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Title: Relationship Between Scores on the Columbia Mental Maturity Scale and the Stanford-Binet Intelligence Scale: Fourth Edition

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This study investigated the relationship between the Stanford-Binet: Fourth Edition and the Columbia Mental Maturity Scale. A kindergarten class of 21 children (10 boys, 11 girls) was administered each test. Six scores were recorded for each subject: CMMS, Binet IV Composite, and four Binet IV Area scores (Verbal, Abstract/Visual, Quantitative, and Short-Term Memory). The male children scored higher on Binet IV Composite, Binet IV Verbal, Binet IV Quantitative, and Binet IV Short-Term Memory. The females' mean score was higher on Binet IV Abstract/Visual and the CMMS. However, no statistically significant differences occurred between male and female means for any of the tests. Pearson product-moment coefficients were

calculated to determine the relationship between the CMMS and the five Binet IV scores. None of the correlations were statistically significant. This study indicates that until further comparative data are available a great deal of caution should be used when employing the CMMS as a quick, screening test.

Relationship Between Scores on the Columbia Mental Maturity Scale and the Stanford-Binet Intelligence Scale: Fourth Edition

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CHAPTER 1

INTRODUCTION

The intelligence test as we know it today was first formulated by the French psychologist Alfred Binet in 1905. During the last 80 years, extensive research has produced many new tests and numerous revisions of old tests to measure and evaluate individual differences in intellectual functioning. With the development of these tests, a heated debate has taken place concerning the definition of intelligence and intelligence testing.

According to Wechsler (1981), intelligence tests are "sets of standardized questions and tasks for assessing an individual's potential for purposeful useful behavior" (p. 7). Coon (1985) stated that most psychologists would agree with Wechsler's general description of intelligence testing. However, Coon went on to explain that many psychologists simply accept an operational definition of intelligence testing. That is, intelligence tests measure an individual's performance on a specific test in relationship to the performance of other people who belong to the same standardized group. Phares (1984) summarized the discussion concerning the definition of intelligence testing by stating the following:

> Definitions of intelligence as the ability to adapt, to learn or to adjust are interesting, but such definitions are so general they are not very useful. This disarray in the quality of definitions has promoted some psychologists to fall back upon the ultimate operational definition: Intelligence is whatever intelligence tests measure (p. 228-229).

When a new or revised test is published, researchers in education and psychology thoroughly study the tests on several dimensions, including the standardization process, test reliability, and test validity. Standardization is the process used by the authors of a test to establish a group of scores as a standard against which any individual's score may be compared. Reliability of a test refers to the ability of a test to yield the same score, or nearly the same score, each time it is given to the same person. Test validity refers to how well the test measures what it is intended to measure. Thus, a great deal of research is generated with the development of each new or revised test of intellectual ability.

In 1986 a new revision of the Stanford-Binet, the Stanford Binet Intelligence Scale: Fourth Edition (Binet IV), was published. The Binet IV Technical Manual (Thorndike, Hagen & Sattler, 1986) includes data concerning the standardization process, test reliability and test

validity. However, the comparative studies cited in the Technical Manual do not include data concerning the relationship of the Binet IV with any of the brief, screening tests of intelligence, including the Columbia Mental Maturity Scale (CMMS).

The Stanford-Binet has been widely used in clinical and educational settings. It has also served as a standard against which other intelligence tests, especially screening tests, have been evaluated. Thus educators and psychologists will want to know what the relationship is between the Binet IV and the brief, screening tests, such as the CMMS.

Review of the Literature

The Stanford-Binet Intelligence Scale has been widely used in clinical and educational settings since the first version was introduced in the early 1900's. Throughout the years, the Stanford-Binet has been revised several times. In 1916 Terman, at Stanford University, revised Binet's 1911 tests for use in the United States. In 1937 two alternative versions of the test were prepared so that a retest instrument would be available. In 1960 and 1972 renorming was accomplished. According to Phares (1984), "this steady series of revisions has combined with extensive research on the scales to make the Stanford-Binet one of the most widely used individual tests of intelligence" (p. 233).

The 1972 Stanford-Binet test provided a continuous scale for assessing intellectual ability in persons from age 2 to adult. The scale consisted of 20 age levels, with six to eight test items of varied content assigned to each level. Each item which is correctly answered earns a mental age score, as specified in the test manual. The scores for each correctly answered test item are added, yielding a final mental age score which is converted into an intelligence quotient. The test takes approximately 30 to 90 minutes to administer.

Throughout the years, the extensive research on the Stanford-Binet has included studies comparing scores obtained on the Stanford-Binet with scores obtained, by the same subjects, on other intelligence tests. The value of the other intelligence test was usually determined by its relationship to the Stanford-Binet. One of the brief, screening tests that has been compared with the Stanford-Binet is the Columbia Mental Maturity Scale (CMMS).

The CMMS was first published in 1954 and, like the Stanford-Binet, underwent revisions. The first revision of the CMMS occurred in 1959; the second occurred in 1972. According to Petroska (1973) the CMMS is best described as an individually administered, non-verbal, intelligence test measuring the ability in both perceptual classification and abstract manipulation of symbolic concepts. The CMMS was designed to test ages 3 1/2 through 9 years old. The test

consists of 92 6-by-19-inch cards, with each card containing three to five pictures. The test items are arranged in a series of eight overlapping levels, with each level having 51 to 65 cards. The level for each subject is indicated by the subject's chronological age. After establishing a starting point, the subject is shown one card at a time and is asked to select the picture which is different from or unrelated to the others. The subject indicates his or her choice by pointing to it. The cards are arranged in order of difficulty. Administration of the CMMS takes approximately 15 to 20 minutes. Scoring, as specified in the CMMS manual (Burgemeister, Blum & Lorge, 1972), produces a standard score, which is called an age deviation score.

Beginning with the first published version of the CMMS in 1954, numerous studies have compared intelligence scores obtained on the CMMS with scores obtained on the Stanford-Binet. These studies have included samples taken from the population of normal school children and several samples taken from special populations. These special populations have included mentally retarded children, children with brain damage, neurologically impaired children, children with cerebral palsy, children with speech handicaps, and children from poverty areas.

Research using samples of normal school children has yielded a wide range of correlation coefficients when

comparing scores obtained on the CMMS with scores obtained, by the same subjects, on the Stanford-Binet. In 1955 Berko tested 30 children and reported a correlation of .82 between the scores on the two tests. French and Worchester (1956) studied the test results of 41 children, 5 years of age and older, and found a correlation of .67 between the CMMS scores and the Stanford-Binet scores. Other research using normal subjects reported correlations of .39 (Johnson, Neely & Alling, 1956) for children age 10 and older and .39 (Levinson & Block, 1960) for preschool children. Bligh (1959) reported a correlation of .70 for 90 4-year-old subjects and a correlation of .59 for 106 6-year-old subjects. In 1959 Witsaman and Jones administered the Stanford-Binet to 12 students who had scores below 90 on the CMMS, producing a correlation coefficient of .55. Witsaman and Jones concluded that the CMMS yielded a much lower score at the low end of the intelligence scale.

Studies comparing scores obtained from mentally retarded children have yielded correlations ranging from .47 to .74. In 1956 French and Worchester administered the 1954 CMMS and the Stanford-Binet to 90 mentally retarded children and obtained a correlation of .67. Gallagher (1957) tested 24 children and reported a correlation of .53. In 1973 Riviere administered the CMMS and the Stanford-Binet to 153 residents of a mental health facility in Illinois. He reported a correlation of .52.

Additionally, Riviere reported a correlation of .47 with scores obtained on the CMMS when subjects were readministered the CMMS 35 days after the first administration of the test. Riviere reported that the mean CMMS score was significantly lower than the mean score derived from the Stanford-Binet. Ritter, Duffey, and Fischman (1974) reported a correlation of .74 between the CMMS score and the 1972 Stanford-Binet score, when testing 45 educable mentally retarded children. In the same study, a t test did not indicate a significant difference between means of the CMMS and the 1972 Stanford-Binet.

Studies concerned with how scores on the CMMS and the Stanford-Binet compare for children with brain damage have revealed correlations of .69 (Gallagher, 1957) and .93 (Gallagher, Benoit & Boyd, 1956). The Gallagher study tested a group of 24 subjects, ages 6 years, 9 months to 14 years, 5 months. The Gallagher, Benoit and Boyd study involved 40 institutionalized children age 7 years, 4 months to 13 years, 10 months.

In 1966 (Hirschenfang, Jaramillo & Benton) 15 neurologically impaired children were administered the CMMS and the Stanford-Binet, yielding a correlation of .84 for the nine boys tested and a correlation of .87 for the six girls tested.

Further studies using children with cerebral palsy yielded correlations between the two tests ranging from .56 to .62 (Berko, 1955; Johnson, Neely & Alling, 1956; Lantz & Wold, 1956).

In 1961 Hirschenfang administered the Stanford-Binet and the 1958 CMMS to 45 children with speech disorders. The data from this study indicated a correlation of .88 between scores obtained from the two tests.

A study conducted in 1966 (Rosenberg & Stroud) concluded that when compared to the Stanford-Binet scores, the CMMS underestimated intelligence in kindergarten children from poverty areas. The study was composed of a sample of 28 Negro children from Baltimore. The difference between the means of the two tests was statistically significant ($t=4.58$, $p<.01$).

Three additional studies should be noted. In 1957 May and Perry compared the vocabulary subtest of the Stanford-Binet with the 1954 CMMS. The subjects for the study were 51 educable mentally retarded children. A comparison of the scores from the CMMS and the Stanford-Binet subtest yielded a correlation of .46 for children below age 13 and a correlation of .41 for children above age 13. The product-moment correlation coefficient between the two measures for the total group was .43. In her 1962 unpublished master's thesis, Fleming reported a correlation coefficient of .33 when comparing mental ages obtained on the CMMS and the

mental age obtained on the Stanford-Binet. The subjects for Fleming's study were 50 children, all exceptional in either behavior or school achievement, and ranging in age from 5 to 13 years old. When Fleming conducted a second comparison, using only the mental ages of the 33 children in the sample whose scores were from 85 to 115 on the Stanford-Binet, she reported a correlation of .63 when comparing the mental ages of the Stanford-Binet and the CMMS. Thus Fleming suggested that the mental ages of the two tests seemed to correlate more closely for students with average intellectual abilities. Fleming further noted that the CMMS consistently reported lower mental ages than the Stanford-Binet.

The final study (Carvajal, McVey, Sellers, Weyand & McKnab, 1987) was the first study to appear in the literature that compared the Binet IV with the CMMS. Carvajal et al. tested a third-grade class of 23 children (11 boys, 12 girls) in a midwest community of 27,000. The correlation between the Binet IV Composite standard age score and the CMMS age deviation score was .477.

As evidenced in the preceding paragraphs, beginning with the first published version of the CMMS in 1954, numerous studies have compared scores obtained on the CMMS with scores obtained on the Stanford-Binet. Additionally, these studies have included samples taken from various populations of children.

The Stanford-Binet Intelligence Scale: Fourth Edition

In 1986 the Stanford-Binet Intelligence Scale: Fourth Edition (Binet IV) was published. This revision of the 1960 Form L-M covers the same age range and includes many of the same type of test items. However, the new test manual (Thorndike, Hagen & Sattler, 1986) lists several differences in the Binet IV's test format. Three of these changes are as follows:

1. Items of the same type are grouped into fifteen tests, with each test requiring a somewhat different cognitive skill and fund of information for successful performance.
2. Four broad areas of cognitive abilities are appraised by the 15 tests. These four areas are: Verbal Reasoning, Abstract/Visual Reasoning, Quantitative Reasoning, and Short-Term Memory.
3. The composite score (final score) that appraises general reasoning ability is retained in the Stanford-Binet Intelligence Scale: Fourth Edition. In addition, the following scores will now be available: scores for the four areas described above, any combination of these four area scores, and the individual test scores for all 15 subtests (p. 1).

Purpose of this Study

As previously mentioned, the comparative studies cited in the Binet IV Technical Manual (Thorndike, Hagen & Sattler, 1986) do not include data concerning the relationship of the Binet IV with any of the brief, screening tests of intelligence, including the CMMS. The only study to appear in the literature that compared the Binet IV with the CMMS (Carvajal, McVey, Sellers, Weyand & McKnab, 1987) used third-grade students as subjects. This study was designed to provide data concerning the relationship between the Binet IV and the CMMS when testing a younger age group, kindergarten students.

The CMMS was chosen for this study for the following three reasons:

1. The CMMS has been the focus of research in the past.
2. Although the format of the CMMS does not include items that test a wide range of abilities as evidenced in the 15 subtests of the Binet IV, the CMMS does examine perceptual classification and abstract manipulation. Thus the CMMS and the Binet IV do have a similar construct.
3. The CMMS is an appropriate test for kindergarten students.

According to research conducted by Egeland (1978):

> The most significant improvement in the latest revision (of the CMMS) is the direct standardization of the test. The norms for the Columbia Mental Maturity Scale were derived from testing 2,600 children carefully selected to control for parental occupation, race, and geographic location; the same appears to be quite representative of the national population (p. 298).

Egeland went on to report that split-half reliabilities for each age group range from .85 to .91, with a median of .88. The CMMS manual (Burgemeister, Blum & Lorge, 1972) reported a correlation of .67 when 52 preschool and first-grade students were administered the CMMS and the Stanford-Binet Intelligence Scale: Form L-M. Kaufman (1978) stated that the CMMS "is undoubtedly the best brief instrument (verbal or nonverbal) available, and it ranks as one of the finest for assessing preschool children" (p. 301).

Significance

Psychologists, teachers, counselors, and other school personnel must periodically make decisions concerning the proper selection of curriculum materials and learning tasks for children, including kindergarten students. Results obtained from recently administered intelligence tests can be an important part of this decision-making.

In clinical and educational settings, the Stanford-Binet has been one of the most widely used individual tests of intelligence. Additionally, quick, screening tests are sometimes administered to meet the demands of time, and the CMMS ranks as one of the finest, brief test for assessing intelligence in young children.

Since the Stanford-Binet has traditionally served as a standard against which the CMMS has been evaluated, data concerning the relationship between the Binet IV and the CMMS will be of interest to psychologists and educators. The Binet IV Technical Manual does not provide this correlative data, and the Carvajal, McVey, Sellers, Weyand & McKnab (1987) study provided data for third-grade students only. Therefore, the present study was designed to provide psychologists and educators with correlative data which can be utilized to determine if the CMMS can be confidently used as a valid screening test for assessing intelligence in young children.

CHAPTER 2

METHOD

Subjects

The sample for this study consisted of 21 kindergarten students who were enrolled in Unified School District #253 in Emporia, Kansas, a midwest community of 27,000. The Superintendent of Schools granted permission to use one entire class of kindergarten students at Butcher Elementary School as participants for this study. The decision to use an intact class was influenced by the prediction that approximately three to four hours of testing would be needed for each subject. Additionally, Butcher Elementary School is housed on the campus of Emporia State University and operates in conjunction with the University in that university students may observe the educational activities at Butcher School. However, the elementary school is part of the public school system; any student within Unified School District #253 may attend Butcher Elementary School.

The parents or guardians of each student were sent a letter explaining both the reason for this study and the testing procedures. Confidentiality was observed, and the children were identified only by age and sex. Names were

not listed. Additionally, an application for the approval to use human subjects was submitted to Emporia State University's Review Board for Treatment of Human Subjects, and was subsequently approved.

The sample included 10 males and 11 females. At the time of testing, the children's range in age was from 5 years, 1 month to 6 years, 11 months. The mean chronological age was 5 years, 8 months.

Variables

In this study there were six variables, all of which were score data.

Variable 1: Each subject has a score on the CMMS.

Variable 2: Each subject has a composite score on the Binet IV.

Variable 3: Each subject has a score for the area of Verbal Reasoning on the Binet IV.

Variable 4: Each subject has a score for the area of Abstract/Visual Reasoning on the Binet IV.

Variable 5: Each subject has a score for the area of Quantitative Reasoning on the Binet IV.

Variable 6: Each subject has a score for the area of Short-Term Memory on the Binet IV.

Materials

The Columbia Mental Maturity Scale (CMMS) and the Stanford-Binet Intelligence Scale: Fourth Edition (Binet IV) were administered to each subject, following the precise directions specified in the respective test manual. A stop watch was used, when specified.

Procedure

Each subject was individually administered the CMMS and the Binet IV to obtain intelligence scores for each test. Tests were administered by school psychology students in the exact manner described in the respective test manuals. All testing was supervised by an expert in intelligence testing at Emporia State University. To prevent experimenter bias, the author of this study did not administer or score any of the tests involved in this study.

All testing was conducted in rooms specifically designed for testing. Approximately two weeks before testing began, subjects were given a tour, as a group, of the testing rooms at Emporia State University. Rapport was developed with the subjects by explaining the general testing procedures, encouraging questions and discussion, and answering all questions. Each examiner was encouraged to build upon this initial rapport when administering the tests.

Tests were administered within a 9 week period during October, November, and December, 1986. In an attempt to

control variables such as hunger, fatigue, and level of attention, all testing was conducted between 1:30 and 3:30 p.m. Although a battery of tests was administered, subjects were not given more than one test on the same day. The school calender indicated no special or extra-ordinary activities during the designated weeks of testing. One examiner administered and scored all of the CMMS tests; another examiner administered and scored all of the Binet IV tests. Thus, there was consistency in developing rapport, administration, and scoring.

Statistical Design

The procedure described above produced six scores for each subject; one score obtained from administering the CMMS and five scores obtained from administering the Binet IV. Group means and standard deviations were determined for each score. The Pearson product-moment correlation was used to estimate the relationship of the CMMS scores with each of the five scores obtained from the Binet IV. A significance level of .05 was used. Additionally, the differences between pairs of means of the same scores were investigated through the use of a *t* test, using a significance level of .05.

CHAPTER 3

RESULTS

Six scores were obtained from administering the Columbia Mental Maturity Scale (CMMS) and the Stanford-Binet Intelligence Scale: Fourth Edition (Binet IV) to 21 kindergarten children (10 males, 11 females). The means, the standard deviations, and the ranges of the obtained scores are presented in Table 1. All of the obtained means were higher than the standardized means for the two tests, which is 100.

Table 1

Descriptive Statistics for Standard Age Scores (SAS) on the Binet IV and Age Deviation Scores (ADS) on the CMMS

Test	M	SD	Range
Binet IV			
Composite SAS	113.38	11.76	87-135
Verbal SAS	113.29	9.31	89-132
Abstract/Visual SAS	105.14	10.07	80-118
Quantitative SAS	112.95	15.98	72-132
Short-Term Memory SAS	113.29	16.37	85-154
CMMS ADS	110.29	12.81	92-136

The ranges varied from 38 to 69, with Binet IV Abstract/Visual having the lowest range and Binet IV Short-Term Memory having the highest range.

Pearson product-moment coefficients were computed to determine the relationships between the CMMS scores and each of the five standard age scores obtained from administering the Binet IV. Table 2 provides the summary of the correlations. None of the correlations were statistically significant ($p>.05$).

Table 2

Comparisons Between Scales on the Binet IV and the CMMS

Tests		r	t
Binet IV Composite SAS	- CMMS ADS	.400	1.05
Binet IV Verbal SAS	- CMMS ADS	.347	1.06
Binet IV Abstract/Visual SAS	- CMMS ADS	.340	1.77
Binet IV Quantitative SAS	- CMMS ADS	.256	.69
Binet IV Short-Term Memory SAS	- CMMS ADS	.320	.80

Note. None of the r or t values achieved statistical significance.

Results of *t* tests determined that there were no statistically significant differences between the mean for CMMS and the mean for any of the five Binet IV standard age scores. Results of the *t* tests are also presented in Table 2.

These data were further analyzed to determine if statistically significant differences occurred between male and female means on any of the tests. The male children scored somewhat higher on Binet IV Composite, Binet IV Verbal, Binet IV Quantitative, and Binet IV Short-Term Memory, while the females' mean score was somewhat higher on Binet IV Abstract/Visual and CMMS; however, none of these differences were statistically significant. Table 3 summarized the data for males and females.

Table 3

Descriptive Statistics for Male and Female Standard Age Scores (SAS) on the Binet IV and Age Deviation Scores (ADS) on the CMMS

	Male Subjects		Female Subjects		
Tests	M	SD	M	SD	t
Binet IV					
Composite SAS	115.1	10.5	111.8	13.1	.63
Verbal SAS	113.7	10.5	112.9	8.6	.19
Abstract/Visual SAS	104.3	11.3	105.9	9.3	.36
Quantitative SAS	118.2	8.4	108.2	19.9	1.48
Short-Term Memory SAS	114.1	15.7	112.5	17.7	.21
CMMS ADS	108.0	11.6	112.4	14.0	.77

CHAPTER 4

DISCUSSION

Major findings of this study are presented here.

The correlation between the Stanford-Binet Intelligence Scale: Fourth Edition (Binet IV) Composite standard age scores and the Columbia Mental Maturity Scale (CMMS) age deviation scores was .40. This correlation coefficient would account for only 16% of the variance on the Binet IV. Additionally, the correlation was much lower than the .67 relationship reported in the CMMS manual between the 1960 Stanford-Binet Form L-M and CMMS (Burgemeister, Blum & Lorge, 1972). The .40 correlation was also lower than the correlation coefficient reported in the recently published Carvajal et al. (1987) study of third-graders (r = .477). The correlation may be low due to the limited range of abilities measured by the CMMS as compared to the wide range of abilities measured by the subtests on the Binet IV. The CMMS requires that the child make perceptual and visual discriminations, and the CMMS manual indicates that "the CMMS is less dependent upon verbal reasoning abilities than is the (1960) Stanford-Binet" (p. 40). Past research using samples of normal school children has yielded a wide range of correlation coefficients when comparing scores obtained on the CMMS with scores obtained on earlier

editions of the Stanford-Binet, ranging from .39 to .82 (Berko, 1955; French & Worchester, 1956; Johnson, Neely & Alling, 1956; Levinson & Block, 1960; Bligh, 1959). Therefore, a great degree of caution should be used when substituting the CMMS for the Binet IV.

The correlations between each of the Binet IV area scores (Verbal, Abstract/Visual, Quantitative, and Short-Term Memory) and CMMS ranged from .26 to .35. None of the correlations were statistically significant.

The data collected indicated that the kindergarten children in this study had higher means than similar-aged children involved in the standardization of the Binet IV and CMMS. In order to determine if the means were actually higher or were simply due to error, additional research needs to be conducted using larger samples of kindergarten children that might more accurately represent the population of normal kindergarten students attending public schools.

Additional studies also need to be conducted using samples taken from special populations. The CMMS has traditionally been utilized with children whose vocabulary skills are limited, because the test was designed to be less dependent upon verbal abilities and more dependent on making perceptual and visual discriminations. Thus further studies need to include samples taken from special populations

which could include mentally retarded children, neurologically impaired children, children with cerebral palsy, children with speech handicaps, and children from poverty areas.

This study indicates that, until further comparative data are available, a great degree of caution should be used when employing the CMMS as a quick, screening test.

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