FACTOR ANALYTIC STUDY OF THE COMPUTERIZED VERSION OF THE CATEGORY TEST - YOUNG CHILDREN'S VERSION

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

DEPARTMENT OF PSYCHOLOGY AND PHILOSOPHY

BY

GLENN ALLEN BROWN, B.A.

DENTON, TEXAS

DECEMBER, 1998

TEXAS WOMAN'S UNIVERSITY
DENTON, TEXAS

November 11, 1998
Date

To the Associate Vice President for Research and Dean of the Graduate School:

I am submitting herewith a dissertation written by Glenn Allen Brown entitled, "Factor Analytic Study of the Computerized Version of the Category Test-Young Children's Version". I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in School Psychology.

Daniel C. Miller, Ph.D., Major Professor

We have read this thesis and recommend its acceptance:

Member

Member

Department Chair

Accepted

Associate Vice President for Research and Dean of the Graduate School

ACKNOWLEDGMENTS

I would like to express my gratitude to my mentor Dr. Daniel C. Miller for his guidance and assistance in the completion of this study. His example of excellence, advocacy, and diligent inquiry into neuropsychological phenomenon, complimented by his encouragement, represent an outstanding model of mentorship.

Appreciation is also expressed to Dr. Basil Hamilton and Dr. Dinah Graham for their gracious consent to serve on my dissertation committee. Their insights and suggestions were illuminating and invaluable.

Immeasurable thanks to my family and close friends for their patience, encouragement, and prayers throughout this edifying experience. Finally, I wish to acknowledge God for bringing each of the aforementioned individuals into my life and for His guidance through my years of formal education.

FACTOR ANALYTIC STUDY OF THE COMPUTERIZED VERSION OF THE CATEGORY TEST - YOUNG CHILDREN'S VERSION

Glenn Allen Brown
December, 1998

The purpose of this study was to perform an analysis of the factor structure of the Computerized Version of the Category Test - Young Children's Version (CVCT-YC). The factor structure was explored across the age range 5-8 years. Two hundred nine children from local schools were administered the CVCT-YC.

Exploratory factor analysis (eigenvalue > 3.0) resulted in a three factor solution which accounted for 32.8% of the variance. The variance accounted for was increased by decreasing the eigenvalue, however, this significantly expanded the number of factors extracted.

A one-way ANOVA found a significant main effect for age on total error scores. A Hotelling's $\underline{T}^2$-Test found a significant effect for age on Subtest-I, Subtest-II, Subtest-III, Subtest-IV, and Subtest-V. Post-hoc analyses confirmed a significant effect for age on Subtest-I, Subtest-II, Subtest-III, and Subtest-V; however no significant effect was confirmed for age on Subtest-IV. A one-way ANOVA found a significant main effect for age on subtotal error scores for Subtests I-IV. A one-way ANOVA found a significant main effect for sex on total error scores.

These results reflect that the CVCT-YC has a three factor structure; however, the factor structure of the CVCT-YC is relatively weak. Factors were designated as Attention to difference, Visual Abstract Reasoning, and Attention to most color. The results also suggest that Subtest-V is not a measure of memory as theorized. The results of this study provide the researcher empirical data for consideration in the development of alternative versions as well as shortening the CVCT-YC. These results also suggest the development of norms based on age for the CVCT-YC.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

Chapter One

Introduction

The purpose of this study was to administer the Computerized Version of the Category Test - Young Children's Version (CVCT-YC: Miller & Brown, 1995) to a heterogeneous sample of 5-8 year old children and then to perform an analysis of the factor structure of the test.

Much of the research on the Category Test has been completed on the Category Test for Adults (CAT-A: Reitan & Wolfson, 1985) and the Category Test Intermediate version for older children (CAT-I: Reitan & Wolfson, 1992b). Limited information is available on research using the Reitan-Indaiana version of the Category Test for Younger Children (CAT-YC: Reitan & Wolfson, 1993). The CAT-A was originally designed as a measure of abstraction ability in adults (Halstead, 1947). There are numerous versions of the Category Test; the CAT-A for adults, Revised Category Test (RCAT: Russell & Levy, 1987), CAT-I for older children, Children's Category Test - Level Two for older children (CCT-L2: Boll, 1993), Children's Category Test - Level One for young children (CCT-L1: Boll, 1993), Computerized Version of the Category Test - Young Children's Version (CVCT-YC: Miller & Brown, 1995). Each version of the Category Test requires the subject to attend to and observe the elements of the item presented, determine which elements are important, and on the basis of logical analysis, abstraction, and reasoning processes, formulate a response which is to be tested.

The CAT-A has been found to load on a range of cognitive factors when compared to other instruments. The CAT-A has well-documented reliability and validity (Anastasi, 1988; Halstead, 1947) and is a robust discriminator in the assessment of brain damaged versus normal functioning adults (Boll, 1978; Klove, 1974; Wheeler, Burke, & Reitan, 1963).

Research has indicated that the CAT-A has a split-half reliability of .90 or above (Kilpatrick, 1970; Klonoff, 1971; Moses, 1985). Several studies have explored the sensitivity of the CAT-A to practice effect and found that previous administration of the test decreased the number of errors on subsequent administrations. The test-retest reliability of the CAT-A is low (r=.60) with normal individuals, however, it tends to increase with impaired individuals (Matarazzo et al., 1976).

The Category tests offer potential as a monitor of treatment efficacy for subjects with neurological impairment in cognitive rehabilitation. However, alternative versions of the CAT would have to be developed for this purpose. A better understanding of the factor structure of the CVCT-YC will facilitate the development of alternative versions of the CVCT-YC.

The traditional Category tests are limited due to their large size and lack of portability. Computerized versions of the CAT requires less space, are more portable, and make unnecessary the manipulation of the reinforcement circuitry.

The original CAT-A consisted of 336 items in nine subtests (Halstead, 1947). Numerous attempts have been made at shortening the CAT-A (Beardsley, Matthews, Cleeland, & Harley, 1978; Boyle, 1975; Calsyn et. al., 1980; Gregory, Paul, & Morrison, 1979; Kilpatric, 1970; Russell & Levy, 1987). Choca, Laatsch, Wetze, and Agresti (1977) indicated that most researched versions of the Category Test have been found to be equivalent to the standard version. However, Brown (1998) found a significant difference between the CAT-YC and both the CVCT-YC, and the CCT-L1. Research suggests that the structure of the CAT-A and CAT-I includes three factors (Fischer & Dean, 1990; Kelly, Kundert, & Dean, 1992).

Research indicates that age is an individual difference which significantly influences performance on the CAT-A. In the elderly, the total error score on the CAT-A increases with the age of the subject; in young children (5-8 years-of-age) younger children obtain higher total error scores on CVCT-YC than older children in this age range (Brown, 1998). Sex differences have not been reported for the American population on Category Test performance; however, sex differences have been reported for Australian and European adults (Ernst, 1987; Cuevas & Osterich, 1990).

Research on a children's version of the CAT must consider the growth of the child's ability to form concepts during cognitive development. Thomas (1992), reported Piaget's stages of growth as consisting of four levels of cognitive development; 1) the sensorimotor period, 2) the preoperational thought period, 3) the concrete operations period, and 4) the formal operations period. Case and Fischer built on Piaget's stage theory and theorized that each major advance in thinking coincides with a dramatic increase in working memory. Research indicates that abstraction, reasoning, concept formation, and logical analysis (all functions measured by the CAT) are generally represented throughout the cerebral cortex (Doehring & Reitan, 1962). Past research also suggests that the CAT does not show any lateralization (Reitan & Wolfson, 1992b). Epstein (1984) suggests that there is a causal relationship between the growth spurts of the brain and cognitive abilities.

Chapter Two
Literature Review

In reviewing the literature related to this study, a general introduction to the Category Test (CAT) will be provided followed by research on the reliability and validity of the CAT, limitations on utilization, and research on shortening the CAT including previous factor analytic findings. A brief description of factor analysis will also be provided followed by a review of theories related to cognitive development and research related to brain development.

Introduction to the Category Test

Much of the research on the Category Test has been completed on the Adult and Intermediate versions. Limited information is available on research using the Category Test-Young Child version (CAT-YC). The CAT was originally designed as a measure of abstraction ability in adults (Halstead, 1947). It is also suggested in the literature that the CAT is a measure of abstract reasoning, problem solving, attention and concentration, memory, conceptual ability, concept formation, and non-verbal learning (Boll, 1981; Jarvis & Barth, 1984; Kelly & Dean, 1990). The

Children's Category Test measures abilities related to reasoning, abstraction, logical analysis, nonverbal learning, memory, concept formation, and problem solving abilities in children (Boll, 1993; Reitan & Wolfson, 1992b).

The CAT for adults (CAT-A) has been found to load on factors of general intelligence (Barnes & Lucas, 1974; Boyle, 1988; Holland & Wadsworth, 1976), complex spatial reasoning (Aftanas & Royce, 1969; Goldstein & Shelly, 1972; Klonoff, 1971; Lansdell & Donnelly, 1977; Royce, Yeudall, & Bock, 1976; Russell, 1974; Swiercinsky, 1979), fluid reasoning (Cullum, Steinman, & Bigler, 1984), non-verbal reasoning (Russell, 1982), and language skills (Goldstein & Shelly, 1972).

Numerous versions of the Category Test require the subject to (1) observe stimulus material, (2) identify recurring similarities and differences, (3) formulate hypotheses related to the organization of the stimulus material, and (4) test these hypotheses with relation to reality considerations (in this case a bell for the correct response and a buzzer for an incorrect response). In other words, the subject must attend to and observe the elements of the item presented, determine which elements are important, and on the basis of logical analysis, abstraction, and reasoning processes, formulate a response which is to be tested. The CAT requires a nonverbal response to stimuli that are presented visually (Telzrow & Harr, 1987).

Reliability and Validity of the Category Test

The CAT has well-documented reliability and validity (Anastasi, 1988; Halstead, 1947). It is a good measure of neuropsychological impairment (Anthony, Heaton, & Lehman, 1980; Bornstein, 1986; Davidoff, Morris, Roth, & Bleiberg, 1985; Fitzhugh, Fitzhugh, & Reitan, 1961; Goldstein, 1990; Goldstein & Shelly, 1972; Halstead, 1947; Horton & Siegel, 1990; Matthews, Shaw, & Klove, 1966; Reitan, & Wolfson, 1992b; Schreiber, Goldman, Kleinman, Goldfader, & Snow, 1976). It is a robust discriminator in the assessment of brain damaged versus normal functioning adults (Boll, 1978; Klove, 1974; Wheeler, Burke, & Reitan, 1963). Boll (1978) reported that the CAT-A is particularly sensitive to organic brain damage. This sensitivity is without preference for specific brain area or type of damage (Reeder & Boll, 1992). The CAT-A has been up to 95 percent effective overall in distinguishing between brain damaged and normal subjects (Klove, 1974, Reitan, 1955).

In the Halstead-Reitan Neuropsychological Test Battery, the CAT-A is considered to be one of the best indicators of diffuse brain damage (Golden, 1978; Reitan & Davison, 1974). Adams and Trenton (1981) reported that the CAT-A is almost as valid as the complete Halstead-Reitan battery in recognizing the presence or absence of brain damage. Reitan suggests that of all the indicators of brain damage derived from the Halstead-Reitan battery, the total error score on the CAT is second only to the Halstead Impairment Index as the most powerful single discriminator of brain damage.

Research has indicated that the Category Test has a split-half reliability of .90 or above (Kilpatrick, 1970; Klonoff, 1971; Moses, 1985). Moses reported a coefficient alpha value of .96 for the standard form of the CAT-A and .95 for the short form of the CAT-A. Matarazzo and colleagues (1976) reported that the test-retest reliability is low (r=.60) with normal individuals, however, it tended to increase with impaired individuals (chronic schizophrenic group, r=.72; carotid endarterectomy group, r=.82; and cerebrovascular disease group, r=.96). Matarazzo and colleagues suggested that the nonimpaired individuals benefited on the second score from having done the test before while the impaired individuals displayed less benefit from the previous administration. Boll (1993) reported a reliability coefficient of .88 for the Children's Category Test - Level One (CCT-L1) for children 5 to 8 years-of-age. Boll also reported a test-retest reliability coefficient of .79 for a group of 35 children 8 years-of-age. In most instances, the absence of improvement on the CCT-L1 given repeated administrations, is an indicator of abnormality (Boll, 1993).

Several studies have explored the sensitivity of the CAT-A to practice effect and found that previous administration of the test decreased the number of errors on subsequent administrations. Byrd and Warner (1986) administered the CAT and the Intermediate Book version of the Category Test to a group of subjects. They found that for both orders of administration, some degree of learning was evidenced by fewer errors on the test taken second. Coutts, et al., (1987) administered the Intermediate version of the CAT to a group of sixth grade students. They found a practice effect for both students with a learning disability and students without a learning disability, with greater practice effect for the students without a learning disability; however, the effects were not significant. Matarazzo, et al., (1976) tested young, normal males with the CAT-A and found evidence of practice effect. DeFilippis, McCampbell, and Rogers (1979) gave repeated administrations of the CAT-A to normal and alcoholic subjects. They found significant effects of practice between the initial and second administration in both samples.

The Category tests offer potential as a monitor of treatment efficacy for subjects with neurological impairment in cognitive rehabilitation; however, given the literature's documentation of practice effect, alternative versions of the CAT would have to be developed and tested for reliability and concurrent validity with the CAT. The CVCT-YC seems particularly amenable to the formation of alternative versions. The CVCT-YC also offers potential as a monitor of treatment efficacy for children with neurological impairment in cognitive rehabilitation. A better understanding of the factor structure of the CVCT-YC will facilitate the development of alternative versions of the CVCT-YC. Once alternative versions of the CVCT-YC have been developed they may be helpful in providing data about the benefits of remediation and medication interventions for young children with cognitive impairment.

Limitations of the Category Test

The traditional Category tests developed by Halstead and Reitan have several practical limitations. The tests require extensive equipment which is cumbersome in size. The traditional Category tests consist of a projection apparatus which includes a slide projector, view screen, and four lighted switches below the screen. A separate room is normally needed to contain the equipment and access to the instrument is limited to those subjects capable of going to the room where the equipment is situated (Adams & Trenton, 1981; Byrd & Warner, 1986; MacInnes, Forch, & Golden, 1981;

McCampbell & DeFilippis, 1979). The need for a separate room and limitations on moving the equipment impedes its use at bedside in a hospital (Wood & Strider, 1980). These same restrictions apply to the CAT-YC. Thus, the literature suggests that an alternative version of the CAT and CAT-YC which require less space, is more portable, and makes unnecessary the manipulation of the reinforcement circuitry, would facilitate the use of the CAT and CAT-YC.

Computerized versions of the CAT requires less space, are more portable, and make unnecessary the manipulation of the reinforcement circuitry. Computerized versions present the figure on the screen, accept the examinee's response, and provide the examinee feedback indicating whether their response was correct or incorrect. The Computerized Version of the Category Test - Young Children's Version (CVCT-YC: Miller & Brown, 1995) meets these same needs during the assessment of children in the range of 5-8 years of age. The CVCT-YC offers the benefits identified above when testing young children for neurological deficits. The CVCT-YC also provides a permanent record of the responses. The possibility of examiner error in scoring the response has also been removed as the computer scores the response.

The original CAT-A consisted of 336 items in nine subtests (Halstead, 1947). Reitan and Davison (1974) reduced the number of items to 208 and the number of subtests to seven. A repeated drawback in the use of the Category test in general has been the length of time required to complete administration (Barker, 1977; Calsyn, O'Leary, & Chaney, 1980; Golden, MacInnes, Kuperman, & Moses, 1981; Wood & Strider, 1980). Walsh (1978) stated, "the test is somewhat lengthy and this, together with the need for special apparatus, means the test is used infrequently apart from the users of the Reitan Battery" (p. 295).

Shortening the Category Test

Numerous attempts have been made at shortening the CAT-A (Beardsley, Matthews, Cleeland, & Harley, 1978; Boyle, 1975; Calsyn et. al., 1980; Gregory, Paul, & Morrison, 1979; Kilpatric, 1970; Russell & Levy, 1987). Russell and Levy (1987) suggest that after about 20 items, there is little improvement of most subjects' scores on a subtest of the CAT-A. They also suggest that a subtest should measure only one mental function, that is homogeneity of all items in each subtest. They removed subtest seven of the CAT-A since it is a memory scale, and not a measure of abstraction; this is consistent with the removal of subtest seven as a means of shortening the CAT-A (Beardsley et al., 1978; Calsyn et al., 1980; Gregory et al., 1979). Russell and Levy suggest several criteria for shortening the CAT: first, reduce the length of each subtest as much as possible without reducing reliability; second, the newly developed shortened version of the CAT should correlate highly with the original version; third, all the principles used in the CAT should be retained; and fourth, the memory subtest should be eliminated. Russell and Levy developed the revised CAT (RCAT) in which they shortened the subtests instead of eliminating entire columns and found this to be a better predictor of the full CAT-A than a method which retained the full length of the subtests but eliminated full columns. They report that the RCAT was as adequate a predictor of the CAT-A as any other shorter versions.

Gregory et al. (1979) suggest that due to the lack of item independence, it is not feasible to construct a shortened form of the CAT-A by omitting items from the beginning or middle of a subtest. In an effort to have no affect on performance of subsequent items, they suggest removing items at the end of a subtest, or completely eliminating subtests. Utilizing this strategy, they derived a 120-item short form Category Test from the 208-item standard Category Test.

Calsyn et al. (1980) selected items for an abbreviated form of the CAT-A based on clinical observations, criteria of not removing items out of sequence, and Boyle's report of limited discriminative power of Subtests V and VI (Boyle, 1975). Reeder and Boll (1992) reduced the number of items in the Intermediate version of the CAT (CAT-I). While the CVCT-YC has fewer items than either the CAT-A or the CAT-I, the notion of reducing the CVCT-YC is a viable area for future research.

Factor Analysis of the Category Test

Research suggests that the structure of the CAT-A includes three factors (Fischer & Dean, 1990). The structure of the Intermediate Version of the CAT has also been found to include three factors; Visual Perception/Spatial Orientation, Visual Abstract Reasoning/Memory, and Number Counting/Attention (Kelly, Kundert, & Dean, 1992). Kelly, Kundert, and Dean's (1992) factor analytic study of the Intermediate version of the CAT indicated that Subtest IV and V loaded on Visual Perception/Spatial Orientation, Subtests III and VI loaded on Visual Abstract Reasoning/Memory, and Subtests I and II loaded on Number Counting/Attention. An understanding of the factor structures of the CVCT-YC may also facilitate the proper reduction in number of items in each subtest and overall length of the CVCT-YC.

Factor Analysis

Factor analysis involves the examination of the interrelationships among variables. The correlation coefficient is used as a measure of this association. Factor analysis is based on the fundamental assumption that there are underlying factors which are responsible for the covariation among the observed variables. Factor analysis addresses whether the observed correlations can be explained by the existence of a small number of hypothetical constructs. There are two fundamental approaches to factor analysis: exploratory and confirmatory. Exploratory factor analysis examines a set of data to determine underlying factor structure without any a priori specification in terms of the number of factors and their loadings. In confirmatory factor analysis, the researcher theoretically identifies the number of factors expected and the items in the data set that will load on each factor (Kim & Mueller, 1978)

The first step in factor analysis is collecting data for analysis and preparing a covariance or correlation matrix. The second step is to find the number of factors that can explain the observed correlations among the variables. This is often accomplished by input of the relevant matrix into a factor analysis computer program. Computers and statistical software programs have greatly facilitated this process (Heppner, Kivlighan, & Wampold, 1992). In the initial solution, some restrictions imposed are that the underlying factors are orthogonal to each other and the first factor accounts for as much of the variance as possible, the second factor accounts for as much of the residual variance left unexplained by the first factor, the third factor accounts for as much of the residual variance left unexplained by the first two factors, and so on. In the third step, the data is rotated in an attempt to simplify the information obtained (Kim & Mueller, 1978). One of the more commonly used rotation techniques is a Varimax rotation, an orthogonal method. The orthogonal method has the restriction that factors obtained are uncorrelated. Unrotated factors are generally difficult to interpret, thus rotation is necessary. All rotations using the same number of factors are mathematically equivalent to each other and the unrotated factors; however, there is no clear recommendation regarding which method or rotation provides the best solution (Heppner, Kivlighan, & Wampold, 1992; Kim & Mueller, 1978). Finally, the meaning given to a factor is typically based on the researcher's subjective examination of what the high loading variables measure, what the variables have in common.

Variables Effecting Performance on the Category Test

Mercer, Harrell, Miller, & Rockers, (1994), conducted a study to show criterion-related validity for the CAT-208 (Reitan & Wolfson, 1985). The results of the study indicated that regardless of the CAT version administered, brain injured adults had higher total error scores than did the non-brain injured adults. Also there were no significant differences between versions of the CAT for total error scores. Additional research also suggests that the CAT-A is not affected by alteration in instrumentation (Beaumont, 1975; DeFilippis & McCampbell, 1979; DeFilippis, McCampbell, & Rogers, 1979; Kupke, 1983; MacInnes, et al., 1981; McCampbell & DeFilippis, 1979; Miller, 1989). Choca, Laatsch, Wetze, and Agresti (1977) indicated that most researched versions of the Category Test have been found to be equivalent to the standard version. Brown (1998) found a significant difference between the Reitan-Indaiana version of the Category Test (CAT-YC: Reitan & Wolfson, 1993) and both the CVCT-YC, and CCT-L1; however, no significant difference was indicated between the CVCT-YC and the CCT-L1. Development of alternate versions of the CVCT-YC would permit serial testing to monitor treatment efficacy. The literature suggests that there would be numerous benefits to the utilization of the CVCT-YC. Mercer, citing Moerland et. al., (1986), reported that little patient resistance was noted to a computerized neuropsychological battery.

Research indicates that age is an individual difference which significantly influences performance on the CAT-A (Aftanas & Royce, 1969; Boyle, Ward, & Steindl, 1994; Elias, Robbins, Walter, & Schultz, 1993; Ernst, 1987; Donnely, Waldman, Murphy, Wyatt, & Goodwin, 1980; Fromm-Auch & Yeudall, 1983; Heaton, Grant & Matthews, 1986; Mack &

Carlson, 1978; Price, Fein, Feinberg, 1980; Prigatano & Parsons, 1976; Query, 1979; Reed & Reitan, 1963a, 1963b; Reitan, 1956, 1964; Reitan & Wolfson, 1986b; Vega & Parsons, 1967). Research suggests that in the elderly (over 65 years-of-age) the total error score on the CAT-A increases with the age of the subject. Brown (1998) completed an analysis of the effects of age (5, 6, 7, and 8 years-of-age) on the CAT-YC, CAT-BK, and the CVCT-YC. A significant difference was found between the group of participants 5 years-of-age and the group of participants 6 years-of-age, 7 years-of-age, and 8 years-of-age. A significant difference was also indicated between the group of participants 6 years-of-age and the group of participants 8 years-of-age. However, no significant difference was found between the group of participants 7 years-of-age and the group of participants 6 years-of-age, and the group of participants 8 years-of-age.

Ernst (1987) reported sex differences on CAT-A performance of Australian subjects with men having significantly fewer errors on Subtest Three, Subtest Four, and total score of the Booklet Category Test. With the significant sex differences confined to Subtest Three and Four (which involve a spatial position component), Ernst suggests that the difference may be due to male superiority in spatial abilities. Cuevas and Osterich (1990) report sex differences on Category Test performance; the goal of the study was to determine the comparability of error scores obtained by Americans and Europeans on the booklet version of the Category Test. In the Cuevas and Osterich study, European women produced significantly higher error scores than did the European men. The error scores of American women were not significantly different from American men. This is consistent with other research in which sex differences on Category Test performance have not been found with the American population (Dodrill, 1979; Kupke, 1983). Brown (1998) found no sex differences on children's performance between the age 5-8 on CAT-YC , CAT-BK, nor the CVCT-YC.

Cognitive Development

One must consider the growth of the child's ability to form concepts during the child's cognitive development. Thomas (1992), reported Piaget's stages of growth as consisting of four levels of cognitive development; 1) the sensorimotor period, 2) the preoperational thought period, 3) the concrete operations period, and 4) the formal operations period. During the period from birth through age two, the sensorimotor period, children are unable to verbalize thoughts very well. Intellectual growth during this period is estimated by the manner in which the children sense the environment and how they acts upon it motorically. Diamond, Werker, and Lalonde (1994) suggested that the very young infant is able to categorize stimuli of differences which are striking to their perceptual system.

Diamond et al. (1994) reported that during the age range of 2-3 months, the child can commence modification of their initial category. McGurk (1972) reported that at 3 months of age the infant can categorize on the basis of line orientation. Bornstein (1981) suggested that an infant of this age can categorize on the basis of color.

During the age range of 4-8 months the child begins to distinguish between self and external objects. This stage also marks the beginning of intentional acts, the child performs an act that has previously lead to satisfaction (this is not goal directed behavior). This intentional behavior reflects an awareness of the environment (Thomas, 1992). Miller and Younger (1982) reported that by 4 months of age an infant can categorize a voice as being male or female and that by 6 months of age, male versus female faces. Bomba and Siqueland (1983) reported that at the age of 6 months an infant can categorize simple patterns.

During the age range of 8-12 months the child displays signs that objects have attained a quality of permanence (Thomas, 1992). The child's behavior is now considered to be truly intentional, the child envisions goals and employs existing schemes to meet those goals. Cohen and Caputo, cited in Diamond et al. (1994), reported that a 10 month old infant can categorize complex figures such as stuffed animals. Kestenbaum and Nelson (1990) reported that infants 7-8 months of age were distracted by salient attributes when categorizing faces; however, infants 10 months of age could ignore the salient features and categorize the faces on the basis of configural information. The younger infant was unable to inhibit the tendency to attend to the conspicuous but irrelevant characteristics of the stimuli (a prefrontal lobe function). When two stimuli are compared in memory the involvement of the prefrontal cortex is often necessary (Diamond et al. , 1994).

During the age range of 12-18 months children try to find out in what ways an object or event is new and will try to induce new results (Thomas, 1992). Children pays greater attention to the way a new object or event differs from their existing mental construct. Children will use intentional accommodation to differentiate existing schemes and construct new ones. During the age range of 18-24 months children can represent objects mentally and can cognitively combine and manipulate them.

The preoperational stage of cognitive development describes children in the 2-7 year old range . During this stage cognitive schemes for problem solving are developed; yet remain relatively unorganized (Thomas, 1992). In this stage the child has not yet developed integrated conceptual thought processes. From around the age of 2-4 the child's use of language is egocentric and there is an emphasis on perception in problem solving (Thomas, 1992). The child suffers from limitations of centration, the child centers on one aspect of the object and believes that this aspect completely characterizes the object. The child is unable to consider two dimensions of the object at the same time.

As children progress from about 5-7 years they makes more use of social and communicative speech with and emphasis on intuitive thinking as opposed to perception alone. It is important to be aware that one of the roles language plays in the development of intelligence is "it internalizes action so the child does not have to depend on manipulating things physically to solve problems. Instead, he can represent them by mental images with which he conducts experiments" (Thomas, 1992, p. 291). During this intuitive stage the child is better at distinguishing more than one characteristic of an object at a time.

Thomas (1992) reported that in the concrete operations stage, age 7-11, the child is able to take identifiable objects which are either directly perceived or imagined and perform operations that are directly related on the object. "During the concrete operations period, from age 7 to around 11 or so, children gradually discover more of the properties of objects and transformations and master mental operations that can be applied to their concrete world" (Thomas, 1992, p. 296).

In the formal operations stage, age range from 11-15, thinking is no longer limited by concrete events (Thomas, 1992). The child can now imagine the condition of a problem and develop a hypothesis about what might occur under a variety of combinations of factors. The development of concrete and formal operations may be related to physiological development of the brain, in particular to maturation of the frontal lobes.

Case views cognitive development as increases in information-processing capacity from more efficient strategy use. According to Case's theory, increases in mental space are due to brain maturation, exercise of strategies, and the acquisition of central conceptual structures. Once strategies become more automatic, less attentional capacity is required and mental space is freed up (Case, 1985; Case & Griffin, 1990).

Fischer's skill theory places more of an emphasis on the child's specific experiences. How much the child's skill generalizes depends on brain maturation and the range of environments to which the child has been exposed. Each child has an upper limit of processing capacity that is limited by brain maturation. Fischer suggested that there are three optimal skill levels; sensorimotor action, representations, and abstractions. Within each level, the child acquires new competencies on specific tasks, integrates them, and transforms them into higher-order skills. Once this higher-order skill is mastered in a particular situation, it is generalized to other similar situations. When the child coordinates several task-specific skills into a broadly applicable principle, cognition advances to a higher level of functioning (Fischer & Pipp, 1984; Fischer & Rose, 1994). Case and Fischer built on Piaget's stage theory and theorized that each major advance in thinking coincides with a dramatic increase in working memory.

The amount of attention a child must utilize on a task depends on how well learned or automatic the task has become for that child. The unskilled child will devote more resources than the skilled child. Hale, Fry, and Jessie (1993) suggested that age-related gains in basic information-processing resources is due to myelinization of neural fibers in the brain. As a result, older children's cognitive systems have a higher capacity; therefore, they can scan information more quickly and generate faster responses in a wide range of situation.

Brain development

Russell and Levy (1987) described two abilities needed to successfully complete the various forms of the CAT: (a) the extraction of a component or attribute such as color, size, or shape from the different geometric designs (this is a parietal function; Hecaien & Albert, 1978) and (b) the ability to shift principles from subtest to subtest (this is a frontally controlled function; Walsh, 1978). Campbell and Whitaker (1986) suggested that after the age of five cortical maturation has a minimal role in the development of higher level cognitive functions; this implies that the cognitive abilities of the young child would be consistent with those of the older child during administration of the appropriate version of the CAT. Research indicates that abstraction, reasoning, concept formation, and logical analysis (all functions measured by the CAT) are generally represented throughout the cerebral cortex (Doehring & Reitan, 1962). Past research also suggests that the CAT does not show any lateralization (Reitan & Wolfson, 1992b).

Rourke, cited in Reitan and Wolfson (1992b), suggests that developmentally, the right cerebral hemisphere acquires abilities before the left hemisphere. The functional lateralization of hemispheres follows a progressive pattern of consolidation of functions which corresponds to neurological development (Dean, 1985). Kolb and Whishaw's theory suggests that the higher-level neuropsychological abilities are more diffusely represented in the brain of young children than in adults (Reitan & Wolfson, 1992b).

About half of the brain's volume is made up of glial cells. Their function is to improve the efficiency of message transfer through myelinization. Myelinization causes the rapid gain in overall brain growth. The cerebral cortex attaines 70% of its adult mass around the age of one; however, the maturity of some functions mediated by some frontal areas are not reached until adolescence (Himwich, 1970). "The notion of development of neuronal substrates to cognitive organization is consistently evident in studies of the progression of myelination in cortical zones and in underlying attentional mechanisms" (Naur, Languis, & Martin, 1991 p. 153). The order in which each area of the cortex develops corresponds to the sequence in which various capacities emerge during development. The frontal lobe is the last area of the cortex to develop neural connections and to myelinate. This area functions more effectively from the age of 2 onward and growth continues to develop. Epstein (1984) suggests that there is a causal relationship between the growth spurts of the brain and cognitive abilities. These growth spurts occur at 2-4 years, 6-8 years, 10-12 years, and 14-17 years. This suggests that the growth spurt of a child's brain at approximately 6-8 years of age, may account for the transition from the preoperational stage of development into the concrete operations stage. This physiologic development at 6-8 years of age, may also account for the age differences in performance on the CVCT-YC, CAT-YC, and CAT-BK (Brown, 1998).

Much of the research on the Category Test has been completed on the CAT-A and CAT-I; limited information is available on research using the CAT-YC. The CAT-A was originally designed as a measure of abstraction ability in adults (Halstead, 1947). There are numerous versions of the Category Test, each version requires the subject to attend to and observe the elements of the item presented, determine which elements are important, and on the basis of logical analysis, abstraction, and reasoning processes, formulate a response which is to be tested.

The CAT-A has well-documented reliability and validity and has been found to load on a range of cognitive factors when compared to other instruments. It is a robust discriminator in the assessment of brain damaged versus normal functioning adults (Boll, 1978; Klove, 1974; Wheeler, Burke, & Reitan, 1963). The CAT-A has a split-half reliability of .90 or above (Kilpatrick, 1970; Klonoff, 1971; Moses, 1985). The test-retest reliability of the CAT-A is low (r=.60) with normal individuals, however, it tends to increase with impaired individuals (Matarazzo et al., 1976).

The Category tests offer potential as a monitor of treatment efficacy for subjects with neurological impairment in cognitive rehabilitation. However, alternative versions of the CAT would have to be developed for this purpose. A better understanding of the factor structure of the CVCT-YC will facilitate the development of alternative versions of the CVCT-YC.

The traditional Category tests are limited due to their large size and lack of portability. Computerized versions of the CAT requires less space, are more portable, and make unnecessary the manipulation of the reinforcement circuitry. The original Category Test consisted of 336 items in nine subtests (Halstead, 1947). Numerous attempts have been made at shortening the CAT-A and most researched versions of the Category Test have been found to be equivalent to the standard version (Choca, Laatsch, Wetze, & Agresti, 1977). However, Brown (1998) found a significant difference between the CAT-YC and both the CVCT-YC, and CCT-L1. Research suggests that the structure of the CAT-A and CAT-I includes three factors (Fischer & Dean, 1990; Kelly, Kundert, & Dean, 1992).

Age is an individual difference which significantly influences performance on the CAT-A. In the elderly, the total error score on the CAT-A increases with the age of the subject; in young children (5-8 years-of-age) younger children obtain higher total error scores on CVCT-YC than older children in this age range (Brown, 1998). Sex differences have not been reported for the American population on Category Test performance; however, sex differences have been reported for Australian and European adults (Ernst, 1987; Cuevas & Osterich, 1990).

Research on a children's version of the CAT must consider the growth of the child's ability to form concepts during cognitive development. Thomas (1992), reported Piaget's stages of growth as consisting of four levels of cognitive development; 1) the sensorimotor period, 2) the preoperational thought period, 3) the concrete operations period, and 4) the formal operations period. Case and Fischer built on Piaget's stage theory and theorized that each major advance in thinking coincides with a dramatic increase in working memory. Research indicates that abstraction, reasoning, concept formation, and logical analysis (all functions measured by the CAT) are generally represented throughout the cerebral cortex (Doehring & Reitan, 1962). Past research also suggests that the CAT does not show any lateralization (Reitan & Wolfson, 1992b). Epstein (1984) suggests that there is a causal relationship between the growth spurts of the brain and cognitive abilities.

The purpose of this study was to administer CVCT-YC to a heterogeneous sample of 5-8 year old children and then to perform an analysis of the factor structure of the test. The hypotheses of this study are: (1) there will be a three factor structure for the CVCT-YC consisting of Attention, Position/Spatial Orientation, and Memory; (2) there will be a significant difference in the mean total error scores of the CVCT-YC between the four age groups in the sample; (3) there will be a significant difference in the mean error score for each subtest of the CVCT-YC between the four age groups in the sample; (4) there will be a significant difference in the mean subtotal error scores for Subtests I-IV of the CVCT-YC between the four age groups in the sample; (5) there will not be a significant difference in the mean total error scores of the CVCT-YC between female and male subjects in the sample.

Chapter Three

Methodology

Subjects

A convenience sample of two hundred nine (N=209) children were included in this study. The age range of subjects was 5 to 8 years, with 36 subjects 5 years-of-age, 62 subjects 6 years-of-age, 67 subjects 7 years-of-age, and 44 subjects 8 years-of-age. Ninety-eight of the subjects were female and 111 male. One hundred twelve of the subjects were Caucasian, 9 Afro-American, 3 Hispanic, 4 Asian, 5 other, and 77 did not report ethnicity. One hundred eighty-three of the subjects were right handed and 19 left handed. Table 1 illustrates the above demographic information and corresponding percentages. Table 2 reports a summary of parent demographic information reporting family income, mother's educational level, father's educational level, mother's occupation, and father's occupation. The children were recruited from local schools and given a certificate of participation. Recruitment was via a letter home to the parent(s) or guardian from the school explaining the study and providing an opportunity for the student to participate. Exclusion criteria was the report of preexisting diagnosis of Brain Impairment, Attention Deficit Disorder, Learning

Disability, Mental Retardation or Emotional Disturbance. Subjects from the volunteer pool who reported positive for one of the screens were withheld from the study. The parent(s) or guardian of the child were asked to sign the consent form prior to the testing session.

Table 1.

Summary of Subject Demographic Data

Descriptor	Number	Percentage
Number of Subjects	209	100%
Sex		
Female	98	46.9%
Male	111	53.1%
Age		
5 years-of-age	36	17.2%
6 years-of-age	62	29.7%
7 years-of-age	67	32.1%
8 years-of-age	44	21.1%
Mean	6.57	
Standard Deviation	1.01	
Ethnicity		
Caucasian	112	53.6%
African-American	9	4.3%
Hispanic	3	1.4%

Table 1 (continued).

Summary of Subject Demographic Data

Descriptor	Number	Percentage
Ethnicity		
Asian	4	1.9%
Other	5	2.4%
Unavailable	77	36.8%
Handedness		
Right	183	87.6%
Left	19	9.1%
Unavailable	7	3.3%

Table 2.

Summary of Parent Demographic Data

Descriptor	Number	Percentage
Family Annual Income		
$10,001 - $20,000	6	2.9%
$20,001 - $30,000	6	2.9%
$30,001 - $40,000	10	4.8%
$40,001 - $50,000	18	8.6%
$50,001 - $60,000	10	4.8%
$60,001 - $70,000	17	18.1%

Table 2 (continued).

Summary of Parent Demographic Data

Descriptor	Number	Percentage
Family Annual Income		
Over $70,000	61	29.1%
Unavailable	81	38.8%
Mother's education level		
Attended high school	4	2.0%
Graduated from high school	12	5.7%
Attended trade/vocational school	6	2.9%
Attended college	26	12.4%
Associate degree	16	7.7%
Bachelor Degree	45	21.5%
Attended graduate school	11	5.3%
Graduate degree	14	6.7%
Unavailable	75	35.9%
Father's education level		
Attended high school	2	1.7%
Graduated from high school	19	10.0%
Attended trade/vocational school	6	1.7%
Attended college	26	15.8%
Associate degree	14	6.7%
Bachelor Degree	52	28.9%
Attended graduate school	12	5.7%

Table 2 (continued).

Summary of Parent Demographic Data

Descriptor	Number	Percentage
Father's education level		
Graduate degree	6	2.9%
Unavailable	72	34.4%
Mother's occupation		
Laborer	2	1.0%
Administrative	14	6.7%
Sales position	10	4.8%
Management	18	8.6%
Professional	53	25.4%
Other	35	16.7%
Unavailable	77	36.8%
Father's occupation		
Laborer	13	6.2%
Administrative	1	0.5%
Sales position	15	7.2%
Management	30	14.4%
Professional	54	25.8%
Other	16	7.7%
Unavailable	80	38.3%

Instrumentation

There was one instrument used in this study, the Computerized Version of the Category Test for Younger Children (CVCT-YC: Miller & Brown, 1995).

The Computerized Version of the Category Test (CVCT-YC)

Miller and Brown (1995) developed the CVCT-YC for the Macintosh computer. Notebook computers are used to administer the CVCT-YC to the subject. The individual 80 items are displayed one at a time on the computer screen. The subject places a marker over the color of choice (red, blue, yellow, or green) and clicks a mouse button. Feedback is given for correct (a bell) and incorrect (a buzzer) responses. The dependent measure is the number of errors. Errors and response time are recorded by the computer. Administration time is approximately 15 minutes. The 80 items on the CVCT-YC are divided into five subtests. On the first four subtests there is one rule or principle which is the same across all items. The purpose of the CVCT-YC is to measure the child's problem solving skills and cognitive flexibility. The last subtest is a memory test which asks the child to recall correct answers from previous sections.

Procedure

The parents or guardians of the subjects were asked to sign an informed consent form prior to the test session. The experimenter provided a brief explanation of the study and informed the parents or guardians and the subjects of their right to participate or not. The testing sessions were held in the child's school building during school hours. The examiners were trained in administration of the CVCT-YC. The examiners were trained to deal with a child's test anxiety, fatigue, and poor motivation. Subjects participated in a single session, approximately 15 minutes in length. Each subject was administered the CVCT-YC, received a certificate of participation, and the parent(s) or guardian received a printout of the child's score. The certificate and scores were presented at the completion of the testing session.

This study addressed five hypotheses. The first hypothesis was that there would be a three factor structure for the CVCT-YC consisting of attention, position/spatial orientation, and memory. The second hypothesis was that there would be a significant difference in the mean total error scores of the CVCT-YC between the four age groups in the sample. The third hypothesis was that there would be a significant difference in the mean error score for each subtest of the CVCT-YC between the four age groups in the sample. The fourth hypothesis was that there will be a significant difference in the mean subtotal error scores for Subtest-I through Subtest-IV of the CVCT-YC between the four age groups in the sample. The fifth hypothesis was that there would not be a significant difference in the mean total error scores of the CVCT-YC between female and male subjects in the sample.

Data Analysis

Raw data were entered into the SPSS computer program and Pearson product moment correlation coefficients were calculated to provide the basis for factor analysis. Factor analysis with a Varimax rotation was performed for hypothesis one. The analysis performed was an exploratory analysis with eigenvalue > 1.0, exploratory analysis with eigenvalue > 2.0, and exploratory analysis with eigenvalue > 3.0. The exploratory analysis with eigenvalue > 3.0 was examined in detail. The second, fourth, and fifth hypotheses were analyzed using one-way ANOVAs followed by the Tukey post-hoc comparisons procedure. The third hypothesis was analyzed using a Hotelling's T^2-Test.

Chapter Four

Results

Hypothesis 1: There will be a three factor structure for the CVCT-YC consisting of attention, position/spatial orientation, and memory. Raw data were entered into the SPSS computer program and Pearson product moment correlation coefficients (see Table A1. in the Appendix for a correlation matrix) were calculated to provide the basis for factor analysis. Results of the exploratory factor analysis of the raw data with eigenvalue > 1.0 resulted in 22 factors accounting for 73.5% of the total variance. Setting the eigenvalue > 2.0 resulted in 8 factors accounting for 48.5% of the total variance. Results of the exploratory factor analysis with eigenvalue > 3.0 indicated a three factor solution for the CVCT-YC. The three factors accounted for 32.8% of the variance in the sample. Table 3 presents this three factor solution in more detail and the factor on which each item loaded.

Each item's factor designation was determined by examining the factor loadings for each item across the three factor solution. An item's largest loading represents the factor of which it was placed. Item loadings for factor one ranged from .05 to .72. Item loadings for factor two ranged from .13 to .90. Item loadings for factor three ranged from .18 to .65.

Factor One accounted for 56.3% of the items and 18.6% of the variance in the sample. Factor One was described by items 01, 03, 04, 06, 07, 08, 13, 14, 15, 17, 20, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 71, 72, 73, 74, 76, 79, and 80. Factor Two accounted for 18.8% of the items and 9.4% of the variance in the sample. Factor Two was described by items 02, 05, 45, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, and 78. Factor Three accounted for 25% of the items and 4.8% of the variance in the sample. Factor Three was described by items 09, 10, 11, 12, 16, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 47, 75, and 77. Table 4 sorts the items by factor and illustrates these results in more detail.

Table 3.

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest I			
01	.05	-.00	-.11

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 3 (continued).

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest I			
02	.07	.13	-.09
03	.28	-.05	-.03
04	.40	.13	.01
05	.08	.17	.01
06	.14	-.02	.11
07	.14	.00	-.01
08	.21	-.01	.08
09	-.10	.00	.31
10	.07	.03	.27
Subtest II			
11	.10	-.07	.18
12	.24	.02	.26
13	.24	.05	.20
14	.45	-.14	.34
15	.26	-.09	.22
16	.17	.01	.35
17	.47	-.15	.32
18	-.00	-.13	.36

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 3 (continued).

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest II			
19	.23	.00	.37
20	.49	-.01	.21
21	-.00	.06	.23
22	.31	.07	.31
23	.21	.04	.59
24	-.06	.08	.56
25	-.02	.13	.64
26	.33	.07	.51
27	.01	.01	.65
28	-.02	.02	.51
29	.02	.22	.52
30	.17	.20	.41
31	.51	-.00	.25
32	.40	.04	.06
33	.45	.04	.18
34	.58	.00	.16
35	.60	.06	.14
36	.72	-.03	.12

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 3 (continued).

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest III			
37	.33	-.07	.22
38	.53	-.00	.06
39	.70	.12	.11
40	.53	.18	.03
41	.63	.14	.03
42	.33	-.03	.15
43	.65	.22	.13
44	.49	.34	.12
45	.05	.19	.01
46	.39	.02	.14
47	.25	.06	.29
48	.35	.22	.06
49	.33	.14	.13
50	.57	.15	.04
Subtest IV			
51	.37	.36	-.07
52	.68	.22	.04
53	.67	.32	-.07

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 3 (continued).

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest IV			
54	.55	.22	-.01
55	.58	.22	-.16
56	.49	.23	.01
57	.68	.25	-.03
58	.68	.22	-.06
59	.60	.18	.04
60	.08	.78	.14
61	.06	.89	.08
62	.13	.83	.06
63	.08	.89	.06
64	.12	.90	.10
65	.09	.86	.03
66	.06	.90	.05
67	.15	.90	.02
68	.05	.83	.08
69	.09	.85	.05
70	.07	.83	.11

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 3 (continued).

Factor Loading and Variance Explained: Three Factor Solution

Items	F1	F2	F3
Subtest V			
71	.22	-.08	.04
72	.36	-.07	.08
73	.67	.26	.00
74	.71	.07	.90
75	.21	.08	.53
76	.26	.09	-.00
77	.13	.02	.35
78	.08	.82	.08
79	.59	.14	-.02
80	.16	.06	.09
Percent Variance	18.6%	9.4%	4.8%
Total Percent Variance		32.8%	

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Subtest-I had 60% of its items load on Factor One, 20% on Factor Two, and 20% on Factor Three. Subtest-II had 25% of its items load on Factor One and 75% on Factor Three. Subtest-III had 90% of its items load on Factor One, 5% on Factor Two, and 5% on Factor Three. Subtest-IV had 45% of its items load on Factor One and 55% on Factor Two. Subtest-V had 70% of its items load on Factor One, 10% on Factor Two, and 20% on Factor Three. This information is presented in Table 5.

Table 4.

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest I			
01	.05	-.00	-.11
03	.28	-.05	-.03
04	.40	.13	.01
06	.14	-.02	.11
07	.14	.00	-.01
08	.21	-.01	.08
Subtest II			
13	.24	.05	.20
14	.45	-.14	.34
15	.26	-.09	.22
17	.47	-.15	.32
20	.49	-.01	.21

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 4 (continued).

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest III			
31	.51	-.00	.25
32	.40	.04	.06
33	.45	.04	.18
34	.58	.00	.16
35	.60	.06	.14
36	.72	-.03	.12
37	.33	-.07	.22
38	.53	-.00	.06
39	.70	.12	.11
40	.53	.18	.03
41	.63	.14	.03
42	.33	-.03	.15
43	.65	.22	.13
44	.49	.34	.12
46	.39	.02	.14
48	.35	.22	.06
49	.33	.14	.13
50	.57	.15	.04

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 4 (continued).

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest IV			
51	.37	.36	-.07
52	.68	.22	.04
53	.67	.32	-.07
54	.55	.22	-.01
55	.58	.22	-.16
56	.49	.23	.01
57	.68	.25	-.03
58	.68	.22	-.06
59	.60	.18	.04
Subtest V			
71	.22	-.08	.04
72	.36	-.07	.08
73	.67	.26	.00
74	.71	.07	.90
76	.26	.09	-.00
79	.59	.14	-.02
80	.16	.06	.09

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 4 (continued).

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest I			
02	.07	.13	-.09
05	.08	.17	.01
Subtest III			
45	.05	.19	.01
Subtest IV			
60	.08	.78	.14
61	.06	.89	.08
62	.13	.83	.06
63	.08	.89	.06
64	.12	.90	.10
65	.09	.86	.03
66	.06	.90	.05
67	.15	.90	.02
68	.05	.83	.08
69	.09	.85	.05
70	.07	.83	.11
Subtest V			
78	.08	.82	.08

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 4 (continued).

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest I			
09	-.10	.00	.31
10	.07	.03	.27
Subtest II			
11	.10	-.07	.18
12	.24	.02	.26
16	.17	.01	.35
18	-.00	-.13	.36
19	.23	.00	.37
21	-.00	.06	.23
22	.31	.07	.31
23	.21	.04	.59
24	-.06	.08	.56
25	-.02	.13	.64
26	.33	.07	.51
27	.01	.01	.65
28	-.02	.02	.51
29	.02	.22	.52
30	.17	.20	.41

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 4 (continued).

Sorted Factor Loading: Three Factor Solution

Items	F1	F2	F3
Subtest III			
47	.25	.06	.29
Subtest V			
75	.21	.08	.53
77	.13	.02	.35
Percent Variance	18.6%	9.4%	4.8%
Total Percent Variance		32.8%	

Note: Eigenvalue > 3.00. Each items largest factor loading is underlined.

Table 5.

Percentage of Subtest Items on Individual Factor: Three Factor Solution

Subtest	F1	F2	F3
I	60%	20%	20%
II	25%	0%	75%
III	90%	5%	5%
IV	45%	55%	0%
V	70%	10%	20%

Hypothesis 2: There will be a significant difference in the mean total error scores of the CVCT-YC between the four age groups in the sample (5-8 years-of-age). A one-way ANOVA was used in analyzing the total error scores for the CVCT-YC and age. A significant main effect did occur for age, $F(3,205) = 14.75$, $p < .001$. Post-hoc analysis using the Tukey procedure indicated a significant difference ($p < .05$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 6). A significant difference ($p < .05$) was also indicated between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 6). However, post-hoc analysis using the Tukey procedure failed to indicate a significant difference between the group of participants 5 years-of-age and the group of participants 6 years-of-age; and between the group of participants 7 years-of-age and the group of participants 8 years-of-age. Table 7 provides a summary of descriptive statistics for age on total error scores of the CVCT-YC.

Table 6.

Post-hoc Analysis: Age on Total Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-3.76	-		
7	-9.99***	-6.23**	-	
8	-12.04***	-8.28***	-2.05	-

**p < .01. ***p < .001.

Table 7.

Summary of Descriptive Statistics: Total Error Scores CVCT-YC by Age.

Age (Yrs.)	n	M Errors	SD
5	36	18.97	11.00
6	62	15.21	11.37
7	67	8.99	8.89
8	44	6.93	6.43

Hypothesis 3: There will be a significant difference in the mean error scores for each subtest of the CVCT-YC between the four age groups in the sample (5-8 years-of-age).

A Hotelling's T^2-Test was used in analyzing age and mean subtest error scores for the CVCT-YC. An effect did occur for age *F*(15, 599) = 4.82, *p* < .001. The Univariable *F*'s revealed that there were significant differences by age for each of the CVCT-YC subtests (Table 8).

Table 8.

Summary of Descriptive Statistics and Univariable F: Age by Subtests of CVCT-YC

Age (Yrs.)	*M* Errors	SD	Univariable *F* for Age
	Subtest-I		6.08**
5	0.72	1.21	
6	0.29	0.49	
7	0.13	0.49	
8	0.23	0.57	
	Subtest-II		15.74***
5	5.56	3.55	
6	4.39	3.49	
7	2.54	2.45	
8	1.71	2.01	

n = (5yr 36; 6yr 62; 7yr 67; 8yr 44).

*p < .05. **p < .01. ***p < .001.

Table 8 (continued).

Summary of Descriptive Statistics and Univariable F: Age by Subtests of CVCT-YC

	Subtest-III		8.59***
5	5.00	4.37	
6	3.53	3.33	
7	2.34	2.86	
8	1.80	1.79	
	Subtest-IV		24.16**
5	5.78	5.56	
6	5.31	6.30	
7	3.05	4.88	
8	2.68	4.19	
	Subtest-V		12.67***
5	1.91	1.46	
6	1.69	1.53	
7	0.93	1.03	
8	0.52	0.79	

n = (5yr 36; 6yr 62; 7yr 67; 8yr 44).

*$p < .05$. **$p < .01$. ***$p < .001$.

The CVCT-YC mean error scores by age group are illustrated in Figure 1.

Age by CVCT-YC Subtest Mean Score.

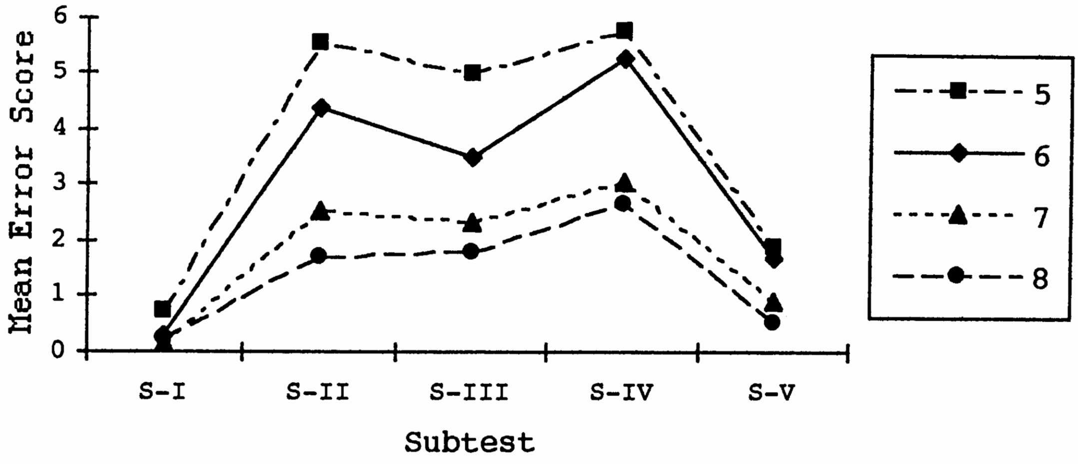


Figure 1. Age by subtest mean score of the CVCT-YC.

Post-hoc analysis of Subtest-I using the Tukey procedure indicated a significant difference ($p < .05$) between the group of participants 5 years-of-age and the group of participants 6 years-of-age, the group of participants 7 years-of-age, and 8 years-of-age (Table 9). Post-hoc analysis of Subtest-II using the Tukey procedure indicated a significant difference ($p < .05$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 10). A significant difference ($p < .05$) was also indicated between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 10). Post-hoc analysis of Subtest-III using the Tukey procedure indicated a significant difference ($p < .05$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 11). A significant difference ($p < .05$) was also indicated between the group of participants 6 years-of-age and the group of participants 8 years-of-age (Table 11). Post-hoc analysis of Subtest-IV using the Tukey procedure indicated no significant difference ($p < .05$) between the four age groups of participants (Table 12). Post-hoc analysis of Subtest-V using the Tukey procedure indicated a significant difference ($p < .05$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 13). A significant difference ($p < .05$) was also indicated between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 13).

Table 9.

Post-hoc Analysis: Age on Subtest-I Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-0.43*	-		
7	-.0.59***	-0.16	-	
8	-0.50**	-0.06	0.09	-

*p < .05. **p < .01. ***p < .001.

Table 10.

Post-hoc Analysis: Age on Subtest-II Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-1.17	-		
7	-3.02***	-1.85**	-	
8	-3.85***	-2.68***	-0.83	-

*p < .05. **p < .01. ***p < .001.

Table 11.

Post-hoc Analysis: Age on Subtest-III Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-1.47	-		
7	-2.66***	-1.19	-	
8	-3.21***	-1.74*	-0.55	-

*p < .05. **p < .01. ***p < .001.

Table 12.

Post-hoc Analysis: Age on Subtest-IV Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-.47	-		
7	-2.73	-2.26	-	
8	-3.10	-2.63	-0.36	-

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 13.

Post-hoc Analysis: Age on Subtest-V Error Scores CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-0.22	-		
7	-0.99**	-0.77**	-	
8	-1.39***	-1.17***	-0.40	-

*$p < .05$. **$p < .01$. ***$p < .001$.

Hypothesis 4: The fourth hypothesis was that there would be a significant difference in the mean subtotal error scores for Subtests I-IV of the CVCT-YC between the four age groups. A one-way ANOVA was used in analyzing the subtotal error scores of Subtests I-IV and age. A significant main effect did occur for age, $F(3,205) = 14.11$, $p < .001$.

Post-hoc analysis using the Tukey procedure indicated a significant difference ($p < .001$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 14). A significant difference ($p < .05$) was also indicated between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 14). However, post-hoc analysis using the Tukey procedure failed to indicate significant difference between the group of participants 5 years-of-age and the group of participants 6 years-of-age; and between the group of participants 7 years-of-age and the group of participants 8 years-of-age (Table 14). Table 15 provides a summary of descriptive statistics for age by subtotal error scores for Subtest I-IV of the CVCT-YC.

Table 14.

Post-hoc Analysis: Age on Subtotal of Error Scores Subtest I-IV of CVCT-YC.

Age (yrs.)	5	6	7	8
5	-			
6	-3.54	-		
7	-9.99***	-5.56**	-	
8	-10.65***	-7.12***	-1.65	-

**p < .01. ***p < .001.

Table 15.

Summary of Descriptive Statistics: Subtotal of Error Scores Subtest I-IV of CVCT-YC.

Age (Yrs.)	M	SD
5	17.06	9.95
6	13.52	10.17
7	8.06	8.13
8	6.41	5.79

n = (5yr 36; 6yr 62; 7yr 67; 8yr 44).

Hypothesis 5: Mean error scores on CVCT-YC would not differ significantly between female and male subjects in the sample. A one-way ANOVA was used in analyzing the relationship between sex and the CVCT-YC total error scores. A significant main effect did occur for sex, $F(1,207) = 5.09$, $p < .05$.

The Univariable *F*'s revealed that there were significant differences by sex on Subtest-IV and the subtotal of Subtest I-IV (Table 16). However, a significant difference for sex was not found for Subtests I, II, III, or V (Table 16). The CVCT-YC subtest mean error scores by sex group are illustrated in Figure 2.

Table 16.

Summary of Descriptive Statistics and Univariable F: Sex by Subtest, Subtotal I-IV, and Total Error Scores of CVCT-YC

Sex	*M* Errors	*SD*	Univariable *F* for Sex
	Subtest-I		0.76
Female	0.35	0.80	
Male	0.26	0.61	
	Subtest-II		1.27
Female	3.16	2.89	
Male	3.67	3.49	

n = (Female 98; Male 111).

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 16 (continued).

Summary of Descriptive Statistics and Univariable F: Sex by Subtest, Subtotal I-IV, and Total Error Scores of CVCT-YC

Sex	M Errors	SD	Univariable F for Sex
	Subtest-III		3.10
Female	2.61	2.70	
Male	3.41	3.73	
	Subtest-IV		5.53*
Female	3.17	4.61	
Male	4.93	5.98	
	Subtest-V		2.57
Female	1.08	1.08	
Male	1.38	1.53	
	Subtotal I-IV		5.21*
Female	9.30	8.29	
Male	12.27	10.27	
	Total		5.09*
Female	10.39	9.07	
Male	13.65	11.54	

n = (Female 98; Male 111).

*$p < .05$. **$p < .01$. ***$p < .001$.

Sex by CVCT-YC Subtest Mean Error Score.

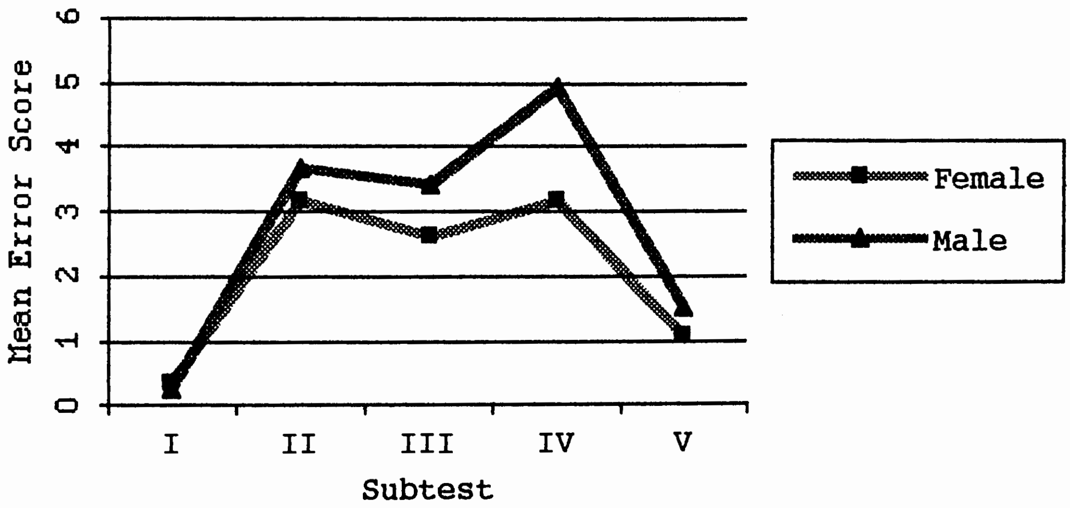


Figure 2. Sex by CVCT-YC Subtest Mean Error Score.

Chapter Five

Discussion

In discussing the results of this study, their relationship to each of the five previously stated hypotheses will first be considered. Implications relating to both theoretical and applied issues will be described. Finally, limitations of the present study will be presented with suggestions for future study and improvements in the Computerized Version of the Category Test - Young Children's Version.

Hypothesis One

Hypothesis one addresses the question of what the CVCT-YC is measuring. The exploratory factor analysis with eigenvalue >3.00 resulted in the extraction of three factors across all age groups in the sample (5-8 years-of-age). Thus, a portion of hypothesis one, that there would be a three factor structure for the CVCT-YC, was supported. The three factor solution accounted for 32.8% of the variance in the sample and leaves 67.2% of the variance unaccounted for. Decreasing the eigenvalue used in factor analysis increased the variance accounted for but also significantly expanded the number of factors extracted. This suggests that while this study supports a three factor structure of the CVCT-YC, the overall factor structure of the CVCT-YC is relatively weak.

Factor One of the three factor solution is described, in rank order of contribution, by 45 items 01, 06, 07, 80, 08, 71, 13, 15, 76, 03, 37, 42, 49, 48, 72, 51, 46, 04, 32, 14, 33, 17, 20, 44, 56, 31, 38, 40, 54, 50, 34, 55, 79, 35, 59, 41, 43, 53, 73, 52, 57, 58, 39, 74, and 36 (see Figure A.1 in the Appendix for a pictorial representation of the items which loaded on Factor One). The items which loaded on Factor One were extracted from across five subtests; Subtest-I, Subtest-II, Subtest-III, Subtest-IV, and Subtest-V. Factor One accounts for 18.6% of the total variance explained by this three factor solution.

Ten of the 45 items which loaded on Factor One require the subject to view a square or circle that has been divided into quarters with each color (red, blue, yellow, green) filling a quarter. One of the quarters (colors) in each of these 10 items has had a portion removed from the image, decreasing the amount of the color from that quarter in comparison to the three other colors. The correct answer is the color which is most different and has had a portion removed, resulting in less color. Twenty-four of the 45 items which loaded on Factor One require the subject to view a series of designs, the shape of the design remains constant in each item, however, the size and color of the shapes varies. The number of shapes in each item also varies from one to four. The correct answer is the color that has a larger shape than the other images in the item. The correct answer is the color that is most different, having more color than the other images in the item. Eleven of the 45 items have three images of the same shape and a fourth of a different shape. The correct answer is the color that is most different, the one with the different shape in each item.

Factor One of the three factor solution is designated Attention; in particular, attention to which color is most different in form or quantity from the other colors. This supports a portion of hypothesis one, that one factor of the CVCT-YC would be attention. This is also consistent with research on the Intermediate Version of the Category Test which identified one factor as Counting/Attention (Kelly, Kunder, & Dean, 1992).

Factor Two is described, in rank order of contribution, by 15 items 02, 05, 45, 60, 78, 62, 68, 70, 69, 65, 61, 63, 64, 66, and 67 (see Figure A.2 in the Appendix for a pictorial representation of the items which loaded on Factor Two). The items which loaded on Factor Two were extracted from across four subtests; Subtest-I, Subtest-III, Subtest-IV, and Subtest-V. Factor Two accounts for 9.4% of the total variance explained by this three factor solution.

Twelve of the 15 items which loaded on Factor Two require the subject to view a square or circle that has been divided into quarters with one of three colors in each quarter and the fourth quarter extracted, replaced with the black background. The correct answer is the color that is missing or has been removed. Clinical observation suggests that these 12 items are the most difficult of all items on the CVCT-YC. This difficulty is related to the subjects tendency to problem solve and respond with one of the three colors present, when the first step is to identify the extracted quarter and then the color that is missing. Each of these twelve items had a factor loading in the range of .78 to .90 on Factor Two. One or the 15 items which loaded on Factor Two has three images of the same shape, but of different sizes and a fourth of a different shape. The correct answer is the color of the shape that is most different. This item had a factor loading of .19 on Factor Two. Two of the 15 items which loaded on Factor Two require the subject to view one geometric shape (a triangle or a circle) and respond correctly with the color of that shape. These two items had a factor loading of .13 and .17 on Factor Two.

Factor Two of the three factor solution is designated Visual Abstract Reasoning. This does not support hypothesis one, that one factor of the CVCT-YC would be attention, position/spatial orientation, or memory. However, this is consistent with research on the Intermediate Version of the Category Test which identified one factor as Visual Abstract Reasoning/Memory (Kelly, Kunder, & Dean, 1992).

Factor Three is described, in rank order of contribution, by 20 items 11, 21, 12, 10, 47, 09, 22, 16, 77, 18, 19, 30, 26, 28, 29, 75, 24, 23, 25, and 27 (see Figure A.3 in the Appendix for a pictorial representation of the items which loaded on Factor Three). The items which loaded on Factor Three were extracted from across four subtests; Subtest-I, Subtest-II, Subtest-III, and Subtest-V. Factor Three accounts for 4.8% of the total variance explained by this three factor solution.

Eight of the 20 items that loaded on Factor Three require the subject to view three or four small circles of which two are the same color. The correct answer is the color that is the same in two of the circles. Seven of the 20 items contain from one to four images, one of which is large. The correct answer is the color of the large image. Three of the 20 items contain three large squares with one small circle of a different color imposed upon the each large square. Two circles and one large square from each item are the same color, resulting in the most color; this color is the correct answer. Two of the 20 items have three images of the same shape and a fourth of a different shape. The correct answer is the color of the shape that is most different.

Factor Three of the three factor solution is designated Attention to most color. This supports hypothesis one, that one factor of the CVCT-YC would be attention. This is consistent with research on the Intermediate Version of the Category Test which identified one factor as Attention (Kelly, Kunder, & Dean, 1992). Factor Three and Factor One both have a construct of Attention; however, Factor Three is Attention to most color, where Factor One is Attention to difference.

Overall, the first hypothesis, that there would be a three factor structure for the CVCT-YC consisting of attention, position/spatial orientation, and memory, was partially supported. The results from this study suggest that the factor structure of the CVCT-YC is relatively weak. Setting the eigenvalue > 3.0 resulted in three factors accounting for 32.8% of the total variance. Decreasing the eigenvalue used in factor analysis increased the variance accounted for but also significantly expanded the number of factors extracted. In this three factor solution, Factor One has been designated Attention to difference, Factor Two as Visual Abstract Reasoning, and Factor Three as Attention to most color.

The purpose of the CVCT-YC is to measure the child's problem solving skills and cognitive flexibility. The 80 items on the CVCT-YC are divided into five subtests. On the first four subtests there is one rule or principle which is the same across all items. Theoretically the principle of each subtest is as follows: Subtest-I, the color of the figure is the correct response; Subtest-II, the color of the largest or most prominent figure is the correct response; Subtest-III, the color of the non-matching figure or shape is the correct response; Subtest-IV, the color of the incomplete or missing portion of the figure is the correct response; and Subtest-V, memory. The last subtest is a memory test which asks the child to recall correct answers from previous sections.

Items from Subtest-I loaded on Factor One, Factor Two, and Factor Three. This suggests that the items in Subtest-I have one of three underlying constructs and that there is not one consistent construct underlying the items that make up the subtest. However, 60% (6 of 10) of the items from Subtest-I loaded on Factor One suggesting that the main construct in Subtest-I is Attention to difference.

Items from Subtest-II loaded on Factor One, and Factor Three. This suggests that the items in Subtest-II have one of two underlying constructs and that there is not one consistent construct underlying the items that make up the subtest. However, 75% (15 of 20) of the items from Subtest-II loaded on Factor Three suggesting that the main construct in Subtest-II is Attention to most color.

Items from Subtest-III loaded on Factor One, Factor Two, and Factor Three. This suggests that the items in Subtest-III have one of three underlying constructs and that there is not one consistent construct underlying the items that make up the subtest. However, most of the items from Subtest-III, 90%, loaded on Factor One suggesting that the main construct in Subtest-III is Attention. In particular Factor One is attention to difference. Thus, the theorized rule for Subtest-III, the color of the non-matching figure or shape, corresponds to Factor One on 90% (18 of 20) of the items from this subtest.

Items from Subtest-IV loaded on Factor One and Factor Two. This suggests that the items in Subtest-IV have two underlying constructs. The first nine items from this subtest loaded on Factor One, attention to difference. The last eleven items loaded on Factor Two, Visual Abstract Reasoning. Clinical observation also suggests that Subtest-IV is the most difficult of the five subtests. The subjects have greater difficulty identifying the rule for the last eleven items in this subtest. Given the factor structure of items from this subtest and clinical observation it is suggested that the last eleven items are more abstract and cognitively challenging.

Items from Subtest-V loaded on Factor One, Factor Two, and Factor Three. This suggests that the items in Subtest-V have one of three underlying constructs and that there is not one consistent construct underlying each item in the subtest. However, most of the items (7 of 10) from Subtest-V loaded on Factor One suggesting that the main construct in Subtest-V is Attention to difference. The theorized rule for Subtest-V, Memory, does not seem to be supported in this study.

Given the weak factor structure of the CVCT-YC and the variability of item factor loadings within each subtest, it is suggested that the subtests not be used to evaluate unique abilities such as attention, position/spatial orientation, visual abstract reasoning, or memory. It is suggested that the total error score is the only valid score for the current version of the CVCT-YC.

Hypothesis Two

The results from this study support the second hypothesis that there would be a significant difference in the mean total error scores of the CVCT-YC between the four age groups in the sample (5,6,7, and 8 years-of-age). An ANOVA indicated a significant main effect for age. Post-hoc analysis indicated a significant difference between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 6). A significant difference was also indicated between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 6). However, post hoc analysis indicated no significant difference between the group of participants 5 years-of-age and the group of participants 6 years-of-age; and between the group of participants 7 years-of-age and the group of participants 8 years-of-age. This is consistent in part with previous research on the effects of age on CVCT-YC total error scores in which a significant difference was found between all age groups with the exception of the group of participants 7 years-of-age and the group of participants 6 years-of-age, and the group of participants 8-years of age (Brown 1998).

The results of this current study are consistent with literature which suggests that the child's ability to categorize information becomes more sophisticated as the child develops (Diamond et al., 1994; Bomba & Sequeland, 1983; Miller & Younger, 1982; Bornstein, 1981; and McGurk, 1972). Literature also suggests that as a child develops, their approach to problem solving progresses from an emphasis on perception alone, to intuitive thinking, to the ability to perform mental operations and apply them to concrete objects. The results of this study are also consistent with literature which suggests that there is a causal relationship between the growth spurts of the brain and cognitive abilities (Epstein, 1984).

Brown (1998) reported a significant difference between the group of subjects five years-of-age and the group of subjects six years-of-age; this current study did not find a significant difference between these age groups on CVCT-YC total error scores. This current study resulted in a significant difference between the group of subjects six years-of-age and the group of subjects seven years-of-age; Brown (1998) did not find a significant difference between these age groups on the CVCT-YC total error scores. Thus, while this current study is consistent with previous research that suggests that the child's ability to categorize information becomes more sophisticated as the child develops, there is some inconsistency in the age ranges in which these changes occur as represented by performance on the CVCT-YC.

The results of this study indicate that the age of the subject has a significant effect on the total error score obtained on the CVCT-YC. It is suggested that a norming study be completed with a significantly large, representative sample of the population to establish individual norms for children 5 years-of-age, 6 years-of-age, 7 years-of-age, and 8 years-of-age.

Hypothesis Three

The results from this study support the third hypothesis that there would be a significant difference in the mean error scores for each subtest of the CVCT-YC between the four age groups in the sample (5,6,7, and 8 years-of-age).

A Hotelling's $\underline{T}^2$-Test for age by subtest errors found a significant difference ($\underline{p} < .05$) for age on Subtest-I, Subtest-II, Subtest-III, Subtest-IV, and Subtest-V (Table 8). Post-hoc analysis indicated a significant difference between the group of participants 5 years-of-age and the group of participants 6 years-of-age, 7 years-of-age, and 8 years-of-age on Subtest-I. Post-hoc analysis also indicated a significant difference between the group of participants 5 years-of-age and the group of participants 7 years-of-age, and 8 years-of-age on Subtest-II, Subtest-III, and Subtest-V. Post-hoc analysis indicated a significant difference between the group of participants 6 years-of-age and the group of participants 7 years-of-age, and 8 years-of-age on Subtest-II and Subtest-V; the group of participants 6 years-of-age also differed significantly from the group of participants 8 years-of-age on Subtest-III. Post-hoc analysis failed to find a significant difference for age on subtest-IV.

Subtest-IV does not discriminate between developmental differences in abstraction ability for children 5 to 8 years-of-age. This suggests that Subtest-IV taps abilities which may not become fully developed until after 8 years-of-age. Clinical observation and item analysis suggest that the construct underlying the final eleven items of Subtest-IV, Abstract Visual Reasoning, develops later than those abilities required to correctly respond to items in Subtests-I, Subtest-II, Subtest-III, and Subtest-V. The results of this study indicate that the age of the subject has a significant effect on the subtest error score obtained on all subtests of the CVCT-YC with the exception of Subtest-IV.

Hypothesis Four

Subtest-V of the CVCT-YC has been theorized to have the underlying construct of Memory. The purpose of the CVCT-YC is to measure children's problem solving skills and cognitive flexibility, this is inconsistent with a subtest that contains a memory construct. Russell and Levy (1987) also suggested the removal of memory subtests. Therefore, this study explored the subtotal of Subtest I-IV error scores which excludes the theorized memory subtest of the CVCT-YC. The results from this study support the fourth hypothesis that there would be a significant difference in the subtotal of Subtest I-IV error scores of the CVCT-YC between the four age groups in the sample (5,6,7, and 8 years-of-age). An ANOVA indicated a significant main effect for age.

Post-hoc analysis indicated a significant difference ($p < .001$) between the group of participants 5 years-of-age and the group of participants 7 years-of-age and 8 years-of-age; between the group of participants 6 years-of-age and the group of participants 7 years-of-age and 8 years-of-age (Table 14). However, post-hoc analysis using the Tukey procedure indicated no significant difference between the group of participants 5 years-of-age and the group of participants 6 years-of-age; and between the group of participants 7 years-of-age and the group of participants 8 years-of-age (Table 14). This is consistent with the findings from this study on total error scores for the CVCT-YC. Given the results from this study indicating that items from Subtest-V do not make any unique contributions to the total error scores of the CVCT-YC, and the consistency of age differences between CVCT-YC total error scores and subtotal of Subtest-I through Subtest-IV, it is suggested that Subtest-V be removed in a revision of the CVCT-YC. This would permit the shortening of the CVCT-YC without forfeiting utility.

Hypothesis Five

The results from this study do not support the fifth hypothesis that the mean total error scores on CVCT-YC would not differ significantly between female and male subjects in the sample. A significant main effect for sex differences was found between females and males. The significant difference between females and males was limited to Subtest-IV, subtotal of Subtest I-IV, and total error score. Analysis of subtests I, II, III, and V did not result in a significant difference between female and male subjects in the sample. This suggests that females between the ages of five and eight are significantly more successful than males of the same age in abstract visual reasoning.

The results from this study are inconsistent with research in which no significant main effect for sex difference was found between females and males (5-8 years-of-age) on CVCT-YC total error scores (Brown 1998). It is also inconsistent with research on the CAT-A performance in which sex differences were found on a sample of Australian adult subjects. Men made significantly fewer errors on Subtest Three, Subtest Four, and total score of the Booklet Category Test (Ernst 1987). Ernst attributed the difference to males superiority in spatial abilities. The results from the current study suggest that female children between the ages of five and eight develop abstract visual reasoning abilities earlier than male children in the same age range.

Aside from the consistencies between this study and the literature, several considerations should be noted. First, this study excluded children with known brain impairment. It would be beneficial to establish norms for the CVCT-YC and children diagnosed with brain impairment. Considering the differences identified in this study between mean error scores based on age group and sex group, it would be beneficial for future norming studies to include norms for each age group and each sex group.

Previous research has indicated the CVCT-YC as a valid measure of reasoning, abstraction, logical analysis, nonverbal learning, memory, concept formation, and problem solving. Application of this study is in the understanding of a three factor solution to the items of the CVCT-YC. This also permits the researcher to explore options in removing items from the CVCT-YC in an effort to decrease administration time without interfering with utility, thus facilitating the use of the Category Test in the assessment of children. Russell and Levy (1987) suggest that in shortening the CAT the researcher should reduce the length of each subtest as much a possible without reducing reliability, the newly developed version should correlate highly with the original version, the principles used in the CAT should be retained, and the memory subtest should be eliminated. It is recommended that these criteria be followed in revising the CVCT-YC.

It is recommended that one version of the CVCT-YC, the Computerized Version of the Category Test - Young Children's

Version Revised (CVCT-YCR) be maintained as a measure of reasoning, abstraction, logical analysis, nonverbal learning, concept formation, and problem solving, without attempting to measure unique abilities by each subtest. Subtest-I of the CVCT-YC appears to be a learning trial. It is recommended that each item in Subtest-I be retained in the CVCT-YCR; however, it is recommended that the error score from this subtest not be a component of the CVCT-YCR total error score. It is recommended that Subtest-II, Subtest-III, and Subtest-IV be retained without change in the development of the CVCT-YCR. The items from Subtest-V have one of three underlying constructs and the hypothesized construct of Memory for this subtest was not supported; therefore, it is recommended that Subtest-V be removed in the development of the CVCT-YCR.

It is recommended that a new version of the CVCT-YC be developed in which the factor structure is more robust. In this new version of the CVCT-YC each subtest should be developed such that the items that make up a subtest have similar underlying constructs and load on no more than two related factors. Subtest-IV of the CVCT-YC is an example of this and should be retained without change in the development of this new version. This new version should correlate highly with the original CVCT-YC and be maintained as a measure of reasoning, abstraction, logical analysis, nonverbal learning, concept formation, and problem solving. This understanding of the factor structure underlying the CVCT-YC also facilitates development of alternate versions which would permit serial testing to monitor treatment efficacy.

It is recommended that future versions of the CVCT-YC maintain the potential for measuring item response time. Hale, Fry, and Jessie (1993) suggest that older children can scan information more quickly and generate faster responses. It is suggested that future research with the CVCT-YC or one of the alternate version, explore the effects of age on response time for the CVCT-YC. The results of this study suggests that the concept underlying Factor Two is the most difficult task of the three underlying concepts, the concept underlying Factor Three the second most difficult, and the concept underlying Factor One the easiest task of the three underlying concepts of the CVCT-YC. It is suggested that future research with the CVCT-YC or one of the alternate versions, explore the effects of the underlying concepts from each factor on response time.

References

Adams, R. L., & Trenton, S. L. (1981). Development of a paper-and-pen form of the Halstead Category Test. Journal of Consulting and Clinical Psychology, 49(2), 298-299.

Aftanas, M. S., & Royce, J. R. (1969). A factor analysis of brain damage tests administered to normal subjects with factor score comparisons across ages. Multivariate Behavioral Research, 4, 459-481.

Anastasi, A. (1988). Psychological testing (6 ed.). New York, NY: Macmillan Publishing Company.

Anthony, W. Z., Heaton, R. K., & Lehman, R. A. W. (1980). An attempt to crossvalidate two actuarial systems for neuropsychological test interpretation. Journal of Consulting and Clinical Psychology, 48, 317-326.

Barker, M. (1977). A short form of the Category Test. Psychological Reports, 40, 1243-1246.

Barnes, G., & Lucas, G. J. (1974). Cerebral dysfunction vs. psychogenesis in the Halstead-Reitan tests. Journal of Nervous and Mental Disease, 158, 50-60.

Beardsley, J. V., Matthews, C. G., Cleeland, C. S., & Harley, J. P. (1978). Experimental T-score norms for the Wisconsin Neuropsychology Test Battery. Madison, WI:

University of Wisconsin, Neuropsychology Laboratory.

Beaumont, J. G. (1975). The validity of the Category Test administered by on-line computer. Journal of Clinical Psychology, 31, 458-462.

Boll, T. J. (1978). Diagnosing brain impairment. In B. B. Wolman (Ed.), Clinical diagnosis of mental disorders: A handbook (pp. 601-675). New York, NY: Plenum Press.

Boll, T. J. (1981). The Halstead-Reitan neuropsychology battery. New York, NY: John Wiley.

Boll, T. (1993). Children's Category Test. San Antonio, TX: The Psychological Corporation.

Bomba, P. C., & Siqueland, E. R. (1983). The nature and structure of infant forms of categories. Journal of Experimental Child Psychology, 35, 294-328.

Bornstein, M. H. (1981). Psychological studies of color perception in human infants: Habituation, discrimination and categorization, recognition, and conceptualization. In L. P. Lipsitt (Ed.), Advances in infancy research (pp. 1-40). Norwood, NJ: Ablex.

Bornstein, R. (1986). Contribution of various neuropsychological measures to detection of frontal lobe impairment. International Journal of Clinical Neuropsychology, 8, 18-22.

Boyle, G. J. (1975). Shortened Halstead Category Test. Australian Psychologist, 10, 81-84.

Boyle, G. J. (1988). What does the neuropsychological Category Test measure? Archives of Clinical Neuropsychology, 3, 69-76.

Boyle, G. J., Ward, J., & Steindl, S. R. (1994). Psychometric properties of Russell's short form of the Booklet Category Test. Perceptual and Motor Skills, 79, 128-130.

Brown, G. A., (1998). Validation of the Computerized Version of the Category Test - Young Chilren's Version. Unpublished master's thesis, Texas Woman's University, Denton.

Byrd, P., & Warner, P. (1986). Development of a booklet version of the Halstead category test from children age nine through fourteen years: Preliminary validation with normal and learning disabled subjects. International Journal of Clinical Neuropsychology, 3 (2), 80-82.

Calsyn, D. A., O'Leary, M. R., & Chaney, E. F. (1980). Shortening the Category Test. Journal of Consulting and Clinical Psychology, 48, 788-789.

Campbell, S., & Whitaker, H. (1986). Cortical Maturation and Developmental Neurolinguistics. In J. E. Obrzut & G. W. Hynd (Eds.), Child neuropsychology New York, NY: Academic Press.

Case, R. (1985). Intellectual development: A systematic reinterpretation. New York: Academic Press

Case, R., & Griffin, S. (1990). Child cognitive development: The role of central conceptual structures in the devevelopment of scientific and social thought. In C. A. Hauert (Ed.), Developmental psychology: Cognitive, perceptual-motor and neuropsychological perspectives (pp. 193-230). Amsterdam: North Halland.

Coutts, R. L., Lichstein, L., Bermudez, J. M., Daigle, M., Mann, D. P., Charbonnel, T. S., Michaud, R., & William, C. R. (1987). Treatment assessment of learning disabled children: Is there a role for frequently repeated neuropsychological testing? Archives of Clinical Neuropsychology, 2, 237-244.

Choca, J. P., Laatsch, L., Wetzel, L., & Aagresti, A. (1997) The Halstead Category Test: A fifty year perspective. Neuropsychology Review, 7, 61-75.

Cuevas, J. L., & Osterich, H. (1990). Cross-cultural evaluation of the booklet version of the Category Test. International Journal of Clinical Neuropsychology, 12, 187-190.

Cullum, C. M., Steinman, D. R., & Bigler, E. D. (1984). Relationship between fluid and crystallized cognitive functions using Category Test and WAIS scores. International Journal of Clinical Neuropsychology, 6, 172-174.

Davidoff, G., Morris, J., Roth, E., & Bleiberg, J. (1985). Cognitive dysfunction and mild closed head injury in traumatic spinal cord injury. Archives of Physical Medicine and Rehabilitation, 66, 489-491.

Dean, R. S. (1985). Foundation and rationale for neuropsychological bases of individual differences. New York, NY: Plenum Publishing.

DeFilippis, N. A., & McCampbell, E. (1979). The Booklet Category Test: Research and clinical form (Manual). Odessa, FL: Psychological Assessment Resources, Inc.

DeFilippis, N. A., McCampbell, E., & Rogers, P. (1979). Development of a booklet form of the Category Test: Normative and validity data. Journal of Clinical Neuropsychology, 1, 339-342.

Diamond, A., Werker, J. F., & Lalonde, C. (1994). Toward understanding commonalities in the development of object search, detour navigation, categorization, and speech perception. In G. Dawson & K. W. Fischer (Eds.), Human Behavior and the Developing Brain. New York, NY: Guilford Press.

Dodrill, C. B. (1979). Sex differences on the Halstead-Reitan Neuropsychological Battery and on other neuropsychological measures. Journal of Clinical Psychology, 1, 339-342.

Doehring, D., & Reitan, R. (1962). Concept attainment of human adults with lateralized cerebral lesions. Perceptual and Motor Skills, 14, 27-33.

Donnelly, E. F., Waldman, I. N., Murphy, D. L., Wyatt, R. J., & Goodwin, F. K. (1980). Primary affective disorder: Thought disorder in depression. Journal of Abnormal Psychology, 89, 315-319.

Elias, M. F., Robbins, M. A., & Schultz, N. R. (1993). The influence of gender and age on Halstead-Reitan Neuropsychological test performance. Journal of Gerontology, 48, 278-281.

Epstein, H. T. (1984). Phrenolysis: Special brain and mind growth periods in human mental development. Developmental Psychology, 7, 217-224.

Ernst, J. (1987). Neuropsychological problem-solving skills in the elderly. Psychology and Aging, 2, 363-365.

Fischer, K. W. & Pipp, S. L., (1984). Processes of cognitive development: Optimal level and skill acquisition. In R. J. Sternber (Ed.), Mechanisms of cognitive development (pp. 45-80). New York: Freeman

Fischer, K. W., & Ross, S. P. (1994). Dynamic development of coordination of components in brain and behavior: A framework for theory. In G. Dawson & K. W. Fischer (Eds.), Human behavior and the developing brain (pp. 3-66). New York: Guilford.

Fischer, W. E., & Dean, R. S. (1990). Factor structure of the Halstead Category Test by age and gender.

International Journal of Clinical Neuropsychology, 12, 180-183.

Fitzhugh, K. B., Fitzhugh, L. C., & Reitan, R. M. (1961). Psychological deficits in relation to acuteness of brain dysfunction. Journal of Consulting Psychology, 25, 61-66.

From-Auch, D., & Yeudall, L. T. (1983). Normative data for the Halstead-Reitan Neuropsychological tests. Journal of Clinical Neuropsychology, 5, 221-238.

Golden, C. J. (1978). Diagnosing and rehabilitation in clinical neuropsychology. Springfield, IL: Charles C. Thomas.

Golden, C. J., Kuperman, S. K., MacInnes, W. D., & Moses, J. A. (1981). Cross-validation of an abbreviated form of the Halstead Category Test. Journal of Consulting and Clinical Psychology, 49, 606-607.

Goldstein, G. (1990). Neuropsychological heterogeneity in schizophrenia: A consideration of abstraction and problem-solving abilities. Archives of Clinical Neuropsychology, 5, 251-264.

Goldstein, G., & Shelly, C. H. (1972). Statistical and normative studies of the Halstead Neuropsychological Test Battery relevant to a neuropsychiatric hospital setting. Perceptual and Motor Skills, 34, 603-620.

Gregor, R. J., Paul, J. J., & Morrison, M. W. (1979). A short form of the Category Test for adults. Journal of Clinical Psychology, 35, 795-798.

Halstead, W. C. (1947). Brain and intelligence. Chicago, IL: University of Chicago Press.

Hale, S., Fry, A. F., & Jessie, K. A. (1993). Effects of practice on speed of information processing speed in children and adults: Age sensitivity and age invariance. Developmental Psychology, 29, 880-892.

Heaton, R. K., Grant, I., & Matthews, C. G. (1986). Differences in neuropsychological test performance associated with age, education and sex. In I. Grant & K. M. Adams (Eds.), Neuropsychological assessment in neuropsychiatric disorders: Clinical methods and empirical findings (pp. 100-120). New York: Oxford University Press.

Hecaien, H., & Albert, M. L. (1978). Human Neuropsychology. New York, NY: Wiley-Interscience.

Heppner, P. P., Kivlighan, D. M., & Wampold, B. E. (1992). Research design in counseling. Pacific Grove, CA: Broods/Cole Publishing Company.

Himwich, W. A. (1970). Developmental Neurobiology. Springfield, IL: Charles C. Thomas.

Holland, T. R., & Wadsworth, H. M. (1976). Assessment of conceptual deficits in brain-damaged and schizophrenic patients. Perceptual and Motor Skills, 43, 951-951.

Horton, A. M., & Siegel, E. (1990). Comparison of multiple sclerosis and head trauma patients: A neuropsychological pilot study. International Journal of Neuroscience, 53, 213-215.

Jarvis, P., & Barth, J. (1984). Halstead-Reitan Test Battery: An interpretive guide. Odessa, FL: Psychological Assessment Resources, Inc.

Kelly, M. K., & Dean, R. (Eds.). (1990). Best practices in neuropsychology. Washington, D.C.: NASP.

Kelly, M. K., Kudert, D. K., & Dean, R. S. (1992). Factor analysis and matrix invariance of the HRNB-C Category Test. Archives of Clinical Neuropsychology, 7, 415-418.

Kestenbaum, R., & Nelson, C. A. (1990). The recognition and categorization of upright and inverted emotional expressions by 7-month-old infants. Infant Behavior and Development, 13, 497-511.

Kilpatrick, D. G. (1970). The Halstead Category Test of brain dysfunction: Feasibility of a short-form. Perceptual and Motor Skills, 30, 577-578.

Kim, J. & Mueller, C. W. (1978). Introduction to factor analysis: What it is and how to do it. Beverly Hills, CA: Sage Publications.

Klonoff, H. (1971). Factor analysis of a neuropsychological battery for children aged 9 to 15. Perceptual and Motor Skills, 32, 603-616.

Klove, H. (Ed.). (1974). Validation studies in adult clinical psychology. Washington, D.C.: V. M. Winston.

Kupke, T. (1983). Effects of subject sex, examiner sex, and test apparatus on Halstead Category and Tactual Performance Tests. Journal of Consulting and Clinical Psychology, 51(4), 624-626.

Lansdell, H., & Donnelly, E. F. (1977). Factor analysis of Wechsler Adult Intelligence Scale subtests and the Halstead-Reitan Category and Tapping tests. Journal of Consulting and Clinical Psychology, 45, 412-416.

MacInnes, W. E., Forch, J. R., & Golden, C. J. (1981). A cross-validation of a booklet form of the Category Test. Clinical Neuropsychology, 3, 3-5.

Mack, J. L., & Carlson, J. J. (1978). Conceptual deficits and aging: The Category Test. Perceptual and Motor Skills, 46, 123-128.

Matarazzo, J. D., Matarazzo, R. G., Wiens, A. N., Gallo, A. E., & Klonoff, H. (1976). Retest reliability of the Halstead Impairment Index in a formal, a schizophrenic, and two samples of organic patients. Journal of Clinical Psychology, 32(2), 338-349.

Matthews, C. G., Shaw, D. J., & Klove, H. (1966). Psychological test performance in neurologic and pseudoneurologic subjects. Cortex, 2 244-253.

McCampbell, E., & DeFilippis, N. A. (1979). The development of a booklet form of the Category Test; A preliminary report. Clinical Neuropsychology, 1, 33-35.

McGurk, H. (1972). Infant discrimination of orientation. Journal of Experimental Child Psychology, 14, 151-164.

Mercer, W. N., Harrell, E. H., Miller, D. C., & Rockers, D. (1994). Performance of Brain-Injured Versus Non-Brain-Injured Individuals on Three Versions of the Category Test. The Clinical Neuropsychologist, 2, 174-179.

Miller, C. L., & Younger, B. A. (1982). The categorization of male and female voices in infancy. Infant Behavior and Development, 5, 143-159.

Miller, D. C. (1989). Relations among three levels of measuring planning: Electrophysiological - event-related potentials, neuropsychological - the Category Test, and psychological - PASS scales in adolescent males. Unpublished doctoral dissertation, Ohio State University.

Miller, D. C. (1995). Computerized Version of the Category Test - Young Children's Version. Denton, TX: Kids Inc.

Moses, J. A. (1985). Internal consistency of standard and short forms of three itemized Halstead-Reitan Neuropsychological Battery test. International Journal of Clinical Neuropsychology, 7, 164-166.

Naour, P. J., Languis, M. L., & Martin, D. J. (1991). Developmental component in brain electrical activity of normal and learning disabled boys. In M. L. Languis, J. J. Buffer, D. J. Martin, & P. J. Naour (Eds.), Monographs in psychobiology and integrated approach.

Price, L. J., Fein, G., & Feinberg, I. (1980). Neuropsychological assessment of cognitive functioning in the elderly. In L. W. Poon (Ed.), Aging in the 1980's: Psychological issues (pp. 78-85). Washington, DC: American Psychological Association.

Prigatano, G., & Parsons, O. (1976). Relationship of age and education to Halstead Test performance in different patient populations. Journal of Consulting and Clinical Psychology, 44, 527-533.

Query, W. T. (1979). Category Test as related to age in two brain-damaged groups. Journal of Clinical Psychology, 35, 802-804.

Reed, H. B. C., & Reitan, R. M. (1963a). A comparison of the effects of the normal aging process with the effects of organic brain damage on adaptive abilities. Journal of Gerontology, 18, 177-179.

Reed, H. B. C., & Reitan, R. M. (1963b). Changes in psychological test performance associated with the normal aging process. Journal of Gerontology, 18, 271-274.

Reeder, K. P., & Boll, T. J. (1992). A shortened intermediate version of the Halstead Category Test. Archives of Clinical Neuropsychology, 7, 53-62.

Reitan, R. M. (1955). Investigation of the validity of Halstead's measures of biological intelligence. Archives of Neurology and Psychiatry, 73, 28-35.

Reitan, R. M. (1956). The relationship of the Halstead Impairment Index and the Wechsler-Bellevue total weighted score to chronological age. Journal of Gerontology, 11, 447.

Reitan, R. (1964). Psychological deficits resulting from cerebral lesions in man. In J. M. Warren & K. A. Akert (Eds.), The Frontal Granular Cortex and Behavior New York: McGraw-Hill.

Reitan, R. M., & Davison, L. A. (1974). Clinical neuropsychology: Current status and applications. Washington, DC: Winston & Sons.

Reitan, R. M., & Wolfson, D. (1985). The Halstead-Reitan Neuropsychological Test Battery: Theory and clinical interpretation. Tucson, AZ: Neuropsychology Press.

Reitan, R. M., & Wolfson, D. (Eds.). (1986a). Cortical Maturation and Developmental Neurolinguistics. New York, NY: Academic Press.

Reitan, R. M., & Wolfson, D. (1986b). the Halstead-Reitan Neuropsychological Test Battery and aging. In T. L.

Brink (Ed.), Clinical Gerontology: A Guide to Assessment and Intervention (pp. 39-61). New York: Haworth Press.

Reitan, R. M., & Wolfson, D. (1992a). Conventional intelligence measures and neuropsychological concepts of adaptive abilities. Journal of Clinical Psychology, 48, 521-529.

Reitan, R. M., & Wolfson, D. (1992b). Neuropsychological evaluation of older children. Tucson, AZ: Neuropsychology Press.

Reitan, R. M. & Wolfson, D. (1993). Neuropsychological evaluation of young children. Tucson, AZ: Neuropsychology Press.

Royce, J. R., Yeudell, L. T., & Bock, C. (1976). Factor analytic studies of human brain damage: I. First and second-order factors and their brain correlates. Multivariate Behavioral Research, II, 381-418.

Russell, E. W., & Levy, M. (1987). Revision of the halstead category test. Journal of consulting and clinical psychology, 55(6), 898-101.

Russell, E. (1974). The effect of acute lateralized brain damage on Halstead's biological intelligence factors. Journal of General Psychology, 90, 101-107.

Russell, E. W. (1982). Factor analysis of the Revised Wechsler Memory Scale tests in a neuropsychological battery. Perceptual and Motor Skills, 54, 971-974.

Schreiber, D. J., Goldman, H., Kleinman, K. M., Goldfader, P. R., & Snow, M. Y. (1976). The relationship between independent neuropsychological and neurological detection and localization of cerebral impairment. Journal of Nervous and Mental Disease, 162, 360-365.

Swiercinsky, D. (1979). Factorial pattern description and comparison of factorial abilities in neuropsychological assessment. Perceptual and Motor Skills, 48, 231-241.

Telzrow, C. F., & Harr, G. A. (1987). Common variance among three measures of nonverbal cognitive ability: WISC-R performance scale, WJBP-TCA reasoning cluster, and Halstead Category Test. Journal of School Psychology, 25, 93-95.

Thomas, R. M. (1992). Comparing Theories of Child Development (3rd. ed.). Belmont, CA: Wadsworth, Inc.

Vega, A., & Parsons, O. A. (1967). Cross-validation of the Halstead-Reitan tests for brain damage. Journal of Consulting and Clinical Psychology, 31, 619-625.

Walsh, K. W. (1978). Neuropsychology: A clinical approach. New York, NY: Churchill Livingstone.

Wheeler, L., Burke, C., & Reitan, R. M. (1963). An application of discriminant functions to the problem of predicting brain damage using behavioral variables. Perceptual and Motor Skills, 16, 417.

Wood, W. D., & Strider, M. A. (1980). Comparison of two methods of administering the Halstead Category Test. Journal of Clinical Psychology, 36, 476-479.

Appendix

Table A2.

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
01	1.00													
02	-0.02	1.00												
03	0.10	-0.02	1.00											
04	-0.03	0.28	0.26	1.00										
05	-0.03	-0.01	0.15	0.19	1.00									
06	-0.05	0.19	0.06	0.33	0.12	1.00								
07	-0.03	-0.02	0.12	0.14	0.39	0.08	1.00							
08	0.10	-0.02	0.10	0.13	0.36	0.07	0.45	1.00						
09	0.03-	-0.01	-0.03	-0.02	-0.02	-0.03	-0.02	0.17	1.00					
10	-0.04	-0.02	-0.04	0.10	-0.03	0.05	-0.04	0.09	0.14	1.00				
11	0.06	0.16	0.21	0.15	-0.01	0.03	0.02	0.06	-0.09	0.02	1.00			
12	-0.01	0.04	0.03	-0.05	0.06	-0.03	0.01	0.11	0.06	0.06	0.02	1.00		

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
13	-0.00	-0.04	0.06	0.09	0.14	0.07	0.01	0.07	0.14	-0.09	0.04	0.16	1.00	
14	-0.08	0.09	0.12	0.09	-0.06	0.18	0.01	-0.01	0.04	0.11	0.15	0.35	0.16	1.00
15	-0.06	-0.03	0.02	-0.06	-0.05	-0.08	-0.06	0.03	0.07	0.09	0.16	0.31	0.28	0.40
16	-0.06	-0.03	0.01	0.13	0.07	0.18	0.13	0.02	-0.05	0.00	0.03	0.18	0.12	0.29
17	-0.07	0.11	0.14	0.18	-0.05	0.08	-0.07	-0.07	-0.05	0.12	0.10	0.35	0.15	0.57
18	-0.06	-0.03	0.03	-0.05	-0.04	-0.08	0.05	-0.06	-0.04	-0.17	0.15	0.09	0.02	0.15
19	-0.06	-0.03	0.02	-0.05	-0.04	-0.08	0.05	0.03	0.08	0.01	0.02	0.11	0.06	0.33
20	-0.05	-0.02	0.06	0.08	0.12	0.03	0.08	0.07	-0.03	0.05	0.07	0.19	0.07	0.24
21	-0.07	0.04	-0.08	0.07	-0.02	-0.03	0.01	0.10	0.06	0.06	-0.01	0.02	-0.02	-0.03
22	-0.00	0.10	0.13	0.17	-0.06	0.07	-0.07	-0.00	0.04	0.11	-0.11	0.04	0.02	0.23
23	-0.07	-0.04	0.16	0.18	0.04	0.02	0.01	0.16	0.15	0.26	0.06	0.09	0.18	0.14
24	-0.02	-0.05	-0.09	0.17	0.02	-0.01	-0.01	0.12	0.21	0.14	0.17	-0.02	0.12	-0.03

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
25	-0.07	-0.03	-0.07	-0.06	-0.05	-0.02	0.03	0.02	0.17	0.00	0.09	0.13	0.11	0.11
26	-0.00	-0.04	-0.01	0.01	0.04	0.19	0.01	0.08	0.14	0.18	0.05	0.20	0.10	0.36
27	-0.07	-0.04	0.00	0.11	0.05	0.09	0.02	0.09	0.26	0.21	0.05	0.16	0.13	0.16
28	-0.00	-0.06	0.04	0.14	-0.09	0.11	-0.11	-0.00	0.22	0.17	0.16	0.03	0.06	0.11
29	0.04	-0.07	-0.03	0.00	0.05	0.00	-0.06	0.10	0.13	0.21	0.16	0.12	0.09	0.02
30	-0.03	-0.05	0.02	-0.01	-0.07	0.08	-0.01	0.04	0.19	0.19	0.03	0.08	0.23	0.15
31	0.03	-0.03	0.20	0.34	0.08	0.21	0.05	0.13	-0.04	0.10	0.21	0.26	0.15	0.33
32	0.04	-0.03	0.03	0.05	0.21	0.07	-0.05	0.04	0.09	0.02	-0.07	0.26	0.22	0.41
33	0.06	-0.03	0.15	0.30	0.10	0.10	0.07	0.16	0.10	0.04	0.09	0.20	0.37	0.26
34	-0.05	-0.03	0.22	0.06	-0.04	0.01	-0.05	0.05	-0.04	0.03	0.14	0.28	0.18	0.38
35	-0.06	-0.03	0.29	0.36	0.08	-0.00	0.05	0.13	-0.04	0.19	0.15	0.24	0.16	0.39
36	0.04	-0.03	0.21	0.36	0.08	0.14	0.05	0.13	-0.04	0.10	0.07	0.17	0.16	0.39

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
37	0.08	-0.02	-0.05	0.09	0.12	0.13	0.09	0.19	-0.03	0.06	0.04	0.08	0.14	0.20
38	0.15	-0.03	0.22	0.27	0.19	0.08	0.06	0.15	-0.04	0.03	-0.06	0.20	0.13	0.28
39	-0.05	-0.03	0.25	0.30	-0.04	0.18	-0.01	-0.05	-0.04	0.23	0.00	0.20	0.10	0.42
40	-0.01	0.09	0.18	0.23	0.03	0.11	0.16	0.13	-0.06	0.10	-0.02	0.19	0.03	0.28
41	0.00	0.11	0.14	0.18	-0.05	0.02	0.10	0.08	-0.05	0.05	0.00	0.07	0.11	0.22
42	-0.06	-0.03	0.12	0.26	0.09	0.23	0.16	0.04	-0.04	-0.06	-0.03	-0.01	0.17	0.12
43	0.03	-0.03	0.10	0.24	0.07	0.06	0.14	0.21	0.07	0.01	0.01	0.03	0.23	0.22
44	0.08	0.06	0.18	0.30	0.16	0.05	0.04	0.14	-0.08	0.10	0.09	0.11	0.14	0.16
45	0.12	0.06	0.07	-0.01	0.09	-0.02	0.11	-0.05	0.01	-0.02	-0.10	0.07	0.04	-0.01
46	0.05	0.15	0.20	0.20	0.06	0.06	0.26	0.11	-0.09	0.07	0.10	0.11	0.05	0.21
47	0.00	0.12	0.08	0.20	0.09	0.12	0.20	0.06	0.02	0.06	0.05	0.17	0.05	0.18
48	-0.07	-0.03	0.09	0.03	0.06	0.02	0.03	0.02	-0.05	0.00	-0.08	0.10	0.11	0.15

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
49	-0.04	-0.02	-0.05	0.22	0.12	0.13	0.09	0.19	-0.03	0.16	0.04	-0.06	0.08	0.14
50	-0.04	-0.02	-0.04	0.10	-0.03	0.14	-0.04	0.08	-0.03	0.06	-0.04	0.06	0.10	0.22
51	0.08	0.24	-0.01	0.10	-0.06	-0.04	0.01	0.08	-0.06	-0.02	0.15	0.15	0.07	0.06
52	0.01	0.12	0.08	0.20	0.06	0.10	0.11	0.26	-0.05	0.07	0.03	0.14	0.05	0.29
53	0.03	0.30	0.10	0.32	0.07	0.05	0.23	0.11	-0.05	0.01	0.07	0.12	0.17	0.21
54	0.03	0.14	0.10	0.33	0.07	0.06	0.14	0.21	-0.05	0.09	0.12	0.07	0.14	0.04
55	0.06	0.18	-0.05	0.19	-0.04	0.02	-0.04	0.06	-0.04	0.04	0.06	0.13	0.12	0.11
56	0.04	-0.03	0.12	0.26	0.09	0.08	0.05	0.24	-0.04	-0.06	0.05	0.11	0.27	0.21
57	0.06	-0.03	0.16	0.19	-0.04	-0.06	0.07	0.06	0.11	0.04	0.06	0.13	0.28	0.22
58	0.05	-0.03	0.14	0.29	0.10	0.01	0.06	0.05	-0.04	0.03	-0.01	0.14	0.25	0.14
59	0.14	-0.03	0.12	0.26	0.21	0.00	0.05	0.14	-0.04	0.02	-0.07	0.11	0.07	0.12
60	-0.05	0.12	-0.06	0.09	0.17	0.01	0.09	0.06	-0.04	0.02	0.13	0.06	0.07	-0.05

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
61	-0.02	0.14	-0.03	0.12	0.20	0.00	0.06	0.14	-0.02	0.05	-0.06	0.09	0.08	-0.02
62	-0.03	0.13	0.06	0.17	0.19	-0.06	0.05	0.08	0.04	0.04	-0.03	0.11	0.11	0.01
63	-0.01	0.15	-0.02	0.20	0.13	0.01	-0.05	-0.07	-0.02	0.06	-0.09	0.10	0.10	-0.02
64	-0.00	0.05	0.04	0.14	0.22	-0.02	0.08	0.06	-0.01	0.07	-0.09	0.11	0.06	0.02
65	-0.01	0.15	0.03	0.20	0.21	0.06	0.07	0.05	0.06	0.07	-0.02	0.08	0.02	0.01
66	0.01	0.17	-0.00	0.09	0.24	0.09	0.03	0.01	-0.00	0.04	-0.05	0.11	0.09	-0.01
67	0.01	0.05	0.11	0.22	0.23	0.04	0.03	0.01	-0.00	0.03	-0.06	0.05	0.06	-0.04
68	0.02	0.06	0.00	0.17	0.08	-0.05	-0.03	0.02	0.00	0.04	-0.02	0.03	0.10	-0.06
69	-0.05	0.06	0.00	0.10	0.08	0.05	-0.10	-0.11	0.00	-0.01	-0.04	0.05	0.10	0.00
70	0.02	0.06	-0.05	0.11	0.09	0.01	-0.03	0.02	0.00	-0.01	-0.05	0.04	0.08	0.01
71	-0.02	-0.01	0.39	-0.02	0.28	-0.03	0.22	0.20	-0.02	-0.03	0.19	0.18	0.06	0.17
72	0.12	0.14	0.02	0.04	-0.05	-0.01	-0.06	0.12	-0.05	-0.07	0.15	0.07	0.05	0.09

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	01	02	03	04	05	06	07	08	09	10	11	12	13	14
73	-0.05	-0.03	0.13	0.27	0.09	0.01	0.17	0.15	-0.04	0.12	0.10	0.12	0.18	0.13
74	0.04	0.15	0.21	0.36	-0.04	014	0.05	0.13	-0.04	0.02	0.15	0.17	0.16	0.34
75	-0.04	-0.05	0.01	-0.02	0.09	.011	-0.02	0.03	-0.08	0.06	0.07	0.16	0.07	0.15
76	0.13	-0.02	0.12	0.14	-0.02	-.004	-0.03	-0.03	-0.02	0.10	0.02	0.07	0.01	0.09
77	0.10	0.11	0.02	0.13	0.02	.003	0.13	-0.01	0.09	-0.00	0.12	0.09	0.09	0.15
78	-0.03	0.07	-0.04	0.12	0.01	-.003	-0.09	-0.10	0.01	0.06	0.02	0.09	0.08	0.01
79	-0.03	-0.02	-0.04	0.13	-0.03	.007	-0.03	0.11	-0.03	0.09	0.00	0.05	0.07	0.14
80	-0.03	-0.02	0.13	-0.03	-0.02	-.004	0.16	0.14	-0.02	-0.03	0.11	0.03	0.02	0.02

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
13														
14														
15	1.00													
16	0.21	1.00												
17	0.45	0.19	1.00											
18	0.13	0.17	0.18	1.00										
19	0.01	0.11	0.27	0.26	1.00									
20	0.13	0.12	0.33	0.07	0.42	1.00								
21	-0.04	-0.03	-0.02	-0.06	0.22	0.15	1.00							
22	-0.09	0.12	0.27	0.11	0.34	0.13	0.16	1.00						
23	0.15	0.18	0.13	0.12	0.21	0.20	0.21	0.42	1.00					
24	-0.03	0.08	-0.00	0.21	0.11	0.10	0.11	0.19	0.31	1.00				

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
25	0.04	0.18	0.13	0.11	0.21	0.11	0.23	0.15	0.39	0.43	1.00			
26	0.05	0.35	0.28	0.07	0.30	0.31	0.08	0.44	0.27	0.20	0.30	1.00		
27	0.07	0.11	0.15	0.14	0.18	0.09	0.12	0.17	0.39	0.35	0.47	0.38	1.00	
28	0.01	0.12	0.06	0.14	0.09	0.02	0.00	0.15	0.26	0.27	0.14	0.22	0.20	1.00
29	0.06	0.10	0.00	0.12	0.14	0.01	0.07	0.15	0.32	0.29	0.28	0.22	0.27	0.46
30	0.04	0.14	0.19	0.10	0.22	0.13	-0.00	0.23	0.21	0.26	0.21	0.31	0.14	0.23
31	0.35	0.27	0.41	0.20	0.07	0.28	0.04	0.05	0.26	0.02	0.10	0.16	0.13	0.05
32	0.08	0.07	0.35	-0.09	0.15	0.15	-0.05	0.17	-0.07	-0.05	-0.05	0.28	0.01	-0.04
33	0.24	0.16	0.18	0.05	0.05	0.18	0.07	0.10	0.22	0.02	0.03	0.16	0.13	0.16
34	0.27	0.31	0.42	0.04	0.22	0.40	0.00	0.08	0.09	-0.04	0.07	0.34	0.00	0.05
35	0.19	0.17	0.28	0.03	0.20	0.22	-0.02	0.21	0.22	-0.01	0.00	0.26	0.09	0.18
36	0.13	0.17	0.38	-0.03	0.20	0.44	0.09	0.21	0.17	-0.01	0.00	0.31	0.09	0.07

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
37	0.14	0.13	0.16	-0.07	0.07	0.31	0.26	-0.04	0.22	0.05	0.12	0.15	0.11	0.08
38	-0.03	0.19	0.26	-0.02	0.22	0.32	0.08	0.28	0.14	-0.04	-0.04	0.24	0.00	0.13
39	0.04	0.10	0.40	-0.01	0.18	0.35	0.03	0.27	0.11	-0.03	0.09	0.33	-0.04	0.12
40	0.03	0.06	0.25	-0.04	0.22	0.23	0.01	0.22	0.05	-0.04	0.05	0.19	-0.01	0.00
41	0.06	0.00	0.26	-0.02	0.22	0.20	0.04	0.35	0.25	-0.00	0.13	0.24	0.02	-0.01
42	-0.04	0.07	0.24	-0.03	0.09	0.15	0.10	0.07	0.13	0.13	0.18	0.03	0.15	0.00
43	0.06	0.10	0.21	-0.04	0.29	0.34	0.06	0.23	0.20	0.14	0.20	0.24	0.07	0.01
44	0.16	0.13	0.17	-0.10	0.13	0.24	0.00	0.26	0.22	0.08	0.08	0.18	0.02	0.17
45	-0.07	-0.05	0.04	-0.06	0.06	0.12	-0.08	0.04	-0.04	0.01	-0.01	0.03	-0.10	0.12
46	0.11	0.11	0.32	0.02	0.12	0.20	-0.04	0.20	0.16	-0.07	0.04	0.12	0.07	0.15
47	0.22	0.15	0.26	0.01	0.00	0.08	-0.01	0.11	0.22	0.10	0.16	0.09	0.21	0.13
48	0.04	0.03	0.09	-0.05	0.05	0.11	-0.01	0.20	0.17	0.03	0.17	0.12	0.10	-0.06

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
49	0.07	0.13	0.03	-0.07	0.00	0.23	-0.02	0.02	0.22	0.17	0.12	0.09	0.17	0.04
50	0.08	0.07	0.11	-0.07	0.16	0.23	0.04	0.26	0.17	0.13	0.14	0.16	0.12	-0.05
51	0.10	0.04	0.13	-0.12	0.07	0.14	0.03	0.11	0.08	-0.05	0.04	0.07	-0.07	-0.01
52	0.18	0.11	0.24	-0.01	0.14	0.29	0.01	0.22	0.15	0.02	0.06	0.27	0.04	0.02
53	0.16	0.14	0.20	0.01	0.12	0.33	-0.02	0.22	0.14	-0.03	0.04	0.27	0.02	-0.04
54	0.17	0.10	0.16	-0.04	0.01	0.27	0.10	0.09	0.20	0.10	0.04	0.10	0.03	0.01
55	0.19	-0.02	0.25	-0.01	0.06	0.28	-0.04	0.23	0.01	0.03	-0.03	0.18	-0.04	-0.12
56	0.26	0.24	0.09	0.03	0.03	0.15	0.03	0.17	0.24	0.13	0.01	0.23	-0.01	0.00
57	0.19	0.11	0.13	-0.01	0.19	0.28	-0.04	0.28	0.18	-0.02	0.04	0.29	0.08	0.05
58	0.16	0.15	0.16	-0.02	0.11	0.33	0.01	0.25	0.21	0.01	-0.04	0.31	0.06	-0.02
59	0.08	0.18	0.19	0.03	0.15	0.30	0.06	0.32	0.18	0.04	0.06	0.33	0.05	0.04
60	-0.00	0.07	-0.04	0.06	0.01	0.05	0.03	0.07	0.03	0.20	0.18	0.16	0.04	0.09

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
61	-0.02	0.06	-0.01	-0.07	0.10	0.05	0.06	0.14	0.04	0.06	0.14	0.12	0.04	0.02
62	0.03	0.07	0.06	-0.05	0.04	0.07	0.06	0.11	0.05	0.06	0.12	0.09	0.08	0.02
63	-0.04	0.08	0.04	-0.06	0.04	0.06	0.07	0.16	0.06	0.06	0.06	0.14	0.06	0.03
64	-0.03	0.06	-0.00	-0.08	0.09	0.07	0.10	0.15	0.11	0.08	0.18	0.13	0.05	0.03
65	-0.04	0.01	-0.07	-0.13	0.08	0.02	0.10	0.14	0.04	0.01	0.10	0.12	0.04	0.06
66	-0.04	0.05	-0.04	-0.10	0.04	0.09	0.05	0.09	0.05	0.06	0.11	0.16	0.01	0.01
67	-0.05	0.04	-0.04	-0.11	0.04	0.09	0.02	0.09	0.11	0.03	0.10	0.13	0.10	0.02
68	0.04	0.06	-0.10	-0.06	-0.03	-0.05	0.09	0.04	0.15	0.10	0.15	0.05	0.05	0.07
69	0.04	0.09	0.00	-0.10	0.09	0.05	0.02	0.07	0.06	0.04	0.15	0.11	0.02	0.04
70	0.01	0.06	-0.06	-0.09	0.10	0.15	0.11	0.08	0.07	0.11	0.16	0.15	-0.01	0.06
71	0.23	-0.04	0.19	-0.11	0.10	0.14	-0.08	0.06	0.07	-0.06	-0.04	0.07	-0.05	0.01
72	0.00	-0.06	0.30	0.25	0.24	0.34	-0.01	0.18	0.06	0.06	0.04	0.19	-0.02	0.04

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	15	16	17	18	19	20	21	22	23	24	25	26	27	28
73	0.09	0.14	0.15	-0.02	0.16	0.40	0.04	0.23	0.20	0.10	0.07	0.24	0.06	0.05
74	0.13	0.06	0.38	0.03	0.14	0.30	0.05	0.21	0.17	0.03	0.16	0.21	0.09	0.03
75	0.18	0.19	0.23	0.32	0.19	0.31	0.08	0.19	0.35	0.22	0.36	0.37	0.28	0.18
76	0.14	-0.06	0.10	0.25	0.05	0.08	-0.05	0.17	0.10	-0.08	-0.06	0.01	0.02	0.08
77	0.17	0.13	0.18	0.07	0.02	0.07	0.06	0.03	0.11	0.18	0.24	0.05	0.22	0.19
78	-0.01	0.01	-0.03	-0.03	0.12	0.07	0.03	0.05	0.10	0.06	0.16	0.12	0.09	0.06
79	0.03	-0.06	0.16	-0.06	0.13	0.30	-0.01	0.15	0.16	0.12	0.02	0.15	0.10	-0.06
80	0.16	0.15	0.12	0.06	0.17	0.10	-0.04	0.02	0.12	-0.07	0.15	0.03	-0.06	0.04

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	29	30	31	32	33	34	35	36	37	38	39	40	41	42
25														
26														
27														
28														
29	1.00													
30	0.32	1.00												
31	0.07	0.01	1.00											
32	0.06	0.20	0.09	1.00										
33	0.06	0.01	0.31	0.20	1.00									
34	-0.00	0.17	0.35	0.44	0.35	1.00								
35	0.12	0.19	0.26	0.35	0.40	0.55	1.00							
36	0.04	0.14	0.44	0.47	0.33	0.55	0.57	1.00						

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	29	30	31	32	33	34	35	36	37	38	39	40	41	42
37	0.07	-0.06	0.22	0.09	0.45	0.25	0.23	0.39	1.00					
38	0.11	0.13	0.16	0.31	0.28	0.26	0.36	0.49	0.17	1.00				
39	0.10	0.25	0.38	0.41	0.31	0.50	0.53	0.60	0.19	0.50	1.00			
40	0.03	0.07	0.31	0.25	0.35	0.26	0.28	0.37	0.24	0.36	0.50	1.00		
41	0.12	0.19	0.22	0.24	0.23	0.27	0.33	0.38	0.16	0.31	0.46	0.51	1.00	
42	-0.02	0.07	0.21	0.04	0.20	0.05	0.10	0.28	0.32	0.24	0.27	0.34	0.40	1.00
43	0.16	0.24	0.35	0.26	0.17	0.33	0.31	0.54	0.14	0.33	0.50	0.39	0.49	0.44
44	0.21	0.19	0.29	0.20	0.20	0.26	0.30	0.30	0.17	0.26	0.29	0.35	0.43	0.16
45	-0.00	0.12	-0.09	0.00	-0.08	0.07	0.01	-0.02	0.01	0.11	0.05	0.06	0.01	0.04
46	0.11	0.06	0.26	0.07	0.12	0.20	0.17	0.24	0.08	0.28	0.24	0.19	0.14	0.19
47	0.12	0.06	0.30	0.07	0.16	0.08	0.12	0.08	0.15	0.05	0.16	0.20	0.15	0.17
48	-0.01	0.05	0.15	0.18	0.09	0.19	0.16	0.16	0.05	0.13	0.27	0.30	0.36	0.12

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	29	30	31	32	33	34	35	36	37	38	39	40	41	42
49	0.07	0.04	0.30	0.09	0.19	0.09	0.08	0.23	0.14	0.01	0.19	0.24	0.22	0.24
50	0.04	0.11	0.24	0.18	0.21	0.36	0.33	0.33	0.25	0.10	0.48	0.27	0.37	0.26
51	0.17	0.18	0.11	0.13	0.06	0.14	0.17	0.17	0.03	0.14	0.17	0.20	0.29	0.03
52	0.16	0.22	0.35	0.21	0.20	0.34	0.36	0.41	0.18	0.28	0.49	0.44	0.46	0.16
53	0.04	0.23	0.23	0.13	0.23	0.26	0.35	0.35	0.14	0.26	0.36	0.33	0.48	0.13
54	0.16	0.12	0.35	0.02	0.30	0.21	0.25	0.31	0.21	0.09	0.24	0.30	0.40	0.14
55	-0.01	0.07	0.26	0.21	0.17	0.30	0.27	0.34	0.12	0.15	0.25	0.21	0.36	-0.00
56	0.06	0.11	0.27	0.04	0.27	0.18	0.28	0.22	0.17	0.18	0.13	0.20	0.29	0.17
57	0.12	0.27	0.13	0.21	0.33	0.30	0.42	0.34	0.03	0.30	0.41	0.26	0.48	0.08
58	0.09	0.18	0.23	0.12	0.30	0.27	0.38	0.38	0.10	0.41	0.37	0.28	0.43	0.12
59	0.17	0.16	0.33	0.23	0.20	0.24	0.28	0.41	0.17	0.38	0.41	0.25	0.35	0.10
60	0.25	0.24	0.08	0.07	0.13	0.13	0.09	0.06	0.02	-0.02	0.17	0.22	0.13	0.00

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	29	30	31	32	33	34	35	36	37	38	39	40	41	42
61	0.17	0.23	0.06	0.09	0.10	0.07	0.07	0.04	-0.03	0.03	0.18	0.24	0.14	0.01
62	0.15	0.20	0.11	0.14	0.16	0.12	0.13	0.09	0.00	0.05	0.20	0.21	0.12	-0.00
63	0.21	0.21	0.11	0.11	0.11	0.08	0.09	0.09	-0.06	0.08	0.20	0.24	0.13	0.03
64	0.22	0.21	0.13	0.12	0.13	0.10	0.14	0.11	0.04	0.10	0.25	0.32	0.19	0.04
65	0.24	0.11	0.05	0.11	0.16	0.05	0.17	0.10	0.03	0.09	0.20	0.25	0.14	0.03
66	0.20	0.22	0.04	0.14	0.10	0.08	0.13	0.05	0.01	0.08	0.19	0.18	0.15	-0.02
67	0.19	0.16	0.11	0.10	0.10	0.11	0.20	0.13	0.05	0.11	0.23	0.21	0.21	0.02
68	0.22	0.13	0.13	0.03	0.16	0.08	0.22	0.06	0.01	0.00	0.16	0.14	0.20	0.03
69	0.20	0.24	0.05	0.11	-0.02	0.13	0.14	0.06	-0.09	0.08	0.20	0.14	0.20	0.07
70	0.19	0.19	0.10	0.12	0.07	0.13	0.11	0.11	0.07	0.13	0.16	0.21	0.17	-0.00
71	0.00	0.04	0.24	-0.04	0.13	0.12	0.25	0.11	-0.03	0.12	0.13	0.06	0.07	-0.04
72	0.06	0.24	0.07	0.26	0.04	0.21	0.13	0.31	0.07	0.27	0.30	0.08	0.25	0.14

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
SItem	29	30	31	32	33	34	35	36	37	38	39	40	41	42
73	0.11	0.21	0.22	0.05	0.28	0.32	0.36	0.36	0.17	0.32	0.50	0.31	0.36	0.18
74	0.12	0.19	0.38	0.35	0.33	0.42	0.45	0.57	0.23	0.36	0.60	0.33	0.48	0.19
75	0.27	0.27	0.19	0.09	0.08	0.19	0.12	0.20	0.23	0.15	0.18	0.10	0.16	0.13
76	0.13	-0.01	0.24	-0.05	0.30	0.06	0.15	0.15	0.09	0.06	0.18	0.16	0.10	-0.05
77	0.19	0.08	0.25	-0.02	0.11	0.07	0.03	0.07	0.22	-0.00	0.07	0.10	0.04	0.19
78	0.15	0.24	0.08	0.06	0.10	0.12	0.18	0.05	0.02	0.03	0.24	0.19	0.21	-0.02
79	0.04	0.11	0.31	0.24	0.16	0.35	0.32	0.42	0.19	0.15	0.48	0.28	0.40	0.24
80	0.16	0.23	0.06	0.07	0.08	0.19	0.06	0.06	-0.04	0.07	0.08	0.10	0.12	-0.05

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	43	44	45	46	47	48	49	50	51	52	53	54	55	56
37														
38														
39														
40														
41														
42														
43	1.00													
44	0.42	1.00												
45	0.10	0.20	1.00											
46	0.28	0.26	0.20	1.00										
47	0.12	0.24	0.17	0.41	1.00									
48	0.35	0.37	0.16	0.24	0.20	1.00								

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	43	44	45	46	47	48	49	50	51	52	53	54	55	56
49	0.51	0.36	0.01	0.22	0.19	0.46	1.00							
50	0.52	0.29	-0.00	0.15	0.13	0.49	0.45	1.00						
51	0.29	0.38	0.08	0.22	0.19	0.08	0.15	0.17	1.00					
52	0.48	0.34	0.05	0.34	0.31	0.25	0.24	0.47	0.36	1.00				
53	0.43	0.37	0.11	0.30	0.23	0.29	0.21	0.30	0.46	0.61	1.00			
54	0.39	0.38	-0.00	0.18	0.22	0.09	0.29	0.23	0.43	0.48	0.54	1.00		
55	0.32	0.27	0.04	0.18	0.10	0.23	0.12	0.41	0.36	0.39	0.51	0.45	1.00	
56	0.32	0.40	0.00	0.11	0.14	0.18	0.24	0.26	0.29	0.38	0.48	0.44	0.43	1.00
57	0.45	0.36	0.08	0.18	0.14	0.23	0.12	0.41	0.36	0.45	0.70	0.45	0.51	0.50
58	0.41	0.36	0.06	0.18	0.10	0.20	0.18	0.37	0.32	0.47	0.65	0.48	0.54	0.60
59	0.38	0.32	0.00	0.19	0.10	0.12	0.09	0.34	0.18	0.59	0.42	0.32	0.43	0.36
60	0.26	0.26	0.15	0.14	0.08	0.24	0.15	0.18	0.29	0.27	0.31	0.19	0.23	0.15

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	43	44	45	46	47	48	49	50	51	52	53	54	55	56
61	0.29	0.36	0.19	0.14	0.10	0.24	0.20	0.18	0.28	0.24	0.27	0.15	0.16	0.16
62	0.23	0.32	0.14	0.16	0.11	0.15	0.05	0.11	0.31	0.28	0.31	0.23	0.22	0.22
63	0.24	0.32	0.16	0.11	0.06	0.16	0.12	0.09	0.33	0.23	0.30	0.24	0.22	0.18
64	0.30	0.35	0.13	0.10	0.10	0.25	0.18	0.20	0.30	0.29	0.35	0.19	0.14	0.24
65	0.21	0.28	0.15	0.05	0.05	0.14	0.08	0.15	0.28	0.21	0.30	0.18	0.22	0.22
66	0.18	0.30	0.14	0.04	0.07	0.18	0.11	0.12	0.33	0.22	0.31	0.18	0.21	0.22
67	0.25	0.37	0.15	0.06	0.08	0.24	0.15	0.22	0.23	0.25	0.34	0.25	0.25	0.26
68	0.19	0.24	0.08	-0.04	0.18	0.15	0.16	0.13	0.28	0.20	0.25	0.26	0.22	0.27
69	0.26	0.32	0.16	0.06	0.07	0.22	0.11	0.23	0.35	0.23	0.32	0.15	0.22	0.27
70	0.24	0.33	0.17	-0.03	0.04	0.23	0.17	0.19	0.26	0.21	0.22	0.16	0.23	0.24
71	0.10	0.12	0.08	0.10	0.06	-0.04	-0.03	-0.03	-0.05	0.08	0.09	0.10	-0.03	0.11
72	0.28	0.12	0.03	0.11	-0.08	0.04	-0.00	0.16	0.15	0.18	0.22	0.11	0.25	0.08

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	43	44	45	46	47	48	49	50	51	52	53	54	55	56
73	0.46	0.38	0.11	0.28	0.20	0.19	0.17	0.44	0.40	0.50	0.62	0.52	0.45	0.44
74	0.48	0.30	-0.03	0.24	0.22	0.22	0.16	0.49	0.27	0.46	0.46	0.36	0.42	0.22
75	0.18	0.15	0.07	0.17	0.19	0.18	0.08	0.15	0.08	0.26	0.12	0.18	0.15	0.13
76	0.14	0.17	0.05	0.14	0.03	0.12	0.09	0.10	0.10	0.20	0.23	0.24	0.19	0.16
77	0.17	0.23	0.22	0.30	0.46	0.15	0.18	0.12	0.14	0.09	0.15	0.13	0.01	0.02
78	0.20	0.31	0.16	-0.03	0.01	0.23	0.14	0.21	0.27	0.17	0.30	0.23	0.26	0.19
79	0.57	0.27	0.00	0.17	0.11	0.44	0.43	0.83	0.23	0.42	0.29	0.30	0.50	0.14
80	0.16	0.13	0.03	0.03	0.12	-0.06	0.10	-0.04	0.21	0.14	0.16	0.16	-0.04	0.07

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

Item	57	58	59	60	61	62	63	64	65	66	67	68	69	70
49														
50														
51														
52														
53														
54														
55														
56														
57	1.00													
58	0.77	1.00												
59	0.50	0.60	1.00											
60	0.19	0.15	0.18	1.00										

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	57	58	59	60	61	62	63	64	65	66	67	68	69	70
61	0.20	0.16	0.20	0.83	1.00									
62	0.30	0.22	0.29	0.76	0.87	1.00								
63	0.22	0.26	0.22	0.74	0.86	0.82	1.00							
64	0.27	0.23	0.24	0.70	0.86	0.78	0.84	1.00						
65	0.31	0.22	0.22	0.62	0.76	0.73	0.76	0.85	1.00					
66	0.21	0.22	0.18	0.67	0.77	0.72	0.79	0.83	0.80	1.00				
67	0.30	0.30	0.26	0.63	0.74	0.73	0.78	0.82	0.79	0.86	1.00			
68	0.22	0.18	0.11	0.58	0.66	0.63	0.70	0.74	0.71	0.77	0.81	1.00		
69	0.26	0.23	0.19	0.60	0.70	0.65	0.72	0.74	0.71	0.80	0.84	0.74	1.00	
70	0.13	0.20	0.20	0.50	0.70	0.61	0.70	0.73	0.71	0.77	0.79	0.74	0.79	1.00
71	0.14	0.12	0.11	-0.02	0.00	-0.01	-0.08	0.01	0.01	0.02	0.02	0.02	-0.07	-0.07
72	0.19	0.16	0.32	0.06	-0.02	0.06	-0.00	-0.06	-0.04	-0.01	-0.01	-0.07	0.04	0.01

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item													
Item	57	58	59	60	61	62	63	64	65	66	67	68	69	70
73	0.75	0.69	0.51	0.27	0.26	0.35	0.24	0.29	0.28	0.24	0.32	0.17	0.25	0.13
74	0.49	0.38	0.41	0.13	0.11	0.20	0.09	0.14	0.13	0.09	0.20	0.14	0.18	0.15
75	0.10	0.21	0.26	0.25	0.08	0.07	0.09	0.11	0.10	0.13	0.09	0.09	0.14	0.18
76	0.19	0.17	0.16	0.09	0.12	0.11	0.13	0.14	0.14	0.09	0.16	0.10	-0.03	0.04
77	0.05	0.05	-0.02	0.10	0.05	0.01	0.03	0.07	-0.00	-0.00	0.03	0.09	-0.00	0.08
78	0.26	0.22	0.10	0.60	0.66	0.62	0.70	0.68	0.66	0.77	0.78	0.73	0.76	0.76
79	0.39	0.36	0.33	0.22	0.15	0.14	0.16	0.18	0.11	0.13	0.19	0.14	0.14	0.14
80	0.22	0.08	0.07	0.06	0.09	0.08	0.03	0.11	0.10	0.05	0.05	0.05	0.05	0.06

Note: *n* = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item									
Item	71	72	73	74	75	76	77	78	79	80
61										
62										
63										
64										
65										
66										
67										
68										
69										
70										
71	1.00									
72	0.10	1.00								

Note: n = 209.

Table A2 (continued).

Pearson Correlation Matrix CVCT-YC Item Scores

	Item									
Item	71	72	73	74	75	76	77	78	79	80
73	0.12	0.15	1.00							
74	0.11	0.36	0.42	1.00						
75	0.03	0.29	0.15	0.16	1.00					
76	0.22	0.04	0.27	0.15	0.04	1.00				
77	-0.03	-0.03	0.10	0.14	0.14	0.02	1.00			
78	-0.06	-0.01	0.25	0.13	0.12	0.12	0.01	1.00		
79	-0.02	0.21	0.45	0.42	0.15	0.13	0.10	0.23	1.00	
80	0.24	0.06	0.19	0.18	0.07	0.16	-0.08	0.07	-0.03	1.00

Note: n = 209.

Factor One Items

S-III, Item 36
(.72)

S-V, Item 74
(.71)

S-III, Item 39
(.70)

S-IV, Item 58
(.68)

S-IV, Item 57
(.68)

S-IV, Item 52
(.68)

S-V, Item 73
(.67)

S-IV, Item 53
(.67)

S-III, Item 43
(.65)

S-III, Item 41
(.63)

S-IV, Item 59
(.60)

S-III, Item 35
(.60)

Figure A1. Factor One Items and Factor Loading (continued).

Factor One Items

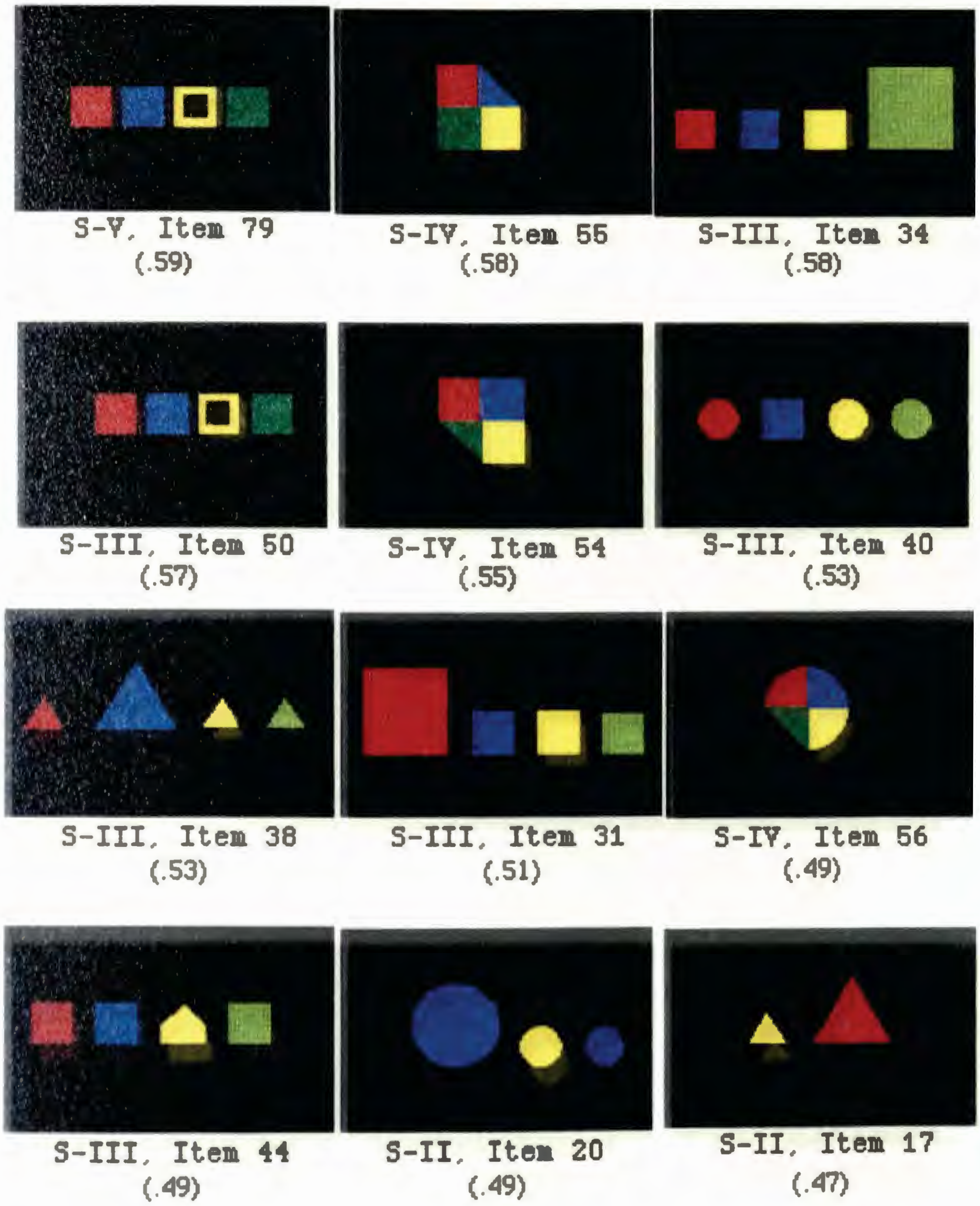


Figure A1. <u>Factor One Items and Factor Loading</u>

Factor One Items

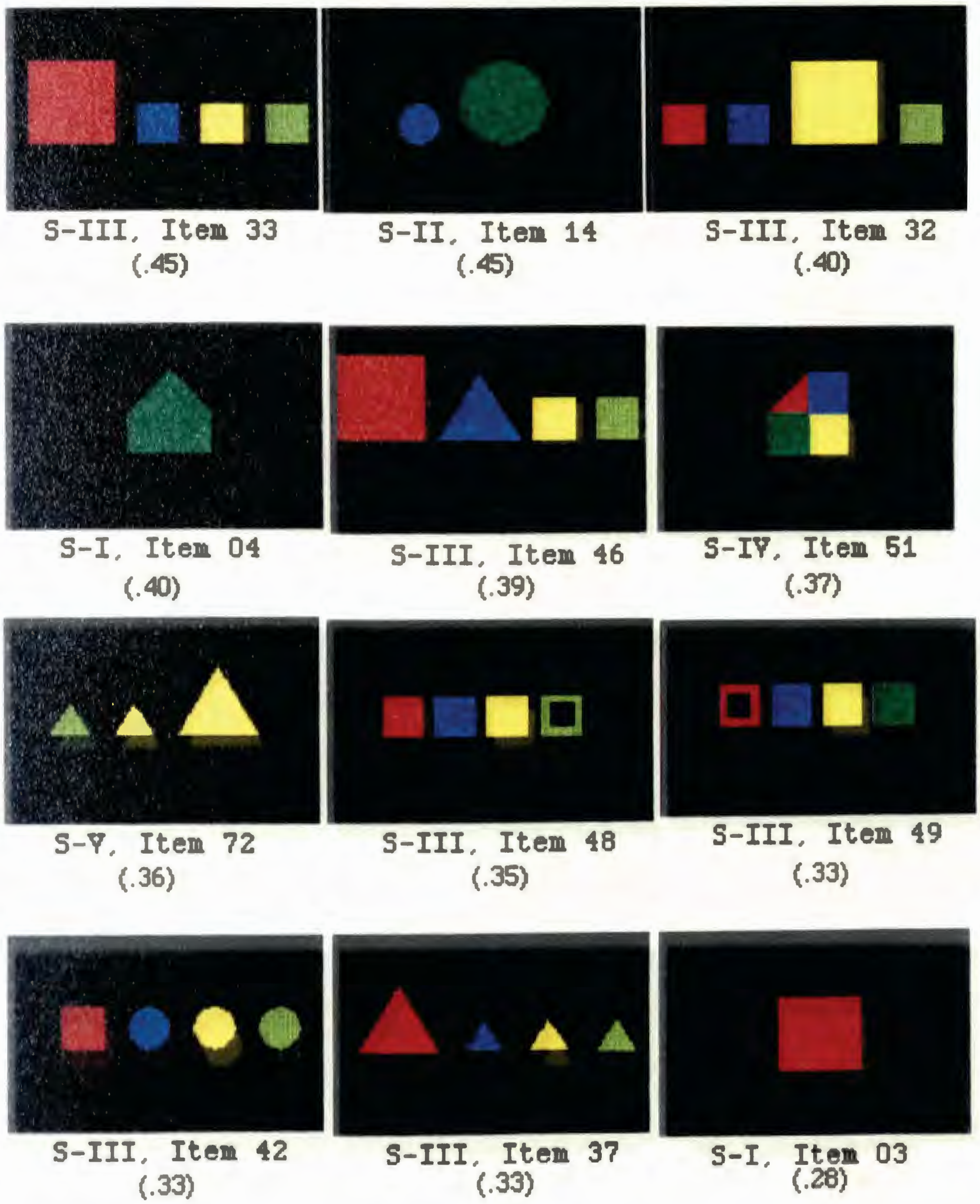


Figure A1. Factor One Items and Factor Loading (continued).

Factor One Items

S-V, Item 76
(.26)

S-II, Item 15
(.26)

S-II, Item 13
(.24)

S-V, Item 71
(.22)

S-I, Item 08
(.21)

S-V, Item 80
(.16)

S-I, Item 07
(.14)

S-I, Item 06
(.14)

S-I, Item 01
(.05)

Figure A1. Factor One Items and Factor Loading (continued).

Factor Two Items

S-IV, Item 64
(.90)

S-IV, Item 66
(.90)

S-I, Item 67
(.90)

S-IV, Item 61
(.89)

S-IV, Item 63
(.89)

S-IV, Item 65
(.86)

S-IV, Item 69
(.85)

S-IV, Item 62
(.83)

S-IV, Item 68
(.83)

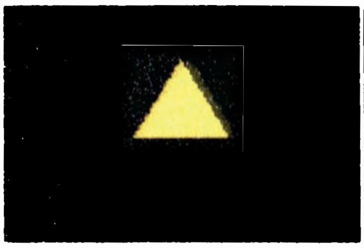
S-IV, Item 70
(.83)

S-V, Item 78
(.82)

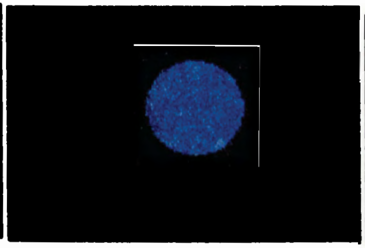
S-IV, Item 60
(.78)

Figure A2. Factor Two Items and Factor Loadings.

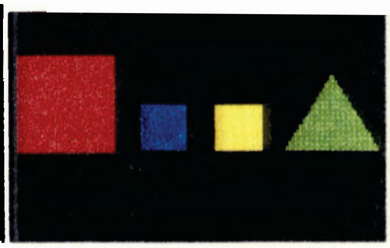
Factor Two Items



S-I, Item 02
(.13)



S-I, Item 05
(.17)



S-III, Item 45
(.19)

Figure A2. Factor Two Items and Factor Loadings (continued).

Factor Three Items

S-II, Item 27
(.65)

S-II, Item 25
(.64)

S-II, Item 23
(.59)

S-II, Item 24
(.56)

S-V, Item 75
(.53)

S-II, Item 29
(.52)

S-II, Item 26
(.51)

S-II, Item 28
(.51)

S-II, Item 30
(.41)

S-II, Item 19
(.37)

S-II, Item 18
(.36)

S-II, Item 16
(..35)

Figure A3. Factor Three Items and Factor Loadings.

Factor Three Items

S-V, Item 77
(.35)

S-I, Item 09
(.31)

S-II, Item 22
(.31)

S-III, Item 47
(.29)

S-I, Item 10
(.27)

S-II, Item 12
(.26)

S-II, Item 21
(.23)

S-II, Item 11
(.18)

Figure A3. Factor Three Items and Factor Loadings (continued)