THE PREDICTIVE VALIDITY OF THE DAT MECHANICAL REASONING AND SPACE RELATIONS SUBTESTS FOR A SELECTED SCHOOL POPULATION

BY

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The Predictive Validity of the DAT
Mechanical Reasoning and Space Relations
Subtests for a Selected School Population

A Research Paper

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

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by

Jimmie Lee Roberts

July, 1979

To the Graduate Council:

    I am submitting herewith a Research Paper written by Jimmie Lee Roberts entitled "The Predictive Validity of the DAT Mechanical Reasoning and Space Relations Subtests for a Selected School Population." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

_____
Major Professor

Accepted for the
Graduate Council:

_____
Dean of the Graduate School

ACKNOWLEGEMENTS

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CHAPTER I

INTRODUCTION

The Differential Aptitude Test (DAT) is a well known and widely used test in educational and vocational counseling of students in grades eight to twelve (Anastasi, 1968). The battery provides eight scores: Verbal Reasoning (VR), Numerical Ability (NA), Abstract Reasoning (AR), Clerical Speed and Accuracy (CSA), Mechanical Reasoning (MR), Space Relations (SR), Spelling, and Language Usage. The DAT also yields a Verbal Reasoning plus Numerical Ability (VR+NA) score in order to provide an indication of scholastic aptitude.

The DAT has been widely praised by many testing theorists for its construction and high validity and reliability. Merwin (1964) stated that an early anonymous reviewer (1948) felt that the publication of the DAT was a "major psychometric event." Berdie (1953) wrote that the DAT was the "best test manual published." Humphreys (1953) stated that "the norms are far better than those available for most tests." Not all reviews of the DAT have been as complimentary as those cited; however, the test does yield consistently high validity and reliability coefficients.

Most of the research investigating the validity of the DAT has been concerned with predictive validity in terms of high school achievement, and, to a lesser extent, college

achievement. In general, the verbal subtests correlate more highly with English courses and the numerical subtests with mathematic courses. The VR+NA score correlates highly with most general academic courses. The research concerning the predictive validity of the DAT when vocational criteria are used is quite limited (Anastasi, 1968).

Review of the Literature

Lunday and Shertzer (1963) completed a study of the DAT's predictive validity using eighth grade students as subjects to determine the correlation between DAT subtest scores and course grades or regents scores. The researchers administered the DAT to students and computed intercorrelations between the individual subtests and final grades in high school subjects. Lunday and Shertzer (1963) found that those students who scored above the 75th percentile on the DAT passed the World History Regents, and that those subjects scoring above the 70th percentile on Numerical Reasoning passed the tenth grade Math Regents examinations. In addition, a correlation of .70 was found between ninth grade English grades and scores on Verbal Ability and between ninth grade science grades and Verbal Ability scores.

A study by Wood and Lebold (1968) sought to determine how accurately the DAT could predict success in an engineering curriculum. The subjects were 616 engineering freshman who were enrolled in an engineering graphics course at Purdue

University. The highest correlations derived from the data were between the Mechanical Reasoning subtest and graphics grades. The Abstract Reasoning subtest also correlated signifcantly with mathematics grades. The researchers concluded that the DAT could be a useful instrument for predicting success in an engineering course.

Elton and Morris (1956) completed a study using entering freshman at Birmingham-Southern College as subjects. A correlation of .57 was found between the Numerical Ability subtest and algebra grades, a coefficient of .54 between the Clerical Speed and Accuracy subtest and algebra grades, and a coefficient of .56 between the Grammar subtest and English grades. These researchers suggest that the DAT is a superior instrument for use in vocational and educational planning.

Chatterji and Mukerjee (1978) conducted a study using as subjects 368 students in six English medium schools in Calcutta, India. The subjects were given the Non-Language Test of Verbal Intelligence (NLTVI) and the DAT-Verbal Reasoning subtest. School examination marks were correlated with test scores. The results indicated that the predictive validity of the DAT was somewhat higher for the girls included in the sample than for the boys. Correlations between the Verbal Reasoning subtest and grades in English, language, science and art for the boys ranged from .47 to .54. The correlation coefficients for the girls ranged from .46 to .63. The researchers also found that

the DAT predicted success in subject areas better than the NLTVI.

Hollenbeck (1967) completed a study of the predictive validity of the DAT with tenth grade subjects. The sample consisted of students from across the nation; however, the subjects were not systematically selected. Only students for whom complete data were available were included in the research. The purpose of the study was to predict high school biology achievement from DAT scores. Hollenbeck (1967) concluded that the Verbal Reasoning plus Numerical Ability score was the best predictor of achievement in this subject area (r = .63).

Not all studies have supported the value of the DAT in predicting success in subject areas. Mogull and Rosengarten (1972) sought to determine the best predictor of success in elementary algebra. The variables investigated were the Iowa Algebra Aptitude Test, the DAT (Verbal Reasoning, Numerical Ability, and Abstract Reasoning) and eighth grade math averages. Correlation coefficients for the DAT and math grades were all below .50. Math averages were shown to be the best predictor (r = .70 for boys; r = .71 for girls). These researchers concluded that the DAT was of insignificant value.

The ability of the Space Relations and Mechanical Reasoning subtests to predict success in an engineering curriculum was studied by Jones and McMillen (1965). The subtests were ad-ministered to engineering freshman at Iowa State University,

using 15-minute time limits in order to increase the predictive value of the test. Thirty-minute time limits are usual, but engineering students generally tend to score higher on these subtests. The researchers felt that a shorter time limit would result in a less skewed distribution. The correlation coefficients for scores on the DAT and first year grade point averages were low; however, the scores on the DAT correlated relatively well with graphics grades. Jones and McMillen (1965) compared their results to those of Bennett, Seashore, and Wesman (1952), who examined the averages of 90 men enrolled in an industrial arts course at State Teachers College in Oswego, New York. Bennett, Seashore, and Wesman (1952) found low correlations of .10 between the DAT Space Relations scores and industrial arts grades and .34 between Mechanical Reasoning subtest scores and industrial arts grades.

Kinsey and Smith (1970) attempted to assess the value of the DAT in a business curriculum. The subjects were juniors in high school. Data were collected for those students who had taken the DAT during their freshman year and had completed a shorthand course. Correlation coefficients of .51 between Language-Usage and shorthand grades, .44 between Spelling and shorthand grades, and .43 between Numerical Reasoning and shorthand grades were obtained.

Layton and Swanson (1958) conducted a study using high school juniors selected from across the state of Minnesota.

Only students who had a complete set of DAT scores were included in the sample. Correlations between DAT scores and high school rank were computed. The researchers concluded that the Verbal Reasoning subtest was the best predictor of high school rank; however, they found that a combination of the Verbal Reasoning and Numerical Ability scores was a better predictor than the verbal test alone.

In the 1956 study, Bennett, Seashore, and Wesman presented an overview of the DAT which included extensive information concerning the validity of the test. They drew the following conclusions about the value of the DAT for use in counseling:

(1) The data support skilled counseling practice. Students with special strengths are found in those curricula and occupations which require the aptitudes good counselors have generally prescribed.

(2) The level of endeavor at which students are found is clearly related to their level of aptitudes.

(3) Job level within an occupational area is related to scores on the most relevant tests.

(4) Within any career group, educational or occupational, will be found individuals with less talent than one would have desired; and others with enough talent for more ambitious goals.

Purpose of the Study

The DAT is a widely used instrument for advisement, and

many studies have confirmed its predictive validity for guidance purposes. However, Hill (1963) emphasized the need for research in the individual setting to obtain information concerning the value of the instrument for use in advising students. Aiken (1971), too, recommended validating a test in the specific setting where it is used, since validation may vary with the setting and population. Therefore, it is the purpose of the present study to investigate the validity of the DAT for predicting the success of high school students in specific vocational courses offered by one particular school system. Specifically, the purpose is to determine the ability of the DAT Space Relations subtest to predict grades in a drafting course, and the ability of the DAT Mechanical Reasoning subtest to predict grades in a building trades course.

CHAPTER II

PRESENTATION OF DATA

Subjects

For the present study, 96 students in grades 9 through 12 enrolled in Montgomery Central High School were used as subjects. Only students who had taken the DAT and had semester grades available in drafting or building trades courses were selected for study. The sample included 79 male and 17 female subjects.

Instrument

The Differential Aptitude Test (DAT) is designed to measure ability in various areas and is used to predict success in certain courses and jobs. The DAT is composed of eight subtests: Verbal Reasoning, Numerical Ability, Abstract Reasoning, Clerical Speed and Accuracy, Mechanical Reasoning, Space Relations, Language Usage: Spelling, and Language Usage: Grammar. The Verbal Reasoning subtest measures ability to reason with and understand words and concepts expressed in words. This ability is important in academic courses and in jobs requiring a great deal of written or oral communication, and in jobs with much authority and responsibility. The Numerical Ability subtest measures ability to deal intelligently with numbers and quantitative materials and ideas. Numerical ability is especially important for success in such fields as

mathematics, chemistry, physics, and engineering and in jobs such as bookkeeping, laboratory technician, and statistician. The Abstract Reasoning subtest is a non-verbal and non-numerical measure of reasoning ability, dealing with the ability to see relationships among objects, patterns, diagrams, or designs. Abstract reasoning is useful in shop, drafting, and laboratory work. The Clerical Speed and Accuracy subtest measures quickness and accuracy in perceiving and marking simple letter and number combinations. This skill is important in paper work in school or wherever records are made or filed or checked. The Mechanical Reasoning subtest measures the ability to comprehend mechanical principles and devices as well as the laws of every-day physics. This is important in courses such as manual training, shop, physical sciences, and technical studies. The Space Relations subtest measures the ability to visualize, think three-dimensionally, or mentally picture the shape, size, and position of objects when shown only a picture or pattern. Drafting and shop courses, among others, require this skill. The Language Usage: Spelling subtest measures skill in spelling which is important in school and college work as in many jobs. This score is also one of the best predictors of the ease and speed with which one can learn typing and shorthand. The Language Usage: Grammar subtest is a measure of how well a person can distinguish between correct and improper grammar, punctuation, and wording of sentences, and is an excellent

predictor of grades in most high school and college courses. Careers in writing and teaching as well as others requiring college training demand competence in this area.

Scoring of the DAT can be performed by hand or machine. The raw score for each test is the number of right answers; there is no correction for guessing. Results are reported in raw scores as well as percentiles. In addition to the eight subtests, a ninth score is obtained by combining the Verbal Reasoning subtest score and the Numerical Ability subtest score and can be used as a measure of general scholastic aptitude.

The high validity and reliability coefficients of the subtests warrant their use in educational and vocational guidance. However, the usefulness of the instrument must be ultimately determined by considering the particular setting in which it is to be used (Bennett, Seashore, and Wesman, 1974).

Procedure

Permission was obtained to enter the cumulative records and record the DAT Mechanical Reasoning and Space Relations subtest scores for all subjects. Course grades in drafting and building trades were also collected from grade sheets. The Pearson product moment correlation procedure was used to determine the relationship between the DAT Mechanical Reasoning scores and building trades grades, and between the DAT Space Relations scores and drafting grades.

CHAPTER III

RESULTS

When the data were analyzed with the Pearson product
moment correlation technique, no significant relationship
was found between subjects' scores on the DAT Mechanical
Reasoning subtest and grades in the building trades course.
A significant relationship was found between the DAT Space
Relations scores and grades in the drafting course. Table I
summarizes this data:

Table I

Correlations Between DAT Subtests and Course Grades

Item	r
1. DAT Space Relations and Drafting	.533*
2. DAT Mechanical Reasoning and Building Trades	.213

* $p > .01$

Means and Standard deviations are shown in Table 2:

Table 2

Means and Standard Deviations

Item	Mean	S D
1. DAT Space Relations	32.34	11.86
2. DAT Mechanical Reasoning	43.67	10.63
3. Building Trades Grades	76.21	12.66
4. Drafting Grades	86.31	9.65

The results indicated that the DAT Mechanical Reasoning subtest was not a valid predictor of success in the building trades course for this sample in this particular school. However, the findings indicated that the DAT Space Relations subtest was a valid predictor for success in the drafting course for this sample.

An expectancy table was constructed to give a more extensive demonstration of possible relationships between DAT Space Relations scores and grades in the drafting course at this particular school (See Table 3).

Table 3

Expectancy Table Showing Relation Between DAT Space Relations
Test and Semester Grades in Drafting for 48 Students at
Montgomery Central High School

Test Scores	Number of Cases	F	D	D	B	A
50-49	4					100
40-49	13				31	69
30-39	7			14	43	43
20-29	17		12	24	29	35
10-19	7		29	29	13	29
0-9	0					

CHAPTER IV

DISCUSSION

The present study was conducted to determine the predictive validity of the Mechanical Reasoning and Space Relations subtests of the DAT in predicting success in building trades and drafting courses in a selected school. Data were collected from the cumulative records and grade sheets of 96 students enrolled in Montgomery Central High School. The Pearson product moment correlation procedure was used to determine the relationship between DAT scores in Space Relations and drafting grades, and between DAT scores in Mechanical Reasoning and a building trades course. A significant correlation was found between the Space Relations subtest and grades in the drafting class. No significant correlation was found between the Mechanical Reasoning subtest and grades in the building trades course.

The results of the present study are similar to other research investigating the relationship of the DAT Space Relations subtest and Mechanical Reasoning subtest to courses related to these areas. Magnuson (1978), using 225 eleventh and twelfth grade students as subjects, found a low and negative correlation between the Mechanical Reasoning subtest and grades in a general building course ($r = -.009$; $p > .05$). In addition, she found no significant relationships between the DAT Space Relations subtests and auto mechanics grades ($r = .295$; $p > .05$).

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Similarly, Jones and McMillen (1965) examined data on engineering freshmen and found low correlations between DAT Space Relations and Mechanical Reasoning subtest scores and first year grade point averages. In addition, Bennett, Seashore, and Wesman (1952) examined the averages of 90 college men enrolled in an industrial arts course and found a low correlation (r = .10; p > .05) between DAT Space Relations scores and industrial arts grades and a low correlation (r = .34; p > .05) between Mechanical Reasoning subtest scores and industrial arts grades. It must be recognized, however, that some studies have found a stronger relationship between DAT scores on these two subtests and related courses. Wood and Lebold (1968) using 616 college engineering freshman as subjects found a high correlation between the Mechanical Reasoning subtest scores and graphics grades. Similarly, Jones and McMillen (1965) found relatively high correlations between the Mechanical Reasoning and Space Relations subtest scores and graphics grades.

It is assumed that the Mechanical Reasoning subtest measures aptitudes which are important in courses like building trades and that the Space Relations subtest measures abilities important for courses like drafting. The results of the present study support the value of the Space Relations subtest, but not that of the Mechanical Reasoning subtest in predicting success in a particular school setting. One factor which must

be considered in interpreting the results of the present study
is the ratio of boys to girls included in the sample. The use
of these results for advisement purposes may be more valid for
male students than female.

In order to obtain a realistic idea about the value of the
DAT, one must consider all the data from the various studies
which have been completed on the instrument. Generally, the
researchers have found the DAT to be a useful and valid instru-
ment for educational and vocational guidance. However, the
results of the present and other studies support the contentions
of Hill (1963) and Aiken (1971) that research should be done
in the specific situation in which the test is used to determine
its value and contributions to advisement in that particular
setting.

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