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TCS AND CCAT AS PREDICTORS OF HIGH WISC-R IQ SCORES

by

© PATRICIA WRINCH

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ABSTRACT

The identification of gifted children frequently requires a measurement of intelligence or cognitive ability. However, the administration of individual intelligence tests to all children who are considered to be potentially gifted would be an impossibility because of time and cost constraints. The use of group ability tests as screening instruments is an alternative means to individual assessments.

In this study an attempt was made to determine if the Test of Cognitive Skills (TCS) and/or the Canadian Cognitive Abilities Test (CCAT) were good predictors of high scores on the Wechsler Intelligence Scale for Children (Revised) (WISC-R). If the test predicted WISC-R scores well, it could then be considered as a screening instrument.

The study subjects comprised 98 male and female students enrolled in Grades 4 and 5 in a large, Canadian city. All students had previously been identified as gifted or of superior ability and had been tested by means of the WISC-R. All subjects were administered the TCS and the CCAT. Multiple regressions were performed to determine which subtests or combinations of subtests were the best predictors of WISC-R scores.

The TCS was an accurate predictor of WISC-R scores

and was recommended for use as a screening instrument in identifying gifted children. The CCAT, when administered along with the TCS, did not add sufficient information to justify recommending it as a screening tool.

The TCS is easy to administer, requiring less time than the CCAT. The test questions appear to hold the students' interest and are current and relevant.

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Chapter 1

INTRODUCTION

In considering the identification of gifted and talented students, several questions emerge. Who are the gifted and talented and, once the criteria for giftedness are determined, how then can the gifted best be located? What measures are most accurate? Which measures should be included? Who should be doing the assessing?

Before one can discuss methods to identify the gifted and talented, it is necessary first to agree upon who they are. There is no precise operational definition of giftedness that is universally accepted. In a study entitled *The Gifted and Talented Students in Canada* (Borthwick, Dow, Levesque, & Banks, 1980), it was determined that there are three types of definitions: objective, descriptive, and comparative. Objective definitions emphasize scores or measures on intellectual or aptitude tests. Descriptive definitions give the characteristics of gifted and talented, after using a check-list to determine occurrence of selected criteria. Comparative definitions single out those who demonstrate superior achievement when compared to the majority (Borthwick et al., 1980). There are very few educators who cling tenaciously to a straight IQ or high academic achievement for identifying giftedness. Most rely on a multiple talent or multiple criteria for identification of gifted students.

The definition of giftedness proposed by the United States Office of Education (U.S.O.E.) (Renzulli, 1979) has been used by many states and school districts for their programs:

> Gifted and talented children are those, identified by professionally qualified persons, who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and/or services beyond those normally provided by the regular school program in order to realize their contribution to self and society.
>
> Children capable of high performance include those with demonstrated achievement and/or potential ability in any one of the following areas, singly or in combination:
>
> 1) General intellectual ability
> 2) Specific academic aptitude
> 3) Creative, productive thinking
> 4) Leadership ability
> 5) Visual and performing arts
> 6) Psychomotor ability (p. 6)

The U.S.O.E. definition calls attention to the wide variety of abilities that should be included in a definition of giftedness (Renzulli, 1979). In offering a more operational definition, Rubenzer (1979) described children of high intellectual ability as those who will function well in almost all academic areas. Children who have specific academic aptitudes excel in only one or two academic areas. A child with exceptional creative ability can generate unusual, frequent, and high-quality solutions to problems.

Those with leadership ability show consistent capacity to motivate and organize others. High ability in visual and performing arts will be demonstrated by production in areas such as graphic arts, sculpture, music, and dance. A child with exceptional mechanical reasoning skills or athletic ability can be classed as possessing psychomotor talent (Rubenzer, 1979, pp. 304-305).

In a report prepared by the "Minister's Task Force on Gifted and Talented Pupils in Alberta" (Alberta, 1983a), it was recommended that Alberta Education accept and use the following definition of gifted and talented pupils:

> Gifted and talented pupils are those who by virtue of outstanding abilities are capable of exceptional performance. These are children who require differentiated provisions and/or programs beyond the regular school program to realize their contribution to self and society.
>
> Children capable of exceptional performance include those with demonstrated achievement and/or potential ability in one or more of the following areas:
>
> a. general intellectual ability
> b. specific academic aptitude
> c. creative or productive thinking
> d. visual and performing arts (p. 40)

The report also recommended that:

> Three to five percent of the general school population be used as a guideline as to what proportion of pupils are considered gifted and/or talented, that is, requiring differentiated provisions and/or programs beyond the regular school program. (p. 41)

The Calgary Board of Education (C.B.E., 1975) has adopted the following definition:

> Gifted children are those identified by specialists as having superior general intelligence and/or creative abilities and talents and who require educational

> opportunities beyond those that can be provided in a regular school program.
>
> Such children would include those with demonstrated achievement, or potential ability, in one or more of the following areas:
>
> a) General intellectual ability
> b) Specific academic aptitude, eg. math, science
> c) Visual and performing arts.
>
> The specialists who would identify these children should include psychologists and those with knowledge and expertise related to the specific aptitude or talent under consideration. (p. 3)

The accurate identification of any human attribute is relatively easy when there is a precise operational definition of that attribute; however, agreeing on a definition for the attribute of giftedness is much more difficult than, for example, that of tallness. Before developing an identification system, an operational definition must be agreed upon for the specific program. Once agreed upon, the question then becomes: Which techniques and instruments will best serve in the identification of appropriate candidates? The criteria of superior intelligence are common to most definitions. The aim of this study was to narrow the focus within the question of identification to which of two group intelligence tests--the Test of Cognitive Skills (TCS) or the Canadian Cognitive Abilities Test (CCAT)--was the best predictor of high scores on an individual intelligence test, the Weschler Intelligence Scale for Children, Revised (WISC-R).

This study was limited to a group of students with scores above the 84th percentile on the WISC-R. Because of the narrowness of the band of scores produced by this sample relative to the total population, resulting correlations were lower than those expected for a normal population. The TCS gives a combined score of abilities, the Cognitive Skills Index (CSI). A similar combined score is not available for the CCAT. It was necessary to determine which test predicted high scores on the WISC-R using the CSI and separate CCAT verbal and non-verbal scores. These data were available in standard age scores and mathematically comparable. The subtests of the TCS do not have norms in standard age scores, making it necessary to employ age percentile norms which are available for both tests. Because full-scale IQ scores on the WISC-R are computed with reference to chronological age, it was considered important to utilize norms which involved an age component. The use of age percentiles rather than standard age scores introduced a larger error of measurement. The results were, therefore, more conservative.

Chapter 2

REVIEW OF SELECTED LITERATURE ON IDENTIFICATION OF THE GIFTED

While researching the literature, the writer focussed on the determination of what techniques or methods have been used and have proven effective in identifying gifted children. The factors which determined the inclusion or exclusion of each method in an identification procedure were considered. Because most accepted definitions of giftedness were found to be multi-faceted, the review is presented here with the assumption that most identification procedures or systems have multiple criteria, or are multidimensional.

Most school districts in Canada and in the United States currently include in their policy the concept that the identification process should incorporate a number of criteria. The use of multiple criteria was designed to broaden the base of decision-making rather than to extend the categories served. It was also a recognition that any criterion is not only limited in its application but is fallible (Alberta, 1983b, pp. 127-128).

The first question considered was: Who can reliably identify gifted children? An obvious choice would be the classroom teacher because of daily contact with the child and knowledge of the child's personality, thinking processes, and production levels. Nominations by teachers is one of the most widely used means of identifying potentially gifted students, yet the method is of limited application. Gallagher (cited in Martinson, 1974, p. 17) found that none of the studies he reviewed showed teachers to good advantage. He said there was great variance in prediction efficiency from one teacher to another and a problem in over nomination of either boys or girls by some individuals. Walton (cited in Martinson, 1974, p. 17) concluded in his study of means for screening and identifying gifted kindergarten children, that teacher judgement alone would have resulted in referral of only one in five who were later identified on the Stanford-Binet test as gifted. He did find, however, that, in combination with other means the success of teacher nomination increased sharply, but of the various means used, teacher judgement proved the least effective.

Pegnato and Birch (1959, p. 303) also observed that teacher nomination was less effective and efficient than other screening means. Their study of junior high school students revealed that teachers overlooked half of the gifted children in the study and, of those referred as gifted, almost one third were not in the gifted or superior range but in the average intelligence range on the Stanford

Binet test.

The research on efficiency and effectiveness of teacher ratings has not shown them to be very good, but Hagen (1980) suggested that many of the deficiencies reported in such studies have been due as much to the deficiencies in the rating scales and procedures utilized as they were to the inability of teachers to discriminate levels of ability. Hagen contended, nonetheless, that every plan for identifying potentially gifted students should include teacher nominations. Her reasons were (1) to improve accuracy, test data need to be supplemented with other valid, relevant data; (2) the appraisal of creativity, persistence, achievement, motivation, artistic aptitude, or music aptitude must be evaluated by non-test techniques; (3) because a test is a single observation, data from a large number of observations and a broader sample of tasks are needed; and (4) from a socio-political viewpoint, it is important to involve the teachers and parents in all aspects of a program for the gifted if it is to have a broad base of support (1980, p. 22).

In a study conducted by Cornish (cited in Gear, 1976, pp. 483-484) dealing with accuracy of teacher-judged giftedness at the elementary grade level, teachers were asked to rate the child according to his abilities, not according to his achievement. Five of the confirmed gifted students were identified through nominations by teachers and their effectiveness score was 31 per cent. Teachers were incorrect in seven of their nominations and their efficiency score was 42 per cent.

Pegnato (in Gear, 1976) offered some reasons for teachers' relative inability to identify gifted students:

> Many do not understand the idea of intelligence and lack criteria for making judgements. Achievement is often confused with aptitude. Teachers' selections are often made on the basis of conforming or pleasant personalities, highly motivated school behavior, or good appearances of special talents. (p. 485)

Pegnato suggested that teachers' selections would be an effective screening method providing they were afforded in-service training in selection techniques.

A significant result of a teacher training program on "Identification of the Potentially Gifted" was the finding that training did improve the effectiveness of teacher referrals. The program dealt with five topics: (1) terminology of gifted education, (2) definition of gifted and talented, (3) selection criteria, (4) role of intelligence tests in the selection process, and (5) characteristics of gifted children. Teachers who participated in the program were twice as effective in making referrals as those who did not have the instruction (Gear, 1978, p. 96).

The literature reviewed clearly indicated that teacher nominations of potentially gifted were lacking in value and effectiveness if used as a single criterion.

When combined with other data, however, the value of the teacher nominations increased. If teachers were afforded a comprehensive training program on identification of the gifted, their nominations again increased in their efficiency, effectiveness, and value in the identification procedure.

In addition to teachers, parents must be considered as possible nominators of potentially gifted students. Parents are in the best possible position to act as observers and recorders of their childrens' behaviour, although they may not always be capable of evaluating what they observe. A Seattle project--after several years of soliciting participants in a longitudinal study of gifted children --found that parents exercised considerable self-selection in nominating intellectually or academically gifted children. This finding was consistent with that of other research on parent involvement in nominations of children for gifted programs. Parents were more often than not fairly realistic about their childrens' abilities. There were, nonetheless, differences among socio-economic groups in their descriptions of the gifted. According to the results of a study by Cheyney (in Roedell, Jackson, & Robinson, 1980, p. 56), parents from lower socio-economic neighbourhoods tended to be more likely to nominate a gifted child than were parents from upper socio-economic neighbourhoods. Consistently, Ciha, Harris, Hoffman, and Potter

(1974, p. 194) reported that parents from higher-status neighbourhoods were less effective in nominating gifted children who would qualify than were those in lower-status neighbourhoods. Some well-educated parents in homogeneous, middle-class communities tended to be unrealistically stringent in what constituted giftedness. Parents were aware of the difficulty of rating their own children's behaviour because of their limited experience with behaviour typical of other children of a specific age (Roedell et al., 1980, pp. 55, 56).

Information can be gathered from parents using objective questionnaires, anecdotal reports, or a combination of both. Data can be gathered through written submissions or during interviews. Input from parents is particularly necessary when dealing with very young children. Because of the instability of intelligence test scores for the very young, it would not be reasonable to predict future performance without other supportive data.

Martinson (1974) recommended that school personnel listen carefuly for cues to giftedness in what parents have to say about their children. She said it is easy to dismiss such cues as parental pride but argued that parents have much more contact with the child than does the teacher. Jacobs (in Martinson, 1974, p. 47) also pointed out that parents are better at identifying giftedness in their children than are teachers.

According to Ciha et al. (1974, p. 194) teachers' identification of giftedness in youngsters at the kindergarten level was below 25 per cent, whereas parents were more able to assess their child's abilities at about 67 per cent.

It was evident in the literature that the role of the parent as nominator should be encouraged. Parents generally were seen to be accurate in their identifications of gifted children. A parent questionnaire would be a reasonable and relevant source of information to be included in any identification system.

Programs identifying the gifted children in a school system should include both subjective and objective measures of ability such as standardized tests. Subjective evaluation--for example, teacher judgement and parental referral--need to be checked by more objective measures of ability such as standardized tests (Kirk & Gallagher, 1979, p. 65). If such tests are to be employed, they should be chosen for inclusion in an identification program.

Even though current definitions of giftedness go beyond strictly the cognitive domain, a strong emphasis remains on intelligence tests for identification. Kirk and Gallagher (1979, p. 62) have suggested that the reasons for this are that they are well developed and proven instruments and they tap the memory, association, reasoning, and information-processing abilities necessary for high performance in school-related activities. They also argued that, even though it is admitted that superior intelligence is but one factor in determining success, achievement, or contribution to society, it still remains a basic ingredient of giftedness. The common denominator is intellectual superiority.

A survey of experts in gifted education regarding the desirable and actual procedures used in identification of gifted students revealed that the individual intelligence test was preferred despite the high cost of administration. In actual practice, tests or other scales that were easy to administer or collect information readily, such as teacher observation scales and group tests, were most often used (Kirk & Gallagher, 1979, p. 66).

Individual intelligence tests have a number of advantages over group tests. A broader sampling of abilities is possible, better testing conditions can be arranged, and interpretation of quality of performance can be evaluated. Even though these tests do not measure all human abilities, they are superior to group tests in identifying gifted children. Individual tests provide a much more accurate ceiling than do group tests and, thus, a better estimate of ability. Because the interview situation is automatically operative, the skilled examiner may learn much of value about the child's attitudes, interests, and background (Martinson, 1974, pp. 56-58). The obvious limitations in using an individual intelligence test are cost, lack of trained personnel in many areas, and unwillingness to assign psychologists to test the gifted (Martinson, 1974, p. 57). The major disadvantages are that testing must be done by an examiner who has been trained to administer, score, and interpret results and that they require from one to two hours of testing time.

Much effort has been devoted to the derivation of short forms of intelligence tests. Killan and Hughes (1978, pp. 111-115) hypothesized that the Vocabulary (V) and Block Design (BD) dyad of the WISC-R would predict the Full-Scale IQ accurately enough to be utilized as a stage in the screening process for intellectually gifted children. These researchers suggested that the two subtests be administered and an IQ score quickly calculated. If the IQ score were to fall above a pre-determined level, the rest of the test would be administered.

Dirks, Wessels, Quarfoth, and Quenon (1980, pp. 40-46) completed a study in which 10 short-form combinations of WISC-R subtests were compared to two measures of school-taught information. The goal of the study was to determine which particular measures were the most effective predictors of high Full-Scale WISC-R IQ. The results obtained showed that those measures that tapped school-taught information were among the poorest predictors of Full-Scale WISC-R IQ. Children who did well on School Grades, Slosson Intelligence Test, Vocabulary-Arithmetic-Information subtests, or

Vocabulary-Arithmetic subtests did not necessarily have high Full-Scale WISC-R IQ. Their results suggested that measures that depend predominantly on school-taught information should not be used as a sole screening device when seeking to locate children of high IQ. In Dirks et al.'s study, the short forms that were seen to be good predictors were Similarities-Object Assembly-Vocabulary or Similarities-Object Assembly (r = .72). The two short forms required the child to rely on reasoning and the perception of relationships, rather than on knowledge of memorized facts. Dirks et al. (1980) suggested that there is considerable merit in using SI-OA-VO or SI-OA as screening instruments to locate children with high WISC-R IQs.

In another study aimed at developing a short form of the WISC-R to identify intellectually gifted children, Karnes and Brown (1981, pp. 169-173) collected data on 946 gifted students. Their results confirmed the findings of Killan and Hughes (1978); that is, that Vocabulary and Block Design was the best dyad short form for gifted students. The use of the tetrad short form--Similarities, Vocabulary, Block Design, and Object Assembly--could increase accuracy without substantial time constraints. Karnes and Brown (1981, p. 171) also reported that employment of the hexad short forms increased reliability to a minor extent and did not justify the increased expenditure of time, and that the use of the tetrad, S, V, BD, and OA was the most efficient short form in terms of reliability and time.

Hagen (1980, p. 19) listed three reasons for her strong opposition to the procedure of shortening or modifying tests: (1) when a test is changed from its standard format the data on reliability, validity, and the norms are no longer applicable; (2) reducing numbers of test items reduces the number of cognitive skills appraised, thus restricting the amount of information that is obtained; and (3) a shortened test is less reliable than the original, full-length version. She maintained that shortened versions of individual scholastic aptitude tests, such as the Slosson Intelligence Test and the Quick Test, are not suitable for identifying the potentially gifted. Their only purpose is to indicate who should be given a full-length Stanford-Binet or Wechsler Intelligence Scale for Children, and that a group test of cognitive ability will do the same thing equally effectively and more cheaply.

There was general agreement in the surveyed literature that an individual intelligence test provides the most accurate assessment of intellectual potential. Thus, it can be reasonably suggested that the individual test be used during a final selection process although it would be too costly and time-consuming for both student and psychologist for use during original screening. The merits of abbreviated forms have been suggested, the major limitations being the need for individual administration. The question of the value and place of group intelligence tests in the identification process must now be considered.

Kirk and Gallagher (1979) noted that most schools have test scores available from group intelligence tests or achievement tests. These could serve as a starting point in selecting candidates for a special program. These researchers recognized limitations in using data from group tests:

1) Group intelligence tests are not as reliable as individual tests
2) They seldom differentiate abilities at the upper levels
3) Some children do not function adequately in a timed test situation (1979, p. 65)

Group tests are practical for use in screening since it is financially prohibitive to test all children with individual tests. Those who are near the cutoff or for whom the group test appears invalid can then be given individual examinations.

When choosing group tests for screening purposes, Vernon, Adamson, and Vernon (1977) recommended opting for those which have both verbal and non-verbal sections since such tests give a better chance to budding scientists or mathematicians. Entirely non-verbal tests, such as Raven's Progressive Matrices, were not suggested because of their low predictive value (1977, p. 102).

In a study by Pegnato and Birch (1959, p. 303) which compared the efficiency of several techniques in selecting gifted 14-year-olds, nominations by teachers or by a group intelligence test each identified correctly about half of the high IQ group. The group test, however, was more efficient in that it identified fewer "false positives"; that is, students who were suggested as gifted but were not. Each method gave about the same number of "false negatives"; that is, failure to identify those who were, in fact, gifted. Group tests certainly have value in preliminary screening but it is necessary to allow rather wide limits. It is not necessary to test all in the top 10 per cent to 15 per cent on a group test; only those who exhibit one or more signs of giftedness such as teacher nomination or evidence of special talent (Vernon, et al., 1977, p. 104).

Evidence of the need to supplement group testing with other means was found in the conclusions of a study by Blosser (in Martinson, 1974, pp. 41, 42) of the relative usefulness of group intelligence tests. The three tests which Blosser evaluated were not very efficient as they identified a number of students who failed to qualify on the Stanford-Binet; that is, they were false positives.

Of greater concern was the result of a California study which found a quarter of the gifted group were eliminated using a cutoff score of 125 or above. Slightly over half would have been eliminated if a criterion of 130 or above had been used (in Martinson, 1974, pp. 41,42).

Group tests are useful and relatively inexpensive and, when combined with other methods, they are effective screening devices. Their limitations are that they fail to identify some gifted students and identify some erroneously. Different language backgrounds, reading deficiencies, group testing pressures, student motivation, and general learning deprivation should all be taken into account when performance of individuals is evaluated (Martinson, 1977, p. 44).

For selecting tests of cognitive ability, Hagen (1980) suggested that one be chosen that yields separate scores of verbal, quantitative, and non-verbal reasoning so that separate talents can be identified. The Cognitive Abilities Test and the Differential Aptitude Tests are two examples of tests she recommended. Group tests that produce only one score provide much less information than do multi-score tests and the single score is more difficult to interpret. A limitation of group tests is that they are designed for a particular age or grade and do not provide sufficient high-level items to discriminate adequately at the top. This lack of discrimination can be overcome by administering a higher level of the test to those who score in the top 15 per cent of the grade level test (Hagen, 1980, pp. 44-45).

The literature surveyed did support the use of group intelligence tests as screening devices insofar as they would be used in conjunction with some other form of evaluation such as parent referral and/or teacher nomination.

Furthermore, the final selection process should involve the use of an individual intelligence test, as the group test does not have sufficient ceiling to test the extremes nor does it provide a means of assessing quality of response. The group intelligence test does have the distinct advantages of being less time-consuming and considerably less costly to administer than the individual test, thus allowing evaluation of greater numbers.

Having established that it was acceptable to administer group intelligence tests as screening devices, the question was then considered as to which of the many available tests should be used in the present research. The merits of two such tests were considered and are discussed in Chapter 3.

Chapter 3

METHODOLOGY

Subjects

The study subjects were students enrolled in Grades 4 and 5, in a large metropolitan centre, who had been referred by a teacher or parent because of suspected giftedness/talent. All students had been assessed by means of an individual intelligence test. Those with Full-Scale scores of 130 or above were identified as gifted, or as "running mates" if scores were 120 to 129 and/or demonstrated creative talents. Students attended either regular classes and received enrichment activities or differentiated programs, or attended a separate school for gifted children whose needs could not be met in their neighbourhood school. The sample of 98 students included: 36 Grade 4 males, 38 Grade 4 females, 14 Grade 5 males, and 10 Grade 5 females. The subjects ranged in age from 8 years 3 months to 11 years 10 months.

Procedure

The purpose of this study was to determine whether or not the Test of Cognitive Skills (TCS) or the Canadian

Cognitive Abilities Test (CCAT) could be used to predict Full-Scale IQ scores on the WISC-R. If, in fact, one or both tests predicted scores on the WISC-R, the group test then could be utilized as a screening device for identification of gifted/talented children.

The CCAT Level B (Verbal and Non-Verbal subtests only) was routinely administered by all teachers throughout the city schools to all Grade 4 students during the last week of October each year. The TCS Level 3 was administered during February 1983 by school psychologists in schools where there were at least four students who had been previously identified as gifted or running mates. It was deemed impractical to use a group test when there were fewer than four students to be tested. Student's individual test scores were obtained from student files. Level 3 of the TCS, although designed for Grades 5 to 7, was chosen to allow for sufficient ceiling.

Teachers of the Grade 4 class in the segregated school for gifted children were asked to rank order their students as to who was most intelligent. No definitions were given to the teachers because all teachers must define their own understanding of intelligence or giftedness when referring students for identification. The rank orders were correlated with test scores on the WISC-R, TCS, and CCAT.

Measuring Instruments

Canadian Cognitive Abilities Test

The CCAT (published by Thomas Nelson and Sons (Canada) Ltd.) has evolved from the Lorge-Thorndike Intelligence Test Series which had been modified to the Canadian Lorge-Thorndike Intelligence Tests. In addition to the verbal (V) and non-verbal (NV) sections that were part of the Lorge-Thorndike, a quantitative test (Q) has been added for the multi-level edition (Grades 3 to 12). The term multi-level indicates that the CCAT consists of three parallel batteries and eight different but overlapping levels (A-H). All the items were especially constructed for the new series. The CCAT purports to measure the "individual's ability to use and manipulate abstract symbols" (Wright, 1974, p. 2). Separate batteries have been provided to assess competence with more types of symbols: those representing words and quantities, and those representing spatial, geometric, and figural patterns. The authors have attempted to emphasize relational thinking; that is, perceiving relationships among abstract elements, and on flexibility of thinking (Wright, 1974, p. 2).

The V subtest (Vocabulary, Sentence Completion, Verbal Classification, and Analogies) is very similar in form and content to other measures of verbal ability or scholastic aptitude. The Q subtest (Quantitative

Relations, Number Series, and Equation Building) is highly school-oriented thus reducing its construct validity. The Non-Verbal battery tests Figure Classification, Figure Analogies, and Figure Synthesis (Hopkins, in Buros, 1978, pp. 255-256). Each of the three subtests requires from 32 to 34 minutes' working time for a total of 98 minutes. This lengthy testing time is a disadvantage in comparison to other tests for which time is quite limited (Hopkins, 1978, p. 256).

The score that a student obtains on the CCAT can be given meaning by relating it either to his chronological age or to his school grade group. Five types of norms are provided for the interpretation of scores: (1) standard scores by age, (2) percentiles by age, (3) stanines by age, (4) percentiles by grade, and (5) stanines by grade (Wright, 1974, p. 4). The Standard Age Score is a normalized score scale in which the average score for each age group on each test is set at 100, with a standard deviation of 16. For any age group, a given numerical value has the same meaning in terms of standing relative to the group. A percentile rank indicates the percentage of examinees in an age or grade group that obtained scores below a particular score. A percentile rank may change for a given individual when the comparison group changes. When considering current classroom activities for a student, the percentile rank in grade is often the most helpful since it relates an individual to the grade group in which he is currently competitive. For predictions into the future, or for some research studies, the age group may provide a more suitable basis of comparison. Stanines are normalized standard score scales consisting of 9 levels with a mean of 5 and a standard deviation of 2. They are relatively easy to understand and interpret and are useful in reporting test information to students and parents (Wright, 1974, p. 46).

A study by Randhawa, Hunt, and Rawlyk (1974, pp. 208-215) of the factor structure, reliability, validity, effectiveness, and efficiency of the CCAT produced a number of conclusions. They determined that: (1) the stability coefficient over a 7-month period was relatively low; (2) from their structural analysis, the CCAT was measuring something structurally independent of that measured on the WISC instrument; (3) many items on each subtest lacked discriminative characteristics; and (4) the efficiency and effectiveness of the CCAT compared with the WISC as a criterion instrument was low. The latter finding prompted the authors to caution that if the CCAT is to be used to identify low, high-IQ subjects for referrals, it should be employed with caution. The general conclusion offered by Randhawa et al. was that the CCAT requires further refinement, particularly at lower levels of measurement.

Test of Cognitive Skills

The TCS comprises a series of ability tests designed to assess the level of aptitude attained by students (CTB/McGraw-Hill, Examiner's Manual, 1981a, p. 1). The TCS is not intended to measure all aspects of mental ability but emphasis is placed on abilities of a relatively abstract nature that are important to success in an educational pro-gram. Such functions include understanding verbal and non-verbal concepts and comprehensive relationships among ideas. There are five levels of the TCS for overlapping grade ranges. Each level includes four subtests (with 20 items in each test): Sequences, Analogies, Memory, and Verbal Reasoning.

The Sequences subtest measures the ability "to comprehend a rule or principle implicit in a pattern or sequence of numbers, letters or figures" (ibid.). The Ana-logies subtest measures the ability "to see concrete and abstract relationships and to classify objects and concepts according to common attributes" (ibid., p. 2). The Memory subtest measures the "ability to recall previously presented material" (ibid.). The Memory subtest is presented in two parts, with 20 obscure words and their definitions being presented at the beginning of the testing session. Then, 25 minutes' later, the memory test is administered. Obscure words are selected so that a student's recall of material would not be affected by previous knowledge. The Verbal Reasoning test measures the student's "ability to discern relationships and reason logically" (ibid.). There are two item types: one which requires the student to identify essential aspects of objects or concepts and another which requires the student to draw logical conclusions from information given in short passages (ibid.). Total administration time is approximately 60 minutes.

The TCS is a major revision of and a successor to the Short Form Test of Academic Aptitude (SFTAA). The new test has the same basic structure. The structure and rationale of the Sequences and Analogies subtests remain the same. The Verbal Reasoning test replaces the Vocabulary test of the SFTAA and removes the problem of using a vocabulary test to predict achievement on another vocabulary test. This was a development concern, because one major use of the TCS is its administration in conjunction with achievement batteries to derive anticipated achievement information. The TCS Memory test is newly designed to measure memory that is not dependent upon reasoning or reading comprehension skills (ibid.).

The TCS was standardized in the fall of 1980. The tests were administered to a United States national sample of approximately 82,400 students enrolled in Grades 2 through 12. The Public School sample was stratified by geographic region, community type, district size, and demographic index based on community characteristics. The Catholic School sample was stratified by region and district size (average elementary school enrolment) (ibid., p. 4).

The basic score for the TCS is the scale score. The scale score for the total test is obtained by averaging the scale scores for the four subtests. Norm-referenced data are obtained by converting scale scores to derived scores based on the normative sample. Four derived scores are available for each subtest and the total test: percentile rank by grade, percentile rank by age, stanine by age, and stanine by grade. An ability indicator in the form of a derived score called Cognitive Skills Index (CSI) is available for the total test. The CSI is comparable to the Full Scale IQ score on the WISC-R with a mean of 100 and a standard deviation of 16. This score indicates a student's overall cognitive ability relative to peers of similar chronological age without regard to grade placement (CTB/ McGraw-Hill Norms Book, 1981b, p. 4). TCS norms compare the ability level of a student, not with the entire population but only with those who are also in school (ibid., p. 7).

The Wechsler Intelligence Scale for Children (Revised) (WISC-R) (Wechsler, 1974) is designed for students aged 6 to 16 years. The WISC-R comprises five subtests producing a Verbal Score and five more generating a Performance Score, which together give the Full-Scale Score.

The various subtests are briefly paraphrased below

(Shertzer & Linden, 1979, p. 139):

1. Information: 25 questions assessing the subject's knowledge of the world and its culture.
2. Comprehension: test of practical judgement and common sense, expecting a generalized, fairly direct answer.
3. Digit Span: Subject first repeats from 3 to 9 digits forward as presented orally, and then repeats another series backward from the order presented. (optional)
4. Similarities: given pairs of words, the subject has to explain the conceptual basis for similarity.
5. Arithmetic: solution of timed problems of increasing difficulty; test of numerical reasoning ability.
6. Picture Arrangement: different sets of cards, much like a cut-up comic strip, require arrangement in a logical order to tell a story.
7. Picture Completion: shown cards containing drawings with an important part missing, the subject must identify the missing part.
8. Block Design: given red and white designs on cards, the subject is required to duplicate the designs by manipulating a set of from 4 to 9 cubes coloured differently on each side.

9. Object Assembly: puzzles made of heavy cardboard require the subject to discover how they are put together.

10. Coding: code substitution; told that the numbers 1 to 9 are each represented by a given symbol, the subject then translates as many as possible within a given amount of time.

11. Vocabulary: words ranging in difficulty are to be defined or explained.

12. Mazes: optional with children; not used with adults.

Although the Wechsler scales are fairly simple to administer, the skill of the examiner may greatly influence the scoring, since the examiner must make sensitive judgements as to the correctness of the subject's responses.

The raw scores on the subtests are converted into scaled scores; that is, normalized standard scores with a mean of 10 and a standard deviation of 3. Wechsler uses a standard-score IQ choosing to fix the mean at 100 and the standard deviation at 16. To arrive at the IQ score, the raw scores are first transformed to standard scores; these are then totalled and the manual is consulted for the meaning of the three IQs: Verbal, Performance, and Full-Scale (Cronbach, 1960, p. 195).

The test is a distillation of clinical experience and this contributes both to its strengths and weaknesses.

It is based on no clear theory of intelligence and makes no effort to separate mental ability from other forms of adaptation (Cronbach, 1960, p. 202). Rules for scoring do not always have sharply defined criteria and are logically inconsistent at times (Freides, in Buros, 1978, p. 350).

The Wechsler scale is interesting to most subjects and is at least as valid as the Stanford-Binet for predictive purposes. It covers a broad range of tastes and affords exceptionally good opportunities for qualitative observation of behaviour and thought processes (Cronbach, 1960, p. 202).

The new or revised items of the WISC-R seem directed at keeping test content up to date and eliminating items that were ambiguous or biased against some groups of children. The WISC-R appears to be a good measure of the capacity to do those things that have traditionally enabled one to succeed in a white, middle-class world (Petrosko, in Buros, 1978, pp. 354, 355).

Hypotheses

The general hypothesis tested in this study stated that there is no statistically significant relationship between subtests or overall scores on the Test of Cognitive Skills (TCS) and/or the Canadian Cognitive Abilities Test (CCAT) and the Full-Scale score of the Wechsler Intelligence Scale for Children (Revised) (WISC-R).

Three additional, specific hypotheses were also tested:

H_1: There is no statistically significant relationship between the WISC-R Full-Scale score and Cognitive Skills Index on the TCS.

H_2: There is no statistically significant relationship between the WISC-R Full-Scale score and age percentiles on subtests of the TCS and CCAT.

H_3: There is no statistically significant relationship between the WISC-R Full-Scale score and age percentiles on subtests of the TCS.

Chapter 4

RESULTS

Analysis of Data

The Multiple Regression, University of Pittsburgh SPSS-10K1 (Statistical Package for the Social Sciences) was used to analyse the study data. When the purpose is to predict one variable from two or more other variables, the techniques of multiple regression are appropriate (Willemsen, 1974, p. 143). Multiple regression is a general statistical technique through which one can analyse the relationship between a dependent variable and a set of independent variables. Among the most important uses of the technique, two are: (1) to find the best linear prediction equation and evaluate its predictive accuracy; and (2) to control for other confounding factors in order to evaluate the contribution of a specific variable (Nie, Hull, Jenkins, & Steinbrenner, 1975, p. 320). In the present study, the step-wise method was used in which each independent variable was entered on the basis of pre-established statistical criteria, a minimum F value. This procedure is generally employed when the aim is to isolate a subset of available predictor variables that will yield an optimal prediction equation with as few terms as possible (Nie et al., 1975, p. 345).

The first step is to enter the variable that explains the greatest amount of variance in the dependent variable; the second step is to enter the variable that explains the greatest amount of variance in conjunction with the first, and so on. All hypotheses were tested at the .01 level of statistical significance. To test the general hypothesis, a multiple regression analysis was performed on individual IQ scores with:

1. TCS subtest Raw Scores,
2. TCS and CCAT subtest Raw Scores,
3. TCS subtest grade percentiles,
4. TCS and CCAT grade percentiles,
5. Cognitive Scale Index of TCS, CCAT Verbal, and CCAT Non-Verbal,
6. TCS subtest age percentiles, and
7. TCS and CCAT subtest age percentiles.

Descriptive Statistics

A frequency polygon is a figure constructed from data in such a way as to create a graphic representation of the data. When plotting the graph of data based on standard scores of the TCS, one would expect a mean of 100 and a standard deviation of 16, if the test were administered to a large, random sample.

The data (see Figure 1) appeared somewhat like a normal distribution, but it did have a negative value of skewness, peaking to the right of the mean. The mean of the CSI was 120.06 with a standard deviation of 10.79. This kind of distribution was expected of the sample which was not normal, the criteria for inclusion being a measured intelligence score above the 84th percentile on the WISC-R. This suggested that the TCS did have a reasonable ceiling for assessing individuals with high levels of ability. Unlike Figure 1, which resembled a normal distribution, Figures 2-5 demonstrated negative skewness. This difference occurred because Figure 1 data represented the relative frequency in the sample whereas Figures 2-5 compared the sample to the total norming population. Figures 2-5 provide frequency polygons of the scores on the subtests of the TCS.

The frequency distribution of Verbal Reasoning subtest scores (Figure 2) had a negative skewness with minimal variation in frequencies in lower categories. One would have expected students of superior intelligence to exhibit consistently high scores in Verbal Reasoning.

The frequency distribution of the Analogies subtest scores (Figure 3) had a negative skewness with a slightly wider variation in the upper scores in comparison to Verbal Reasoning scores.

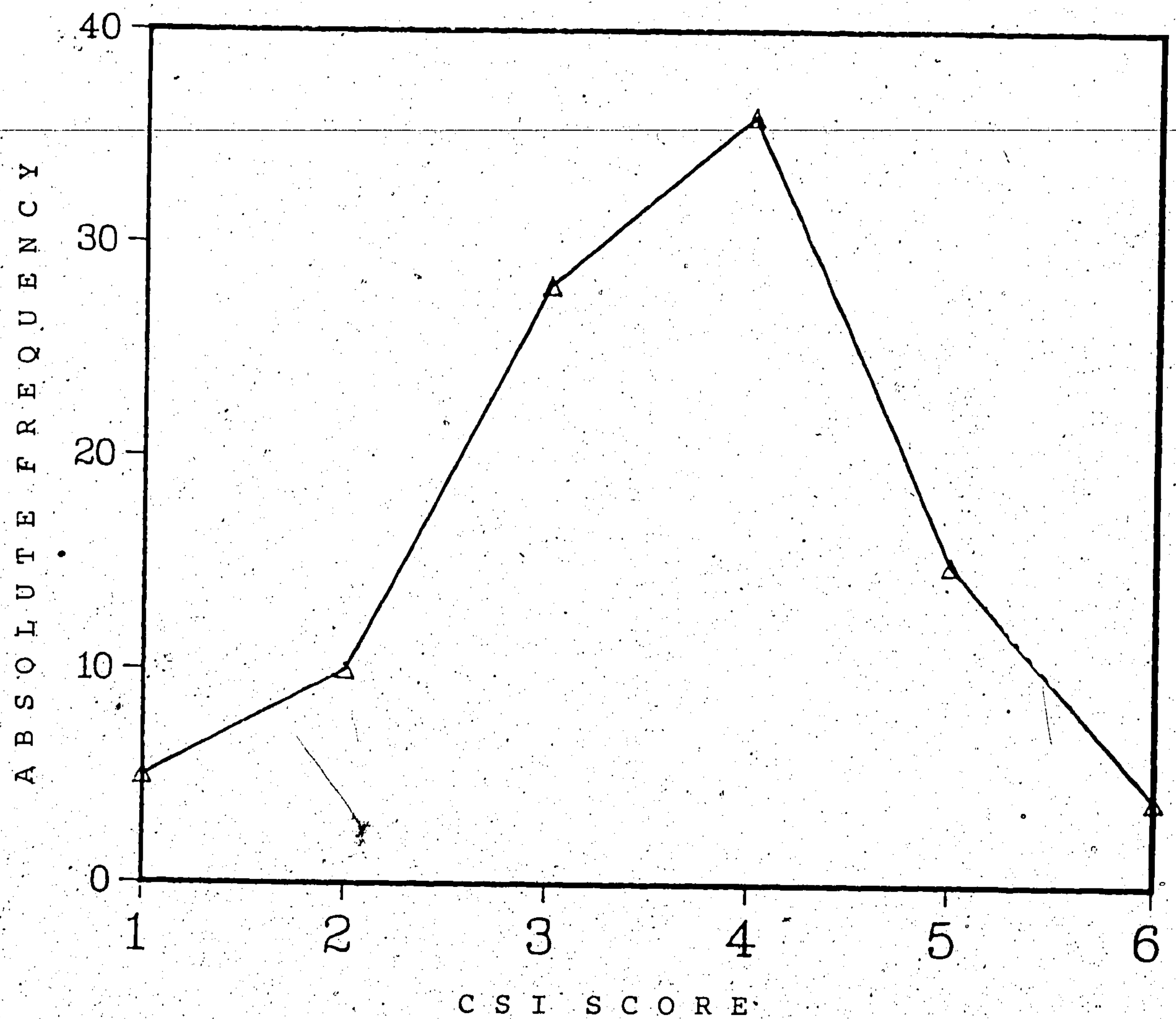

Figure 1 Frequency distribution of TCS, CSI.

Kurtosis: -0.05
Skewness: -0.26

			Frequency
1.	90 - 99		5
2.	100 - 109		10
3.	110 - 119		28
4.	120 - 129		36
5.	130 - 139		15
6.	140 - 149		4

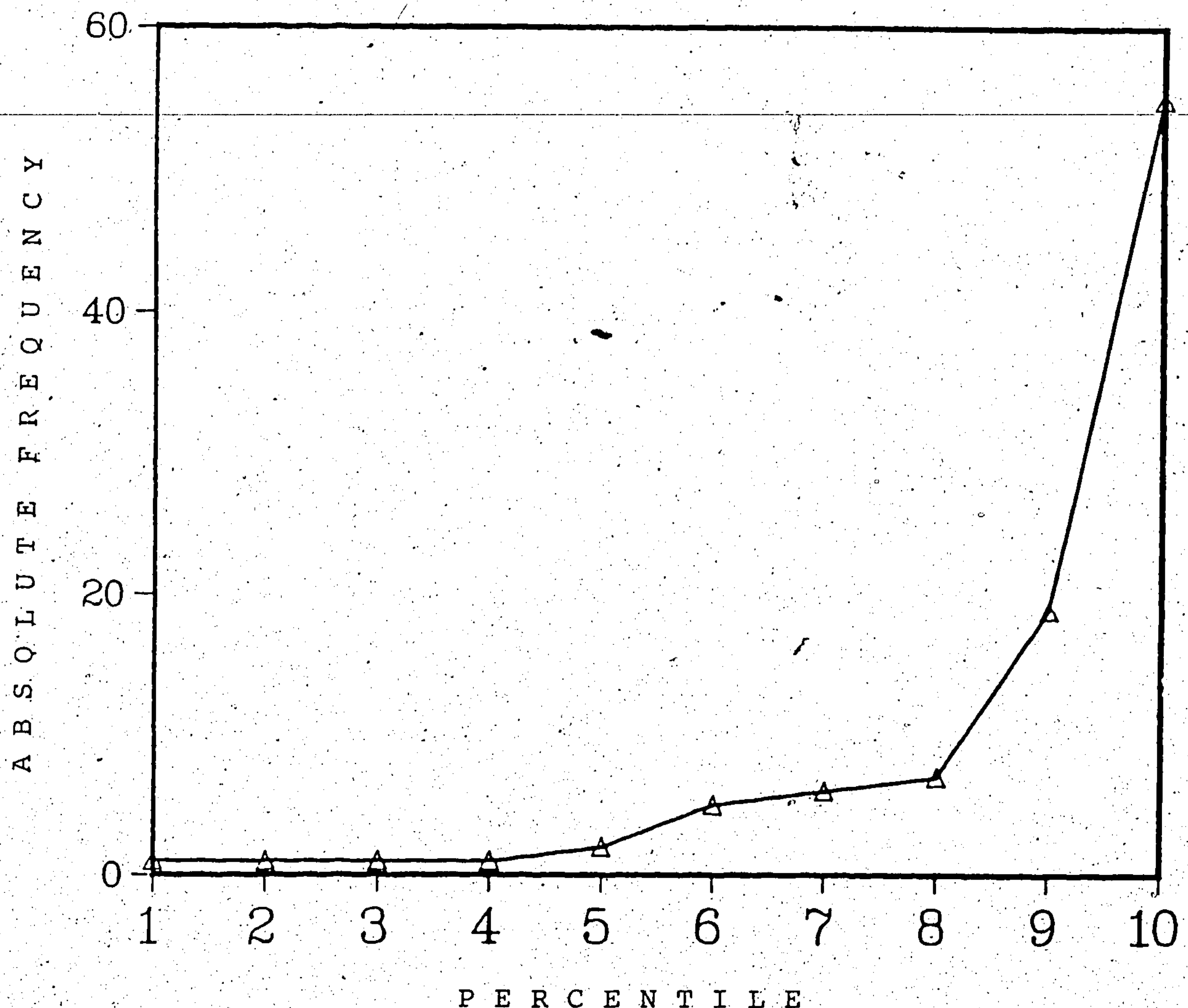

Figure 2 Frequency distribution of Verbal Reasoning, age percentile norms.

Kurtosis: 4.38

Skewness: -2.04

		Frequency
1.	0 - 9	1
2.	10 - 19	1
3.	20 - 29	1
4.	30 - 39	1
5.	40 - 49	2
6.	50 - 59	5
7.	60 - 69	6
8.	70 - 79	7
9.	80 - 89	19
10.	90 - 99	55

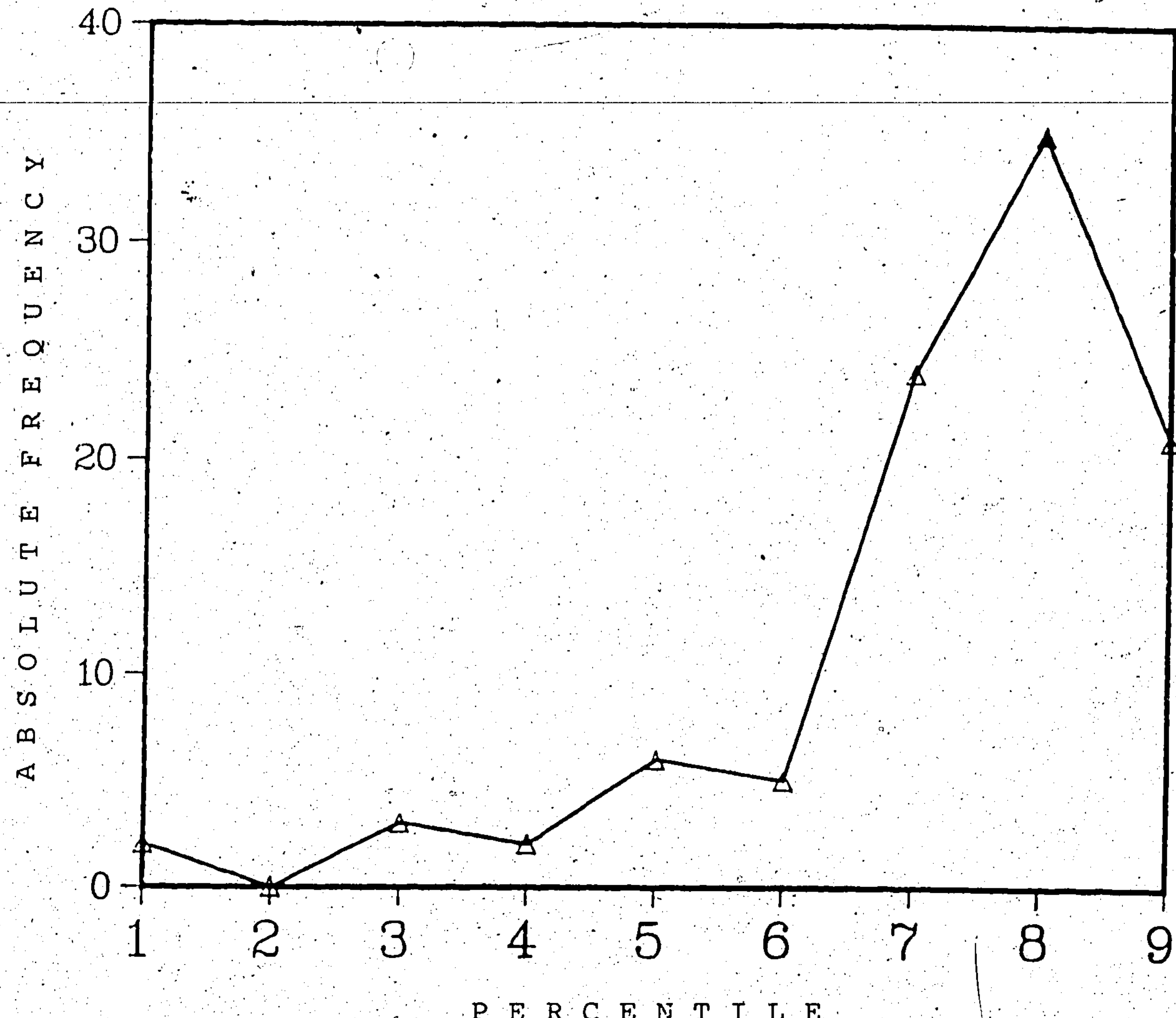

Figure 3 Frequency distribution of Analogies, age percentile norms.

Kurtosis: 3.57

Skewness: -1.78

		Frequency
1.	10 - 19	2
2.	20 - 29	0
3.	30 - 39	3
4.	40 - 49	2
5.	50 - 59	6
6.	60 - 69	5
7.	70 - 79	24
8.	80 - 89	35
9.	90 - 99	21

The frequency distribution of the Sequences subtest scores (Figure 4) also skewed to the right as expected with the given sample. This distribution was very similar to that of the Analogies subtest, with a few in the lower categories, and the majority grouping in the upper scores.

The frequency distribution of the Memory subtest scores (Figure 5) showed a slight negative skewness with greater scatter among the lower scores than on the other subtests, but with still the characteristic large group having high scores.

Statistical Analysis

A series of multiple regression analyses performed to compare WISC-R scores with raw scores and grade percentiles on the TCS and CCAT produced low correlations. These data are reproduced in the Appendices (Tables 10 - 15 inclusive) and will not be discussed here.

Table 1 presents correlations of the CSI of the TCS and the Verbal and Non-Verbal Standard Age scores on the CCAT with WISC-R Full-Score IQ (WISC-R FSIQ). All scores were mathematically comparable with a mean of 100 and a standard deviation of 16. A correlation will provide a single number which summarizes the relationship between two variables. These correlation coefficients indicate the degree to which change in one variable is related to change in another variable. A correlation coefficient summarizes

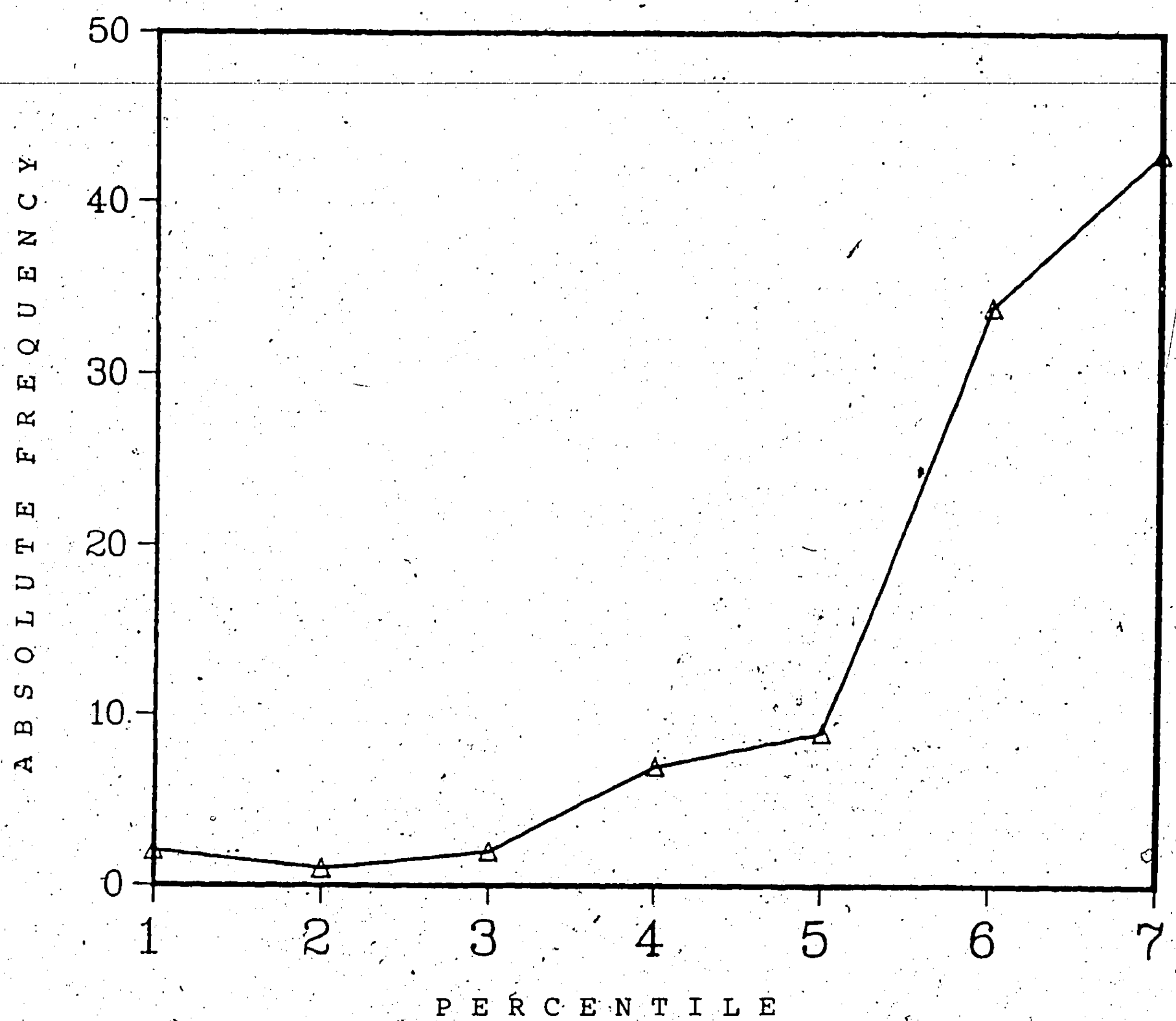

Figure 4 Frequency distribution of Sequences, age percentile norms.

Kurtosis: 3.35

Skewness: -1.69

		Frequency
1.	30 - 39	2
2.	40 - 49	1
3.	50 - 59	2
4.	60 - 69	7
5.	70 - 79	9
6.	80 - 89	34
7.	90 - 99	43

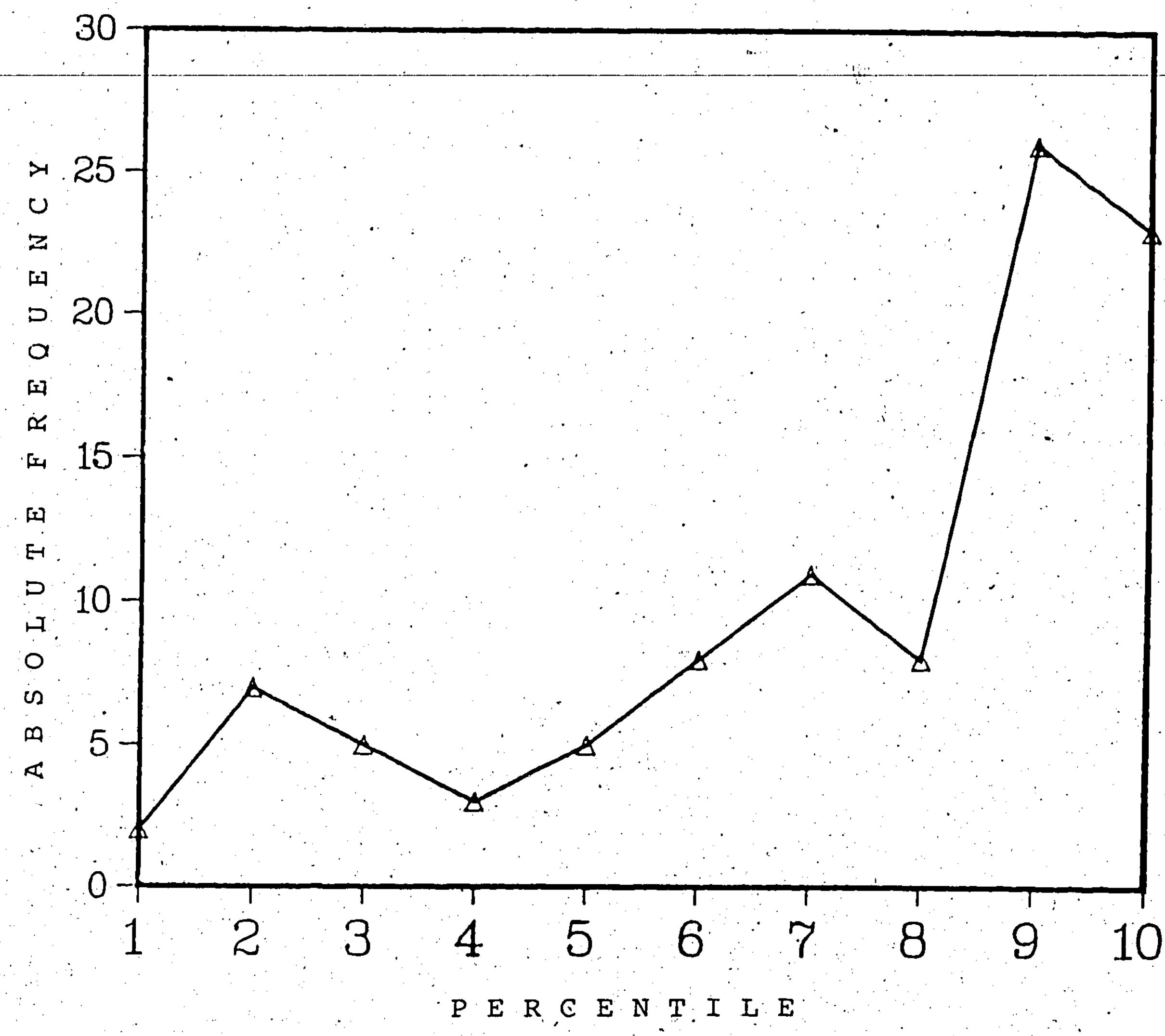

Figure 5 Frequency distribution of Memory, age percentile norms.

Kurtosis: -0.32

Skewness: -0.92

		Frequency
1.	0 - 9	2
2.	10 - 19	7
3.	20 - 29	5
4.	30 - 39	3
5.	40 - 49	5
6.	50 - 59	8
7.	60 - 69	11
8.	70 - 79	8
9.	80 - 89	26
10.	90 - 99	23

the strength of association between a pair of variables, and also allows for comparing the strength of relationship between one pair of variables and a different pair (Nie et al., pp. 276, 277).

Table 1

CORRELATION MATRIX OF WISC-R FSIQ WITH TCS, CCAT VERBAL AND CCAT NON-VERBAL

Variable	IQ	CSI	Verbal	Non-Verbal
IQ	1.00	0.48	0.28	0.34
CSI	0.48	1.00	0.55	0.54
Verbal	0.28	0.55	1.00	0.41
Non-Verbal	0.34	0.54	0.41	1.00

For $p < 0.01$, $r \geq 0.26$; $n = 98$

Of the three variables in the present study, the highest correlation was between the CSI of the TCS and the WISC-R FSIQ with $r = 0.48$.

Table 2 data indicated that when using age percentile norms, WISC-R FSIQ correlated best with three subtests of the TCS: Verbal Reasoning, $r = 0.40$; Analogies, $r = 0.40$; and Sequences, $r = 0.38$.

Table 3 data reflect results from the test of Hypothesis 1. The hypothesis was rejected at the .01 level of significance obtained on an F ratio value of 29.24. This means that there was a significant relationship between the Full-Scale score on the WISC-R and the CSI on the TCS.

Table 2

CORRELATION MATRIX OF WISC-R FSIQ WITH TCS AND CCAT AGE PERCENTILE NORMS

Variable	IQ	Sequences	Analogies	Memory	Verbal Reasoning	Verbal	Non-Verbal
IQ	1.00	0.38	0.40	0.02	0.40	0.24	0.32
Sequences	0.38	1.00	0.45	0.10	0.34	0.18	0.39
Analogies	0.40	0.45	1.00	0.04	0.29	0.26	0.24
Memory	0.02	0.10	0.04	1.00	0.20	0.35	0.21
Verbal Reasoning	0.40	0.34	0.29	0.20	1.00	0.50	0.38
Verbal	0.24	0.18	0.26	0.35	0.50	1.00	0.46
Non-Verbal	0.32	0.39	0.24	0.21	0.38	0.46	1.00

For $p < 0.01$, $r \geq 0.26$; $n = 98$

Table 3

REGRESSION OF WISC-R FSIQ WITH CSI, CCAT VERBAL AND CCAT NON-VERBAL

Variable	Multiple R	R^2	R^2 Change	F	df	B
CSI	0.48	0.23	0.23	29.24	1/96	0.36D
CCAT Non-Verbal	0.49	0.24	0.01	15.23	2/95	0.09D
						76.08

The data in Table 3 also show that the CSI accounted for 23 per cent (R^2 = .23) of the total variance in predicting a Full-Scale IQ WISC-R from the CSI. Included in this regression were Verbal and Non-Verbal standard age scores on the CCAT. The new multiple R, when the CCAT Non-Verbal score was included, was 0.24, which was significant at the .01 level obtained on an F ratio value of 15.23. The inclusion of the CCAT Non-Verbal score did provide additional information but it changed the R^2 value by only less than 1 per cent. The CCAT Verbal score was not included as the F level was insufficient for computation.

Table 4 provides data resulting from the test of Hypothesis 2. Hypothesis 2 was rejected for all subtests except CCAT Verbal at the .01 level of significance obtained on F ratio values ranging from 18.92 to 7.62. This finding demonstrated that there was a significant relationship between the Full-Scale score on WISC-R and the four subtests of the TCS, and also the Non-Verbal subtest of the CCAT. Again, the CCAT Verbal score was not included as the F level was insufficient for computation. The use of the subtests Verbal Reasoning, Analogies, Sequences, CCAT Non-Verbal and Memory accounted for 29 per cent of the total variance in predicting WISC-R FISQ. This relationship was stronger than that found between CSI and FSIQ (R^2 = .23).

Table 5 depicts the results of the test of Hypothesis 3. Hypothesis 3 was rejected at the .01 level of

Table 4

REGRESSION OF WISC-R FSIQ WITH TCS AND CCAT
AGE PERCENTILE NORMS

Variable	Multiple R	R^2	R^2 Change	F	df
Verbal Reasoning	0.40	0.16	0.16	18.92	1/96
Analogies	0.50	0.26	0.10	16.30	2/95
Sequence	0.53	0.28	0.02	12.05	3/94
CCAT Non-Verbal	0.54	0.29	0.01	9.37	4/93
Memory	0.54	0.29	0.00	7.62	5/92

Table 5

REGRESSION OF WISC-R FSIQ WITH TCS SUBTEST
AGE PERCENTILE NORMS

Variable	Multiple R	R^2	R^2 Change	F	df	B
Verbal Reasoning	0.40	0.16	0.16	18.92	1/96	0.14D
Analogies	0.50	0.26	0.10	16.30	2/95	0.13D
Sequences	0.53	0.28	0.02	12.06	3/94	0.12D
Memory	0.53	0.28	0.00	9.09	4/93	-0.02D
						98.82

significance for all subtests obtained on F ratio values ranging from 18.92 to 9.09. This finding indicates that there was, in fact, a significant relationship between the Full-Scale score on the WISC-R and the four subtests of the TCS, excluding the use of CCAT scores. Utilization of the four subtests of the TCS accounted for 28 per cent of the total variance in predicting WISC-R FSIQ. This relationship was not as strong as was the TCS subtests when the CCAT Non-Verbal score was included ($R^2 = .29$). The difference in R^2 values was 0.01 or 1 per cent.

A predicted score was determined for each student in the sample using the regression equation (79.86 + .42D) determined for the CSI on the TCS. A cut-off score of CSI at 125 was selected and the data were analysed to determine the numbers who would be identified as having a WISC-R FSIQ score of $\geq$ 130. A false positive was classed as having a CSI $\geq$ 125, but a WISC-R FSIQ < 130; a false negative as having CSI < 125 but a WISC-R FSIQ $\geq$ 130. When both scores fell below the cut-off they were counted as positive identification. As illustrated in Table 6, identification accuracy was 67 per cent.

The TCS was administered to another classroom of 47 students in Grade 5 who had been identified as possibly gifted. Predicted scores using multiple regression equation for the CSI were determined and analysed for accuracy of identification. Table 7 data indicate that accurate

Table 6

ACCURACY OF PREDICTION USING CSI:
TOTAL SAMPLE (N = 98)

Positive Identification		Negative Identification	
Both Scores Above Cutoff	Both Scores Below Cutoff	False Positive	False Negative
59	8	28	3
(59.7%)	(7.2%)	(25.5%)	(4.2%)

Table 7

ACCURACY OF IDENTIFICATION USING CSI:
NON-SAMPLE GROUP (N = 47)

Positive Identification		Negative Identification	
Both Scores Above Cutoff	Both Scores Below Cutoff	False Positive	False Negative
33	0	12	2
(70.2%)	0	(25.5%)	(4.2%)

identification with this group was 70 per cent.

Predicted scores were determined using regression equations developed from age percentile norms on the four subtests of the TCS. The data were analysed and tabulated for the original sample, as shown in Table 8. Accurate identification occurred in 68 per cent of the cases.

Table 8

ACCURACY OF IDENTIFICATION USING TCS SUBTESTS: TOTAL SAMPLE (N = 98)

Positive Identification		Negative Identification	
Both Scores Above Cutoff	Both Scores Below Cutoff	False Positive	False Negative
57	10	28	3
(58.2%)	(10.2%)	(28.57%)	(3.06%)

The results of the correlations of teachers' rank order of student ability with the WISC-R, TCS, and CCAT showed no significant correlations at the S < .05 level. The correlation matrix is presented in Table 9. These results suggested that there was no relationship between teachers' perceived levels of students' ability and their performance on standardized tests.

Table 9

CORRELATION MATRIX OF RANK ORDER OF
WISC-R, TCS, AND CCAT

	WISC-R	Sequences	Analogies	Memory	Verbal Reasoning	Verbal	Non-Verbal
Rank	-0.24	-0.15	-0.16	0.00	0.14	0.26	-0.29
$S \leq .05$	S=0.09	S=0.21	S=0.19	S=0.50	S=0.22	S=0.08	S=0.05

Having tested the hypotheses, the following conclusions can be stated:

1. There is a statistically significant relationship between the WISC-R Full-Scale score and the Cognitive Skills Index on the TCS.
2. There is a statistically significant relationship between the WISC-R Full-Scale score and age percentiles on all subtests of the TCS but only one subtest (Non-Verbal) on the CCAT.
3. There is a statistically significant relationship between the WISC-R Full-Scale score and age percentiles on all subtests of the TCS, the CCAT excluded.

Chapter 5

SUMMARY AND IMPLICATIONS FOR FURTHER RESEARCH

Summary

The results of this study indicated that the Test of Cognitive Skills would be a useful screening device in the identification of gifted students. The correlations between the Full-Scale IQ scores on the WISC-R and the Cognitive Skills Index, or between the WISC-R and separate subtests, were not particularly high, which indicated that the two tests were not measuring identical constructs. When a regression equation is applied, it is possible to identify a reasonable and practical number of candidates for further evaluation. The TCS appears to have sufficient ceiling, if one chooses the level of test designed for the next higher grade level. Because the test produces subtest scores in addition to a full-scale score, information is provided of the differing levels of the students' strengths. The TCS is more straightforward with simpler instructions than the CCAT, thus requiring shorter administration time. The TCS has the added advantage of up-to-date, relevant questions. The real strength of the TCS lies in its accuracy in identifying students with high WISC-R scores. The number of false negatives is low, meaning few high scores are missed.

The inclusion of the Canadian Cognitive Abilities Test as a screening device to identify gifted students is not recommended. The non-verbal scores on the test provided statistically significant data but increased the measure of variation (R^2) by less than 1 per cent. This minimal increase in information makes the administration of the test impractical. Verbal scores on the CCAT were not statistically significant and this is a further reason for precluding the test.

The present study concurred with previous research results (Randhawa et al., 1974) that the CCAT measures something structurally independent of that measured on the WISC. There was no significant relationship between CCAT and WISC-R, and since WISC-R test results are used as the test criteria for inclusion in a program for the gifted, the CCAT does not merit inclusion as a tool in the screening process.

In utilizing the TCS as a screening device, it would appear that the inclusion of subtest scores and the regression equation generated from them would be the best choice. The four subtests employed in this study accounted for 28 per cent of the variance in the dependent variable, and the Cognitive Skills Index accounted for 23 per cent of the variance. The four subtests also provided slightly more information about the students. The regression equation determined that using the CSI did have the advantage of being simpler to calculate. This advantage is of significance only when numbers are small and hand-scoring is the practice.

The TCS is a much more accurate predictor of high scores on the WISC-R than are teacher nominations. When teachers rank ordered students in terms of intelligence, the correlation between rank and WISC-R scores was negative. The teachers were unable to assess effectively the ability of the students. Because teachers often fail to identify those students with high ability, it would be of great advantage in a school system to have within the system's testing program a group ability test which is an accurate predictor of scores on an individual intelligence test. Results of these group tests can then be employed in conjunction with other data as a basis for referral, rather than placing heavy dependence on teacher nominations.

As suggested in the literature review, no single group cognitive ability test should be used as the sole criterion for placing students in a program for the gifted and/or talented. The TCS could be administered as a screening tool and, along with parent recommendations and teacher nominations, would determine which students would be referred for an individual assessment.

Implications for Further Research

In choosing tests for service in a school system, the TCS would appear to be a better choice than the CCAT. The purpose of system-wide testing using the CCAT is to assess the students' general academic potential. Other purposes are to assist students to achieve a more accurate picture of their potential and to enhance students' self-esteem by identifying their relative strengths.

The TCS should be evaluated for these purposes in a large student sample. If functional, it carries with it the advantage of being a reasonable screening device.

Apart from considering the TCS as the ability test to be included on a system-wide basis, further research should be conducted relative to its utility as a screening device. This study was limited only to those students who had been referred by parents or teachers for possible inclusion in a program for gifted students. The next logical step is to administer the TCS to regular classes of students, to identify by means of prediction equations those who should be assessed by administering an individual intelligence test, and then to carry out that assessment.

There are two situations in which a screening device of this nature would be helpful, time-saving, and cost efficient: the first would be in those schools where often no students are referred as possible candidates for giftedness because emphasis is placed on students with difficulties in the other direction, and, second, in those schools where, at the other extreme, large numbers of students are referred. Research with these two groups would be helpful in determining the effectiveness and efficiency of the TCS as a screening tool.

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APPENDICES

APPENDIX A

Table 10

Table 11

Table 10

CORRELATION MATRIX OF WISC-R FSIQ WITH
TCS AND CCAT GRADE PERCENTILES

Variable	IQ	Sequences	Analogies	Memory	Verbal Reasoning	Verbal	Non-Verbal
IQ	1.00	0.31	0.38	0.01	0.37	0.21	0.28
Sequences	0.31	1.00	0.36	0.08	0.37	0.17	0.38
Analogies	0.38	0.36	1.00	0.01	0.27	0.23	0.23
Memory	0.01	0.08	0.01	1.00	0.18	0.31	0.23
Verbal Reasoning	0.37	0.37	0.27	0.18	1.00	0.51	0.37
Verbal	0.21	0.17	0.23	0.31	0.51	1.00	0.44
Non-Verbal	0.28	0.38	0.23	0.23	0.37	0.44	1.00

Table 11

CORRELATION MATRIX OF WISC-R FSIQ WITH
TCS AND CCAT RAW SCORES

Variable	IQ	Sequences	Analogies	Memory	Verbal Reasoning	Verbal	Non-Verbal
IQ	1.00	0.25	0.32	0.05	0.28	0.18	0.28
Sequences	0.25	1.00	0.29	0.13	0.26	0.08	0.36
Analogies	0.32	0.29	1.00	-0.02	0.30	0.24	0.26
Memory	0.05	0.13	-0.02	1.00	0.10	0.38	0.20
Verbal Reasoning	0.28	0.26	0.30	0.10	1.00	0.41	0.39
Verbal	0.18	0.08	0.24	0.38	0.41	1.00	0.38
Non-Verbal	0.28	0.36	0.26	0.20	0.39	0.38	1.00

APPENDIX B

Table 12

Table 13

Table 12

REGRESSION OF WISC-R FSIQ WITH
TCS and CCAT GRADE PERCENTILES

Variable	Multiple R	R^2	F	df
Analogies	0.38	0.14	16.05	1/96
Verbal Reasoning	0.47	0.22	13.48	2/95
Non-Verbal	0.48	0.23	9.61	3/94
Sequences	0.49	0.24	7.39	4/93
Memory	0.50	0.24	5.99	5/92
Verbal	0.50	0.25	4.95	6/91

Table 13

REGRESSION OF WISC-R FSIQ WITH
TCS GRADE PERCENTILES

Variable	Multiple R	R^2	F	df
Analogies	0.38	0.14	16.06	1/96
Verbal Reasoning	0.47	0.22	13.45	2/95
Sequences	0.48	0.23	9.49	3/94
Memory	0.48	0.23	7.13	4/93

APPENDIX C

Table 14

Table 15

Table 14

REGRESSION OF WISC-R FSIQ WITH
TCS AND CCAT RAW SCORES

Variable	Multiple R	R^2	F	df
Analogies	0.32	0.10	11.00	1/96
Non-Verbal	0.38	0.14	8.07	2/95
Verbal Reasoning	0.40	0.16	6.06	3/94
Sequences	0.41	0.17	4.80	4/93
Verbal	0.41	0.17	3.80	5/92

Table 15

REGRESSION OF WISC-R FSIQ WITH
TCS RAW SCORES

Variable	Multiple R	R^2	F	df
Analogies	0.32	0.10	11.00	1/96
Verbal Reasoning	0.37	0.14	7.71	2/95
Sequences	0.40	0.16	5.83	3/94
Memory	0.40	0.16	4.34	4/93