

THE PREDICTION OF HIGH SCHOOL ACADEMIC SUCCESS FROM STANDARDIZED  
TESTS OF READING, LISTENING AND INTELLIGENCE

by 45

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## INTRODUCTION

The need for the discovery of talent among students and providing appropriate educational opportunities, for the maximum development of such talent, is of great concern to educators today. The method commonly used to discover this talent is measurement by standardized testing programs.

The measurement problems in the secondary schools are many and varied. One of the most difficult problems facing the high school counselor is concerned with selecting tests that will provide him with the maximum amount of valid and reliable information about his students at the minimum amount of cost, time for administration, and complexity of interpretation. Also, the selected tests must be amenable to effective utilization by teachers and other school personnel who have had little or no special training in the field of measurement.<sup>1</sup>

Once these tests have been selected the high school counselor uses the tests for four basic purposes: to supplement teacher grades and other achievement data in counseling students with regard to the academic decisions which must be made during high school; to provide an independent estimate of the student's ability to pursue formal educational programs beyond high school; to identify those students who are achieving far above or far below the levels of which they appear capable; and to formulate and corroborate predictions of vocational success

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<sup>1</sup> Pairlee J. Stinson and Mildred M. Morrison, "Sex Differences Among High School Seniors," Journal of Educational Research, 53:103-104, November, 1959.

and adjustment. How well the tests fulfill the applications stated above depends on an unknown complex of subtle factors which make each school system somewhat unique. While a few generalizations may be made, the evidence most clearly indicates that the efficiency of any test varies widely from one high school to another. No amount of experimentation with a test appears sufficient to permit any exact estimate of its effectiveness in a given school system. Thus, any counselor who hopes to derive maximum value from each testing dollar must be prepared to carry on at least a moderate program of local research.<sup>1</sup> It was in this frame of reference that this study was undertaken.

#### STATEMENT OF THE PROBLEM

The purpose of this study was to evaluate the effectiveness of certain standardized tests in predicting academic success in the Manhattan, Kansas, High School, since curricular, administrative, and instructional decisions are often based on information of this kind. The need for such a study was reported by Long.

Very few research studies on the prediction of academic success have been conducted on the secondary school level. An objective method of predicting success would greatly aid high school guidance workers in the academic counseling of their students. The increased diversity of our school population brought about by cultural changes, the ever increasing numbers of young people in our public schools, and the emphasis on discovering talented students and providing

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<sup>1</sup>James F. Adams, Counseling and Guidance (New York: The Macmillan Company, 1967), p. 253.

appropriate educational opportunities for these students are some reasons why prediction of academic success is needed during the high school years.<sup>1</sup>

#### DEFINITION OF TERMS USED

Academic Success. As traditionally used, the term "academic success" refers to some method of expressing a student's scholastic standing. Usually this is a grade for a course, an average for a group of courses, an average for a group of courses in a subject area or an average for all courses (grade-point average). The grade-point average is usually taken as the measure of academic success. Another measure of academic success, sometimes used instead of grades is the standardized achievement test.<sup>2</sup> For this study both cumulative grade-point average and an achievement test (American College Testing Program Examination) were used as the criteria of academic success.

Grade-Point Average. Cumulative grade-point average as used at Manhattan, Kansas, High School was first expressed nominally (A, B, C), and then converted to a numerical value (A=4, B=3, C=2, D=1, F=0), so that grade-point average for all courses could be computed. The grade-point average was then taken as the measure of academic performance. Physical education and music grades were not included in the grade-point

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<sup>1</sup>J. Robert Long, "Academic Forecasting in the Technical-Vocational High School Subjects," Personnel and Guidance Journal, 37:666, May, 1959.

<sup>2</sup>David E. Lavin, The Prediction of Academic Performance (New York: Russell Sage Foundation, 1965), p. 18.

averages.

Once determined, the grade-point average is a seemingly continuous variable with units correct to three significant digits to the right of the decimal point (2.358). In this form it is manipulative in predictive and comparative studies. In addition, grade-point average is a vital statistic referred to in making decisions about placement and selection.<sup>1</sup>

In Manhattan High School the grade-point average was computed for each student after the completion of each semester of work. The grade-point average, used as a measure of academic success for this study, was for the culmination of eight semesters of successful work.

#### OBJECTIVES

The objectives of this investigation were:

1. To predict academic success at Manhattan High School.
2. To evaluate the standardized aptitude and achievement tests currently being used at Manhattan High School as they correlate with high school academic success. Of particular interest was the Brown-Carlson Listening Comprehension Test as it related to academic success.
3. To develop from these tests a localized multiple regression formula to predict cumulative grade-point average.
4. To develop from these tests a localized multiple regression

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<sup>1</sup>Norman M. Chansky, "A Note on the Grade-Point Average in Research," Educational and Psychological Measurement, 24:95, Spring, 1964.

formula to predict the cumulative American College Testing Program Examination standard score.

In developing the major objectives of the study the following subsidiary goals were included:

1. To provide a single useful tool for prediction of academic success that could be used by administrators, counselors, and teachers.
2. To provide a single useful tool by which estimates of the student's ability to pursue formal educational programs beyond high school could be made.
3. To provide a single useful tool which would identify those students who are achieving far above or far below the levels of which they appear capable.

#### LIMITATIONS

The results of this study are limited to Manhattan, Kansas, High School as only Manhattan High School students were included in the sample. It is therefore uncertain whether the results would be applicable to other schools.

It is a limitation of this study, to predict academic success, that no measure of socioeconomic status is included in the variables considered. Socioeconomic status is a basic correlate of academic performance.<sup>1</sup>

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<sup>1</sup>Lavin, op. cit., p. 43.

The sample was limited to only the graduates of Manhattan High School, 1965-67, who had scores for all four standardized tests used as variables in the study. A further sample limitation was that American College Testing Program Examination scores were available for only sixty-one percent of this sample population. No attempt was made to predict failure in high school.

#### REVIEW OF LITERATURE

Prediction in the broadest sense of the word is the primary goal of scientific investigation whether in astronomy, chemistry, psychology, medicine, or education. The social sciences, such as education and psychology, are concerned with prediction about the human organism itself, particularly in relation to its learning capacity, potential growth, success, and adjustment. By increasing man's ability to foretell human behavior under prescribed conditions, science makes it possible for man to make decisions about future courses of action which have a greater probability of fulfilling his goals or purposes.<sup>1</sup>

When one desires to predict a certain type of behavior, it would be very convenient to be able to locate an appropriate test, administer it, and make decisions accordingly. The situation is not that simple, however. Usually the behavior to be predicted is too complex to forecast adequately with a single predictor. Furthermore, different schools

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<sup>1</sup>Goldine C. Gleser, "Prediction," Encyclopedia of Educational Research (New York: The Macmillan Company, 1960), pp. 1038-39.

may demand quite different types of performance in courses which have similar labels making this approach undesirable. The only valid basis for prediction is experimental verification of the relationship between potential predictors and actual performance of a group of subjects who are representative of the population for which it is desired to make prediction.<sup>1</sup>

The history of academic prediction has run an ever-changing course over the past fifty years.<sup>2</sup> Studies have ranged from those involving simple reactions to those involving numerous factors and complicated statistical techniques. Most of the criteria used in the past have involved correlations between grades and some other index. The major aim of most of these studies was to discover those factors that will enable prediction of academic performance or success (usually measured by GPA). This search for predictive factors has focused primarily upon various characteristics of the student, such as his aptitudes, his personality traits, and the like. Relationships between such predictors and performance criteria are not always strong. Researchers usually view this as an indication of: (1) failure to isolate enough of the right variables, and/or (2) measurement error in the predictors.<sup>3</sup> One must also consider that the possibility of low correlations might be due to uncontrolled sources of variation in grades themselves.

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<sup>1</sup>Ibid., p. 1039.

<sup>2</sup>Benjamin S. Bloom and Frank R. Peters, Academic Prediction Scales (New York: Free Press of Glencoe, Inc., 1961), p. 8.

<sup>3</sup>Lavin, op. cit., p. 19.



These sources of variations fall into two categories. First, not all students take the same courses, and some types of majors may be more difficult than others. Second, teachers use different criteria in assigning grades.<sup>1</sup> This problem has been discussed by various researchers, notably Baker and Doyle,<sup>2</sup> Kelley,<sup>3</sup> Chansky,<sup>4</sup> and Fishman.<sup>5</sup> Fishman suggests the use of uniform tests (such as standard achievement tests) as one means of overcoming the error associated with the use of grades as an index of academic success. He points out that it would help to eliminate uncontrolled subjective criteria that may enter into the teachers' grading practices. For this reason it would seem advisable to use uniform test scores as supplementary criteria of performance or success. However, their use as the sole criterion of performance is questionable because it would lead away from a consideration of the teacher as a theoretically significant factor.

Though one may question the reliability of the grade point average as a measure of academic success, no other criterion is as easily accessible or as widely used. Until research develops more objective

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<sup>1</sup> Ibid.

<sup>2</sup> Robert L. Baker and Roy P. Doyle, "Teacher Knowledge of Pupil Data and Marking Practices at the Elementary School Level," Personnel and Guidance Journal, 37:644-647, May, 1959.

<sup>3</sup> Eldon G. Kelley, "A Study of Consistent Discrepancies Between Instructor Grades and Term-End Examination Grades," Journal of Educational Psychology, 49:328-334, June, 1958.

<sup>4</sup> Chansky, op. cit., p. 96.

<sup>5</sup> Joshua A. Fishman, "Unsolved Criterion Problems in the Selection of College Students," Harvard Educational Review, 28:345, May, 1958.

criteria, grade-point average will still be used by schools, colleges, employers, and others in attempting to assess individual potential and achievement.

By limiting the study to Manhattan High School the study is, in part, controlling for this subjective error (teacher variance), assuming the teachers within one school system would give student grades more consistently than teachers in several school systems. "The reference group for a student's grades in school is the group of students and teachers in that school, whereas, the reference group for a student's grades as an index for some other criteria, such as his college potential, consists of the students and teachers from a large number of high schools."<sup>1</sup>

#### Literature On the Relationship Between Reading, Listening and Intelligence Tests and Their Use as Predictors of Academic Success

The diagnostic or predictive value of a psychological test depends upon the degree to which it serves as an indicator of a relatively broad and significant area of behavior.<sup>2</sup> If reading skills, listening skills and intelligence are of a common nature, a test of one should make it possible to predict the others, or the testing of all should produce results in high agreement. If a student was trained in one, any improvement he might make should be reflected in the others. The literature

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<sup>1</sup> Bloom and Peters, op. cit., p. 115.

<sup>2</sup> Anne Anastasi, Psychological Testing (New York: The Macmillan Company, 1961), p. 22.

does not support this concept of commonality.<sup>1</sup>

There is considerable variance in the relationships of listening, reading and intelligence tests as reported by various investigators. Cleland and Toussaint, using the Gates Reading Survey and Sequential Tests of Educational Progress-Listening, found a positive correlation between the two of .6679. By combining STEP-Listening and SRA Primary Mental Abilities Test, an intelligence test, to predict reading achievement, they found a multiple  $r$  of .7564. They also cited correlations between the Gates Reading Survey and the Stanford-Binet Intelligence Test of .61, between the STEP-Listening and Stanford-Binet Intelligence Test of .63.<sup>2</sup>

Rose set out to study the relationships between the subtest skills and total test skills that are measured by standardized reading tests and the Brown-Carlson Listening Comprehension Test and the influence of intelligence upon those skills. He found the simple coefficients of correlation between the reading and listening subtests range from .32 to .60. The multiple coefficient for total test scores ranged from .54 to .67. A combination of the three reading tests and the listening test gave a multiple coefficient of .63 for boys and .65 for girls. He concluded that listening and reading comprehension as measured by standardized tests are not composed of closely related skills,

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<sup>1</sup>Paul W. Keller, "Major Findings in Listening in the Past Ten Years," Journal of Communication, 10:32, March, 1960.

<sup>2</sup>Donald L. Cleland and Isabella H. Toussaint, "The Interrelationships of Reading, Listening, Arithmetic Computation and Intelligence," Reading Teacher, 15:230, January, 1962.

intelligence is a significant factor which seems to be inherent in the tests, and the relationship between reading and listening drops significantly when intelligence is ruled out.<sup>1</sup>

Listening comprehension scores were compared with various reading measures showing relationships of from .417 to .66 for high school students as reported in the Brown-Carlson Listening Comprehension Test Manual of Directions. The publishers concluded, "The magnitude of the correlations between listening comprehension and reading comprehension suggests that the two skills are in no way identical and that measures of both may be valuable in diagnosing learning difficulties."<sup>2</sup>

Other studies by Stromer,<sup>3</sup> and Biggs,<sup>4</sup> show that listening comprehension tests and reading comprehension tests are measuring two skills. Stromer stated, "Listening training did not produce significant changes in reading comprehension."<sup>5</sup>

#### Relationships between listening comprehension and intelligence

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<sup>1</sup>Ervin Rose, "A Comparative Study of the Brown-Carlson Listening Comprehension Test and Three Tests of Reading Comprehension," Doctor's Thesis, New York, New York University, Abstract: Dissertation Abstracts, 19:2007, 1958.

<sup>2</sup>James I. Brown and G. Robert Carlson, Brown-Carlson Listening Comprehension Test Manual of Directions (New York: World Book Company, 1955), p. 18.

<sup>3</sup>Walter F. Stromer, "An Investigation Into Some of the Relationships Between Reading, Listening, and Intelligence," Speech Monographs, 21:159-160, August, 1954.

<sup>4</sup>Berniece P. Biggs, "Construction, Validation, and Evaluation of Diagnostic Test of Listening Effectiveness," Speech Monographs, 23: 9-13, March, 1956.

<sup>5</sup>Stromer, op. cit., p. 160.

were reported by Kramer, who found moderate correlations of .54 between Brown-Carlson Listening Comprehension Test and Wechsler-Bellevue Intelligence scale and .55 between American College Examination Intelligence Test and Brown-Carlson Listening Test.<sup>1</sup> Farrow found a marked lower correlation of .151 between objective listening attention scores and intelligence.<sup>2</sup> Correlations between the Listening Comprehension Test and several mental ability measures were recorded in the Brown-Carlson Test Manual. These ranged in the case of high school students from .67-.78. The authors of the manual also pointed out, "When allowance is made for the fact that neither Brown-Carlson Listening Test nor intelligence scores are perfectly reliable, it is clear that there is considerable overlapping between the two measures. Since both involve language comprehension and interpretation of verbal symbols, this is to be expected."<sup>3</sup>

In several other studies correlations were cited between reading, listening and intelligence. Condon concluded that listening is positively related to reading, intellectual ability, grade-point average in English and grade-point average in all school subjects. She cited

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<sup>1</sup>Edward J. J. Kramar, "The Relationships of the Wechsler-Bellevue and American College Examination With Brown-Carlson Listening Comprehension Test," Doctor's Thesis, Tallahassee, Florida, State University, Abstract: Dissertation Abstracts, 15:2599, 1955.

<sup>2</sup>Vern Leslie Farrow, "An Experimental Study of Listening Attention at the Fourth, Fifth and Sixth Grades," Doctor's Thesis, Eugene, University of Oregon, Abstract: Dissertation Abstracts, 24:3146, 1964.

<sup>3</sup>Brown and Carlson, op. cit., p. 17.

positive correlations from .51 to .86.<sup>1</sup> In a study in which he controlled for sex and reading ability, Haberland, found relationships between the Brown-Carlson Listening Comprehension Test and the Otis Self Administering Test of Mental Ability from .38 for men with average or below average reading ability to .73 for women of average or above average reading ability.<sup>2</sup>

In summation, the literature shows that reading and listening comprehension are similar skills, but are not identical. As both are basic to the learning process, both should be included in any attempt to predict academic success. It appears that listening comprehension is a little more closely related to intelligence than to reading measures. But, there is considerable variance in the scores on each of the two types of tests not accounted for by the elements which are common to both. It is reasonable then to compare the results of a listening comprehension test with the results of an intelligence test for diagnostic purposes. As pointed out by Eckelberry, "The listening comprehension test is most valuable when used in combination with a reading test and, if possible, also with an intelligence test."<sup>3</sup>

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<sup>1</sup>Edwyna Forsyth Condon, "An Analysis of the Differences Between Good and Poor Listeners in Grades Nine, Eleven and Thirteen," Doctor's Thesis, Lawrence: University of Kansas, Abstract: Dissertation Abstracts, 26:3106, 1965.

<sup>2</sup>John A. Haberland, "A Comparison of Listening Tests With Standardized Tests," Journal of Educational Research, 52:301, April, 1959.

<sup>3</sup>R. H. Eckelberry, "Brown-Carlson Listening Comprehension Test," Educational Research Bulletin, 34:84, March, 1955.

Literature on Sex Differences in Academic Performance and  
Standardized Test Results

The studies that assessed the relation between sex and academic performance showed that females have higher academic performance than males.<sup>1,2,3</sup> The literature on sex differences in regards to performance on certain standardized tests and predicting academic success showed mixed results.

Seashore, using the Differential Aptitude Tests concluded "academic grades of women in high school and college are better predicted from aptitude tests than are academic grades of men."<sup>4</sup> He found, of 520 comparisons between Differential Aptitude Test scores and high school or college grade-point averages, sixty-one percent of the cases showed higher validity coefficients for girls than boys, thirty-six percent of the cases showed higher validity coefficients for boys than girls, and three percent had no difference.<sup>5</sup> Similar findings were reported by Jacobs. Using five of the sub-tests from the Differential Aptitude Test Battery and three other tests as variables to predict high school academic success, he found, "a general consistency of higher relationships

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<sup>1</sup>Arwood S. Northby, "Sex Differences in High School Scholarship," School and Society, 86:63, January, 1958.

<sup>2</sup>Donald P. Hoyt, "Size of High School and College Grades," Personnel and Guidance Journal, 37:573, April, 1959.

<sup>3</sup>H. G. Seashore, "Women Are More Predictable Than Men," Journal of Counseling Psychology, 9:262, Fall, 1962.

<sup>4</sup>Ibid., p. 270.

<sup>5</sup>Ibid., p. 262.

(boys .310 to .657; girls .437 to .716) existing between the predictor test variables and criterion variable for girls than for boys."<sup>1</sup> In a more recent study, Boney found boys' grade-point average less predictable than that of girls.<sup>2</sup> Quite different results were reported in a study by Stinson and Morrison. They found a selected battery of tests, including some of the sub-tests of the Differential Aptitude Test, seemed to predict academic success or behavior for boys much better than for girls. Correlations from .30 to .68 for boys and .30 to .49 for girls were cited between the predictor variables and criterion.

Early studies of listening comprehension indicated that boys were better listeners than girls.<sup>3,4</sup> These studies were further supported in more recent years by Murphy,<sup>5</sup> who found consistently higher relationships for boys between listening comprehension, as measured by the Brown-Carlson Listening Comprehension Test, and high school grades in four major academic areas. The results of this investigation were:

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<sup>1</sup>James N. Jacobs, "Aptitude and Achievement Measures in Predicting High School Academic Success," Personnel and Guidance Journal, 37: 335, January, 1959.

<sup>2</sup>J. D. Boney, "Predicting the Academic Achievement of Secondary School Negro Students," Personnel and Guidance Journal, 44:702, April, 1966.

<sup>3</sup>Clyde Dow, "The Development of Listening Comprehension Tests For Michigan State College Freshmen," Speech Monographs, 2:120, June, 1953.

<sup>4</sup>John Caffrey, "Auding Ability at the Secondary Level," Education, 75:309, January, 1955.

<sup>5</sup>Wm. Carl Murphy, "A Study of Listening Ability and High School Grades in Four Major Academic Areas," Doctor's Thesis, Tuscaloosa: University of Alabama, Abstract: Dissertation Abstracts, 23:3693, 1963.



|   | <u>Boys</u> | <u>Girls</u> | <u>Total</u> |
|---|-------------|--------------|--------------|
| Listening Ability and English Grades        | .61         | .55          | .53          |
| Listening Ability and Social Science Grades | .52         | .38          | .41          |
| Listening Ability and Science Grades        | .57         | .55          | .52          |
| Listening Ability and Mathematics Grades    | .57         | .47          | .49          |

Brown, from his investigation, reported, "boys tend to listen better than girls."<sup>1</sup> Other studies disputed these findings: "Correlations of objective listening attention with sex tended to favor girls";<sup>2</sup> "There are no significant sex differences, although girls generally have higher relationships between reading and listening than do boys";<sup>3</sup> "Women scored significantly higher, on this test, than men. This is contrary to findings reported by other investigators who reveal a superiority of men over women";<sup>4</sup> "The performance of women was significantly superior to that of men in B-C Listening."<sup>5</sup>

Although there seemed to be a difference of opinion among the researchers as to which sex scored higher on aptitude and listening tests and as to which sex one is best able to make predictions of academic success, this emphasizes the need for control of sex differences

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<sup>1</sup> Charles T. Brown, "Three Studies of the Listening of Children," Speech Monographs, 32:137, June, 1965.

<sup>2</sup> Farrow, op. cit., p. 3146.

<sup>3</sup> Rose, op. cit., p. 2007.

<sup>4</sup> John Haberland, "Speaker Effectiveness and the Brown-Carlson Listening Test," School and Society, 86:199, April 26, 1958.

<sup>5</sup> Walter S. Friesen, "A Descriptive Study of Freshman Performance in English Composition I At Kansas State University, 1961, In Relation to Fifty-two Variables," Doctor's Thesis, Greeley: Colorado State College, Abstract: Dissertation Abstracts, 24:290, 1964.

in predicting academic success.

Literature on Non-intellectual Variables Used in Prediction of Academic Success

Even though the present study was limited to predicting academic success from test scores and sex differences some mention should be made of other variables often used by researchers in predicting academic success. These variables can be roughly grouped into two areas, personality factors and sociological determinants. An attempt to review the studies in this area would be exhaustive. A review of representative studies reported by Lavin in his evaluative survey of recent literature on determinants of academic achievement will suffice for this review.<sup>1</sup>

Personality Factors as Predictors. A number of studies were reported using personality measures as predictors. School achievement was associated to some degree with measures of: study habits, attitudes toward school, interests, achievement motivation, independence, anxiety, impulsivity, introversion, self image, adjustment, aggression, cognitive style, defensiveness, extrasensory perceptions, and various multivariant approaches. Most of these studies had yielded only slightly positive or inconclusive results. In most studies ability was controlled either by means of partial correlation analysis or by multiple correlation in which the contribution of a personality variable to a battery of intellectual factors is assessed. The result was rather low correlations (.29

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<sup>1</sup>Lavin, op. cit., pp. 64-149.

to .44) between personality characteristics and school success.

Although, two studies reported correlations as high as .63 and .80 using multiple variables.<sup>1</sup> Lavin concludes:

Essentially, we think that the literature presents a somewhat disappointing picture. Yet we do not conclude that personality variables are simply not very useful as predictors. The current disappointing state of affairs may be more a reflection upon how personality variables have been used rather than upon their absolute usefulness.<sup>2</sup>

Sociological Determinants as Predictors. Lavin's reports indicated school adjustment as a complex process, whereby individuals react to and are acted on by a number of complex forces and circumstances. School achievement was associated to some degree with such sociological determinants as: socioeconomic status, religious background, regional and rural-urban variation, high school size, academic load, age, broken homes, home conditions, extra class activities, irregular attendance, overemphasis on social life, school curriculums, place in the family, health, student-to-student relationship and student-teacher role expectations. The studies varied in their relationship with school success from virtually no relationship as in the case of school load to a high relationship in regards to socioeconomic status and academic performance. Positive relations were found between socioeconomic status and academic performance at all levels except the upper, where the relationships

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<sup>1</sup>Ibid., pp. 64-111.

<sup>2</sup>Ibid., p. 111.

became inverse.<sup>1</sup> Lavin concluded, "Socioeconomic status is a significant variable in the study of academic performance because it summarizes systematic variations in attitudes, motivations, and value systems that are related to such performance."<sup>2</sup>

#### Literature on Related Multiple Variable Studies Predicting High School Success

There have been literally thousands of studies regarding the prediction of academic prediction. These studies varied according to educational level, where we can distinguish between studies of performance in elementary, high school, college, and graduate school settings. The vast bulk of the studies dealt with prediction of college success. It is not practical to review all of the studies here, but representative studies, basically on the high school level, which illustrate the types of investigations that have been completed together with major findings will be reported.

Two studies showed that grade-point averages earned in elementary and junior high school were the best predictors of high school grade-point average. In an early study (1929), using junior high grade-point average and two intelligence tests, Howard found junior high grade-point average was the best predictor of grade-point average at Manhattan,

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<sup>1</sup>Ibid., pp. 122-150.

<sup>2</sup>Ibid., p. 128.

Kansas, High School.<sup>1</sup> Lewis reported generally increasing correlations from grade one to high school show an increasing relationship between pre-college and college achievement (first grade .05; eighth grade .49; high school .52). He concluded, "eighth grade and high school level GPA's are effective predictors of college GPA. Grade seven (.41) seems to be the transition grade that holds the most promise for the early identification of students with college potential."<sup>2</sup>

A high correlation (.66) between the Brown-Carlson Listening Comprehension Test and high school grade-point average was reported by Still, in a study in which he also used measures of intelligence and reading.<sup>3</sup> Boney found Negro and white secondary school students were equally predictable, when school marks were used as the criterion and mental ability and aptitude tests served as predictors.<sup>4</sup> Ewald, using only the sub-tests of the Differential Aptitude Test, reported "the part scores of the DAT obtained in the sophomore year of high school were good predictors of general scholastic success and success in specific

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<sup>1</sup>C. W. Howard, "The Prediction of High School Scholarship From Junior High School Grades and Mental Tests" (unpublished Master's thesis, Kansas State College, Manhattan, 1929), p. 32.

<sup>2</sup>William A. Lewis, "Early Prediction of College Grade-Point Average, Using Pre-College School Grades," Journal of Educational Measurement, 3:35, Spring, 1966.

<sup>3</sup>Dana S. Still, "The Relationships Between Listening Ability and High School Grades," Doctor's Thesis, Pittsburgh: University of Pittsburgh, Abstract: Dissertation Abstracts, 15:1761, 1955.

<sup>4</sup>Boney, op. cit., p. 703.

course areas.<sup>1</sup>

One of the most revealing studies in the literature was conducted by Brown. His findings included:

1. Watching television improves listening ability. (Mean listening score for children watching television was about twenty percent higher than for the nonviewers.)
2. Middle children in the family were not better listeners than older or younger brothers and sisters.
3. Children of small families were better listeners than those from large families.<sup>2</sup>

In another area of the study, Brown<sup>3</sup> correlated measures of listening, reading and intelligence with criteria of achievement test scores and teacher awarded grades. The results:

|   |      |
|---|------|
| Listening comprehension and achievement | .052 |
| Reading comprehension and achievement   | .413 |
| Intelligence and achievement            | .468 |
| Listening comprehension and grades      | .405 |
| Reading comprehension and grades        | .091 |
| Intelligence and grades                 | .395 |

From these results he hypothesized, "Asserting that the terms listening, reading and achievement are acceptable at face value, listening is more important than reading to scholastic achievement when the criterion is teacher grades, but reading is more important than listening to scholastic achievement when the criterion is the score on an achievement

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<sup>1</sup>Hattie Hoff Ewald, "The Relationship of Scores on the Differential Aptitude Test to Scholarship in High School," Doctor's Thesis, Vermillion: University of South Dakota, Abstract: Dissertation Abstracts, 22:800, 1961.

<sup>2</sup>Charles T. Brown, op. cit., p. 138.

<sup>3</sup>Ibid., p. 137.

test."<sup>1</sup>

Another investigator found that multidimensional tests of abilities do not necessarily predict most highly for the content areas in which they would be expected to predict. Wolking found the highest correlations were of the order of .50.<sup>2</sup> In predicting general academic success, Jacobs found, the Arithmetic Proficiency Test of the Metropolitan Achievement Tests proved to be the best predictor of total grade point average, while the Terman-McNemar Tests of Mental Ability (a verbal general intelligence test) was the best single predictor of the composite score of the Essential High School Content Battery (an achievement test). He also reported that differential aptitude measures were not superior to global ability measures for the prediction of grades in specific courses. He concluded, "For purposes of predicting high school academic success in the sample studied, the inclusion of four Differential Aptitude Tests, Verbal Reasoning, Numerical Ability, Mechanical Reasoning, and Language Usage, does not seem justified. The achievement and intelligence test (mentioned above) are more effective as predictors of academic success."<sup>3</sup>

Two recent studies using multiple variables should be mentioned. Van Pelt investigated six independent variables, creativity, IQ, a

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<sup>1</sup>Ibid., p. 138.

<sup>2</sup>William D. Wolking, "Predicting Academic Achievement with the Differential Aptitude and the Primary Mental Abilities Test," Journal of Applied Psychology, 39:118, February, 1955.

<sup>3</sup>Jacobs, op. cit., p. 341.

standardized achievement measure, self concept, chronological age, and sex as to their relationship with grade-point average. He reported, "Standardized achievement scores (California Achievement Test) and sex, in that order, are the independent variables reflecting the most consistent and substantial relationship to the criterion."<sup>1</sup> He also reported the least significant of the six variables were self concept and chronological age. The creativity test proved significant only in predicting for girls.<sup>2</sup> Tenopyr, using some of the sub-tests from the School and College Ability Tests and Sequential Tests of Educational Progress along with some measures of social intelligence, reported a multiple correlation of .72 for all tests and grade-point average. He found that social intelligence tests alone yielded only a moderate level of prediction of academic success, .45.<sup>3</sup>

A study to determine how the Scholastic Index of the Differential Aptitude Test, scores on the Iowa Silent Reading Test and Brown-Carlson Listening Comprehension Test, and the cumulative grade-point average could be used individually or in combination to predict the grade a student would receive if he were to take a first course in a foreign language at Manhattan, Kansas, High School was investigated by Crary. Using some of the same data and variables used in this study she

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<sup>1</sup>Newell Van Pelt, "Academic Achievement," Clearing House, 41:171, November, 1966.

<sup>2</sup>Ibid.

<sup>3</sup>M. L. Tenopyr, "Social Intelligence and Academic Success," Educational and Psychological Measurement, 27:65, Winter, 1967.



concluded,

. . . that cumulative grade-point average was a better predictor of grade in a first course in foreign language than was the result of any one of the three tests used. It was furthermore, determined that the use of test results with grade-point average in any combination would only slightly increase the accounted for variability in foreign language course grades. Therefore, cumulative grade-point average alone should be used to predict the grade in a first course in a foreign language.<sup>1</sup>

No mention is made in the study as to whether grade-point average is for junior high, high school or a cumulative grade point prior to enrollment in a first course in foreign language. One can only assume it was the latter.

In summary, the literature review highlights several relevant bits of information:

1. Grade-point average is a common criterion for measuring academic success.
2. Psychological tests of ability and achievement are related to academic success.
3. Listening, and reading comprehension tests measure different skills.
4. Failure to control for sex differences in studies of academic performance may lead to a number of difficulties.
5. More accurate predictions are made when these variables are used in combination, as in multiple regression studies.
6. Previous school academic record also forecasts high school grades. This may be due at least in part, to the fact that this variable probably reflects both scholastic ability and motivation to use that ability in academic undertakings.

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<sup>1</sup>Helen L. Crary, "A Study of Scholastic Aptitude, Reading and Listening Ability, and Grade-Point Average, as Predictors of Achievement in a First Course in Foreign Language" (unpublished Master's report, Kansas State University, Manhattan, 1964), p. 45.

7. Many factors, other than the intellectual ones noted above, are associated with academic success.

#### DESCRIPTION OF TESTS

"Basically, the function of psychological tests is to measure differences between individuals or between the reactions of the same individual on different occasions."<sup>1</sup> At present, schools are among the largest test users. Traxler lists ten uses of tests by local school districts:

1. To help board of education, school administrators, and teachers obtain a general picture of the intelligence or scholastic aptitude of the pupils in the local schools as compared with that of schools throughout the United States or region or state.
2. To help board of education, school administrators, and teachers with general information about the achievement of the pupils in the school as compared with achievement to be expected on the basis of scholastic aptitude.
3. To help classroom teachers know the level of ability and achievement of their different class groups.
4. To help teachers study the achievement of individual pupils in their classes in comparison with the scholastic aptitude of their pupils.
5. To help administrators and teachers appraise the ability of class groups and individuals in the tools of learning--reading, arithmetic, language usage, spelling, etc.
6. To help teachers and counselors understand pupils' interests.
7. To help enhance a school's understanding of its pupils' personal qualities or personality.
8. To help in the guidance of individual pupils toward educational and vocational goals.

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<sup>1</sup>Anastasi, op. cit., p. 3.

9. To help a school study changes in the ability and achievement of its pupils over a period of years.
10. To help in studying the development of individual pupils over a period of time.<sup>1</sup>

In the Manhattan, Kansas, High School, the results of four particular tests, on practically all of the students, are available for the use of school officials. These tests are the Brown-Carlson Listening Comprehension Test, the Differential Aptitude Tests, the Iowa Silent Reading Test, and the Science Research Associates Test of Educational Ability. These tests are administered in the tenth, eighth, ninth and tenth grades respectively. Transfer students and absentees may have taken the test at a different grade level. All of these tests are sold by reputable publishers and have been in use long enough that norms, validity and reliability have been established. Because of their availability and current use these tests were used in this study to predict academic success at Manhattan, Kansas, High School. A short description and evaluation of the tests follows.

#### Brown-Carlson Listening Comprehension Test

The Brown-Carlson Listening Comprehension Test was first published in 1953. The test was constructed to measure the ability of students to comprehend spoken language and has been used extensively to test large groups.<sup>2</sup> According to Lorge, "The test represents a first

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<sup>1</sup>A. E. Traxler, "Using Tests in Schools," American School Board Journal, 139:12, July, 1959.

<sup>2</sup>Brown and Carlson, op. cit., p. 1.

attempt at measuring an important educational objective and component of scholastic success, listening."<sup>1</sup>

What the test measures. This test attempts to measure listening comprehension. "By listening comprehension is meant the aural assimilation of spoken symbols in a face-to-face speaker-audience situation, with both oral and visual cues present."<sup>2</sup> Norms are provided for grades nine through college freshmen. The test, comprising seventy-six multiple choice items, measure, five important listening skills. They are:

1. Immediate Recall, which measures the ability to keep a sequence of details in mind, until a question is asked which requires thinking back over a sequence;
2. Following Directions, which measures the ability to follow oral directions;
3. Recognizing Transitions, which measures awareness of the function of transitional words and phrases within sentence contexts;
4. Recognizing Word Meanings, which measures the ability to recognize meanings of words from context;
5. Lecture Comprehension, which measures the ability to listen for details, get the central idea, draw inferences, understand the organization, and note degree of relevancy in a brief lecture presentation read by the examiner.<sup>3</sup>

This test also measures individual differences in listening ability.

Uses of the test. The Brown-Carlson Listening Comprehension Test

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<sup>1</sup>Irving Lorge, "Listening Comprehension," The Fifth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959), p. 652.

<sup>2</sup>Brown and Carlson, loc. cit.

<sup>3</sup>Ibid., p. 3.

may be used to diagnose learning difficulties of students, to measure his improvement in listening skills, or it may be used in the measurement of improvement in listening skills that may be attained through the use of various instructional procedures. The availability of a second equivalent form of the test enhances its usefulness for this purpose. The mere administration of the test is likely to awaken, in students, a recognition of the importance of listening skills and an understanding of the fact that people vary greatly in their listening ability. A comparison of a student's listening and reading comprehension scores should provide definite evidence of under-achievement in either of these two skills.<sup>1</sup>

Evaluation of the test. The test was administered for standardization purposes to approximately 8,000 students in twenty-five high schools from sixteen states, and to more than three hundred college freshmen.<sup>2</sup> Reviewers of the test have been, for the most part, very critical of the test. Lindquist states, "No satisfactory evidence of validity of the test, either in the form of a carefully developed rationale or of experimental data proving that the test measures anything not measured by a silent reading test, is found in the test manual."<sup>3</sup> Lorge felt the test manual should be revised to include more

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<sup>1</sup>Ibid., pp. 17-19.

<sup>2</sup>Ibid., p. 3.

<sup>3</sup>E. F. Lindquist, "Listening Comprehension," The Fifth Mental Measurement Yearbook. Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959), p. 651.

recent standardization data and generally supported Lindquist in his evaluation.<sup>1</sup> Kelley, in a study of the Brown-Carlson Listening Comprehension Test and the Sequential Test of Educational Progress: Listening, concluded, "The construct validity of each was questionable because the two tests failed to correlate significantly higher among themselves than with reading and intelligence tests."<sup>2</sup> Keller in partial support of the test stated, "Perfect reliability is not claimed for the test, but satisfactory correlations with several tests of mental maturity, intelligence, verbal skills, and mental ability appear to confirm its usefulness."<sup>3</sup> Other studies cited in the review of literature of this paper would support its usefulness.

Some studies cite disadvantages to administering the test.

"Because the test must be read to the student, variation from reader to reader affect the reliability of the results, and also the dependability of the norms."<sup>4</sup> Johnson and Frandsen found that this problem could be eliminated by pre-recording the test on standard audio tape. They also found that a video tape presentation did not alter the results to any extent.<sup>5</sup>

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<sup>1</sup>Lorge, loc. cit.

<sup>2</sup>Charles M. Kelley, "An Investigation of the Construct Validity of Two Commercially Published Listening Tests," Speech Monographs, 32: 43, June, 1965.

<sup>3</sup>Keller, op. cit., p. 32.

<sup>4</sup>Lorge, loc. cit.

<sup>5</sup>F. Craig Johnson and Kenneth Frandsen, "Administering the Brown-Carlson Listening Comprehension Test," Journal of Communication, 13:45, March, 1963.

At Manhattan, Kansas, High School the test is administered to all students at the same time, over the public address system. The students are located in several rooms, throughout the building, thus, minimizing the number of students in each room, yet standardizing the oral presentation.

#### Differential Aptitude Tests

The Differential Aptitude Tests were developed as an integrated battery of aptitude tests. The battery includes eight tests. The standardization of all eight tests is based on a single population.<sup>1</sup> For this study only the index score will be used. This score is obtained by summing the Verbal Reasoning and Numerical Ability scores.

#### What the Verbal Reasoning and Numerical Ability Tests measure.

The Verbal Reasoning test is a measure of ability to understand concepts framed in words. The Numerical Ability test is a measure of the student's ability to reason with numbers, to manipulate numerical relationships and to deal intelligently with quantitative materials. The two sub-tests team as a measure of general learning ability.<sup>2</sup> This index score is the equivalent in meaning of "mental ability" scores on most traditional group tests of "intelligence."<sup>3</sup> Blosser found practically

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<sup>1</sup>George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Differential Aptitude Tests Manual (third edition; New York: The Psychological Corporation, 1959), p. 3.

<sup>2</sup>Ibid., p. 6.

<sup>3</sup>Ibid., p. 77.

no difference between two group intelligence tests (Otis and Henman-Nelson) and the Differential Aptitude Tests - VR+NA, for screening ninth grade students for identification as gifted students.<sup>1</sup>

Uses for the index score. The primary use of the index score for this study was as an "intelligence test"; however, the index score has many other applications. The index score is commonly used as a predictor of future academic performance. The counselor can use the index score to guide the student into a desirable course of study, and to provide the student with a basis for comparing his present abilities with those of his peers. Administrators and counselors are using the index score for educational selection and placement. A summary measurement of scholastic ability of the students may aid the curriculum specialist in deciding what level courses should be offered by the school. As pointed out by Frederikson, "There is ample evidence of the usefulness of Differential Aptitude Test scores in a wide variety of situations."<sup>2</sup>

Evaluation of the Differential Aptitude Tests. The norms published in the Differential Aptitude Test Manual were based on over 47,000 pupils in grades eight through twelve from communities throughout

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<sup>1</sup>George H. Blosser, "Group Intelligence Tests as Screening Devices in Locating Gifted and Superior Students in the Ninth Grade," Exceptional Children, 29:286, February, 1963.

<sup>2</sup>Norman Frederiksen, "Differential Aptitude Tests," The Fifth Mental Measurements Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959, p. 673.



the country.<sup>1</sup> The reviews of the Differential Aptitude Test are, for the most part, very complimentary.

Carroll stated that the test is the product of careful scientific research in test construction, norming, and validation. He was very complimentary of the test manual and commended the publishers for its organization, comprehensiveness, and clarity. He concluded,

At the present time it can be said that considering the tests themselves and all the supporting data, the DAT constitutes the best available foundation battery for measuring the chief intellectual abilities and learned skills which one needs to take account of in high school counseling.<sup>2</sup>

Frederiksen added, "This reviewer does not hesitate to recommend the Differential Aptitude Tests for use in testing programs at the secondary school level."<sup>3</sup> Schutz, in a more recent appraising, stated, "From a relative point of view this is the best we can currently offer; no alternative procedures of any sort which possess greater utility can be suggested at the present time."<sup>4</sup>

The only criticisms of this test seems to be rather insignificant. One was that the authors were more interested in obtaining a

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<sup>1</sup> Bennett, Seashore, and Wesman, op. cit., p. 4.

<sup>2</sup> John B. Carroll, "Differential Aptitude Tests," The Fifth Mental Measurements Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959, p. 673.

<sup>3</sup> Frederiksen, op. cit., p. 676.

<sup>4</sup> Richard E. Schutz, "Differential Aptitude Tests," The Sixth Mental Measurements Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 1005.

valid test than they were in obtaining a test of "pure" factors of ability.<sup>1</sup> The other was that no multiple correlation results were given in the manual.<sup>2</sup>

### Iowa Silent Reading Test

The Iowa Silent Reading Test is a diagnostic reading test designed to measure a wide range of skills necessary for effective reading. Diagnostic tests in reading vary widely in the thoroughness of analysis they permit and in the specific procedures followed. They range from group tests to intensive clinical programs for individual case studies. The Iowa Silent Reading Test is an example of a relatively short and widely used group test.<sup>3</sup>

What the test measures. The Iowa Silent Reading Advanced Test is designed to measure economically, accurately, and reliably the proficiency of pupils in high school and junior college in doing silent reading of the work-study type.<sup>4</sup> The test is designed to cover a wide range of the skills known to be necessary for effective reading of the work-study type. The test measures three broad general areas of silent reading abilities. These are Rate of Reading at a Controlled Level of

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<sup>1</sup>Frederiksen, loc. cit.

<sup>2</sup>Carroll, loc. cit.

<sup>3</sup>Anastasi, op. cit., p. 462.

<sup>4</sup>H. A. Greene, A. N. Jorgensen, and V. H. Kelley, Iowa Silent Reading Tests, New Edition, Advanced Test: Manual of Directions (New York: World Book Company, 1943), p. 1.

of Comprehension; Comprehension of Words, Poetry, Sentences, Paragraphs, and Longer Articles; and Ability to Use Skills Required in Locating Information.<sup>1</sup>

Uses of the test. The test can be used in class to provide the teacher with a rather exact estimate of the level of development of a number of important elements of silent reading abilities in the class, as well as with specific information in certain important skill areas concerning the limitations of the individuals comprising the class. By comparing the class results with norms, a clear idea of the general ability of the class in silent reading of the work-study type can be obtained. The test can be used to diagnose the students' weaknesses and strengths by analyzing the sub-test scores. The test has also proved very valuable for grouping pupils or classes for instructional purposes.<sup>2</sup>

Evaluation of the test. The test was standardized on a population of over 10,000 high school students and college freshmen, and then checked against an additional population of over 18,000.<sup>3</sup> The population was distributed geographically over seventeen communities in eleven states. The communities were chosen at each grade level to yield an average of 100 IQ on the Terman-McNemar Test of Mental Ability.<sup>4</sup>

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<sup>1</sup>Ibid., p. 2.

<sup>2</sup>Ibid.

<sup>3</sup>Ibid., p. 13.

<sup>4</sup>Ibid., p. 6.

The test has not been revised since 1943, leading to this critical review by Jones:

Upon examination it soon becomes evident that some of the paragraphs and statements used in the tests contain informational material which is considerably outdated. It is felt that the paragraph comprehension sub-tests are somewhat jumbled, and the sentence meaning sub-tests contain too many specific determiners which tend to give away the correct answers. Because of the limitations and weaknesses mentioned, it is the opinion of this reviewer that the Iowa Silent Reading Tests should not be used unless they are thoroughly revised.<sup>1</sup>

#### SRA Tests of Educational Ability

The SRA Tests of Educational Ability (TEA) are designed to provide measures of aptitude for school work. Their major purpose is to estimate scholastic ability in order to provide the teacher and guidance director with a basis for judging the student's potentiality for success in school.<sup>2</sup>

What the test measures. The SRA Tests of Educational Ability for grades nine to twelve provide three part scores and a total score. The part scores were selected on the basis of a variety of studies to establish the kinds of aptitude measures that provide predictions of success in high school work. The three part scores are:

1. Language, composed of Vocabulary items and Word-grouping items. In the preparation of the items for the vocabulary type of

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<sup>1</sup>Worth R. Jones, "Iowa Silent Reading Tests," The Sixth Mental Measurements Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 1070.

<sup>2</sup>Science Research Associates, Manual of Instruction for the SRA Tests of Educational Ability (Chicago: Science Research Associates, Inc., 1965), p. 2.

measure effort was made to attain a high degree of difficulty without including rare or specialized vocabulary. The word grouping type of measure was designed to measure verbal reasoning rather than vocabulary.

2. Reasoning, designed to measure abstract reasoning.
3. Quantitative, composed of number-judgment items. In the preparation of these items, the authors attempted to formulate questions that would measure a "feel for numbers and numerical systems" rather than specific computational skills.<sup>1</sup>

Scores from the three aptitude measures are combined to obtain the Total Score. The Total Score is then converted to an IQ score and a percentile score. The Total Score is probably the most important result of TEA testing. The TEA Total Score correlates highly (between .65 and .80) with single score IQ tests, with high school grade averages (.69 to .73), and with general tests of educational achievement.<sup>2</sup>

Uses of the Test. There are many important uses of the TEA Total Score in the high school program. It may be used to identify students of superior talent for enrichment programs and students of low educational ability for slow learner programs. It may be used to obtain the mean IQ for each year's entering class. It may be used to identify students who are poorly motivated. The Total Score may provide a starting point for discussion with students and parents about students' future academic plans. The major use of the Total Score is to estimate scholastic ability.<sup>3</sup>

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<sup>1</sup> Ibid., p. 4.

<sup>2</sup> Ibid., p. 2.

<sup>3</sup> Ibid.

Evaluation of the test. Score standards for the TEA grades nine to twelve were derived by means of an equi-percentile equating of TEA raw scores to the 1957 revised norms for the Iowa Tests of Educational Development. The choice of this particular approach was determined largely because the TEA and the ITED are substantially related (.61 and .71), and the recency of the standardization of the ITED and the care with which it was executed.<sup>1</sup> A later nation-wide standardization program was conducted in April, 1962. A total of 20,338 students in sixty-four schools were tested. Every region of the country was included in this sample.<sup>2</sup>

Most reviews of the test are favorable. Fishman stated, "The TEA seems to be a quite adequate instrument for estimating current academic ability of a global nature."<sup>3</sup> Ahmann supported this evaluation, "There is much to recommend these tests, provided the need of the individual selecting the tests is for a single score representing scholastic aptitude."<sup>4</sup> Horrocks adds, "In general, while the TEA represents nothing new in intelligence testing it is a good example of its type and should

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<sup>1</sup>Science Research Associates, SRA Tests of Educational Development Technical Supplement (Chicago: Science Research Associates, Inc., 1958), p. 12.

<sup>2</sup>Science Research Associates Manual of Instruction, op. cit., p. 41.

<sup>3</sup>Joshua A. Fishman, "Tests of Educational Ability," The Fifth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959), p. 510.

<sup>4</sup>J. Stanley Ahmann, "Tests of Educational Ability," The Sixth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 773.

prove as satisfactory as any other available group measure of general intelligence.<sup>1</sup>

The main criticism of the test dealt mainly with the validity, reliability, and especially the standardization procedures followed by the authors.<sup>2</sup> The 1962 standardization seems to answer most of these criticisms.

#### American College Testing Program

Inaugurated in 1959, the principal function of the American College Testing Program is to "transmit timely information that is especially relevant to the student, his high school, and his college during the transition from secondary to higher education."<sup>3</sup>

The American College Testing Program's student assessment program uses four tests of educational development and academic potential, a set of self-reported high school grades, and a student information blank. The tests and grade reports provide information on the student's potential for academic achievement in various areas. The information blank provides information about his background, special needs, and potential for achievement in non-academic areas. The only part of the program

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<sup>1</sup>John E. Horrocks, "Tests of Educational Ability," The Sixth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), p. 774.

<sup>2</sup>William B. Michael, "Tests of Educational Ability," The Fifth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1959), p. 512.

<sup>3</sup>American College Testing Program Technical Report (1965 edition; Iowa City, Iowa: ACT Publications, 1965), p. 1.

used for this study was the four tests of educational development and academic potential.<sup>1</sup>

What the test measures. The American College Testing Programs Examination is designed to measure as directly as possible the degree to which each student has developed the general skills and abilities needed for success in college work.<sup>2</sup> The four sub-tests are:

1. English usage, which measures the student's understanding and use of the basic elements in correct and effective writing.
2. Mathematics usage, which measures the student's mathematical reasoning ability. It emphasizes the solving of practical quantitative problems which are encountered in many college curricula.
3. Social studies reading, which measures the evaluative reasoning and problem-solving skills required in the social studies.
4. Natural sciences reading, which measures the critical reasoning and problem-solving skills required in the natural sciences.<sup>3</sup>

Uses of the test. The basic uses of the American College Testing Program Examination are threefold.<sup>4</sup>

1. To identify differential abilities before leaving high school, in order to help the student develop plans which take these special characteristics into account, or help the student change (overcome deficiencies, develop strong points).

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<sup>1</sup>Ibid., p. 2.

<sup>2</sup>Ibid., p. 5.

<sup>3</sup>Ibid., pp. 2-3.

<sup>4</sup>The uses listed in this section apply to the results of the test as used by the student and secondary school counselors. There are many other uses of the program on the college level.



2. To estimate potential for success at specific colleges, so that students will be able to make wiser college choices.
3. To judge appropriateness of educational and vocational plans, so that the student makes educational and vocational plans which are realistic.<sup>1</sup>

In this study the American College Testing Program Examination was used as a criterion of academic success. In this sense, we are using the composite standard score as a measure of achievement. There is some question as to whether the examination is an achievement test. The following statements are listed in support of this use. Oscar K. Buros lists the test in the achievement test section of the Sixth Mental Measurement Yearbook.<sup>2</sup> The ACT technical report stated:

The ACT tests are oriented toward major areas of college and high school instructional programs rather than toward a factorial definition of various aspects of intelligence. Thus the scores have a direct and obvious relation to the student's educational progress, and a meaning that can be readily grasped by both the instructional staff and the student.<sup>3</sup>

Engelhart said of the test:

Tests of this character do place a high definite premium on the possession of a rich store of knowledge, but they do so indirectly rather than directly. The tests are not constructed to measure the acquisition of subject matter content per se. The questions do not call directly for specific information. Rather, they test the student's ability to use whatever knowledge he possesses in the solution of complex problems. . . . Subject

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<sup>1</sup>Using ACT in Secondary Schools, "A Handbook for Counselors" (Iowa City, Iowa: ACT Publications, 1967), pp. 17-21.

<sup>2</sup>Oscar K. Buros (ed.), The Sixth Mental Measurement Yearbook (Highland Park, New Jersey: The Gryphon Press, 1965), p. 1.

<sup>3</sup>American College Testing Program Technical Report, op. cit., p. 5.

matter knowledge is measured by the ACT tests to the extent that it can be measured for students of varied high school learning experiences.<sup>1</sup>

Whether or not the tests should be classified as measures of achievement, aptitude, or developed ability is an academic question. In terms of construction, the tests are simply measures of academic potential which rely partly on a student's innate abilities and partly on his current knowledge, but which emphasizes his ability to use both.<sup>2</sup>

Evaluation of the test. The test was originally standardized by the equi-percentile method of equating, with the Iowa Test of Educational Development in 1959. Each year since 1959 a check has been made of the ACT-ITED equating on the basis of the test results for all Iowa twelfth-grade students who took both the current form of the ACT and the ITED. After the 1962 ITED national standardization program, the new norms were adopted as national twelfth-grade norms for the ACT tests.<sup>3</sup>

Reviews of the American College Testing Program are for the most part good. In general they state the program offers a secure college admission testing service, based on well-conceived and well built tests. The test content is excellent and the composite score is predictive of college achievement. They give high acclaim to the efficient score

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<sup>1</sup>Max D. Engelhart, "American College Testing Program," The Sixth Mental Measurement Yearbook, Oscar Krisen Burros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), pp. 2-3.

<sup>2</sup>American College Testing Program Technical Report, op. cit., p. 5.

<sup>3</sup>Ibid., pp. 35-37.

reporting service. The main criticism is that even though the tests are logically designed, they do not justify the claim of differential prediction.<sup>1,2</sup>

## METHODS AND PROCEDURES

### Data

Permission to copy test results and grade-point averages from the records in the Manhattan, Kansas, High School was obtained from the school administrators. The following data were copied from the records for all students of the graduating classes of 1965, 1966, and 1967.

Index score from the Differential Aptitude Test

Test score from the Iowa Silent Reading Test

Listening Comprehension Test

Test score from the SRA Test of Educational Ability

Composite score from the American College Testing

Program Examination

Cumulative grade-point average.

All test scores were total test scores with the exception of the Scholastic Index score from the Differential Aptitude Test. The Scholastic Index score is the sum of two of the sub-test scores, Verbal Reasoning and Numerical Ability. All test scores were in percentiles

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<sup>1</sup>Engelhart, op. cit., pp. 2-7.

<sup>2</sup>Warren G. Findley, "American College Testing Program," The Sixth Mental Measurement Yearbook, Oscar Krisen Buros, Editor (Highland Park, New Jersey: The Gryphon Press, 1965), pp. 7-10.

except the ACT composite score which was in the form of a standard score. Cumulative grade-point average, as used at Manhattan High School, is defined in the definition of terms section of this paper.

Whether percentile scores would be appropriate for the statistical measures used in this study was questioned by the investigator. Anastasi and others have questioned the use of percentiles for the computation of means, standard deviations and other statistical measures.<sup>1</sup> However, Dr. Arthur Dayton of the Department of Statistics and Computer Science at Kansas State University, stated that "percentile scores would be appropriate for use in the statistical analysis employed in this paper." He also stated that the central limit theorem (as the sample size increases without limit, the distribution of the sample means approaches a normal distribution)<sup>2</sup> would be applicable in this study. From a practical point of view, the percentile scores are readily understood, even by relatively untrained persons. Most standardized test scores, used in schools, are recorded in percentiles. They would therefore be available for easy application to the regression formulas, developed in this study, by teachers, counselors, and administrators. With this rationale in mind, it was decided to use the percentile scores from the standardized tests as the independent variables.

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<sup>1</sup>Anastasi, op. cit., pp. 86-90.

<sup>2</sup>A. Huntsberger, Elements of Statistical Inference (Boston: Allyn and Bacon, 1967), p. 147.

### Samples

The samples used as the basis for this study were taken from the graduating classes of Manhattan, Kansas, High School for the years 1965, 1966, 1967, and 1968. Four sample groups were used in the study. These samples were termed (1) original total, (2) original with ACT, (3) original without ACT and (4) cross validation.

The original total sample (Group I) consisted of all students in the graduating classes of 1965, 1966, and 1967, who had all four predictor test scores. Because all students did not take the American College Testing Program Examination, the original ACT sample consisted of those students from the original total sample with ACT scores (Group II). The original without ACT sample were the remaining students of the original total sample (Group III). A complete breakdown of the three original samples, by graduating classes, is shown in Table I.

TABLE I  
NUMBERS AND PERCENTAGES OF STUDENTS AT MANHATTAN HIGH SCHOOL  
WHO MADE UP THE ORIGINAL SAMPLE POPULATIONS

| Year  | Total number<br>of graduates | Group<br>I | Percent | Group<br>II | Percent | Group<br>III | Percent |
|-------|------------------------------|------------|---------|-------------|---------|--------------|---------|
| 1965  | 338                          | 232        | 69      | 135         | 58      | 97           | 42      |
| 1966  | 304                          | 224        | 74      | 143         | 64      | 81           | 36      |
| 1967  | 320                          | 239        | 75      | 147         | 62      | 92           | 38      |
| Total | 962                          | 695        | 72      | 425         | 61      | 270          | 39      |

The original total sample (Group I) consisted of 695 graduates or seventy-two percent of the total graduates for the years 1965, 1966 and 1967. The original with ACT scores sample (Group II) consisted of 425 graduates or sixty-one percent of the original total sample. The original without ACT scores sample (Group III) consisted of 270 graduates or thirty-nine percent of the original total sample.

The cross validation sample consisted of twenty-five students, selected at random through the use of a table of random numbers, who met the criteria (four test scores and grade-point average), from the class of 1968. Of the twenty-five, fourteen had ACT scores or fifty-six percent. A  $t$  test indicated there was no significant difference at the .05 level between the mean grade-point average of the cross-validation sample and the mean grade-point average of the class of 1968, and there was no significant difference at the .05 level between the mean ACT composite score of the cross-validation sample and the mean ACT composite score of the class of 1968.

#### Method of Treatment of the Data

The first part of the study determined by means of correlation technique, the interrelationship among the four test variables and their respective relationship with school academic success. The purpose of this part of the study was to evaluate the tests currently being employed at Manhattan High School as they relate to academic success. The four tests to be evaluated were: (1) Scholastic Index of the Differential Aptitude Test, (2) Iowa Silent Reading Test, (3) Brown-Carlson Listening Comprehension Test, (4) SRA Test of Educational Ability.

Pearson product-moment Correlations are shown in Table III.

The second part of the study was to predict academic success. Five different predictor variables were used. These variables represented quantified information about the student, normally available to teachers, counselors, and administrators at Manhattan High School, during the first year of high school. The five variables included the four test scores mentioned above and sex. The criterion was school academic success, as signified by cumulative grade-point average or a twelfth grade achievement test score (American College Testing Program Examination).

The essential statistical tool was the multiple-regression analysis. The multiple-regression analysis weights each variable in terms of its importance in making the desired prediction. The scores each student received on the prediction variables are placed in the formula and a prediction on the student's behavior can be calculated.<sup>1</sup>

In this analysis, weighted numerical values were determined for each of the predictor variables, for Groups I and II separately. These weights were used to develop two equations, one for each group.

After the equations had been developed from the original samples, scores of the cross-validation sample were fitted into them. By this process, statistical predictions were made as to the students expected grade-point average and expected composite score on the American College Testing Program Examination. Comparisons were then made between his

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<sup>1</sup>Walter R. Borg, Educational Research An Introduction (New York: David McKay Company, Inc., 1965), p. 161.

- (1) actual grade-point average and predicted grade-point average,
- (2) actual ACT examination score and predicted ACT examination score.

### Statistical Analysis and Results

Means. Initial inspection of the variables for each of the three original samples (Groups I, II, III) indicated a definite pattern of means. These mean scores are shown in Table II.

It can easily be seen that mean scores for Group II were the highest, whereas mean scores for Group III were the lowest on all variables. This was to be expected, as most of the students taking the ACT examination were college bound students. Assuming the college bound students are higher achievers than the average student, this then would explain the higher mean scores on the predictor variables for Group II. This difference probably would be greater except for two points:

(1) Manhattan, Kansas is a college town and a high percentage of students attend the university. (2) Several college bound students did not take the ACT examination as they were planning to attend colleges that do not require the ACT examination. The general conclusion reached by the study of the mean scores was that Group II was a selective group of higher ranking students than is Group I.

Standard deviations. A study of the standard deviations showed less variation from the mean scores in Group II, and the highest variation was found in Group III. As Group II was a more selective group, this would be expected.

In comparing the original groups (I and II) with the cross-



validation sample it can be seen from Table II that there was no stable pattern of means. A  $t$  test was used to see if there was significant difference between the means of the criteria measures of the original groups (I and II) and the means of the cross-validation groups. There was no significant difference at the .05 level between Group I mean grade-point average and the cross-validation group mean grade-point average. There was a significant difference at the .05 level between

TABLE II

THE MEAN AND STANDARD DEVIATIONS OF THE PREDICTOR VARIABLES\* AND CRITERIA FOR EACH OF THE FOUR SAMPLE GROUPS

| Group            | N.  | Sex | S.I. of<br>DAT | ISR     | BC      | TEA     | GPA     | ACT            |
|------------------|-----|-----|----------------|---------|---------|---------|---------|----------------|
| 1                | 695 | m   | 0.52           | 66.98   | 57.56   | 67.46   | 69.22   | 2.69           |
|                  |     | sd  | (0.50)         | (26.94) | (29.95) | (26.97) | (25.04) | (0.71)         |
| 2                | 425 | m   | 0.50           | 76.81   | 67.48   | 76.78   | 78.73   | 2.98           |
|                  |     | sd  | (0.50)         | (20.69) | (26.03) | (20.99) | (18.69) | (0.61) ( 4.79) |
| 3                | 270 | m   | 0.54           | 51.52   | 41.96   | 52.81   | 54.26   | 2.22           |
|                  |     | sd  | (0.50)         | (28.37) | (29.10) | (28.80) | (26.45) | (0.68)         |
| C.V.S.**         | 25  | m   | 0.44           | 60.12   | 61.32   | 59.84   | 71.60   | 2.59           |
|                  |     | sd  | (0.83)         | (30.59) | (26.69) | (26.67) | (24.30) | (0.70) ( 5.20) |
| Class<br>of 1968 | 319 | m   | -              | -       | -       | -       | -       | 2.65           |
|                  |     | sd  | -              | -       | -       | -       | -       | (0.72) ( 4.90) |

\*\* Cross-Validation Sample

\* Scholastic Index of Differential Aptitude Test  
Iowa Silent Reading Test  
Brown-Carlson Listening Test  
Test of Educational Ability  
Grade-Point Average  
American College Testing Program Examination

Group II ACT composite score and the cross-validation group ACT composite score. One can conclude: (1) There is no significant difference at the .05 level, in regard to mean grade-point average between the cross-validation sample and the original sample, Group I. (2) There is a significant difference at the .05 level, in regards to mean ACT composite scores, between the cross-validation sample and the original sample, Group II.

Correlations. Table III summarizes the product moment correlations of the predictor variables for Groups I and II. A study of the table revealed the following:

1. Correlations existing between some of the variables are quite high. For example the correlations for the TEA and the other three test variables range from .75 to .82 in Group I, and from .64 to .76 in Group II. The correlations between the Scholastic Index of the DAT and the other three test variables, from .72 to .82 for Group I and from .61 to .76 for Group II.
2. A particularly high correlation is shown between the two tests that correlate high with intelligence, the Scholastic Index and TEA, .82 for Group I and .76 for Group II.
3. The relationship between reading and listening was the lowest in each group (.58 in Group II and .68 in Group I).
4. The relationships between listening and intelligence as measured by the TEA and intelligence as measured by the Scholastic Index of the DAT were approximately the same for

Groups I and II (Group I, .75 and .73 respectively for the two tests; and Group II, .64 and .62 respectively for the two tests).

5. Correlations were higher in Group I than correlations in Group II.
6. Girls' scores on the listening test were slightly higher than boys', but not enough to be significant at the .05 level.

These correlations substantiate findings of previous studies. Despite these high correlations, all test variables were used in the second part of the study because their effect as predictor variables was not known.

TABLE III  
PRODUCT MOMENT CORRELATION COEFFICIENTS\* FOR THE  
FIVE PREDICTOR VARIABLES\*\*

|                | X <sub>1</sub> | X <sub>2</sub> | X <sub>3</sub> | X <sub>4</sub> | X <sub>5</sub> |
|----------------|----------------|----------------|----------------|----------------|----------------|
| X <sub>1</sub> | --             | -.001          | -.117          | -.068          | -.060          |
| X <sub>2</sub> | .050           | --             | .72            | .73            | .82            |
| X <sub>3</sub> | -.103          | .61            | --             | .68            | .77            |
| X <sub>4</sub> | -.067          | .62            | .58            | --             | .75            |
| X <sub>5</sub> | .017           | .76            | .69            | .64            | --             |

\*Correlations above the diagonal are for subjects in Group I (N=695); those below the diagonal are for subjects in Group II (N=425).

\*\*X<sub>1</sub>--Sex; X<sub>2</sub>--DAT Index of Scholastic Aptitude; X<sub>3</sub>--Iowa Silent Reading; X<sub>4</sub>--Brown-Carlson Listening; X<sub>5</sub>--Test of Educational Ability.

Coefficients of correlations between the four test variables and the two criteria measures are shown in Tables IV and V.

It may be observed, in Table IV, that the coefficient of correlation,  $r$ , for Scholastic Index results and grade-point average is 0.68. The coefficient of determination,  $r^2$ , is 0.46. Considering grade-point average to be the dependent variable, one could say that the Scholastic Index results explains  $r^2$  percent, 46 percent, of the variation in grade-point average. It follows that  $(1-r^2)$  percent, 54 percent, of the variation in grade-point average is not explained by Scholastic Index results. Only one test (TEA, Table V) accounts for over half (52 percent) of the variation in either of the criteria measures.

TABLE IV  
COEFFICIENTS OF CORRELATION AND COEFFICIENTS OF DETERMINATION  
FOR GRADE-POINT AVERAGE (N=695)

| Variables                           | $r$ | $r^2$ |
|-------------------------------------|-----|-------|
| Scholastic Index (Dat) and GPA      | .68 | .46   |
| Iowa Silent Reading and GPA         | .67 | .45   |
| Brown-Carlsen Listening and GPA     | .66 | .44   |
| Test of Educational Ability and GPA | .67 | .45   |

TABLE V  
COEFFICIENTS OF CORRELATION AND COEFFICIENTS OF DETERMINATION  
FOR ACT COMPOSITE SCORE (N=425)

| Variables                                 | r   | $r^2$ |
|---|-----|-------|
| Scholastic Index (DAT) and ACT score      | .71 | .50   |
| Iowa Silent Reading and ACT score         | .65 | .42   |
| Brown-Carlson Listening and ACT score     | .66 | .44   |
| Test of Educational Ability and ACT score | .72 | .52   |

Regression equations. The second part of the study was to develop two multiple-regression equations, which would combine the predictive value of the five variables to predict respectively cumulative grade-point average and ACT examination composite score. Table VI shows the five independent variables added stepwise by contribution, with grade-point average as the dependent variable.

It may be observed, in Table VI, that the contribution to  $R^2$  by the Scholastic Index and grade-point average is 0.469. This means that the Scholastic Index explains 46.9 percent of the variation in grade-point average.

The second row of the table shows the added contribution to  $R^2$  by the Iowa Silent Reading Test, 0.065. This amount combined with the contribution of the Scholastic Index gives an  $R^2$  of 0.534. Meaning that the two tests take care of 53.4 percent of the variation in grade-point average.

Observing the fifth row of Table VI, it can be seen that the five

independent variables give a combined  $R^2$  of 0.583. Meaning that all five independent variables when combined, account for 58.3 percent of the variation in grade-point average.

TABLE VI  
CONTRIBUTION OF THE INDEPENDENT VARIABLES--GRADE-POINT  
AVERAGE AS THE DEPENDENT VARIABLE

| Variable        | Contribution<br>to R-Squared | R-Squared | D.F.  | F      | Significance |
|-----------------|------------------------------|-----------|-------|--------|--------------|
| S.I. of D.A.T.* | .469                         | .469      | 1,693 | 612.13 | .01          |
| I.S.R.          | .065                         | .534      | 1,692 | 95.98  | .01          |
| Sex             | .027                         | .561      | 1,691 | 43.25  | .01          |
| B.C.            | .021                         | .582      | 1,690 | 34.73  | .01          |
| T.E.A.          | .001                         | .583      | 1,689 | 1.79   | n.s.         |

\* For explanation of abbreviations see Table IV.

Values of F are given in the fifth column. The first F-value is used to determine whether the coefficient of correlation ( $R^2$ ) of the first independent variable with the dependent variable is significantly greater than zero. The following F-values are given so that it may be determined whether the additional explained variation attributable to an added independent variable is significant. The degrees of freedom to be used with the F-values are given in the fourth column. The sixth column

gives the significance of the F-value at the .01 level of confidence. When the F-values indicate that the probability is as great as ten percent that the added variable actually contributes nothing to the explained variation, but is in fact due only to chance variation in the data, the letters n.s. appear in the sixth column.

The first four independent variables are all significant at the .01 level of confidence. The fifth independent variable (Test of Educational Ability) is not significant and should not be included in the multiple-regression formula for predicting grade-point average when the other four predictor test variables are used.

Table VII shows the five independent variables added stepwise by contribution with ACT examination composite score as the dependent variable. All five of the independent variables are significant at the .01 level of confidence, and should be included in the formula for predicting ACT composite scores. The five independent variables when combined, account for 65.9 percent of the variation in ACT examination composite scores.

The prediction equation was  $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$  where Y is a computed value of the dependent variable; where a is a constant,  $b_1, b_2, b_3, b_4, b_5$  are regression coefficients,  $X_1, X_2, X_3, X_4, X_5$  are the independent variables. It should be noted that the regression coefficients are represented in the equation by an abbreviated notation. Thus, to write  $b_1$  in full we should write  $b_{y1.2345}$  showing that this is a regression coefficient for Y and  $X_1$ , with the

TABLE VII  
CONTRIBUTION OF THE INDEPENDENT VARIABLES—A.C.T. EXAMINATION  
COMPOSITE SCORE AS THE DEPENDENT VARIABLE

| Variable       | Contribution<br>to R-Squared | R-Squared | D.F.  | F      | Significance |
|----------------|------------------------------|-----------|-------|--------|--------------|
| T.E.A.*        | .524                         | .524      | 1,423 | 466.25 | .01          |
| B.C.           | .067                         | .591      | 1,422 | 69.98  | .01          |
| S.I. of D.A.T. | .032                         | .623      | 1,421 | 35.45  | .01          |
| I.S.R.         | .016                         | .639      | 1,420 | 18.28  | .01          |
| SEX            | .020                         | .659      | 1,419 | 24.18  | .01          |

\*For explanation of the abbreviations see Table II.

variables  $X_2$ ,  $X_3$ ,  $X_4$ ,  $X_5$  held constant.<sup>1</sup>

The weights or regression coefficients (b) as developed for Groups I and II are shown in Tables VIII and IX.

It may be observed in Table VIII, that the regression coefficient for the Scholastic Index and grade-point average is 0.008. This means that 0.008 is the weight to be multiplied with the individuals' Scholastic Index score to give one component of the prediction equation. Column three shows the standard deviations of the regression coefficients. Column five shows the t-values. The t-values can be used to determine

<sup>1</sup>Cyril H. Goulden, Methods of Statistical Analysis (second edition; New York: John Wiley and Sons, Inc., 1952), p. 135.



whether the regression coefficient of the first independent variable with the dependent variable is significantly different than zero. Column four shows the degrees of freedom to be used with the t-values.

TABLE VIII  
INDEPENDENT VARIABLE REGRESSION COEFFICIENTS (WEIGHTS)—  
GRADE-POINT AVERAGE THE DEPENDENT VARIABLE

| Variable         | Regression coefficient (b) | Standard deviation of b | D.F. | t     | Significance |
|------------------|----------------------------|-------------------------|------|-------|--------------|
| S.I. of D.A.T. * | .008                       | .001                    | 689  | 6.66  | .001         |
| I.S.R.           | .005                       | .001                    | 689  | 5.77  | .001         |
| SEX              | -.226                      | .035                    | 689  | -6.42 | .001         |
| B.C.             | .006                       | .001                    | 689  | 5.29  | .001         |
| T.E.A.           | .002                       | .001                    | 689  | 1.34  | n.s.         |
| Intercept **     | 1.444                      | .142                    | —    | —     | —            |

\* For explanation of the abbreviations see Table II.

\*\* The constant for the multiple regression equation (a).

The first four regression coefficients are all significant at the .001 level of confidence. The fifth regression coefficient (TEA as the independent variable, grade-point average as the dependent variable) should not be included in the multiple regression equation. By excluding the fifth independent variable, the variation in grade-point average

accounted for by the multiple regression equation will be decreased to 58.2 percent.

It may be observed in Table IX, that all five regression coefficients are significant at the .001 level of confidence. Therefore, all five regression coefficients should be included in the multiple regression coefficient to predict ACT examination composite scores.

TABLE IX  
INDEPENDENT VARIABLE REGRESSION COEFFICIENTS (WEIGHTS)—  
ACT EXAMINATION COMPOSITE SCORE THE  
DEPENDENT VARIABLE

| Variable       | Regression<br>coefficient<br>(b) | Standard<br>deviation<br>of (b) | D.F. | t    | Significance |
|----------------|----------------------------------|---------------------------------|------|------|--------------|
| T.E.A.*        | .061                             | .013                            | 419  | 4.76 | .001         |
| B.C.           | .058                             | .009                            | 419  | 6.42 | .001         |
| S.I. of D.A.T. | .054                             | .011                            | 419  | 5.10 | .001         |
| I.S.R.         | .038                             | .008                            | 419  | 5.08 | .001         |
| SEX            | 1.369                            | .278                            | 419  | 4.92 | .001         |
| Intercept**    | 5.877                            | 1.290                           | ---  | ---  | ---          |

\* For explanation of the abbreviations see Table II.

\*\* The constant for the multiple regression equation.

The derived formula for predicting grade-point average at Manhattan, Kansas, High School is:

$$\text{GPA} = 1.444 + .008X_2 + .005X_3 + .006X_4 - .226X_1$$

Where:

GPA = predicted grade-point average

$X_2$  = percentile score of Scholastic Index of the Differential Aptitude Test (VR+NA)

$X_3$  = percentile score of Iowa Silent Reading

$X_4$  = percentile score of Brown-Carlson Listening Test

$X_5$  = sex (1 for boys; 0 for girls)

The standard error of estimate (more correctly called the standard deviation from regression)<sup>1</sup> was plus or minus .457. Meaning that if an individual had a predicted grade-point average of 2.00, the chances are approximately: two in three that his actual grade-point average will be within plus or minus one standard error of estimate of 2.00 ( $2.00 \pm .457$ ), or 1.643 - 2.457; ninety-five in one hundred it is within plus or minus two standard error of estimates of 2.00 ( $2.00 \pm .914$ ), or 1.086 - 2.914.

The formula for predicting ACT examination composite score at Manhattan, Kansas, High School is:

$$\text{ACT} = 5.877 + .061X_5 + .058X_4 + .054X_2 + .039X_3 + 1.369X_1$$

Where:

ACT = predicted composite score American College Testing Program Examination

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<sup>1</sup>Edward C. Bryant, Statistical Analysis (second edition; New York: McGraw-Hill Book Company, 1966), p. 135.

$X_5$  = percentile score of Test of Educational Ability

$X_4$  = percentile score of Brown-Carlson Listening Test

$X_2$  = percentile score of Scholastic Index

$X_3$  = percentile score of Iowa Silent Reading

$X_1$  = sex (1 for boys; 0 for girls)

The standard error of estimate was plus or minus 2.87.

Expectancy tables. Probably the most important element in a prediction study is the expectancy table. Presenting predictions in probability terms is absolutely necessary if predictions are to be used by individuals who may either place too much or too little emphasis on the predictions. Such a table will allow one to determine easily the probability of a student's obtained grade-point average or obtained ACT composite score being near his predicted grade-point average or ACT composite score.

The expectancy tables were constructed as follows:

1. The standard error of estimate was rounded to the nearest even tenth. Standard error of estimate for grade-point was .457, this becomes .4. Standard error of estimate for ACT composite score was 2.81, this becomes 2.8.
2. Divide the rounded standard error of estimate in half.
3. Starting with the lowest obtainable grade average or ACT composite score, a scale of intervals of one-half of the rounded standard error of estimate were constructed.
4. The expectancy scales were transferred to the expectancy

tables in the following manner. On the left-hand side, in the column labeled "predicted average" or "predicted score," the scale values were entered from the lowest to the highest obtainable average from bottom to top. In the row along the top of the tables the scale values were entered from the lowest to the highest obtainable average from left to right.<sup>1</sup>

Tables X and XI were constructed in the above manner for cumulative grade-point average and ACT composite score respectively, at Manhattan High School.

Table X is used to determine the chances of students obtaining certain cumulative grade averages or better from a knowledge of their predicted grade averages. It may be observed from the table for instance, a student at Manhattan High School has a predicted grade average of 3.411. What chance does he have of a grade average of at least 3.000? Locate the value nearest to 3.411 on the left-hand side of the table. This is 3.4. Locate along the top of the expectancy table the value nearest 3.00. This is 3.0. The number in the intersection of the row corresponding to 3.4 and the column corresponding to 3.0 gives the chances in 100 that students with predicted averages of 3.4 have of earning an average of 3.0 or higher. This figure is 84. Looking at it another way, by following the horizontal row labeled 3.4 to the first figure (99), it will be noted that the vertical column is labeled 2.4. This is read as saying that 99 out of 100 students with predicted

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<sup>1</sup> John M. Duggan and Paul H. Hazlett, Jr., Predicting College Grades (New York: College Entrance Examination Board, 1963), pp. 60-61.

TABLE X

## EXPECTANCY TABLE FOR CUMULATIVE GRADE-POINT AVERAGE

| Chances in 100 that a student will obtain a cumulative grade average equal to or higher than |     | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Predicted cumulative grade average   | 4.0 |     |     |     |     |     |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  |
|  | 3.8 |     |     |     |     |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  | 31  |
|  | 3.6 |     |     |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  | 31  | 16  |     |
|  | 3.4 |     |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  | 31  | 16  | 7   |     |
|  | 3.2 |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  | 31  | 16  | 7   | 2   |     |
|  | 3.0 |     |     |     |     |     | 99  | 98  | 93  | 84  | 69  | 50  | 31  | 16  | 7   | 2   | 1   |
|  | 2.8 |     |     |     |     |     |     | 99  | 98  | 84  | 69  | 50  | 31  | 16  | 7   | 2   |     |
|  | 2.6 |     |     |     |     |     |     |     | 99  | 98  | 84  | 69  | 50  | 31  | 16  | 7   | 1   |
|  | 2.4 |     |     |     |     |     |     |     |     | 99  | 98  | 84  | 69  | 50  | 31  | 16  |     |
|  | 2.2 |     |     |     |     |     |     |     |     |     | 99  | 98  | 84  | 69  | 50  | 31  |     |
|  | 2.0 |     |     |     |     |     |     |     |     |     |     | 99  | 98  | 84  | 69  | 50  |     |
|  | 1.8 |     |     |     |     |     |     |     |     |     |     |     | 99  | 98  | 84  | 69  |     |
|  | 1.6 |     |     |     |     |     |     |     |     |     |     |     |     | 99  | 98  | 84  |     |
|  | 1.4 |     |     |     |     |     |     |     |     |     |     |     |     |     | 99  | 98  |     |
|  | 1.2 |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 99  |     |
|  | 1.0 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

TABLE XI  
EXPECTANCY TABLE FOR ACT COMPOSITE SCORE

| Chances in 100 that a student will obtain an ACT composite score equal to or higher than |      |
|--|------|
| 1.0  | 36.0 |
| 99   | 50   |
| 98   | 31   |
| 93   | 16   |
| 84   | 7    |
| 69   | 2    |
| 50   | 2    |
| 31   | 1    |
| 16   | 1    |
| 7  | 1    |
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averages of 3.4 would be expected to obtain averages of 2.4 or higher.<sup>1</sup>

#### Cross-validation

The scores of the twenty-five students, who made up the cross-validation sample, were inserted in the derived multiple regression equations. Predicted criteria scores were determined. The results are shown in Table XII.

One of the results in a prediction study is that the predicted criterion values tend to "regress," or move toward, the average prediction. This means that the distribution of criterion values is less spread out than the distribution of obtained criterion values. In other words, the value of the standard deviation which describes the spread of criterion value, is usually smaller than the standard deviation of the obtained criterion values. Therefore, extremely high criterion values or extremely low criterion values will usually not be predicted with any accuracy.<sup>2</sup> (Note obtained and predicted grade-point averages of students number two and twenty-three in Table XII.)

It had already been ascertained, that there was no significant difference at the .05 level of confidence, between the mean score of the cross validation sample and the mean score for the total class of 1968. Therefore, if many samples were drawn from the total population 5 out of 100 would show significant difference in mean scores. However, there was a significant difference at the .05 level between the mean ACT

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<sup>1</sup>Ibid., p. 61.

<sup>2</sup>Duggan and Hazlett, op. cit., p. 59.



composite score of the cross-validation sample and the mean ACT composite score of Group II. As the data upon which the multiple regression equation was based came from Group II, it might be questioned whether the predictions would be accurate. To see if the multiple regression formula for ACT composite scores would still correctly predict ACT scores with this known variance the following procedure was followed.

Differences between the obtained criteria variables and the predicted criteria variables were computed. The perfect mean difference would be 0.00. The standard deviation of the mean differences (standard error of estimate)<sup>1</sup> should be small. If the predicted criteria values are accurate, the standard error of estimate of the predicted criteria values should be smaller than the standard error of estimate of the respective multiple regression equations. The mean differences for grade-point average was .072 with a standard error of estimate of .074. The mean difference for ACT composite score was -1.94 with a standard error of estimate of 2.09. The standard error of estimate for the multiple regression equations for predicting the criteria were respectively .457 and 2.81. It can be seen that the standard error of estimate of the predicted criteria values are smaller than the standard error of estimate of the respective multiple regression equations. It may be said then, that two-thirds of the predicted grade-point averages will fall within a range of  $-.457 \leq \text{predicted grade-point average} \leq +.456$ , and that two-thirds of the predicted ACT composite scores will fall

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<sup>1</sup>Howard B. Lyman, Test Scores and What They Mean (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963), p. 63.

TABLE XII  
OBTAINED AND PREDICTED CRITERIA VALUES OF THE  
CROSS-VALIDATION SAMPLE

| Stu-<br>dent | Sex* | X <sub>2</sub> ** | X <sub>3</sub> | X <sub>4</sub> | X <sub>5</sub> | Obtained<br>GPA | Predicted<br>GPA | Obtained<br>ACT | Predicted<br>ACT |
|--------------|------|-------------------|----------------|----------------|----------------|-----------------|------------------|-----------------|------------------|
| 1            | 1    | 70                | 60             | 71             | 73             | 2.568           | 2.504            | 18              | 21.9             |
| 2            | 1    | 80                | 90             | 75             | 69             | 1.206           | 2.758            | 15              | 23.6             |
| 3            | 0    | 45                | 40             | 13             | 45             | 2.000           | 2.082            | —               |                  |
| 4            | 1    | 60                | 49             | 35             | 81             | 1.775           | 2.153            | —               |                  |
| 5            | 0    | 80                | 71             | 73             | 91             | 3.054           | 2.887            | —               |                  |
| 6            | 0    | 30                | 20             | 13             | 43             | 2.364           | 1.862            | 12              | 11.0             |
| 7            | 0    | 40                | 49             | 51             | 77             | 1.886           | 2.649            | 18              | 18.9             |
| 8            | 0    | 99                | 95             | 96             | 99             | 3.400           | 3.287            | 25              | 26.5             |
| 9            | 0    | 30                | 47             | 57             | 65             | 2.083           | 2.261            | 11              | 16.7             |
| 10           | 0    | 1                 | 8              | 22             | 13             | 1.526           | 1.624            | —               |                  |
| 11           | 0    | 90                | 80             | 65             | 87             | 3.057           | 2.954            | 19              | 22.9             |
| 12           | 1    | 65                | 47             | 75             | 60             | 2.4272          | 2.089            | —               |                  |
| 13           | 0    | 95                | 83             | 91             | 81             | 3.410           | 3.165            | 23              | 24.5             |
| 14           | 1    | 50                | 24             | 18             | 31             | 2.132           | 1.846            | —               |                  |
| 15           | 1    | 90                | 82             | 32             | 92             | 2.150           | 2.540            | 22              | 22.4             |
| 16           | 1    | 95                | 71             | 97             | 98             | 3.484           | 2.915            | 27              | 26.8             |
| 17           | 0    | 80                | 71             | 73             | 92             | 2.971           | 2.877            | —               |                  |
| 18           | 1    | 15                | 15             | 35             | 37             | 2.026           | 1.623            | —               |                  |
| 19           | 0    | 90                | 99             | 68             | 87             | 3.237           | 3.067            | 25              | 23.8             |
| 20           | 1    | 65                | 85             | 54             | 84             | 2.324           | 2.487            | 21              | 22.2             |
| 21           | 1    | 99                | 85             | 94             | 00             | 3.714           | 2.999            | 28              | 27.0             |
| 22           | 0    | 15                | 47             | 57             | 50             | 1.829           | 2.141            | —               |                  |
| 23           | 1    | 97                | 92             | 91             | 86             | 4.000           | 3.000            | —               |                  |
| 24           | 0    | 40                | 44             | 57             | 67             | 2.229           | 2.326            | —               |                  |
| 25           | 0    | 90                | 79             | 83             | 93             | 3.774           | 3.057            | 18              | 21.0             |

\* Boys are signified by 1; Girls are signified by 0.

\*\* See Table II for identification of independent variables.

GPA =  $1.444 + .008X_2 + .005X_3 + .006X_4 - .226X_1$   
The standard error of estimate was plus or minus .457.

ACT =  $5.877 + .61X_5 + .058X_4 + .039X_3 + .054X_2 + 1.369X_1$   
The standard error of estimate was plus or minus 2.81.

within a range of  $-2.81 \leq$  predicted ACT composite score  $\leq +2.81$ .

### SUMMARY AND CONCLUSIONS

The major purpose of this study was to evaluate the effectiveness of certain standardized tests in predicting high school academic success. A subsidiary goal was to provide a useful tool (multiple regression formula), whereby administrators, counselors, and teachers could estimate a student's ability to succeed in high school, and to pursue formal education programs beyond high school. The formula may also be used to identify those students who are achieving far above or far below the levels of which they appear capable.

The criterion used as a measure of high school success was:

(1) cumulative high school grade-point average, or (2) the composite score of the American College Testing Program Examination, an achievement test.

The standardized tests to be evaluated and used as a basis for prediction of high school academic success were: (1) the Scholastic Index from the Differential Aptitude Test Battery, (2) the Iowa Silent Reading Test, (3) the Brown-Carlson Listening Comprehension Test, and (4) the SRA Test of Educational Ability. It was decided that rather than to run a separate analysis for boys and girls, sex would be used as a variable in the analysis of data.

Results of the tests mentioned above and cumulative grade-point averages were copied from the records in the Manhattan, Kansas, High School for students of the graduating classes of 1965, 1966, and 1967

who met the requirements of having all test scores for all four variables and cumulative grade-point average. Both criterion measures were not available for all students, therefore the students were divided into two groups. Group I included those students with scores from all four standardized tests and cumulative grade-point average (N=695). Group II included those students with scores from all four standardized tests, cumulative grade-point average, and an ACT examination composite score (N=495).

Using the data from Groups I and II, a multiple regression analysis was undertaken with the aid of the IBM 360 Model B computer. On the basis of this analysis, formulas were derived for the prediction of academic success, and expectancy tables were constructed—one for each of the two groups. The accuracy of these formulas was checked by a random sample taken from the graduating class of 1968.

Within the limits of the study, the following conclusions appear warranted:

1. The criteria measures can be predicted with success from standardized test results.
2. All standardized tests used in this study contribute significantly to the prediction of academic success as defined by the study. This is not to say, that other tests measuring similar skills would not be as successful.
3. The Test score from the SRA Test of Educational Ability does not contribute significantly to the formula, when used with the other independent variables to predict cumulative

grade-point average.

4. All standardized test scores contribute significantly to the formula for predicting ACT composite score.
5. The Reading and Listening tests are measuring similar, but not identical skills.
6. The Listening test correlates higher with the intelligence measures, than with the Reading test.
7. Prediction of a standardized test score from other standardized test scores was more accurate than prediction of cumulative grade-point average from standardized tests.
8. Girls tended to score higher on the standardized predictor tests than did the boys.
9. Girls tended to have higher grade-point averages than boys, whereas boys tended to score higher on the American College Testing Program Examination.
10. Whether boys listen better than girls was not substantiated from this study.

The following recommendations are made by the investigator:

1. That the prediction formulas and expectancy tables derived by this study should be made available to the administrators, counselors and teachers of Manhattan High School, so that they may be used in conjunction with junior high grade-point average to make more meaningful curricular, administrative and instructional decisions involving students.
2. That this study be evaluated in future years by cross-validation

with subsequent classes to see if the findings still hold true.

3. That time be spent teaching listening skills as well as reading skills.
4. That while predictions of specific averages may be a useful procedure, the real problem may be more qualitative than quantitative. That is, it is more desirable to know if an individual will complete high school or will fail in that effort than it is to know he will earn a grade-point average of 2.00. Prediction of a qualitative criterion might be more meaningful and would be an area for future research.

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**APPENDIX**

TABLE XIII

CONVERTING AMERICAN COLLEGE TESTING PROGRAM EXAMINATION  
COMPOSITE STANDARD SCORES TO PERCENTILE RANKS—  
LOCALIZED NORMS BASED ON THE CLASS OF 1967\*

| Scale | Boys<br>Percentile rank | Girls<br>Percentile rank |
|-------|-------------------------|--------------------------|
| 36    | 99                      | 99                       |
| 35    | 99                      | 99                       |
| 34    | 99                      | 99                       |
| 33    | 99                      | 99                       |
| 32    | 98                      | 99                       |
| 31    | 95                      | 99                       |
| 30    | 91                      | 99                       |
| 29    | 86                      | 99                       |
| 28    | 82                      | 97                       |
| 27    | 75                      | 93                       |
| 26    | 64                      | 87                       |
| 25    | 54                      | 79                       |
| 24    | 48                      | 69                       |
| 23    | 40                      | 59                       |
| 22    | 32                      | 51                       |
| 21    | 28                      | 45                       |
| 20    | 25                      | 37                       |
| 19    | 23                      | 30                       |
| 18    | 20                      | 23                       |
| 17    | 16                      | 15                       |
| 16    | 11                      | 10                       |
| 15    | 8                       | 7                        |
| 14    | 6                       | 4                        |
| 13    | 3                       | 2                        |
| 12    | 2                       | 1                        |
| 10    | 1                       | 1                        |
| 9     | 1                       | 1                        |
| 8     | 1                       | 1                        |
| 7     | 1                       | 1                        |
| 6     | 1                       | 1                        |
| 5     | 1                       | 1                        |
| 4     | 1                       | 1                        |
| 3     | 1                       | 1                        |
| 2     | 1                       | 1                        |
| 1     | 1                       | 1                        |

\* Taken from the ACT High School Profile Report College Bound--  
1966-67, for Manhattan, Kansas, High School.

**THE PREDICTION OF HIGH SCHOOL ACADEMIC SUCCESS FROM STANDARDIZED  
TESTS OF READING, LISTENING AND INTELLIGENCE**

by

**DAVID ALLISON MICKEY**

**B. S., Kansas State Teachers College, 1958**

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**AN ABSTRACT OF A MASTER'S REPORT**

**submitted in partial fulfillment of the**

**requirements for the degree**

**MASTER OF SCIENCE**

**College of Education**

**KANSAS STATE UNIVERSITY  
Manhattan, Kansas**

**1969**



The need for the discovery of talent among students and providing appropriate educational opportunities for its maximum development is of great concern to educators today. The method commonly used to discover this talent is through measurement by standardized testing programs.

The major purpose of this study was to evaluate the effectiveness of certain standardized tests in predicting high school academic success. A subsidiary goal was to provide a useful tool (multiple regression formula), whereby administrators, counselors, and teachers could estimate a student's ability to succeed in high school and to pursue formal education programs beyond high school. The formula may also be used to identify those students who are achieving far above or far below the levels of which they appear capable.

The criterion used as a measure of high school academic success was: (1) cumulative high school grade-point average, or (2) the composite score of the American College Testing Program Examination, an achievement test.

The standardized tests to be evaluated and used as a basis for prediction of high school academic success were: (1) the Scholastic Index from the Differential Aptitude Test Battery, (2) the Iowa Silent Reading Test, (3) the Brown-Carlson Listening Comprehension Test, and (4) the SRA Test of Educational Ability. It was decided that rather than to run a separate analysis for boys and girls, sex would be used as a variable in the analysis of data.

Results of the tests mentioned above and cumulative grade-point averages were copied from the records in the Manhattan, Kansas, High

School for students of the graduating classes of 1965, 1966 and 1967 who met the requirements of having all test scores for all four variables and cumulative grade-point average. Both criterion measures were not available for all students. Therefore, the students were divided into two groups. Group I included those students with scores from all four standardized tests and cumulative grade-point average (N=695). Group II included those students with scores from all four standardized tests, cumulative grade-point average and an ACT Examination composite score (N=495).

Using the data from Groups I and II, a multiple regression analysis was undertaken with the aid of the IBM 360, Model B computer. On the basis of this analysis, formulas were derived for the prediction of academic success, and expectancy tables were constructed—one for each of the two groups. The accuracy of these formulas was checked by a random sample taken from the graduating class of 1968.

Within the limits of this study, and the review of literature, the following conclusions appear warranted: (1) The criteria can be predicted with success from standardized test results. (2) All standardized tests used in this study contribute significantly to the prediction of academic success as defined in the study, except the SRA Test of Educational Ability. This test does not contribute significantly to the prediction formula, when used with the other independent variables to predict cumulative grade-point average. (3) Verified previous studies in that reading and listening skills, as measured by standardized tests, are similar, but not identical skills. (4) Verified

previous studies in that listening comprehension, as measured by the Brown-Carlson Listening Comprehension Test, correlates higher with intelligence measures than with the reading test. (5) Verified previous studies in that prediction of a standardized test score from other standardized test scores was more accurate than prediction of cumulative grade-point average from standardized tests. (6) Girls tended to score higher on the standardized predictor tests, and tended to have higher grade-point averages than did boys. (7) Boys tended to score higher on the achievement test. (8) Whether boys listened better than girls remained a moot question.