TEST-RETEST RELIABILITY OF THE KAUFMAN

ADOLESCENT AND ADULT

INTELLIGENCE TEST

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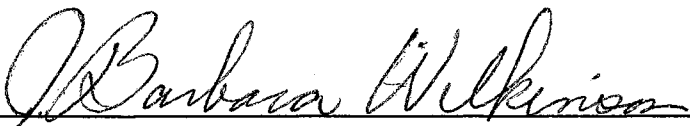the Degree of
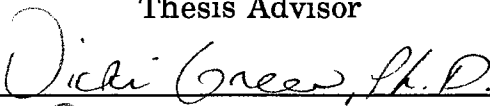DOCTOR OF PHILOSOPHY
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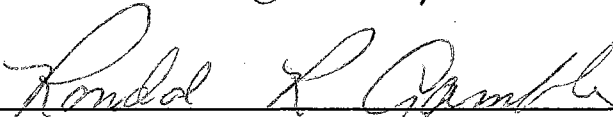
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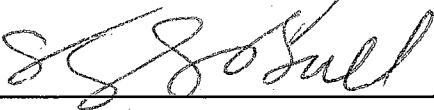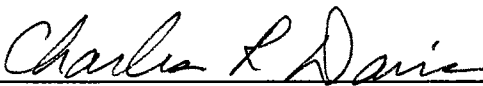Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Background

The Kaufman Adolescent and Adult Intelligence Test (KAIT) is a newly developed intelligence test (Kaufman & Kaufman, 1993) designed to assess individual age ranges from 11-85. The KAIT is based on three developmental models of intelligence including: (a) The Cattell-Horn theory of Fluid and Crystallized intelligence, (b) Piaget's fourth theory of cognitive development--specifically the fourth level--of formal operations, and (c) Luria and Golden's Block 3 planning ability. The main theoretical construct of the KAIT lies in the scale structures, which are based upon the Cattell-Horn theory of fluid and crystallized intelligence.

Kaufman and Kaufman (1993) designate three major objectives in the development of the KAIT which include:

1. to construct a practical intelligence scale that includes developmentally appropriate tasks and optimally suits the purposes of adolescent and adult assessment;

2. to construct a test battery whose scale structure is anchored in an intellectual theory that accounts for developmental changes in intelligence across the life span; and

1

3.　to construct an instrument that will provide rich clinical and neuropsychological information (p. 9).

<center>KAIT Scales, Subtests, and Scoring</center>

The KAIT contains three scales and eleven subtests. The scales are as follows: Crystallized, Fluid, and the combination of these two, which is called Composite Intelligence. The KAIT Fluid and Crystallized Scales are comprised of eight subtests which yield measures of intelligence and measures of memory. Three of these subtests: Definitions, Double Meanings, and Auditory Comprehension, form the Crystallized Scales. Rebus Learning, Mystery Codes, and Logical Steps are used to form the Fluid Scale. Alternate subtests can be used for each of these two scales. These are Famous Faces (Crystallized) and Memory for Block Designs (Fluid). The KAIT includes two additional subtests. These are used to discriminate delayed recall capacity from immediate recall. These subtests are Rebus Learning Recall and Auditory Comprehension Recall. An eleventh subtest (Mental Status) is available for use when the examiner questions the individual's ability to take the test. See Table I (all Tables appear in the Appendix) for a summary of these scales and subtests.

The Crystallized Scale includes four subtests that reflect mental functioning when solving experience-related and academically oriented problems. This scale measures abilities/tasks that are dependent upon advanced education and acculturation as well as "verbal conceptual development" (Kaufman & Kaufman, 1993, p.7). A brief description of each subtest is as follows: Definition--the subject is shown a clue about a word

and displays the word with letters missing. The subject is to use these clues to figure out the word. Double Meanings--the subjects are presented two sets of word clues in which to figure out the word that will associate with both sets of clues. Auditory Comprehension--the subjects listen to a tape of various news stories and are then asked questions about the various stories. Famous Faces (Alternative Subtest)--the subjects are shown photos of famous people and are asked to identify them.

All Crystallized Scale Subtests require a verbal response; and most of the subtests in this scale relate to real-life events. Reading ability could affect performance on the scale since the subtests of Double Meanings and Definitions emphasize problem solving as well as assess word knowledge and verbal concept formation. Poor performance on the Crystallized Scale may,

> reflect a reading problem and a lack of achievement rather
> than a low level of intelligence. The Crystallized Scale appears
> to improve with middle age and to maintain its level toward
> old age before gradually declining during the latter portion of
> the life span (Kaufman & Kaufman, 1993 p. 12).

The Fluid Scale indicates the level of intelligence when faced with novel problems. A brief description of each scale is as follows: Rebus Learning--the subject is shown pictures or designs (like hieroglyphics), and each design or pictures has a word meaning; these are displayed together. On the next page the subject is to read the phases or sentences which are rebus drawings only. Thus the subject must integrate picture word associations. Mystery Codes--the subject is presented various series of

pictorial stimuli along with identifying codes. The subject must then figure

which code applies to the pictorial stimulus. Logical Steps--the subject is

presented one or more logical premises both visually and aurally. The

subject must answer questions by deducting information from the logical

premises. Memory for Block Design (Alternate Subtest)--the subject is

shown a picture for five seconds and then asked to copy the design using six

blocks in a form board.

The Fluid Scale measures one's adaptable flexibility when confronted

with novel problems. Emphasis is on Luria's Planning ability (i.e., decision

making, evaluation, temporary continuity, impulse, and emotional control,

delay of gratification focusing of attention, flexibility, and creativity)

(Golden, 1981) as well as Piaget's formal operational thinking. Therefore,

formal schooling and acculturation are not factors in the ability to do well

on the Fluid Scales. The authors believe that,"memory and speeded items

on the KAIT Fluid Scale enhances its value as a comprehensive clinical

measure of adolescent and adult problem solving ability" (Kaufman &

Kaufman, 1993, p. 12).

The two scales relevant to assessing immediate versus delayed recall

are Rebus Delayed Recall and Auditory Delayed Recall. A brief description

of each is as follows: Rebus Delayed Recall is a subtest which is

administered approximately 45 minutes past the administration of the

Rebus Learning Subtest. Subjects are shown Rebus items and asked to

read them as best they can. Auditory Comprehension Recall is

administered approximately 25 minutes after the Auditory Comprehension test is administered. The subjects are asked questions about the tape they listened to earlier. Table II summarizes how subtests are used to compare immediate and delayed memory.

The KAIT's short Supplementary Mental Status Subtest is a quick screening of attention and assessment of one's orientation to their environment such as time, places, and events. Ten general mental status questions are asked which may be answered verbally or gesturally. The Supplementary Mental Status subtest only yields raw scores. The raw scores in this subtest are converted to descriptive categories, which are as follows: ages 11-54--Average, Below Average, Lower Extreme; Ages 55 to 85 and older--Average, Below Average, Lower Extreme--Mild Deficit, Lower Extreme--Moderate Deficit, Lower Extreme--Severe Deficit.

The organization of the KAIT allows the examiner to administer either a Core Battery, which is composed of six subtests, or the Expanded Battery, which is composed of 10 subtests. Both test batteries contain the Crystallized and Fluid Scales. The six subtests of the Core Battery are taken only from the Crystallized and Fluid scales. The Expanded Battery includes the subtests in the Core Battery as well as four additional subtests: Famous Faces and Memory for Block Designs (subtests that can be used as alternates in the Core Battery to enhance neuropsychological assessment), Rebus Delayed Recall, and Auditory Delayed Recall.

The test is unique in that it yields several different scores. The three scales yield standard scores and have a mean of 100 and a standard deviation of 15. Each of the subtests gives a mean of 10 and a standard deviation of 3. These scores are consistent with other popular individualized intelligence tests such as the Wechsler Scales (Wechsler, 1974; 1981; 1991). The following scores may be obtained after converting raw scores to scaled scores: (a) I.Q. for each scale, (b) confidence intervals for obtained I.Q., (c) percentile ranks for obtained I.Q., (d) mean scaled scores for each I.Q. scale, and (e) descriptive categories for obtained I.Q.'s. Descriptive categories for the Fluid and Crystallized I.Q. are based upon the six core subtests, even if the expanded battery is administered. The examiner is advised to sum only six subtest scaled scores (three for Crystallized and three for Fluid) to obtain the sum for the composite intelligence scale. Examiners may choose 90 or 95 percent confidence intervals. The KAIT yields descriptive categories for commonly used I.Q. ranges. The same categories are used to describe standard scores on the Kaufman Assessment Battery for Children (Kaufman and Kaufman, 1983a; 1983b), Kaufman Test of Educational Achievement (Kaufman and Kaufman, 1985a; 1985b), and Kaufman Brief Intelligence Test (Kaufman and Kaufman, 1990). The examiner may also compare the Crystallized versus Fluid I.Q. scores, graph scores on the test protocol, as well as determine significant strengths to weaknesses among the subtests.

Validity and Reliability

Any instrument employed to measure intelligence must present adequate predictive validity and reliability. Optimally, one will utilize an instrument which has both high reliability and validity. Subjectivity and biases may lead one to believe that a test is very good and works well in assessing various types of behaviors. However, only when tests are subjected to studies on reliability and validity can one assume the test is effective. When a new instrument has both good reliability and validity, we can feel confident that the test is both stable and measuring what it is intended to measure (Anastasi, 1988).

<u>Validity</u>

If a test is assessing what it is proported to measure, it is considered a valid test. Validity can be assessed in four basic ways: content, construct, predictive, and concurrent validity. Tests have content validity if they measure that which they intend to measure. Construct validity is the degree to which a test measures an intended hypothetical construct or non-observable traits. Concurrent validity is the degree to which scores on the instrument relate to scores on another established instrument administered at the same time. Predictive validity is the degree to which an instrument can predict some relevant criteria. The degree or extent of validity is assessed using correlational analyses.

<u>Reliability</u>

Reliability refers to how consistently the instrument measures what it is intended to measure. The reliable portion of the score is presumed to represent the true abilities of the examinee. Reliability can be assessed in five ways. These are test-retest (stability), equivalence, alternate forms, internal consistency, and split-half.

Test-retest reliability compares scores obtained from the same subjects over a given period of time. A variable that greatly affects test-retest reliability, is "the amount of time that elapses between successive administration of the same test" (Sax, 1980, p. 260). Alternate forms, internal consistency, and split-half reliability compare different parts of a task with each other. As with validity, the degree or extent of reliability is assessed using correlational analyses. If there is consistency between scores, the correlation will be high.

<center>KAIT Validity and Reliability</center>

Construct, concurrent, and diagnostic validity were assessed for the KAIT. The construct validity studies were quite extensive, investigating such areas as: (a) age changes on the KAIT subtests and I.Q. scales, (b) factor analysis of the KAIT, and (c) joint factor analysis with the Wechsler subtests.

Age changes on the subtests and scales were investigated for the sample ages 17 and older both with and without adjusting for years of

education. On all subtests there was a fairly steady increase in the mean raw scores in the 11-24 age group. The Crystallized scale subtests varied substantially among the age groups, yet the change in Fluid scale subtests were more moderate. The Crystallized scale scores leveled off in the mid twenties, and remained consistent until age 54. The mean scores decreased steadily on these four subtests for those 54 and older. The Fluid scale subtests dropped somewhat from ages 20-24, yet remained at approximately the same level for those ages 25-54. After the age of 54 the drop in mean scores is very steep. The average mean scores of the Fluid scale subtests for those age 75+ are well below the mean of 11 year olds. These age-related patterns changes are consistent with the Horn-Cattell theory.

Note: due to our educational system, differences in the years of formal education are present. Thus, Kaufman (1990) indicates on the average those subjects in their twenties and thirties were better educated than those over the age of 40 due to mandatory education/attendance laws. Since I.Q. and education correlate a great deal (approximately .60 - .70) within age groups, this cohort difference confounded the interpretation of age differences. To control for years of education received by persons of different ages, analyses of covariance were conducted for each subtest and I.Q. scale, with years of education serving as the covariate. Kaufman and Kaufam (1993) indicate "The adjustment for education tends to lower the mean for groups who are the most educated and raise the means for the age groups with the least formal schooling" (p. 86).

The factor analysis strongly support the construct validity of the
KAIT. These analysis were consistent with Horn and Cattell's--Fluid and
Crystallized factors. Other analysis also lend support of construct validity
for clinical populations using the KAIT.

The joint analysis of the KAIT and Wechsler subtests yielded four
distinct conclusions. According to Kaufman and Kaufman (1993),

> We draw the following conclusions from the joint factor analyses of
> KAIT and Wechsler subtests:
>
> 1. Three factors define the joint matrices of the KAIT and the
>   Wechsler scales: Crystallized/Verbal, Fluid, and Perceptual
>   Organization.
>
> 2. The constructs underlying the KAIT Fluid and the Wechsler
>   Performance Scales are distinctly different. The Fluid and
>   Perceptual Organization correlate about as highly with each
>   other as they do with the Crystallized/Verbal factor.
>
> 3. The constructs underlying the KAIT Crystallized and the
>   Wechsler Verbal scales seem virtually identical; all component
>   subtests load substantially on the Crystallized/Verbal factor.
>
> 4. The KAIT Crystallized and Fluid subtests load consistently on
>   the factors underlying their respective scales. The Wechsler
>   subtests, however, sometimes do not load highly on the factor
>   underlying the scale to which they belong (p. 94).

Concurrent validity was demonstrated by correlations of the KAIT
with two brief measures of cognitive ability, which are the Kaufman Brief
Intelligence Test (KBIT) and the Peabody Picture Vocabulary Test Revised
(Dunn & Dunn, 1981). The KABC Achievement Scale and the KAIT yield a
correlation of .82, which enhances support of the KAIT's concurrent validity.

Diagnostic validity of the KAIT with clinical profiles was conducted
by examining the mean I.Q. as well as subtest profiles of each clinical

sample as follows: neurologically impaired, left versus right-hemisphere damage, clinically depressed, Alzheimers-type dementia, and reading disabled. These profiles were compared to profiles of a control group which were selected from the standardization sample matched on the following variables: age, gender, race or ethnic group, and years of education. The overall results indicate the KAIT possesses a favorable potential in assessing clinical profiles. The use of the Expanded Battery over the Core Battery was of more value. "The specific findings for these clinical samples, while interesting are still tentative and need cross-validation" (Kaufman & Kaufman, 1993, p. 107).

The KAIT was assessed for two measures of reliability: internal consistency which was estimated by the split-half method, and test-retest reliability. One short term test-retest reliability study was conducted by the publisher. Subjects were 153 individuals closely matching the 1988 census in regard to race and gender. The mean time interval was 31 days, the range was from 6-99 days. Test-retest reliability coefficients for the three scales are .94 for the Crystallized, .87 for the Fluid, and .94 for the Composite.

Split-half reliability was assessed using 50 clinical cases (eight Alzheimer's-type dementia and 42 brain damaged). Given the considerable variability inhibited by this group, the split-half reliability coefficient of .87 indicated very high reliability of this subtest for this clinical population.

Purpose of the Study

The purpose of the study was to investigate the reliability of the KAIT using test-retest procedures. The KAIT was a new instrument in which proven reliability has not been demonstrated over long time periods, e.g., of at least one year. Subjects were tested then retested after a years interval. The present study controlled for age, gender, and educational level. Socio-economic level was assessed with the examinee's or parental educational level.

Problem Statement

Currently, the literature does not identify large longitudinal (one year) test-retest studies using the KAIT. This study used a total sample of 120 (N=120), controlling for three age groups, gender, and educational level. These three variables were controlled for in the national standardization. Race and geographic region were not controlled for in this study, due to the unavailability of certain racial groups, as well as the lack of feasibility to travel to collect data from a geographically diverse group. It was intended for this study to establish the degree of test-retest reliability of test scores on the KAIT over time (one year interval).

Hypotheses

I.   A.   Null: The demonstrated test-retest reliability coefficient of the

KAIT scale scores will be less than .60.

Research: The demonstrated test-retest reliability coefficient of

the KAIT scale scores will be at least .60.

B.   Null: The demonstrated test-retest reliability for the ten subtests

will be less than .60.

Research: The demonstrated test-retest reliability for the ten

subtests will be at least .60.

C.   Null: The demonstrated test-retest reliability coefficient of the

KAIT scale scores and subtest scores for the ages 11-24, 25-54,

and 55+, as well as gender, will be less than .60.

Research: The demonstrated test-retest reliability coefficient of

the KAIT scale scores and subtest scores for the ages 11-24, 25-54,

and 55+ will be at least .60.

II.A.   Null: There will be no significant different in overall test scores of

male and females participants on the KAIT.

Research: There will be a significant different in overall test

scores of male and females participants on the KAIT.

B.   Null: There will be no significant difference in the KAIT scale

scores among 11-24, 25-54, and 55+ age groups.

Research: There will be a significant difference in KAIT scale scores depending on age level, with the 11-24 and 55+ groups scoring significantly lower than 25-54 group.

C. Null: There will be no significant difference on the Fluid scale scores among all three age groups.

Research: There will be a significant difference in Fluid scale scores among the three age groups, with the 55+ age group scoring lower than the other two age groups.

Limitations.

This dissertation has several limitations, or threats to validity, which may negatively affect the generalizability of the results. This study was given to 120 caucasians in the southwest region of the United States, which limits generalizability. The following are threats to validity:

I. History may affect some of the items, given events occurring around the time of the administrations of the test. The Persian Gulf War appeared to affect the test salience of two items. On the KAIT Auditory Comprehension subtest, a story, ("Foreign Objects") addresses issues faced by American women in Saudi Arabia. It appeared that subjects who were administered the test were more likely to correctly answer the question, "In what country did Foreign Objects take place?", than might have been expected before the Gulf War. Furthermore, on the subtest Gestalt Closure, which is not a part of the KAIT, yet was

administered for the 1990 Standardization Version, an individual who

served in the Persian Gulf War indicated that the giraffe was a camel.

II.   The standardization version ranged from one hour and 45 minutes to

two hours and 30 minutes. Different administration times may

differentially affect test attitude. Several subjects appeared frustrated

and this may have affected test performance on the remaining subtests

for these subjects.

III.   There is possible improvement on an individual's post test scores

resulting from the subjects having taken a pretest (Gay, 1981). This

improvement may differ by cohort. Younger subjects may have learned

more, while older subjects may have lost knowledge or skills.

IV.   As a general issue, confounding cohort with education, is also a

possible source of error. It is possible that some subjects did not

report their educational level accurately. Many people with little or no

education do not like to admit their low education levels.

V.   Carry-over effects combine results in which multiple treatment

interference was present. This was demonstrated by subjects'

responses after the retesting. Remarks included: "'I remember this

one', 'I like this one', 'I hate this part', 'I do/don't think I got that one

right last time"'. One astonishing example was from a 32 year old

lady. During the second testing session, after the examiner flipped to

the first page of the Rebus Learning subtest and before the examiner

said anything, the lady responded by saying "that is 'bus', 'plane',
'something' and 'the'".

CHAPTER II

REVIEW OF THE LITERATURE

Foundation of the KAIT

The Kaufman Assessment Battery for Children (KABC) is an individual cognitive test as well as a test that measures academic strengths and weakness in children ranging from age 2½ to 12½ (Kaufman and Kaufman, 1983a & b). The KABC was standardized on a population of 2,000, controlling for age, gender, race, geographic region, parental education, community size. The KABC is composed of ten subtests of which seven are simultaneous and three are sequential. Four Scale (Composite Scores) are yielded by the KABC: a) Simultaneous Scale; b) Sequential Scale; c) Mental Processing Composite (MPC); and d) Achievement Scale. The Global Scale yields a mean of 100 and a standard deviation of 15, and the subtests yield a mean of 10 and a standard deviation of 3. A standard error of measurement may be calculated for the examiner to use for the range of scores on the protocol. The test score also may be converted to stanines, age equivalents, and grade equivalents.

Cohen, Montague, Nathanson, & Swerdilk (1988) indicate that this instrument looks at problem solving and information processing as well as

abilities which are easier to remediate educational defaults. Cohen, et al (1988), as well as Kaufman and Kaufman (1983b), have stated that the mental processing portion of this instrument relies more upon one's fluid abilities, and the achievement portion relies upon the crystallized portion as it deals with more school-related knowledge.

The development of the KABC consisted of a merging of different perspectives--cognitive psychology and neuropsychology. Luria's (1966) work has been credited as the basis of Kaufman's measure of intelligence (Das, 1984; Sternberg, 1984a). The scope of Luria's (1966) processing analysis may be correctly identified as a subcomponent of the conceptualization of the KABC. Luria's work derived from Sechenov's investigations in 1878, indicating that some sections of the brain are predominantly associated with simultaneous spatial syntheses, while other parts of the brain are responsible for the function or synthesis of successive orderly constructed processes (Majovski, 1984). Luria (1966) defined the meaning of the terms successive and simultaneous as follows:

> These terms are not sufficiently accurate. In fact, in the first case is meant the synthesis of successive (arriving one after another) elements into simultaneous spatial schemes, and in the second--the synthesis of separate elements into successive series. We shall continue to use this terminology in the future, bearing in mind that it is conventional (p. 74).

Luria placed great emphasis on the frontal occipital processing dichotomy, whereas Sperry (1968) interpreted the processing dichotomy as a mere function of right-left brain processing. Despite these differences in localization of the processing dichotomy, Luria and Sperry seemed to agree

on their definitions of mental processing. These interpretations also clearly resembled the distinction between serial and parallel processing which has been identified by researchers in the field of cognitive psychology (Neisser, 1967; Cohen, 1973).

Das, Kirby, and Jarman (1979) attempted to integrate the findings from the fields of cognitive psychology and neuropsychology. Through factorial analysis, Dean (1984) showed the relation of two distinct factors which correspond to Luria's sequential-simultaneous dichotomy. Das et al (1979). labeled such a mental processing dichotomy as successive-simultaneous. These mental processes consist of the successive (sequential) process which reflects linear, analytic, and temporal processing and the simultaneous process which requires gestalt, holistic, and spatial processing. There have been many labels or names placed upon these types of mental processing. The Kaufmans incorporated a convergence of results from several different perspectives in the two fields of cognition and neuropsychology (Kaufman & Kaufman, 1983a; 1983b). Further reading may enhance one's understanding of the development of the KABC (Anastasi, 1984; Jarman & Nelson, 1980; Jensen, 1984; Kamphaus & Reynolds, 1987; Spearman, 1904; Sternberg, 1983, 1984a; Piaget, 1965).

KAIT - Different from KABC

The KAIT is a clear departure from the KABC (Kaufman & Kaufman 1983a; 1983b). The two main factors affecting the decision to approach the intellectual assessment differently from the KABC include: (a) development

and neurological changes that occur at about ages 11-12 years, and (b) the inadvisability of measuring cognitive ability separately from language development and achievement for adolescents and adults (Kaufman & Kaufman, 1993). The integration of neuropsychology with cognitive psychology provides a sound basis for the KAIT.

Neuropsychological Basis. In adolescence major changes have been documented in both cognitive and neurological development which indicate the frontal lobes are not fully developed. Around the age of 12, "the prefrontal areas of the brain that serve as the tertiary level of the output/planing unit start to develop" (Golden, 1981, p. 292). The tertiary levels describe levels of Luria's Block Three Planning Ability main functions, which include: "planning (decision making) evaluation, temporal continuity, impulse and emotional control (delay of gratification), focusing of attention, and flexibility (creativity)" (Golden, 1981, pp. 285-286). Measures of frontal lobe abilities would be useless in a battery for those whose frontal lobes have not yet been developed. Work by McCallum, Merritt, Dickson, Oehler-Stinnett, and Spencer (1988) indicated that, "tertiary frontal lobe development does not occur until adolescence, precluding development of complex planning ability in preadolescent children" (p. 410). Thus, the inclusion of tasks measuring frontal lobe skills appears to be appropriate for the KAIT.

Cognitive Basis. Hypothetical deductive reasoning is characteristic of Piaget's stage of formal operations which has an average onset of ages 11-12

(Inhelder & Piaget, 1958). In formal operations individuals demonstrate the ability to deal with abstract concepts, generate and test hypotheses, and address matters extending beyond their own personal experiences. Formal operational skills appear to be consistent with Luria's (1973; 1980) description of planning abilities in terms of problem solving, self-monitoring, answering new questions, programming, regulating, verifying, and organizing conscious activity.

Piaget (1972) indicated that these skills do not develop suddenly:

> From ages 11-12 years to 14-15 years, a whole series of
> novelties highlight the arrival of a more complete logic,
> attaining a state of equilibrium once the child reaches
> adolescence at about 14-15 years. In addition, the onset of
> professional specialization occurs around 15 to 20 years of age
> and usually corresponds to the individuals aptitude which led
> to the construction of a life program (p. 11).

According to Kaufman, Kaufman, and Flaitz (1987), the Piagetian formal operations stage is divided into two sub-stages: (a) age 11-15 is a period of organization and (b) age 15 to adulthood is a period of achievement. Several studies indicate that formal operational thought fails to fully develop in many individuals (Lawson & Renner, 1974; Blasi & Hoeffel, 1974). Lawson and Renner (1974) indicate the educational system may be a factor in the low incidence of formal operational thinking. There has been an emergence of a second subperiod referred to as post formal operations (Kramer, 1983). Kaufman and Kaufman (1993) believe that a Piagetian framework per se does not exist and that with a combination of

the cognitive and neuropsychological approaches, the emergence of

adolescence through adulthood intelligence is better understood.

Theoretical Constructs

Kaufman and Kaufman (1993) acknowledge three theoretical models

which are the basis for the development of the KAIT. While the Piagetian

framework does not provide a model for adulthood, "the abstract skills

required to enter the formal operation stage are appropriately complex to

serve as a model for instructing new tasks to assess adolescent and adult

thinking" (p. 10). Furthermore, Golden's (1981) modification of Luria's

tasks and the "initial development of the KAIT make a natural link between

the Piagetian and Cattell-Horn theories" (Kaufman & Kaufman, 1993, p.

40). All three models are developmentally focused on the variables that

affect the growth of crystallized and fluid intelligence.

Cattell-Horn Theory of Intelligence

The fluid-crystallized distinction was presented by Cattell (1941). In

the 1960's, Horn and Cattell (1966) merged their theory of fluid and

crystallized measures of intelligence with their measure of general

intelligence. Horn has continuously re-examined the fluid/crystallized

model and identified other abilities of general intelligence (Horn, 1985,

1989; Horn, Donaldson, & Engstrom, 1981; Horn & Hofer, 1992). Horn's

model extends to the Fluid and Crystallized (Gf-Gc theory) abilities to

include memory demands, sensory modalities, speed of response, and quantitative abilities (Horn, 1985). According to Cattell and Horn (1978), fluid intelligence (Gf) is the ability to solve new problems especially not associated with formal education or acculturation. Tasks that involve fluid intelligence abilities should involve stimuli and concepts that are of equally availability to any one in a culture (Kaufman & Kaufman, 1993). Abilities that are closely related to success are fluid intelligence tasks that include flexibility, adaptability, and analytic ability (Cattell & Horn, 1978; Horn, 1970; 1978; 1989; 1991; Horn & Cattell, 1966; 1967; Horn & Hofer, 1992).

The Cattell-Horn definition of crystallized intelligence (Gc) is composed of a range of abilities which are closely related to, as well as dependent on, fluid tasks. These crystallized tasks may include symbolic, semantic, or figural stimuli which may involve high level skills such as abstract/reasoning, comprehensive reasoning, concept formation, perceiving relationships, verbal comprehension tests of general information and the ability to assess one's experiences. The content of the crystallized tasks is always closely related to advance education and acculturation. Gc represents one's knowledge which is needed to function in a culture. At a personal level, Gc indicates the amount to which an individual has internalized the intelligence of a culture (Horn, 1989).

The Cattell-Horn (1978) theoretical distinction is as follows:

> It does not pertain to the type of tasks involved. Instead, it
> pertains to the kind of development that leads to the
> separation of two structures... The many influences that
> promote incorporation of the intelligence of a culture work in

> loose harmony to produce the broad pattern of abilities of Gc,
> while many influences related to incidental learning and
> associated with neurophysiological health represent a unity
> that binds together a broad pattern of abilities seen in Gf (p.
> 140).

The theory of Gc and Gf has produced a focus on research dealing with aging and the decline of intelligence in late adulthood, as well as studies designed to enhance abilities in the elderly (Baltes, Dittmann-Kohli, & Kliegl, 1986; Baltes & Willis, 1982; Dixon, Kramer, & Baltes, 1985; Kausler, 1982; Schaie & Willis, 1986).

<center>Theoretical Basis</center>

According to a study by Harrison, Kaufman, Hickman, and Kaufman (1988), the most common reason for assessing adolescents and adults is to assess brain functions as well as to obtain clinically relevant information. Thus, Kaufman and Kaufman (1993) believe that,

> the assessment of adolescent and adult intelligence should
> reflect a relatively broad spectrum of both fluid and crystallized
> abilities, since both are important in various aspects of life.
> Even if poor language and academic skills are due more to
> motivational and cultural factors than to so-called intellectual
> potential, the outcome for adolescents and adults is the same:
> they are functionally less academically intelligent than their
> peers. Participating intelligently in adult society - socially,
> vocational, or culturally - demands crystallized abilities in the
> form of effective verbal communication, alertness to the
> environment, and well-developed verbal concepts.

Verbal as well as crystallized skills improve with age into the 60's. Conversely, nonverbal and fluid abilities peak during late adolescence and decline with aging (Cattell & Horn, 1978; Horn, 1985; Kaufman, 1990; Kaufman, Reynolds, & McLean 1989; Persuad, 1991; Kaufman, Kaufman-

Packer, McLean & Reynolds, 1991; and Wang & Kaufman, 1993). Kaufman

and Kaufman, (1993) indicate that language, as well as acquired knowledge,

need to be included with problem solving abilities. These authors conclude

that the exclusion of language and acquired skills would penalize the

elderly. Thus, according to Kaufman and Kaufman (1993), the crystallized

items on the KAIT,

> assess acquired skills that are functional (understanding news
> stories, in Auditory Comprehension); focus on everyday verbal
> concepts (Definitions, Double Meanings); and reflect alertness
> to the visual and auditory media that describe the world
> (identifying famous people from history and U.S. culture, in
> Famous Faces). If intelligence is segmented, it may not be
> clinically relevant. Thus, the KAIT measures the degrees of
> intelligence, "that are associated with adolescent and adult
> thought processes and that capture the absence of planning
> abilities and formal operational thoughts (p. 11).

Building of the KAIT

Subtest and Item Pool Development

The KAIT's construction began in 1984 with development of the item

pool as well as subtest construction. During this time 30 subtests and

almost 2500 items were generated. After careful analysis, the Tryout

Edition of the KAIT was developed. A key to item selection was, "to develop

as many tasks as possible that required Piaget's formal operational thought

and Luria-Golden's Block 3 planning ability" (Kaufman & Kaufman, 1993,

p. 67). These tasks are generally called measures of "problem-solving" in

cognitive psychology literature (Denney and Palmer 1981; Reese &

Rodeheaver, 1985). The authors of the KAIT sought measures of formal operational thought or planning ability that have face validity as complex abstract tests, whether they required manipulation of verbal stimuli (Double Meanings), nonverbal stimuli (Mystery Codes), or both (Logical steps, Rebus Learning).

National Tryout

A national tryout was conducted from 1986 to 1987. The Tryout Edition had 28 subtests and approximately 1850 items. Due to the length, "six group-administered forms of the KAIT were developed along with a seventh form that had to be individually administered because of the nature of the subtests" (Kaufman & Kaufman, 1993, p. 67). A total of 1140 adolescents and adults, ranging in ages 10-84, took part in the Tryout Edition. "The samples came from sites in four major regions of the United States and include White, Black, Hispanic, and Asian males and females from a wide range of socioeconomic levels" (Kaufman & Kaufman, 1993, p. 67).

Data obtained in the Tryout Edition were analyzed to make the final selections of the subtests and items for the National Standardization of the KAIT. "Two factor solutions seemed to give the best fit to date for the two adolescent and two adult age-groups studied" (Kaufman & Kaufman, 1993, p. 11). Of all the theoretical models considered, Sperry's (1968) left versus right hemisphere distinction or the Cattell-Horn dichotomy provided an

acceptable interpretation of the two tryout factors for all age-groups. The final decision of a theoretical model was delayed until standardization.

National Standardization

Between April, 1988 and October, 1991 a representative sample of 2,600+ subjects ranging in ages 11-94 years old were tested. During this time there were two standardization versions. The 1988 standardization version consisted of 16 subtests. To shorten the length of the test by eliminating some of the items, 451 tested cases were analyzed. The analysis was also used, which finalized the choice of the fluid/crystallized theoretical model (Kaufman & Kaufman, 1993, p. 11), thus the decision was to base the test on the fluid and crystallized dichotomy.

> "Explanatory (both orthogonal and oblique rotations) and confirmatory (LISREL) factor analyses gave strong support to a two-factor structure. These factors were consistent across age range and were easily defined as fluid intelligence and crystallized intelligence" (p. 70).

As a result of various analysis, (reliability estimates, length of administration, and costs) these data determined the selection of the final 1990 version which contained the KAIT Core and Expanded battery subtests.

Sample Selection

A stratified sample within each age group by gender, by geographic region, by socioeconomic status, and by race or ethnic group was used. The

U.S. Census (1988) data was used to establish the standardization sample. Gender was sought to match the distribution of females (51.4%) and males (48.6%). The KAIT gender distribution matched closely with 51.6% females and 48.4% males. The standardization ratio is within three points of the U.S. Census for all age groups. Four major regions of the U.S. were identified: Northeast, North Central, South, and West as defined by the U.S. Bureau of the Census (1990). While the South and North Central Regions were adequately represented, Kaufman and Kaufman (1993) acknowledged an under-representation of the Northeast and an over-representation of the West. As these authors purport that educational level has a plausible casual link to both measured intelligence and socioeconomic status (SES), educational level was used as a substitute variable for SES. "The standardization sample is within two percentage points of the 1989 Census projections in nearly every instance" for SES (Kaufman & Kaufman, 1993, p. 71). Race or ethnic group classifications were taken from the U.S. Bureau of the Census (1986, 1988). These were: white, black, Hispanic, and other (including Native Americans, Native Alaskans, Pacific Islanders, Asians, and all others not classified as White, Black, or Hispanic). Thus, the KAIT ethnic/racial categories consisted of four groups. The percentages of individuals within each category was within one percent of the U.S. population figures.

The Crystallized and Fluid Scales are described in detail in the following manner - the major abilities assessed, psycholinguistic aspects and

the major influences on performance. These descriptions can be found in the KAIT 1993 manual.

Crystallized Scale

The Crystallized Scale includes four subtests that reflect mental functioning when solving experience-related and academically-related problems. These subtests are described in detail.

Definitions Subtest. The Definitions subtest entails figuring out a word that is presented (with some letters missing) based on the word's configuration and a clue about the word's meaning. The major abilities assessed by Definitions include: Crystallized Intelligence, acquired knowledge (school related), fund of information, long-term memory, verbal comprehension and expression, verbal concept formation, visual closure, visual perception/processing of abstract or symbolic stimuli, and word knowledge. The psycho-linguistic aspects include input of both visual and auditory stimuli and output of vocal stimuli. Major influences affecting test performance may include cultural opportunities, foreign language background, intellectual curiosity and interests, outside reading, reading ability, richness of early environment, school learning, and spelling ability. Note: the Definitions subtest resemble Riddles subtest (KABC) as the examinee must integrate two separate clues in order to respond correctly, because one clue will usually not suffice. An alternate form of Definitions appears on the Kaufman Brief Intelligence Test (KBIT).

Auditory Comprehension Subtest. The Auditory Comprehension subtest requires the examinee to listen to a recording of a news story and then answer both literal and inferential questions from the story he/she just heard. The task requires that the examinee have a good attention span, and more than just rote recall, because the questions require some inferences to be made. This subtest allows examiners to see if the examinees are able to process messages at higher levels of the auditory system, even though the ability to repeat them is intact (Lezak, 1983). One must make inferences to answer some questions correctly. The major abilities assessed in this section include crystallized intelligence, acquired knowledge (school related), auditory sequencing, long-term memory, sequential processing, short-term memory, verbal comprehension and expression, and verbal concept formation. The psycholinguistic aspects include input auditorily and vocal output. The major influences that may affect test performance include alertness to the environment, anxiety, attention span, concentration, cultural opportunities, distractibility, flexibility, foreign language background, interests, outside reading, and richness of early environment.

Double Meanings Subtest. The Double Meanings subtest is a new type of test. The Double Meaning subtest was developed to assess an individual's ability to demonstrate verbal concept formation across two-word pairs, (e.g. almond/pistachio and bolt/screw; what is the common denominator word). Virtually all of the words used are common, everyday

words and concepts; the challenge is to unify apparently disparate semantic

stimuli. Furthermore, the KAIT subtest demands considerable flexibility of

thought for the examinee to think of two entirely different meanings for the

same simple word. The use of two sets of clues encourages each individual

to generate and reject hypotheses in search of the one-word solution. Thus,

this verbal subtest assesses the type of integrative, organizational, and

processing strategies that are associated with both Luria's planning ability

and Piaget's formal operations. It is easy and objective to score. Note: The

Double Meaning test resembles the Word Overlap subtest in the group

administered CAS test battery (Childs, 1982), that is published by the

National Foundation of Educational Research in England. Word Overlap is

an easier task than Double Meanings because of its multiple-choice format

in Word Overlap, the person actually sees the correct answer and must

select it among five choices, while the KAIT task forces the examinee to

generate the response.

Famous Faces Subtest (Alternate). The Famous Faces subtest

requires people to name people of current, or historical fame or places from

around the world, based upon photographs and a verbal cue. This test

measures the examinee's range of general information which is usually

acquired via newspapers, magazines, and television. This information

covers a wide area of diversity. It is believed that this test measures one's

environmental alertness which demonstrates functional skills for everyday

living. The major abilities assessed by this subtest include crystallized

intelligence, acquired knowledge (school related), cross-model integration, fund of information, long-term memory, range of general factual knowledge, verbal comprehension, and visual perception/processing of meaningful stimuli. The psycholinguistic aspects of this test include visual and auditory input and vocal output. The major influences that may affect test performance include alertness to the environment, attention to television, newspapers, magazines, and other visual media, cultural opportunities, foreign language background, intellectual curiosity and striving, interests, outside reading, reading ability, richness of early environment, school learning, and social/adaptive functioning. From a neurological perspective, there have been investigations to devise a task in which one may assess recognition memory of unfamiliar faces (Kagan & Kline, 1973; Leehey and Cahn, 1979; Benton, 1980; Young, 1984; Sergent & Bindra, 1981; Marzi & Berlucchi, 1977). Note: the Famous Faces subtest is an adaptation of the KABC achievement subtest.

Fluid Scale

The Fluid Scale includes four subtests that indicate one's level of functioning when faced with novel problems. These subtests are described in detail.

Logical Steps Subtest. The Logical Steps subtest is a test to measure deductive reasoning and syllogistic thinking; these appear to be closely related to Piaget's planning ability and formal operational thought. This

subtest requires the examinee to attend to logical stimuli presented visually and aurally and then respond to a question by making sense of logical stimuli. The major abilities assessed in this subtest include fluid intelligence, abstract reasoning, cross-model integration, facility with numbers, deductive reasoning, new learning efficiency, spatial visualization, speed of mental processing, syllogistic reasoning, and visual perception/ processing of abstract/symbolic stimuli. The psycholinguistic aspects of this subtest include auditory and visual (figural and symbolic) input and vocal output. The major influences that may affect test performance include ability to respond when uncertain, anxiety, attention span, cognitive style, concentration, distraction, and working under time pressure. Note: the concept of this task emerged from a subtest the Law School Admission Test (LSAT) named Logical Games (Gruber & Gruber, 1982).

Rebus Learning Subtest. The Rebus Learning subtest requires one to learn the word/concept associated with the various rebus symbols. The examinee reads various phrases, sentences, paragraphs, and close paragraphs made up of the rebuses. This subtest stimulates one's reading process and is somewhat like learning a new language. The examiner is able to observe examinees engaged in the learning process and see how they use their strategies, coping styles, ability to tolerate frustration, powers of concentration, and ability to incorporate feedback. Rebus Learning emphasizes concepts instead of focusing on simple paired associations. Thus, this subtest is a distinct measure of new learning. The major abilities

assessed include fluid intelligence, cross-modal integration, long-term memory, new learning efficiency, aspired associate learning, sequential processing, short-term memory, visual perception/processing of abstract or symbolic stimuli, and visual sequencing. The psycholinguistic aspects include input, auditory and visual, and vocal output. Major influences that could affect test performance may include ability to respond when uncertain, anxiety, attention span, concentration, and distractibility. Note: the concept of rebus was originally developed by Woodcock and Johnson (1977) and Woodcock (1978 & 1987) for their Psycho-Educational Battery and their Reading Mastery Test.

Mystery Codes Subtest. The Mystery Codes subtest requires the examinees to study codes that are associated with a set of pictorial stimuli . Then, they are required to ascertain a code for these pictorial stimuli. The major abilities assessed in this subtest include fluid intelligence, abstract reasoning, ability to distinguish essential from nonessential details, deductive reasoning (planning), new learning efficiency, speed of mental processing, and visual perception/processing of abstract/symbolic stimuli. The psycholinguistic aspects include visual (symbolic and figural) input and motor output. The major influences that may affect performance include ability to respond when uncertain, cognitive style, concentration, and working under time pressure. Note: this subtest was developed to assess complex problem solving behaviors that utilized many different facets of Luria's (1966) planning ability and Piaget's formal operations. These facets

include generating hypotheses, asking new questions, forming plans of

action, inspecting performance and regulating behavior, self-monitoring,

dealing with abstractions derived from propositions rather than from

experience, testing one's own hypotheses, and displaying one's flexibility of

thought.

Memory for Blocks Subtest (Alternate). The Memory for Blocks

subtest entails that the examinee be exposed for 5 seconds to a printed

abstract design, and he/she must then reconstruct the design from memory

using six blocks and a form board. The major abilities assessed by the

Memory for Blocks subtest include fluid intelligence, long-term memory,

nonverbal concept formation, perceptual organization, simultaneous

processing, short-term memory, spatial visualization, speed of mental

processing, visual motor coordination, and visual perception/processing of

abstract/symbolic stimuli. The psycholinguistic aspects of this subtest

include input of visual stimuli, and output of motor skills. The major

influences that affect performance on this subtest include anxiety, attention

span, cognitive style, concentration, distractibility, and visual perceptual

problems. Note: this subtest is an integration of two well received clinical

and neurological tests: Kohs' (1923) Block Design and the 1916 first edition

of the Stanford Binet (Terman, 1916).

CHAPTER III

METHOD

Subjects

This study was conducted with 120 caucasians only. This study did not sample the ethnic groups specified in the KAIT by Kaufman and Kaufman (1993). Additionally, subjects were selected from a four-state area of the southwestern United States, with the majority of subjects located in Oklahoma. Thus, this study did not sample all the geographic regions tested by Kaufman and Kaufman. However, age, gender, and education levels matched those delineated by Kaufman and Kaufman. The subjects represented five grade categories: grade 0 through 8, grade 3 through 11, high school graduation, 1 through 3 years of college/vocational training, college graduate and above. For subjects age 11 through 24, the educational level was obtained by using subject's parents' education level, not subjects' educational level. The subjects ranged in age from 11 through 83 years (median age = 28). The subjects were divided into three age groups: (a) 11-24, (b) 25-54, and (c) 55+. Fifty subjects were in each of the first two groups and 20 in the last group. The sample included 60 females and 60

males. The subjects were selected to yield 25 males and 25 females in the first age group, 11-24; 25 males and 25 females in the second age group, 25-54; and 10 males and 10 females in the last age group , 55+. See Tables III through V for a summary of the numbers of male and female subjects by educational level separately for each age group.

Many subjects for this study (N=46) were part of the 1990 standardization sample. The remainder of the subjects (N=74) were selected to make uniform cell sizes for this study. Six additional subjects were tested in anticipation of possible attrition for gender and age level. Four subjects refused to retest. Thus, four of the additional subjects were used to substitute for the refusals.

Instrument

In the 1990 KAIT standardization test there were 16 subtests. The more recent final form of the KAIT includes 10 of these original subtests. To insure comparability and equal testing time, and to maintain the same testing climate, the instrument used in the present study was the 1990 standardization version of the KAIT.

Procedures

The original subjects were contacted by telephone explaining the need for a retest to occur at a year interval. Of the 50 subjects taking the 1990 version, 46 took the retest. At the same time another 80 subjects were

sought and given information either in person or by telephone as to the need for testing as well as follow up testing at a year interval. Eighty of these were tested. The interval between the test and the retest procedure ranged from 519 to 293 days. The mean interval was 373.5 (SD = 28.3); the median was 368 days.

On both the test and retest, subjects were administered the KAIT following the format described in the 1990 standardization procedures (American Guidance Service, 1990). Each subject was retested approximately one year later using the same administrative procedure. Both the test and retest were administered by the experimenter. Scoring of the 10 KAIT subtests was performed by American Guidance Service (AGS); therefore, for two subjects for whom subscale scores were not available, mean scores were substituted scoring is considered to be consistent. The Mental Status Test (supplementary test) was not administered to any individual in this study. For two subjects for whom subscale scores were not available, mean scores were substituted .

Design

Data analysis focused upon the 10 KAIT subtests only. The primary analyses utilized were Pearson Product Moment Correlational analyses to determine test-retest reliabilities for the three scales scores, and the 10 subtests, for the whole group and separately for the three age groups and for the two genders. Additionally, Analysis of Variance (ANOVA) was

utilized to ascertain gender differences or differences among the age groups. In testing for significant differences among the age groups, Tukey's Studentized Range (HSD) test was used. Descriptive and simple statistics for scores were also obtained. The univariate procedure was used to obtain the testing date and age ranges.

CHAPTER IV

RESULTS

Hypotheses were examined using the Pearson Product Moment
Correlational Analyses. Refer to Tables VI, VII, and VIII (Appendix) for a
summary of these data. Hypothesis IA (the Research Hypothesis) stated
that the test-retest reliability coefficients for the KAIT scale scores would be
at least .60. All of the KAIT scale scores test-retest reliabilities were above
.60. Therefore the null hypothesis was rejected. Hypothesis IB (the
Research Hypothesis) stated that the test-retest reliability coefficients for
each of the ten subtests would be at least .60. For two of the subtests,
Double Meaning and Auditory Comprehension Recall, test-retest reliabilities
were below .60. All others were above .60 thus the null hypothesis was
only partially rejected. Hypothesis IC stated that test-retest reliability
coefficients of the KAIT scale and subtest scores for the ages 11-24, 25-54,
and 55+, as well as male and female groups, would be at least .60. Several
subtest scores for the three age groups and gender fell below .60 (see tables
VII and VIII). For all age groups and both genders the remainder of the
test-retest reliabilities were above .60. Therefore the null hypotheses was
only partially rejected.

Hypothesis IIA (the Null Hypothesis) stated there would be no significant differences between male and female participants on the KAIT. This hypothesis was tested by means of a one-way ANOVA with an alpha level of .05. Refer to Table IV (Appendix) for a summary of this analysis. Significant differences were found ($F_{1,118}$ = 4.71, p ≤ .05). Thus the null hypothesis was rejected.

Hypothesis IIB predicted a significant differences in the KAIT scale scores among the three age levels. It was predicted that the 11-24 and 55+ groups would present significantly lower scores than the 25-54 group. This hypothesis was tested by means of a one-way ANOVA with an alpha level of .05. Refer to Table XI (Appendix) for a summary of this analysis. Significant differences were found ($F_{2,117}$ = 5.34, p < .05). Tukey's Studentized Range (HSD) test was used to assess where the differences occurred. Refer to Table XII (Appendix) for a summary of these analysis. Results of the Tukey's HSD revealed significant differences between the age groups 11-24 and 55+, and between the age groups 25-54 and 55+. No significant differences were found between age groups 11-24 and 25-54. Thus while one half of the prediction was supported the second half was not. For Hypothesis IIB, the null hypothesis could not be rejected.

Hypothesis IIC predicted a significant difference in Fluid scale scores among the three age groups with the 55+ age group scoring lower than the other two age groups. This hypothesis was tested by means of a one-way

ANOVA with an alpha level of .05. Refer to Table XIV (Appendix) for a summary of this analysis. Significant differences were found ($F_{2,117.} = 1.64$, $p > .05$). Tukey's Studentized Range (HSD) test was used to assess where the differences occurred. Refer to Table XV (Appendix) for a summary of the analysis. Results of the Tukey's revealed significant differences between the 11-24 age group and the 55+ age group and between the 25-54 age group and the 55+ age group. No significant differences were found between the 11-24 and 25-54 age groups. Thus, the null hypothesis IIC was rejected.

CHAPTER V

DISCUSSION, RECOMMENDATIONS, AND
CONCLUSIONS

Discussion

Scale scores for the entire sample for the Total KAIT, Crystallized, and Fluid Scales were found to be reliable measures. Additionally, most of the subtest scores in the KAIT, the exception being the Double Meanings (.56) and Auditory Comprehension Recall (.48) subtests, had adequate reliability for research work, i.e. they were .60 or greater. Sub-test reliablities are the foundation for establishing relablity for the entire test. Results of this study demonstrate stability of the KAIT. The KAIT was found to assess adolescent and adult abilities with stable scores over a one year interval.

The three composite scales,(fluid, crystallized, and total compasite) for each of the three age groups demonstrated acceptable reliability coefficients. Of the three total composite scales, one for each age group, the lowest reliability coefficient was for the 55+ age group (.79). Notably, this is a relatively high reliability coefficient. For all three age groups, the

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reliability coefficients for the Crystallized Composite Scales were also notably high; all were between .86 and .87. Although within the acceptable range, the reliability coefficients for Fluid Composite scales for the 55+ age group was relatively low at .63. The coefficients for the 11-24 and 25-54 age groups were notably higher (.71 and .82, respectively). Overall there is acceptable reliability in the scale groups. Further research might examine the reliability of the Fluid scale for the 55+ age group. For two of the age groups, subtests were stable over time. However, problems were seen with the 55+ age group. This group demonstrated a notably low reliability for the Fluid Scale score as well as 3 (out of 4) unacceptable Fluid subtest reliability scores. If this reliability is related to normative age changes, this finding is consistent with exsisting research which indicates that Fluid intelligence declines after late adolescence and adulthood (Horn, 1978, 1982, 1992; Kaufman and Kaufman, 1990, Kaufman, Reynolds, and McLean, 1989; Kaufman, 1991; Persuad, 1991, and Wang & Kaufman, 1993).

Results indicate that the test-retest reliability correlation coefficient scale scores and the subtests reliability scores for both males and females were found to be reliable measures of intelligence on the KAIT. The subtest reliability scores for females indicate that the majority of the subtest scores were acceptable, with the exception of Memory for Block Design, .59 (males .72) and Auditory Comprehension Recall, .45 (males .51). For males, the results indicated that the subtests Auditory Comprehension .56 (females.70), Double Meanings .42 (females .70), and Mystery Codes .59

(females .67), were unacceptable. Auditory Comprehension Recall was the only subtest to fall below .60, with males scoring .51 and females scoring .45.

The KAIT score results for both males and females indicates that it is a stable instrument among reliability scale scores. Reliabilities for the subtest scores for the most part, appear to be more reliable for females than males. One should use caution with the male test-retest reliability performance. Although four subtests fell below .60 the composite tests scales were notably acceptable for males and females. Further research might examine the reliability for males and females on the KAIT.

It must be noted that none of the groups met the adequate correlation coefficient of .60 or better on the subtest Auditory Comprehension Recall. However, this subtest is not a factor within the three intelligence scale scores, one should also be cautioned in using this subtest in the interpretation of the Measure of Memory.

An examination of the mean scores for males and females on the overall test score indicated that females scored significantly higher on the KAIT than did males. Currently, no data had been published to date on gender differences on the KAIT. Further research should investigate this issue.

Results regarding differences in the overall test scores for the three age groups indicated the 55+ age group differed from the two younger age groups. Average score for this group is contrary to expectations. In the

author's opinion the educational differences between the younger group and the middle group were not as great as the effects of aging on the oldest group. Further research should explore this issue.

An ANOVA was also used to test for a difference between the Fluid scale and the Crystallized scale among age groups with the older age group scoring significantly lower. Results from the follow-up analyses regarding age and Fluid/Crystallized abilities support existing research which indicates a decrease in Fluid intelligence in older persons (Horn, 1978; Kaufman and Kaufman 1982, 1990, & 1992, Kaufman, et al, 1989; Kaufman, et al, 1991; Persuad, 1991, and Wang & Kaufman, 1993).

Recommendations

A concern of this study is that educational level was not included in several analyses. If education was used as a covariate in the ANOVA, data may have indicated other/no differences. It is recommended that in future studies education be analyzed as a covariate (ANCOVA). This will enable one to be more assured of their analysis being less biased.

The findings of this study indicated that females scored significantly higher on the overall KAIT than did males. While this may be due to innate gender differences, it may also be as Sternberg (1984 B) indicates, "some tasks on intelligence tests tend to favor females and others tend to favor males" (p. 379). The KAIT may include tasks that favor females. As

stated previously, further studies relating to gender by KAIT interaction must be conducted.

Conclusions

The past decade has seen the emergence of many new intelligence tests. This is a recognition that individuals differ in processing and learning styles. For many years, more content oriented (in that their subtests are based upon the products of verbal/nonverbal processes) instruments such as the Stanford Binet and the Weschler Scales dominated the field of intelligence testing. The increasing need for more diverse intelligence tests in the 1980's has brought an onset of many new, as well as more revised instruments (KABC, Sternberg Multidimensional Abilities Test, Differential Abilities Scale, KBIT, WJ-R, WISC-III, WRAT-III, S-B IV, KAIT, and currently the WAIS-R is being revised).

This emergence of new I.Q. tests allows the professional to select an instrument which addresses the unique processing abilities and learning styles of the examinee. Thus, an instrument that is more tailored to the individual will yield a more reliable measure of the individual's abilities. This will lead to more confidence, by the professionals when evaluating the data and making recommendations.

Given the recognized need for new I.Q. tests, it is important to identify tests which are valid and reliable. The purpose of this study was to examine the reliability of the KAIT.

The KAIT offers a unique dichotomous instrument utilizing fluid and crystallized intelligence. The overall results of this study clearly support the Cattell-Horn theory of intelligence which is the basic constructs of the KAIT. The test-retest reliabilities demonstrate the KAIT is a stable instrument which one may feel confident in the reliability.

As with any assessment instrument, the need for additional research will serve to enhance the validity and reliability of the test. This study of the KAIT has identified several areas in which further investigation should be conducted, and serves as a basis for future research. Additional research will hopefully support the KAIT's unique characteristics as an instrument that is more tailored to the individual, which yields a more reliable measure of the individual's abilities. This will lead to more confidence in the utilization of the KAIT by professionals when evaluating the data and making recommendations for an individual's unique needs.

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APPENDIX

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TABLE I

KAIT SCALES AND SUBTESTS

FLUID	CRYSTALLIZED
Rebus Learning	Definition
Mystery Codes	Auditory Comprehension
Logical Steps	Double Meanings
alt. Memory for Designs	alt. Famous Faces

MEMORY SCALE (Delayed)	SUPPLEMENTARY SCALE
Rebus Learning Recall	Mental Status
Auditory Comprehension Recall	

TABLE II

MEASURES OF MEMORY: IMMEDIATE AND DELAYED

		Crystallized	Fluid	
	Immediate	Auditory Comprehension	Rebus Learning	Immediate Recall Measures
Memory				
	Delayed	Auditory Comprehension Recall	Rebus Learning Delayed	Delayed Recall Measures

TABLE III

SUBJECT SELECTION FOR 11-24 AGE GROUP
N = 50

EDUCATIONAL LEVEL	1	2	3	4	5
Male		1	6	9	9 = 25
Female		2	8	6	9 = 25

TABLE IV

SUBJECT SELECTION FOR 25-54 AGE GROUP
N = 50

EDUCATIONAL LEVEL	1	2	3	4	5
Male		2	6	8	9 = 25
Female		1	7	9	9 = 25

TABLE V

SUBJECT SELECTION FOR 55+ AGE GROUP
N = 20

EDUCATIONAL LEVEL	1	2	3	4	5	
Male			4	4	2 = 10	
Female		3	3	3	1 = 10	

TABLE VI

TEST-RETEST RELIABILITY COEFFICIENTS
OF THE KAIT SCALE AND SUBTESTS

	Final Analysis Total N=120
TOTAL COMPOSITE	
KAIT	.87
COMPOSITE SCALES	
Crystallized Composite	.82
Fluid Composite	.80
CRYSTALLIZED SUBTESTS	
Definitions	.83
Auditory Comprehension	.65
Double Meanings	.56
Alternate--Famous Faces	.78
FLUID SUBTESTS	
Rebus Learning	.72
Logical Steps	.69
Mystery Codes	.65
Alternate--Memory for Block Design	.65
MEASURES OF MEMORY (Delayed)	
Auditory Comprehension Recall	.48
Rebus Learning Recall	.73

TABLE VII

TEST-RETEST RELIABILITY COEFFICIENTS FOR KAIT
SCALES AND SUBSTESTS AMONG THE THREE
AGE GROUPS

	11-24 N=50	25-54 N=50	55+ N=20
TOTAL COMPOSITE			
KAIT	.86	.89	.79
COMPOSITE SCALES			
Crystallized Composite	.86	.87	.86
Fluid Composite	.71	.82	.63
CRYSTALLIZED SUBTESTS			
Definitions	.75	.90	.86
Auditory Comprehension	.63	.58	.67
Double Meanings	.57	.60	.63
Alternate--Famous Faces	.78	.72	.88
FLUID SCALE			
Rebus Learning	.68	.79	.76
Logical Steps	.72	.69	.36
Mystery Codes	.62	.67	.42
Alternate--Memory for Block			
Design	.69	.67	.34
MEASURES OF MEMORY (Delayed)			
Auditory Comprehension Recall	.39	.57	.36
Rebus Learning Recall	.67	.77	.74

TABLE VIII

TEST-RETEST RELIABILITY COEFFICIENTS OF THE KAIT SCALES AND SUBTESTS FOR GENDER

Final Analysis	Males N=60	Females N=60
TOTAL COMPOSITE		
KAIT	.83	.90
COMPOSITE SCALES		
Crystallized Composite	.73	.87
Fluid Composite	.79	.79
CRYSTALLIZED SUBTESTS		
Definitions	.77	.88
Auditory Comprehension	.56	.70
Double Meanings	.42	.70
Alternate--Famous Faces	.73	.83
FLUID SUBTESTS		
Rebus Learning	.79	.64
Logical Steps	.66	.71
Mystery Codes	.59	.67
Alternate--Memory for Block Design	.72	.59
MEASURES OF MEMORY (Delayed)		
Auditory Comprehension Recall	.51	.45
Rebus Learning Recall	.84	.60

TABLE IX

ANOVA SCORES FOR AGE GROUP DIFFERENCES

Dependent variable: KAIT					
SOURCE	DF	SUMS OF SQUARES	MEAN SQUARE	F VALUE	PR > F
Model	2	1089.35	544.675811	5.34	0.0060
Error	117	11930.40	101.969199		
Corrected Total	119	13019.75			

TABLE X

TUKEY'S STUDENTIZED RANGE (HSD) FOR
AGE GROUP DIFFERENCES

Age Group	Simultaneous Lower Confidence Limit	Difference Between Mean	Simultaneous Upper Confidence Limit
25-54 vs. 11-24 years	-3.79	1.00	5.79
25-54 v.s 55+ years	2.15	8.49	14.83*
11-24 vs. 25-54 years	-5.79	1.00	3.80
11-24 vs. 55+years	1.15	7.49	13.84*
55+ vs. 25-54 years	-14.83	-8.49	-2.15*
55+ vs. 11-24 years	-13.84	-7.49	-1.15*

*Significant at the .05 level

Age Group	Means
11-24 years	106.04
25-54 years	107.04
55+ years	98.53

TABLE XI

ANOVA SCORES FOR GENDER DIFFERENCES

Dependent Variables: KAIT					
Source	DF	Sums of Squares	Mean Square	F Value	Pr > F
Model	1	499.35	499.3508581	4.71	0.032
Error	118	12520.40	106.1050597		
Corrected Total	119	13019.75			

TABLE XII

MEAN SCORES FOR GENDER

Sex	Number	KAIT	
		Mean	SD
Female	60	107.25	11.35
Male	60	103.17	9.13

TABLE XIII

ANOVA FOR CRYSTALLIZED DIFFERENCES
AMONG AGE GROUPS

Dependent Variables: Crystal					
Source	DF	Sums of Squares	Mean Square	F Value	PR > F
Model	2	357.86	178.9323183	1.64	0.198
Error	117	12763.41	109.0889972		
Corrected Total	119	13121.28			

TABLE XIV

ANOVA FOR FLUID DIFFERENCES AMONG AGE GROUPS

Dependent Variable: Fluid					
Source	DF	Sums of Squares	Mean Square	F Value	Pr > F
Model	2	1801.40	900.700833	6.28	0.0026
Error	117	16776.39	143.387949		
Corrected Total	119	18577.79			

TABLE XV

TUKEY'S STUDENTIZED RANGE FOR FLUID
DIFFERENCES AMONG AGE GROUPS

Age Group	Simultaneous Lower Confidence Limit	Difference Between Mean	Simultaneous Upper Confidence Limit
25-54 vs.11-24 years	-4.09	1.60	7.29
25-54 vs.55+ years	3.49	11.01	18.53*
11-24 vs.25-54 years	-7.29	-1.60	4.09
11-24 vs.55+ years	1.89	9.41	16.93*
55+ vs. 25-54 years	-18.53	-11.01	-3.49*
55+ vs. 11-24 years	-16.93	-9.41	-1.89*

Age Group	Fluid Means
11-24 years	102.36
25-54 years	103.96
55+ years	92.95

VITA

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