning academic subjects.

TABLE 3

CORRELATIONS OF W-B FACTORS WITH MARKS IN FIVE ACADEMIC SUBJECTS

| School Subjects | | W-B Factors | | | |
|---|---|---|---|---|---|
| | | A | B | C | E |
| English | L-A's | .32 | -.11 | .35 | .13 |
| | A's | .36 | .00 | .23 | .44** |
| Mathematics | L-A's | .18 | .10 | .30 | -.00 |
| | A's | .16 | .26* | .35 | .26** |
| Science | L-A's | .40 | -.17 | .31** | .04 |
| | A's | .30 | .14** | .07 | .19* |
| Social Studies | L-A's (N=40) | .52** | .06 | .23 | .07 |
| | A's (N=30) | .18 | -.03 | .29 | .37** |
| Foreign Language | L-A's (N=32) | .31 | .25 | .25 | .08 |
| | A's (N=32) | .36 | .22 | .24 | .21* |

Factor A--Verbal Comprehension (Information, Comprehension Similarities, Vocabulary)

Factor B--Perceptual Organization (Block Design and Object Assembly)

Factor C--Memory (Digit Span and Arithmetic)

Factor E--A Digit Symbol Specific

*P less than .05
**P less than .01

The difference between means on Digit Symbol (which is Factor E), though not great in weighted score points, is significant beyond the .01 level. It will be noted that its ranks in the subtest hierarchies of the A's and L-A's are widely divergent (Table 2), and it differentiates the groups on each of the correlations with school subjects (Table 3). These combined findings suggest that the A's and L-A's differ in respect to the intellectual functioning involved in the performance of the Digit Symbol subtest.[1]

The difference between mean scores of the two groups on Vocabulary is significant beyond the .05 level, though the amount is only .6 of a weighted score point. Because Vocabulary is only one of the four subtests comprising Factor A it isn't possible to evaluate its effect on the correlation with school marks, but it occupies divergent positions in relation to the other subtests in the rank hierarchies, higher for the L-A's.

Factor C is the only other W-B variable on which the A's and L-A's differ significantly, the A's having the higher

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[1]McCarthy (39) indicates that left-handed people often score lower on Digit Symbol because they may cover the key with their arm and must then continually raise it, thereby losing speed. About twelve per cent of the L-A's (5 boys) were left-handed as opposed to about three per cent of the A's (one boy). However, judging by the investigator's memory (which may not be quite accurate) and their results, this does not seem to have caused the score discrepancy. The weighted scores of the left-handed boys are not markedly low, ranging from 9-14, and in no case lower than the I.Q. level. Rather, their performance tended to be fast but inaccurate--similar to that of many others, both L-A's and A's.

mean by one weighted score point. Digit Span and Arithmetic, which comprise Factor C, do not have greatly variant positions relative to the other subtests in the rank hierarchies, and Factor C differentiates the groups only on the correlation with science.

The rank difference correlation (Table 2), is high enough to consider the possibility that the A's and L-A's are samples of a common population, but in view of the fact that two of the subtests which show the widest divergence, Digit Symbol and Vocabulary, also show significant differences between means, it seems quite likely that the groups represent distinct populations in regard to the abilities involved in performance of the W-B. These populations would, of course, be similar or equivalent on many of the characteristics of the test, but a difference in even one respect could be important in terms of its influence on academic functioning.

The correlations of school subjects with W-B factors (Table 3), indicate that the A's and L-A's are making different use of whatever intellectual processes are common to the factors and academic learning.

As mentioned above, Factor E (Digit Symbol) correlates higher for the A's with every subject. Factor B correlates higher with mathematics and science for the A's, whereas Factor A correlates higher for the L-A's with social studies, and Factor C correlates higher for them with science.

Comparing each subject with all the factors, the correlations suggest that in English the groups differ in their use of Factor E only (i.e., the processes measured by

Factor E), the A's using it more. In learning mathematics the A's make more use of the Factors B and E. In science the L-A's make greater use of Factor C; the A's of Factors B and E. In social studies the L-A's make greater use of Factor A, whereas the A's make more use of Factor E. In language there is again only one difference; the A's make greater use of Factor C.

Iowa Test of Educational Development

The comparisons which were made of the groups' ITED results were similar to those on the W-B. Differences between their subtest means were evaluated (Table 4) to determine whether the proportionate contributions of the individual subtests to the Composite Scores varied, or whether the groups had similar profiles of high and low scores. A rank-difference correlation was computed to provide additional evidence of the degree of similarity between the groups' profiles (Table 5). And the differences between correlations of ITED subtests with academic subjects were evaluated (Table 6).

No significant differences were found between means of the ITED subtests, nor was there a difference in subtest scatter (Table 4). In contrast with the W-B scores, the Rho value on the rank-difference correlation of .935 (Table 5) indicates very close agreement in the hierarchies of strong-to-weak subtests. But despite these resemblances, there are eight significant differences, out of nineteen, between the correlations of ITED subtests with marks (Table 6), indicating

TABLE 4

DIFFERENCES BETWEEN MEANS ON THE IOWA TEST OF EDUCATIONAL DEVELOPMENT

| ITED Subtests | Class %ile | Mean L-A's | S.D. | Mean A's | S.D. | t-value |
|---|---|---|---|---|---|---|
| 1. Background in Social Studies | 66 | 84 | 14.2 | 85 | 11.5 | -.203 |
| 2. Background in Natural Science | 69 | 90 | 9.6 | 91 | 10.4 | -.486 |
| 3. English Usage | 55 | 65 | 18.9 | 70 | 18.9 | -1.241 |
| 4. Quantitative Thinking | 71 | 88 | 14.3 | 87 | 12.9 | .258 |
| 5. Interpretation of Social Studies | 65 | 80 | 14.4 | 75 | 18.2 | 1.363 |
| 6. Interpretation of Natural Science | 73 | 88 | 10.4 | 88 | 10.5 | -.169 |
| 7. Interpretation of Literature | 68 | 79 | 18.3 | 78 | 15.6 | .155 |
| 8. Vocabulary | 68 | 88 | 9.4 | 85 | 11.5 | 1.022 |
| Range (in percentiles) between Highest and Lowest Subtest Scores | | 39 | 16.8 | 36 | 18.4 | .756 |

N of L-A's = 43 N of A's = 36

that the A's and L-A's make different use of whatever abilities are common to ITED performance and academic learning, as is the case with the abilities tapped by the W-B. Prediction 10 was supported; 6, 7, and 8 were not.

Comparing the tests with various subjects (Table 6), the L-A's show a higher correlation of #1, Background in Social Studies, with social studies. On #3, English Usage,

TABLE 5

RANK HIERARCHIES OF ITED SUBTESTS

| L-A's | A's | Rho = .935* |
|---|---|---|
| 1. Background in Natural Science | 1. Background in Natural Science | |
| 2.(Interpretation of (Natural Science ( | 2. Interpretation of Natural Science | |
| 2.(Vocabulary | 3. Quantitative Thinking | |
| 4. Quantitative Thinking | 4. Vocabulary | |
| 5. Background in Social Studies | 5. Background in Social Studies | |
| 6. Interpretation of Social Studies | 6. Interpretation of Literature | |
| 7. Interpretation of Literature | 7. Interpretation of Social Studies | |
| 8. English Usage | 8. English Usage | |

*For N = 8; P = .02, Rho = .833 (28, p. 549)

the A's show higher correlations with mathematics and foreign language. On #4, Quantitative Thinking, the L-A's show a higher correlation with language. The A's show a higher correlation of #6, Interpretation of Natural Science, with science, and the L-A's show a higher correlation of #7, Interpretation of Literature, with English and foreign language.

Comparing subjects with various tests, the higher correlation of English with #3 for the A's, and with #7 for the L-A's suggests a very different approach to the subject by the groups. The correlations with foreign language seem to bear this out. Again, #3 correlates higher for the A's

TABLE 6

CORRELATIONS OF ITED SUBTESTS WITH MARKS IN FIVE ACADEMIC SUBJECTS

| Marks in School Subjects | ITED Subtests (1) Bkgd. Soc. Stud. | (2) Bkgd. Nat. Sci. | (3) English Usage | (4) Quant. Thinking | (5) Interp. Soc. Stud. | (6) Interp. Nat. Sci. | (7) Interp. Lit. | (8) Vocab. |
|---|---|---|---|---|---|---|---|---|
| English | | | | | | | | |
| L-A's | | | .47 | | .52 | .42 | .55** | .40 |
| A's | | | .64 | | .50 | .47 | .36 | .51 |
| Mathematics | | | | | | | | |
| L-A's | | | .18 | .32 | | | | .23 |
| A's | | | .49** | .23 | | | | .29 |
| Science | | | | | | | | |
| L-A's | | .42 | | .04 | | .30 | | |
| A's | | .45 | | -.03 | | .44* | | |
| Social Studies | | | | | | | | |
| L-A's (N=40) | .51** | | | | .47 | | | .18 |
| A's (N=30) | .19 | | | | .51 | | | .13 |
| Foreign Language | | | | | | | | |
| L-A's (N=32) | | | .27 | .39** | .52 | .25 | .35* | |
| A's (N=32) | | | .50** | .16 | .51 | .13 | .19 | |

*P less than .05
**P less than .01

and #7 (though not to the same extent as with English) for the L-A's, who in addition show a higher correlation of language with #4. Apparently, the A's are making more and/or better use of their grammatical ability in meeting English and foreign language course requirements, whereas the L-A's are relying more on the abilities involved in literary interpretation--to their detriment. In mathematics the A's make greater use of whatever functioning is common to mathematics and grammar. The higher correlation of the A's of Science with #6 suggests that they make better use of their reasoning ability in learning this subject. This appears to be consistent with the greater use made by the L-A's of Factor C, a memory factor; i.e., the groups seem to use different approaches, the L-A's (not-too-successfully) relying on memory and the A's on their reasoning ability. Social studies correlates higher with #1 for the L-A's, which again suggests that they rely more strongly on memory in learning this than do the A's.

Rank Difference Correlation of Academic Subjects

There is very little correlation between the academic strengths and weaknesses of the A's and L-A's (Table 7), which tends to corroborate prediction 11 to the effect that differences in the order of difficulty of academic subjects reflect differences in the proportions of the abilities required for their mastery, or differences in the use which is made of these abilities in meeting the task-

TABLE 7

RANK HIERARCHIES OF ACADEMIC SUBJECTS

| L-A's | A's | Rho = .325* |
|---|---|---|
| 1. Social Studies | 1. Science | |
| 2. Science | 2.(Mathematics | |
| 3. English | 2.(Social Studies | |
| 4. Foreign Language | 4. Foreign Language | |
| 5. Mathematics | 5. English | |

*For N = 5; P = .10, Rho = .900 (28)

requirements of learning the subjects. To what extent the divergencies reflect abilities can't be determined, but the A's appear to be more oriented toward mathematics; the L-A's toward verbal courses.

Your Educational Plans

The chi-aquare analysis of ten YEP questions (Table 8) indicates that the A's show greater potentiality for

TABLE 8

CHI SQUARE OF YOUR EDUCATIONAL PLANS DATA

| | A's | L-A's |
|---|---|---|
| Per Cent High College Expectancy | 63 | 55 |
| Per Cent Low College Expectancy | 37 | 45 |

Chi square = 5.23; P less than .05

college than the L-A's, corroborating prediction 12. The following are the items in the YEP for which the chi-square technique was used:

1. Student's Occupational Aspirations
2. Father's Occupational Level
7. Student's College Plan
11. Financial Need (of family in regard to college)
12. Father's Sentiments Regarding Student's Educational Goals
13. Mother's Sentiments Regarding Student's Educational Goals
14. Father's Educational Level
15. Mother's Educational Level
29. Best Friend's College Intentions
30. Best Friend's Sentiments Regarding Student's Educational Goals.

The students' responses had been coded, low numbers indicating high potential for college and high numbers low potential (in accordance with national norms). A cut-off point establishing high versus low college expectancy was arbitrarily determined for each of these items, and the percentage of each group in each category found.

Other Data

A review of the health records and advanced placement recommendations showed few differences between the groups. However, one L-A has visited the nurse a remarkably disproportionate number of times (for vaguely defined

complaints). As for elementary school teacher-evaluations, of those available (on about three quarters of the group), the teachers' recommendations for advanced placement often bore no resemblance to the achievement test and I.Q. results they had entered on the same card--but this was true for both groups.

## CHAPTER V

## THE SIGNIFICANCE OF DIFFERENTIAL TEST RESULTS

The central issue of this study is to gain insight into how the abilities of low-achieving students, as measured by the differential between marks and a measure of scholastic aptitude differs from that of the achievers--if it does. "How," is meant to include, but not be limited to, "how much." The data indicate that the L-A's apparently differ from the A's not in quantitive measures of ability, but in the processes they use to obtain their very similar test results.

The evidence of such differences is necessarily quite indirect. It is difficult enough to infer what psychological processes are utilized in the performance of a test from the test scores and it is even a more doubtful task to infer the processes used in learning an academic subject from a teacher's evaluation of his accomplishment, to say nothing of inferences as to which elements are responsible for correlations between these. Nevertheless, the nature of the tests (the Wechsler-Bellevue and Iowa Test of Educational Development) should yield clues to the nature of the differences in the mental functioning of the A's and L-A's.

Four factor analyses of the W-B[1] provided complementary information regarding the probable functioning measured by this test.

The earliest study, by Balinsky (3), compared test results at six (non-continuous) age levels from 9 through 50-59. The samples were of a restricted I.Q. level, the range being a few points above and below 100. They were drawn from the original standardization population, and the subtest Similarities was omitted. Cohen, in one study (10) used three groups of hospitalized male neuropsychiatric patients: psychoneurotic, schizophrenic, and brain-damaged. In a later study (11) he drew samples at four age levels from 18-19 through 60-75+ from the WAIS standardization population. A full range of I.Q.'s was included, and his N's ranged from 200-350. The same factors were found in these two studies. Davis (13), using high school students, included various reference tests in order to corroborate his hypothesized factors. He hypothesized six factors but found eleven.

In the present experiment, the most notable difference between the groups on the W-B is on Factor E, Digit Symbol. Cohen (10, 11) found this factor something of a puzzle because of its inconsistent correlations with the other subtests and factors at various age levels. In the oldest group (11), it loaded on Factors B (Perceptual Organization), C (Memory) and D (Picture Arrangement). (The findings on the brain-damaged group (10) were similar.)

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[1]One is of the WAIS, but for the purposes of this discussion the WAIS resembles the W-B enough to equate them.

In the youngest group it correlated with Digit Span. Balinsky found Digit Symbol to load on his Verbal factor at several age levels whether or not it loaded on his Performance factor as well. It also loaded twice on a memory factor, at ages 25-29 and 35-44, which would bear out the implications of Cohen's findings that memory is part of the functioning required to perform this subtest. In addition, because of its frequent inclusion in the Performance factor, Balinsky considered Digit Symbol to involve "visualization": perception of form and space relations.

Davis, who unfortunately did not include reference tests for either memory or space relations, found that Digit symbol was included in the factors of Numerical Facility, Fluency, and Perceptual Speed. Fluency was characterized as: "A tendency to be responsive and uninhibited, with consequent free flow of responses to stimulation." He expressed surprise that it loaded on Numerical Facility, commenting: "If what is called numerical facility is really the ability to manipulate numerical-type symbols rapidly, whether for arithmetic operations or not, it would be of interest to know whether such a test could be used effectively to predict numerical aptitude."

The findings of Coombs (12), in his factor-analysis of number ability in high school students, indicated that it probably could be so used. He found perceptual speed to be a factor in number ability, as well as evidence of common factors in tests of number ability and word fluency, as did Fruchter (21) in an analysis of verbal fluency. His study

was designed to test the hypothesis that manipulation of a (familiar) symbolic system is the essence of number ability, and his results confirmed this hypothesis. Although the tests he used do not closely resemble Digit Symbol, they probably involve much the same functioning; i.e., perceptual speed, fluency (as Davis characterized it), and memory.

Thus, Digit Symbol appears to require cognitive processes common to number ability and verbal fluency, and, judging by the fairly high correlations with school marks obtained by both L-A's and A's, these processes are also common to academic learning, but evidently not everyone utilizes them to the same extent, or perhaps in the same way. The data of the present study do not indicate what aspects of the functioning required to perform Digit Symbol are different in the A's and L-A's, but speculation is possible, based on the factorial similarity of Digit Symbol to Factor B.

Factor B, Perceptual Organization, differentiates the A's from the L-A's in relation to mathematics and science. The subtests which compose Factor B, Object Assembly and Block Design, always load on a factor of visualization or perceptual organization (the names vary from study to study, but the factor appears to be the same). However, in addition they load on some factors comprising mostly verbal tests. Since Cohen found a G factor to account for about half the variance on the entire WAIS, and the verbal factors on which Object Assembly and Block Design load in Balinsky's and Davis' studies seem to be characterized strongly by G (i.e., something that is equated with Spearman's g), the

question is: How, and to what extent are the non-G aspects of Factor B related to academic learning?

Similar to what has been found by others in regard to the correlation of Performance tests with scholastic achievement (1, 44, 54), this factor tends to have the lowest correlations with marks for both groups; usually less than .2 (positive or negative). The highest correlations are with mathematics (for the A's) and with foreign language (for both groups).

Since mathematical and language ability--grammatical ability, at least--usually correlate positively with each other, it would be interesting to know what aspects of the functioning involved in Factor B are responsible for the correlation with these subjects, and whether the same things are involved in the correlation with science. The L-A's have a lower correlation of mathematics with Factor B, and also seem to use grammar less--or to be worse at it--in learning English and foreign language (Table 3), which suggests that they might be deficient in an ability which is common to grammar, mathematics and Factor B. However, Factor B has virtually zero correlation with English for both groups. Learning mathematics, grammar, and to an extent, science requires the arbitrary manipulation of symbols, certain relationships among which being "right" and others "wrong,"[1] and since both Object

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[1]From the viewpoint of the development of these branches of knowledge the relationships among symbols are of course lawful, but the high school student doesn't yet

Assembly and Block Design require the ability to synthesize parts into a whole and so to judge which relationships among parts will be the right ones to form a pattern, this might be the common ability at the level of thought-association. (I.e., the ability to discern the relevant cues by which parts--symbolic or concrete--are fitted together into their proper whole. Probably this is matching or classificatory behavior which includes visual memory.) At this level, also, Factor B might involve processes common to Digit Symbol. If such a common ability exists it might conceivably play a more important role in differentiating A's from L-A's than the present correlations suggest, because these tests might not include enough of the relevant functionings. This lack could contribute to the rather low correlation of tests with academic achievement, but probably more knowledge of thought-association processes is necessary before tests can be designed to measure it (cf. 29). Perhaps tasks similar to those used in Bruner's (7) concept-attainment experiments would be appropriate.

Factor C, Memory, differentiates the groups with respect to science; the L-A's having a higher correlation. The fact that the A's show a higher correlation of science with ITED #6, Interpretation of Natural Science, suggests

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know enough to be able to appreciate why certain relationships are necessary and others necessarily wrong. For him the task is (largely) to learn to differentiate correct from incorrect on the basis of what appears to be arbitrarily determined conventional usage.

that the L-A's may be relying more on memory; the A's on reasoning. If the speculations offered above regarding the ability to manipulate symbols have validity, the A's higher correlations of Factors B and E, as well as ITED #6 with science may all reflect this symbolic manipulation, which seems to be a part of reasoning ability. Thus, despite their equivalent test scores, the A's may make better use of reasoning in learning science, particularly in high school. At the high school level it probably requires a somewhat different ability from what was required in the elementary school, which is the basis of their ITED scores. Inspection of their academic records shows that the L-A's have more difficulty in chemistry than in their freshman general science course, which is probably more nearly like the elementary school curriculum.

Factor A, Verbal Comprehension, differentiates the groups in relation to social studies. Comparison of Tables 3 and 6 shows that the correlations of social studies with Factor A and with ITED #1, Background in Social Studies, are almost identical for both the A's and L-A's. To the extent that school marks represent the functioning involved in learning, the L-A's evidently utilize to a considerably greater extent whatever the tests measure in common. As appears to be the case in science, this may be rote memory functioning, since that is probably common to both tests, but there is no other evidence to support this possibility.

The only other difference in the correlations with

social studies is on Factor E, Digit Symbol; the A's having the higher correlation. This may be consistent with the fact that the A's show a higher correlation of Factor E and ITED #3 (English Usage) with English and foreign language, whereas the L-A's show higher correlations with ITED #7 (Interpretation of Literature) with these subjects. These facts appear to reflect consistent differences in some aspects of their verbal ability. Two of the factors Carroll (8) found to comprise Thurstone's Verbal Relations factor seem to be relevant: one, characterized as the richness of an individual's stock of linguistic responses, which is probably closely related to Factors A (Verbal Comprehension) and C (Memory) and the L-A's functioning; and another, characterized as the ability to handle semantic relationships, which is probably closely related to Factors B (Perceptual Organization) and E (Digit Symbol) and the A's functioning. The L-A's may have particular strength in verbal fluency and memory, enabling them to learn and store a great many facts which they can easily recall on signal, e.g., when confronted with the clues offered by multiple-choice tests. The A's, on the other hand, may have in addition to these strengths the ability of symbolic manipulation, as discussed above. These possibilities could be investigated by comparing A's and L-A's on the appropriate Thurstone tests. Perhaps relevant Wechsler-Bellevue items could be included. Carroll's factors might also be associated differentially with mathematics. This is suggested by the L-A's higher

correlation of ITED #4 (Quantitative Thinking) as well as #7 (Interpretation of Literature) with foreign language, in contrast to the A's higher correlation of ITED #3 (English Usage) with both language and mathematics.

To the extent that these conjectures have validity--and this would have to be determined by further experimentation--the differences between the A's and L-A's appear to be in certain aspects of functioning which are primarily associated with verbal and quantitative abilities. This is consistent with the importance tests of these abilities have come to assume in the prediction of total scholastic aptitude, and it is also consistent with the findings of Goldberg (23) that bright under-achievers have particular weakness in mathematics and language, and Frankel (20), that their verbal and arithmetic reasoning ability drops during their high school years, and Hughes (35), who found high achieving ninth graders to be significantly higher in quantitative ability than low achievers on both the Differential Aptitude Test and the Scholastic Abilities Test.

Because the high school curriculum is probably sufficiently more complex than that in elementary school to require qualitatively different abilities[1] (cf. 30) it

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[1]Ability is used in the sense of capability of mastering knowledge, skills, etc., under the assumptions that the nature of what is to be learned and used requires specific kinds of intellectual functioning (imposes certain restrictions on one's responses), and the functioning involved is apt to be factorially complex. Also, that abilities represent both genetic endowment and environmental experience, which have been interacting throughout the person's life.

seems plausible to expect cognitive differences among students which have not previously been evident, to appear in high school.

However, there is some evidence that underachievement begins in the elementary school (48, 50), and, as has been noted above, there is a great deal of evidence demonstrating the role(s) of motivational factors in achievement. In fact, in the present study the hypothesis that the L-A's would show less probability of attending college as a consequence of their background and attitudes was confirmed.

But these findings aren't necessarily in opposition to each other. Not only could motivational (emotional) and cognitive attributes each contribute to achievement, but motivation and other aspects of emotional functioning could directly affect cognitive behavior. Differences of anxiety or "investment" in academic tasks might, and probably do, act as selective facilatators or depressants of, for example, memory, or other cognitive processes. Perceptual distortion, "blocking," motoric or mental slowness are other possible effects of anxiety, and in one whose personality is badly integrated (or disintegrating) these and other phenomena can seriously impair cognitive functioning in a few or in many spheres. That is, the person might be able to perform well in some situations but not in others. On the other hand, mild anxiety (such as comes from a desire to be liked by the teacher?) might facilitate an optimum "set" for learning,

and perhaps such things as fluency, memory, etc. as well. EEG studies could probably contribute much to an understanding of the precise relationships. But experiments involving learning and memory tasks under conditions of induced anxiety, or using people categorized according to aspects of mental health, would also be enlightening.

One important implication of the fact that in the present study many more differences appeared between the correlations with academic subjects than between aspects of the tests themselves, is that tests which of necessity primarily require the application of past experience to a new situation give little understanding of the processes by which that experience was acquired. Probably only by developmental studies (cf. 4, 19) can all the elements of the linking of new knowledge to one's store of "information" be sorted out: the effects at a given point in time of differential abilities, education, and training; of special talents; of good or bad habits; as well as students' current anxiety (a reflection of his mental health) or positive involvement in learning.

# CHAPTER VI

## SUMMARY AND CONCLUSIONS

Two groups of high school boys, designated Achievers and Low Achievers, were compared on the Wechsler-Bellevue, the Iowa Test of Educational Development, and on correlations of subtests of these with marks in five academic subjects. Few quantitative differences of ability, as reflected by test scores, were found, but seventeen differences between correlations with academic subjects were found, out of a possible thirty-nine, which were interpreted to signify qualitative differences in the intellectual functioning common to the tests and the learning of these subjects. The functioning seems to be predominately of memory and aspects of verbal and non-verbal reasoning, but its nature would have to be determined by further studies.

## APPENDIX I

### THE MATCHING OF A's AND L-A's ON IOWA TEST OF EDUCATIONAL DEVELOPMENT COMPOSITE SCORE

| "C" Score Percentile | No. of L-A's | "C" Score Percentile | No. of A's |
|---|---|---|---|
| 98)<br>97) | 10 | 99)<br>98)<br>97 | 6 |
| 95)<br>93) | 7 | 95)<br>93) | 8 |
| 91)<br>88) | 13 | 91)<br>88) | 9 |
| 84 | 3 | 84 | 3 |
| 80 | 5 | 80 | 5 |
| 75 | 2 | 75 | 2 |
| 70 | 3 | 70 | 3 |
| Total : | 43 | Total : | 36 |

## APPENDIX II

### EXACT TITLES OF IOWA TEST OF EDUCATIONAL DEVELOPMENT SUBTESTS[1]

1. Understanding of Basic Social Concepts
2. General Background in the Natural Sciences
3. Correctness and Appropriateness of Expression
4. Ability to Do Quantitative Thinking
5. Ability to Interpret Reading Materials in the Social Studies
6. Ability to Interpret Reading Materials in the Natural Sciences
7. Ability to Interpret Literary Materials
8. General Vocabulary

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[1]The abbreviations, except of #3, are those supplied by the publisher with the summary of the class's test results. Test #3 includes usage, grammar, punctuation and spelling.

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