CONFIRMATORY FACTOR ANALYSIS OF THE NEPSY: A DEVELOPMENTAL NEUROPSYCHOLOGICAL ASSESSMENT, SECOND EDITION IN A MIXED CLINICAL SAMPLE OF CHILDREN

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DEDICATION

This dissertation is dedicated to my father, Dale Petrini, whose steadfast love, support, guidance, and encouragement has profoundly impacted the woman I have become. Thank you for reminding me that I could do anything I set my mind to.

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ABSTRACT

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CONFIRMATORY FACTOR ANALYSIS OF THE NEPSY: A DEVELOPMENTAL NEUROPSYCHOLOGICAL ASSESSMENT, SECOND EDITION IN A MIXED CLINICAL SAMPLE OF CHILDREN

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The NEPSY: A Developmental Neuropsychological Assessment, Second Edition (NEPSY-II) is a comprehensive battery of neuropsychological measures purported to assess the neurocognitive functioning in children between the ages of 3 to 16 (Korkman, Kirk, & Kemp, 2007a). Specifically, the measure is intended to identify problems that underlie poor academic performance and disinhibited behaviors. The NEPSY-II and its predecessors were developed out of a growing need for systematic, comprehensive, and normative assessment tools to assess neurocognitive deficits in children. While this measure is commonly used among pediatric neuropsychologists to assess neurocognitive functioning, specific research on this measure is limited. In fact, fewer than five studies have been conducted examining the psychometric properties of the NEPSY-II and there have been no studies confirming the Korkman, Kirk, and Kemp, (2007b) theoretical model of neurocognitive functioning in children. A Confirmatory Factor Analysis (CFA) is a critical step in providing empirical support for the Korkman et al. (2007b) theoretical position.

The purpose of this study was to examine the underlying factor structure of the NEPSY-II in a mixed clinical sample of children. A CFA was used to determine if a modified-five factor theoretical model proposed by Korkman et al. (2007b) provides the best fit for the observed data. The data utilized in this study are archival and were collected from case studies submitted to fulfill requirements for the KIDS, Inc. School Neuropsychology Post-Graduate Certification Program. The results indicated that a modified-five factor theoretical model was an inadequate fit; a further modified-five factor model demonstrated a slightly more adequate fit. Interpretations of the finding were discussed with an emphasis on the complexity of neurocognitive constructs and the importance of using the NEPSY-II along with other clinical data to develop a diagnostic impression of a child. Future research on the NEPSY-II should include a replication of this study along with examining the author-proposed model in comparison with other neurocognitive models to determine which model fits best with the data.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The NEPSY: A Developmental Neuropsychological Assessment, Second Edition (NEPSY-II), is a cohesive battery of neuropsychological measures purported to evaluate cognitive functions in children between the ages of 3 to 16 (Korkman, Kirk, & Kemp, 2007a). Specifically, the measure is intended to identify problems that underlie disinhibited behaviors and poor academic performance. Historically, the NEPSY-II and its predecessors were developed out of an interest in the field of pediatric neuropsychology in the 1970's. At the time, pediatric neuropsychological assessment tools were sparse; thus, there was a pronounced need for systematic, comprehensive, and normative pediatric assessment tools to assess neurocognitive deficits in children. Neuropsychological assessment with pediatrics continues to attract considerable interest as the data drawn from neuropsychological assessments provides more information than traditional assessments, thus allowing for enhanced intervention strategies (D'Amato, Gray, & Dean, 1988).

The theoretical foundation of the NEPSY-II and its predecessors, the NEPSY and NEPS, originates from the work of A.R. Luria (Korkman, Kirk, & Kemp, 2001; Luria, 1980). Luria contended that human mental processes are founded on complex functional systems which are comprised of interconnected neural networks throughout the brain (Luria, 1980). These systems were theorized as three specific functional units: the arousal unit, (Unit 1), the sensory input unit (Unit II), and the output/planning unit (Unit III). Each of these systems maintain an important role in human cognitive processes (Luria, 1980). In terms of neuropsychological assessment, Luria postulated that the primary purpose of neuropsychological assessment was to better delineate the function of neuropsychological symptoms (Luria, 1980).

The NEPS was developed to meet the need for a comprehensive tool that measured neurocognitive domains utilizing a Lurian neuropsychological assessment approach through the assessment of attention, language, sensorimotor functions, visuospatial functions, and memory/learning abilities (Korkman, 1999). Historically, this measure was an important beginning to pediatric neuropsychological assessment, yet the assessment had some weaknesses related to the limited age range along with the pass/fail scoring system. In order to address the aforementioned issues, the NEPS subtests were revised and expanded with the inclusion of more test items. The measure was renamed the NEPS-U in Finnish and the NEPSY in English (Korkman, 1988). In 1990, interest in the measure was emerging in the United States, resulting in the introduction of the 1997/1998 version of the NEPSY which was comprised of 27 subtests that were divided into five functional domains: Attention and Executive Functions, Language, Sensorimotor Functions, Visual-Spatial Functions, and Memory and Learning (Korkman, Kirk, & Kemp, 1998; see Table 1 for test information).

Table 1

Domains and Subtests of the NEPSY

Attention/ Executive Functions	*Language*	*Sensori-motor Functions*	*Visuospatial Processing*	*Memory and Learning*
Tower	**Body Part Naming**	**Fingertip Tapping**	**Design Copying**	**Memory for Faces**
Auditory Attention and Response Set	**Phonological Processing**	**Imitating Hand Positions**	**Arrows**	**Memory for Names**
Visual Attention	**Speeded Naming**	**Visuomotor Precision**	**Block Construction**	**Narrative Memory**
Statue	**Comprehension of Instructions**	Manual Motor Sequences	Route Finding	**Sentence Repetition**
Design Fluency	Repetition of Nonsense Words	Finger Discrimination		List Learning
Knock and Tap	Verbal Fluency			
	Oromotor Sequences			

Note. Bolded items were recommended core subtests that should be completed in a comprehensive evaluation.

Korkman and colleagues (1998) claimed that the NEPSY demonstrated strong reliability and validity in its technical properties. Examining the psychometric properties of the NEPSY is important; however, the factor structure of the measure should be examined. The NEPSY's authors claimed that factor analysis was not appropriate to examine the structure of the NEPSY as the five domains were not theorized as independent factors. However, the five independent domains represent an intrinsic psychometric structure to the tool.

Stinnett, Oehler-Stinnett, Fuqua, and Palmer (2002) conducted a preliminary study on the underlying factor structure of the NEPSY utilizing the NEPSY standardization sample. The study yielded a one factor solution termed a language/comprehension factor that accounted for 24.9% of the variance. Similarly, Mosconi, Nelson, and Hooper (2008) studied to further understand the factor structure of the NEPSY. This study used the 14 core subtests of the NEPSY and Block Construction to complete a confirmatory factor analysis on the normative sample employing AMOS Version 4.0, structural equation modeling software (Arbuckle & Wothke, 1999). Mosconi et al. (2008) found that amongst the standardization sample of children aged five to 12, the author-proposed five-factor model was not a good fit for the data.

To address some weaknesses in the original measure, the revision process of the 1998 NEPSY began in late 2003 with the authors reviewing research in neuropsychology, child development, and child psychology (Korkman, Kirk, & Kemp, 2007b). To enhance this process, authors requested feedback about the measure from experts in the field of pediatric neuropsychology and psychologists using the measure in practice. Based on research, Korkman and colleagues (2007b) developed four primary goals in the NEPSY revision process. The NEPSY-II development process underwent three distinct phases: a pilot, a tryout, and a standardization phase. During the standardization phase in 2005–2006, behavioral observations were added to several subtests with adjustments to several subtests (Korkman et al., 2007b). The final product included 32 subtests and four delayed tasks. The subtests were divided into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuospatial Processing. See Table 2 for NEPSY-II domains and subtests.

Table 2

NEPSY-II Domains and Subtests

Attention/ Executive Functioning	Language	Memory/ Learning	Sensorimotor	Social Perception	Visuospatial Processing
Animal Sorting	Body Part Naming/ID	List Memory	Visuomotor Precision	Affect Recognition	Arrows
Auditory Attention/ Response Set	Comprehension of Instructions	List Memory Delayed	Fingertip Tapping	Theory of Mind	Block Construction
Clocks	Oromotor Sequences	Memory for Designs	Imitating Hand Positions		Design Copying
Design Fluency	Phonological Processing	Memory for Designs Delayed	Manual Motor Sequences		Geometric Puzzles
Inhibition	Repetition of Nonsense Words	Memory for Faces			Picture Puzzles
Statue	Speeded Naming	Memory for Faces Delayed			Route Finding
	Word Generation	Memory for Names			
		Memory for Names Delayed			
		Narrative Memory			
		Sentence Repetition			
		Word List Interference			

Psychometric properties of the NEPSY-II are considered to be impressive (Korkman et al., 2007b). Results of the NEPSY-II reliability studies conclude that most of the NEPSY-II subtests demonstrate adequate to high internal consistency. Across measures of validity, the NEPSY-II manual provides information from multiple research studies designed to address each type of validity resulting in ratings of medium to high validity. However, Korkman and colleagues (2007b) did not complete a factor analysis to further study the underlying factor structure of the NEPSY-II, limiting available information on the validity of the measure. After an extensive search of the literature, not a single study could be found that examined the underlying factor structure of this measure. Instead, Korkman and colleagues provide an implied factor structure based on neuropsychological assessment theory (see Figure 1 for implied factor structure).

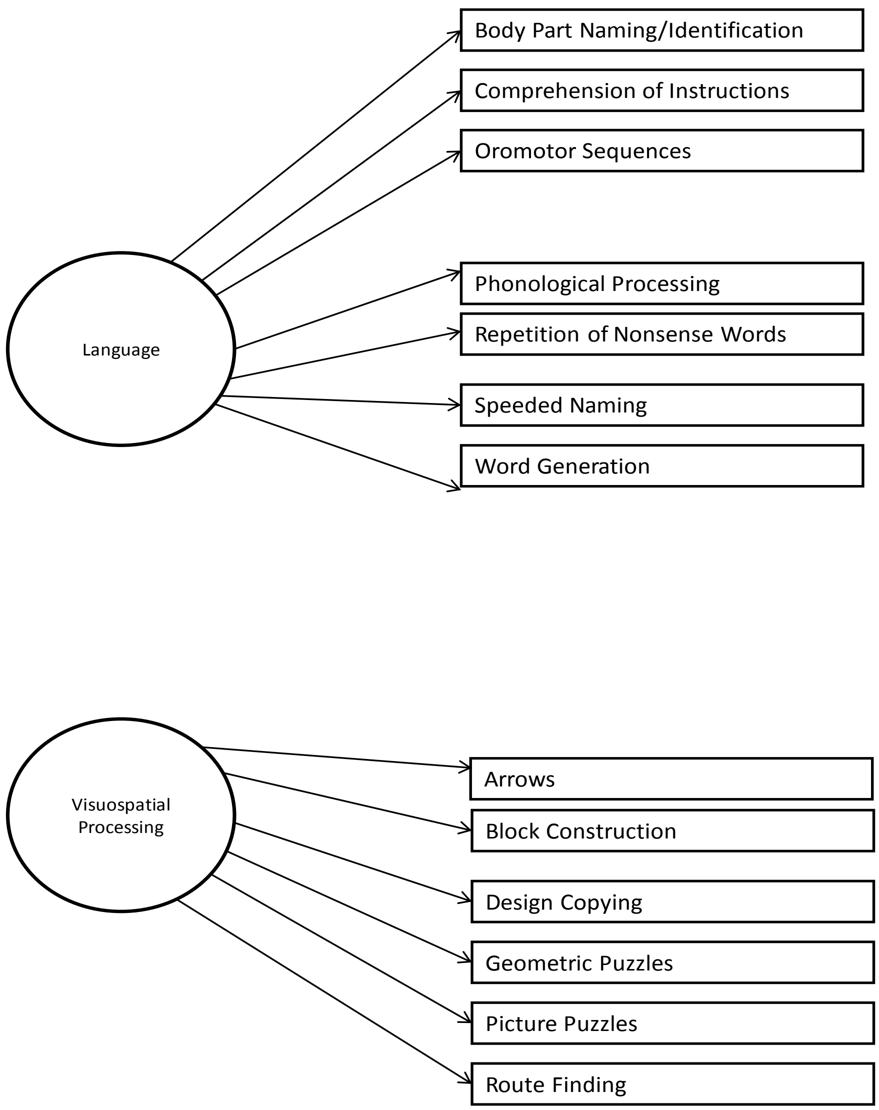

Figure 1. Korkman and Colleagues (2007b) Proposed Factor Structure of the NEPSY-II

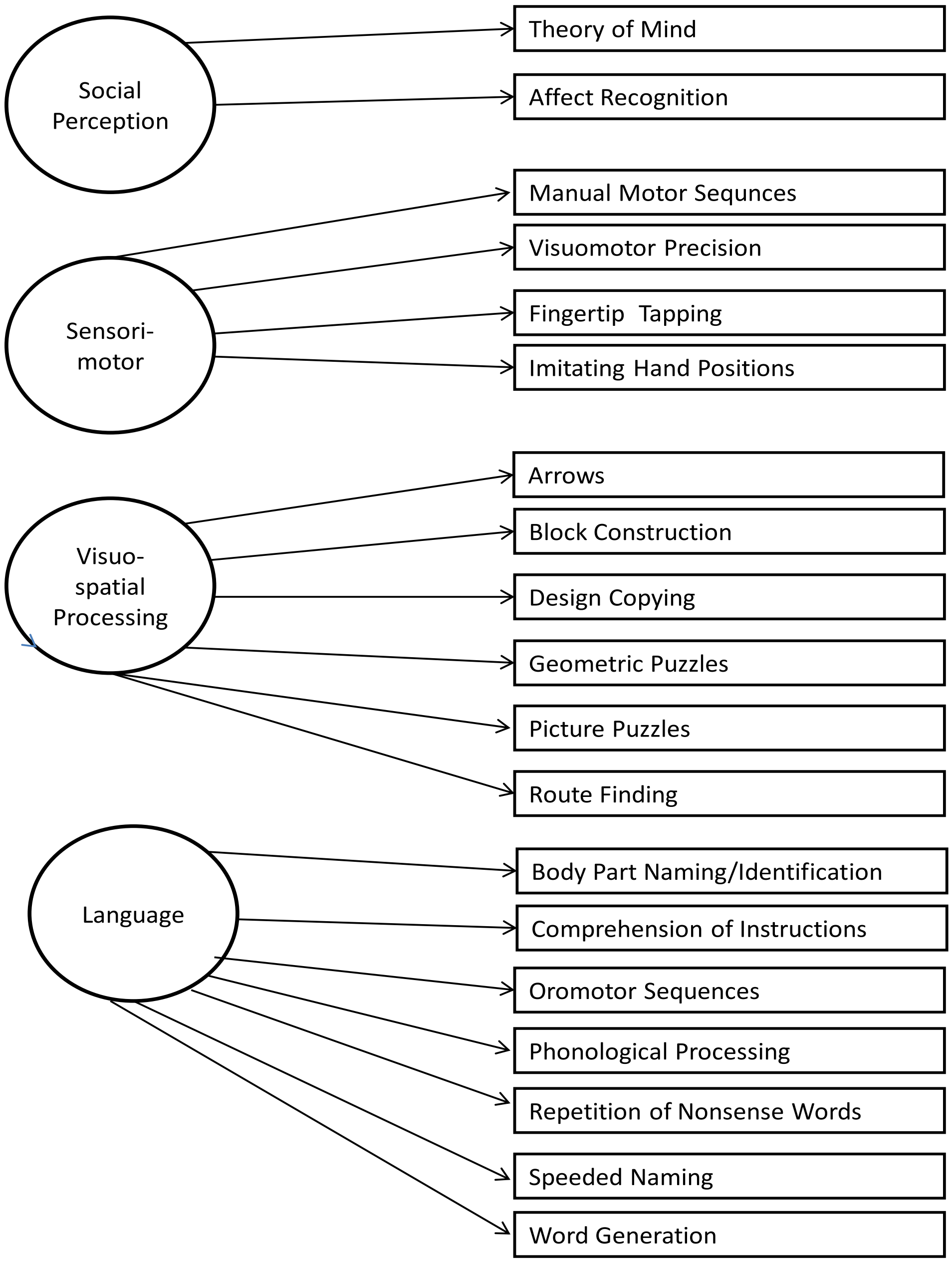

Figure 1, *continued*. Korkman and Colleagues (2007b) Proposed Factor Structure of the NEPSY-II

Purpose, Rationale, and Significance of the Study

The 32 subtests and four delayed tasks of the NEPSY-II are separated into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuopatial Processing. This division of the subtests into six content domains implies that the measure has an underlying factor structure; however, the authors de-emphasize the importance of statistically validating this theoretical factor structure due to the complexity of neurocognitive functions. In fact, the authors purport that the subtests that comprise each domain may not be highly correlated with one another as they vary in terms of stimulus presentation, administration, response type, and scoring emphasis. Further, subtests across domains could be highly correlated as a result of comparable methodology and crossover abilities. Therefore, the authors state that the domains are theoretically derived and are not based on statistical analyses.

The manual does not report factor analysis data on a normative or clinical sample (Brooks, Sherman, & Strauss, 2010; Titley & D'Amato, 2008). Despite its widespread use within pediatric neuropsychology, at this time there are less than five studies that provide an overall critique of the NEPSY-II and no studies conducted that examine the underlying factor structure of the measure. Further, several researchers have stressed the need for research that examines the factor structure of this measure, as it is used pervasively within pediatric neuropsychology (Brooks, Sherman, & Strauss, 2010; Davis & Matthews, 2010; Titley & D'Amato, 2008). From a psychometric perspective, confirmatory factor analysis (CFA) is seen as a crucial step in the validation of an assessment tool (Cole, 1987). When a CFA is conducted on a measure the results often provide more empirical support for the authors' theoretical positions.

The purpose of this study was to examine the underlying factor structure of the NEPSY-II within a mixed clinical sample. A CFA was utilized based on the Korkman, Kirk, and Kemp six-factor model with the content domains of: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuopatial Processing. The specific research questions were:

Is the underlying factor structure of the NEPSY-II in a mixed clinical sample of children best described by:

a. The theoretical model of neurocognitive functioning proposed by Korkman, Kirk, and Kemp.

b. An alternate conceptual model that provides a better fit with the data.

CHAPTER II

REVIEW OF THE LITERATURE

The investigation of the underlying factor structure of the NEPSY-II requires foundational knowledge of this measure and its predecessors (Korkman et al., 2007b). Thus, the NEPSY-II will be discussed in terms of the evolution of the measure over the past decades. The framework of the NEPSY-II originates with A. R. Luria's approach to neuropsychological assessment. Luria's theoretical approach will be delineated as it relates to the development of the NEPSY-II. Additionally, assessment information regarding the NEPSY-II precursors, the NEPS and NEPSY will be discussed in terms of the measure's evolution, purpose, constructs, and psychometric properties. The chapter will continue with an overview delineating the test's purpose, domains, standardization, reliability, and validity. The research basis and conceptualization of the proposed factor structure of the NEPSY-II will be described. Additionally, current research within pediatric clinical groups utilizing the measure will be highlighted. Finally, a review regarding the purpose and rationale of the proposed study will be discussed.

Theoretical Underpinnings and Development of the NEPSY

Luria's Theory

The theoretical underpinning of the NEPSY-II and its predecessors, the NEPSY and NEPS, originates from the work of A.R. Luria (Korkman, 2004; Luria, 1980). Luria has postulated that human mental processes are founded on multifaceted functional systems which are comprised of interconnected neural networks throughout the brain. These systems were conceptualized as three distinct functional units: the arousal unit (Unit I), the sensory input unit (Unit II) and the output/planning unit (Unit III). Each of these processes maintains a distinctive and important role in human cognition (Luria, 1980).

Luria described the functions of Unit I as maintaining respiration, heartbeat, arousal, and attention/concentration (Luria, 1980). Furthermore, each of these functions is located respectively in the following areas of the brain: the brain stem, the diencephalon, and the mesial/medulla regions of the brain. In terms of function, Unit I has the primary responsibility for regulating energy, consciousness, and filtering sensory input.

The overarching task of the secondary area, or Unit II, involves promoting sensory reception which occurs in the temporal, occipital, and parietal lobes (Luria, 1980). Each lobe is divided into three zones of functioning with the Primary Zone receiving, sorting, and recording information; the Secondary Zone organizing and coding information; and the Tertiary Zone synthesizing and merging information. The utility of the primary area entails receiving, sorting, and recording input from the occipital, temporal, and parietal lobes. Next, the secondary area organizes and codes information obtained from the primary zone. The tertiary area is hypothesized to promote cross-modality processing including: auditory-visual integration, auditory-tactile integration, and visual-tactile integration. The synthesizing of information that occurs in the tertiary area of Unit II allows for the complex output and planning that occurs in Unit III.

Luria theorized that the role of Unit III, which corresponds to the frontal lobe of the brain, involves higher-order processing including planning, organizing, and initiating goal-directed behavior (Luria, 1980). Unit III is also divided into primary, secondary, and tertiary zones. The primary zone recruits the muscles required for motor performance and speech. In conjunction with the primary zone, the secondary zone organizes and sequences motoric output. The tertiary zone is then responsible for the planning, creativity, attention, impulse control, and evaluation required to rationally respond to environmental and sensory demands.

In terms of neuropsychological assessment, Luria believed that the primary purpose was to better delineate the function of neuropsychological symptoms (Luria, 1980). Thus, throughout the assessment process tasks are presented across various contexts; in this way, an individual’s deficits become apparent (Bauer, 2000). In this respect, Luria’s approach was both client- and problem-centered.

NEPS Development

In the 1970s, interest in the neuropsychological assessment of the pediatric population was growing; however, there were no standardized neuropsychological measures for use with this population. The NEPS was created over 30 years ago with the intention of filling this void (Korkman et al., 2001). The NEPS was comprised of 2 to 5 tasks intended for use with 5- and 6-year-olds. This measure was a close adaptation of Luria’s neuropsychological assessment approach due to its assessment of the following constructs: attention, language, sensorimotor functions, visuospatial functions, and memory/learning abilities (Korkman, 1999). The items on the NEPS were pass/fail yielding scores of zero, one, or two with no overall sum scores. Due to the item adjustment based on age, most children passed the NEPS in a prescribed manner. The measure was an important beginning to pediatric neuropsychological assessment, yet the assessment had some weaknesses related to the limited age range along with the pass/fail scoring system. For example, intelligent 5- and 6-year olds often passed the NEPS despite the presence of a learning disorder. Young children with impairments often failed the tasks; but, the assessment provided little information regarding their underlying neurocognitive impairments.

In order to address the aforementioned issues, the NEPS subtests were revised and expanded with the inclusion of more test items. The subtest results were described as sum scores which were then converted into z-scores (-3 to 1), based on age norms. In addition to the psychometric revisions, the assessment content was also modified with the addition of new subtests. Shortened versions of the Token Test (DeRenzi & Faglioni, 1978) and the Visual Motor Integration Test (VMI; Beery, 1983) were utilized to compliment other test items on the NEPS revision. Additionally, normative data were collected on children between the ages of 3 years, 6 months and 9 years, 6 months. The assessment was named the NEPS-U in Finnish and the NEPSY in English (Korkman, 1988). In 1990, the NEPSY was published in Swedish while interest in the measure was mounting in other Scandinavian countries and the United States (Korkman, 1999).

NEPSY Development

This growing interest in the measure provided the impetus for an American version of the NEPSY as well as further revisions of the measure (Korkman, 1999). One of the major goals in the NEPSY revision process was to extend the age range to include children between the ages of 3 to 12 years. Therefore, to incorporate a broader age range, additional items were needed to establish appropriate test floors and ceilings. While undergoing this revision, subtests were renamed, subtest content was modified, and some subtests were completely removed from the measure. The result was the introduction of the 1997/1998 version of the NEPSY which consisted of 27 subtests that were divided into five functional domains: Attention and Executive Functions, Language, Sensorimotor Functions, Visual-Spatial Functions, and Memory and Learning (Korkman, et al., 1998). The authors delineated four main purposes for the NEPSY, including detecting deficiencies in neuropsychological functioning that can interfere with children's learning, providing a method by which the effects of brain damage could be understood in children, creating a measure that could be useful in long-term follow-up in children, and studying typical and atypical neuropsychological development in pediatrics.

Attention and Executive Functions Domain

Five individual subtests comprise the Attention and Executive Functions domain with the purpose of assessing a child's ability to plan, sustain attention, exhibit behavioral motor control, display nonverbal fluency abilities, and utilize selective visual attention (Korkman et al., 1998). Tower, a subtest within this domain, is an adaptation of the Tower of London test by Shallice (1982). On the NEPSY, Tower was intended for children between the ages of 8 to 12. During this task a child is required to place three balls on pegs to replicate specific patterns from the stimulus book; however, only a prescribed number of moves is permitted (Korkman et al., 1998). This task was designed to assess planning and task initiation. Auditory Attention and Response Set was designed as a two-part subtest. In the first part, a child hears several different words from a recording. When the word “red” is said, the child takes a red token from a pile of different colored tokens and places it in a box. The test assesses sustained attention as it is lengthy and monotonous. In the second part of the subtest, the task increases in complexity as the child must place a yellow token in the box when the word “red” is said, and a red token in the box when the word “yellow” is said. In addition, the child must place a blue token in the box when “blue” is said. This task assesses a child’s sustained attention and inhibition.

Visual Attention is another task within the Attention and Executive function domain (Korkman et al., 1998). During this task, a child is given two sheets: one with figures in a lined array and one with figures in a random array. A target figure is on the top of each page and the child must find and mark all figures similar to the target on the page. This task is purported to measure selective attention. Another task within this domain is Statue. During the Statue subtest, a child is asked to stand still like a statue with their eyes closed while the examiner makes a series of noises such as coughing and dropping a pencil. This subtest measures the child’s ability to inhibit their impulses. Design Fluency is also within this domain and is an adaptation of the 5-Point Test by Regard, Strauss, and Knapp (1982). During this task the child must develop unique designs by connecting dots in small square boxes. The child must develop as many designs as possible in one minute. This task measures a child’s ability to initiate and demonstrate cognitive flexibility. Knock and Tap is the final subtest within this domain

(Korkman et al., 1998). During this subtest, the child must perform the opposite action as the examiner. For example, the child must knock on the table if the examiner taps the table and vice versa. This subtest provides another measure of inhibition.

Language Domain

The Language domain contains seven subtests that assess: phonological processing, speeded naming, body part naming, comprehension of instructions, repetition of nonsense words, verbal fluency, and oral motor sequences (Korkman et al., 1998). The Body Part Naming subtest requires the child to name the body part that the examiner points to in the stimulus book. This subtest assesses a child's expressive language, semantic knowledge, and word-finding abilities. Phonological Processing is a subtest comprised of tasks that measure phonemic awareness. In Word Segment Recognition the child must point to a picture that represents a word. As the complexity of this task increases, a word segment is presented orally and the child must point to a picture that represents the word segment. The second task is Phonological Segmentation which consists of the child repeating a word and creating a new word by omitting a phoneme and substituting that phoneme with a new phoneme.

Speeded Naming is another subtest within the Language Domain (Korkman et al., 1998). On this task the child is required to name the size, color, and shape of 20 figures in the stimulus book. This task is purported to measure expressive language, processing speed, and naming abilities. Another subtest within this domain is Comprehension of Instructions. This subtest requires a child to listen to multiple-step verbal instructions and point to the designated stimuli. The task is meant to assess receptive language and semantic knowledge. Verbal Fluency, another measure within this domain, involves a child naming as many animals and items to eat or drink in one minute as he or she can. Older children progress to the second half of the subtest where they name as many words as they can that begin with S and F in one minute. This subtest is purported to evaluate expressive language, processing speed, and initiation. Finally, Oromotor Sequences is the last subtest within this domain. This measure requires the child to repeat tongue twisters with the goal of assessing a child's motor programming and speech production.

Sensorimotor Functions Domain

The Sensorimotor Functions domain is comprised of several subtests developed to assess the components of sensorimotor functioning such as consecutive finger and hand movements, the ability to imitate hand positioning, and the use of a writing utensil with precision and speed (Korkman et al., 1998). This domain is comprised of the following subtests: Fingertip Tapping, Imitating Hand Positions, Visuomotor Precision, Manual Motor Sequences, and Finger Discrimination. These subtests are believed to assess a child's abilities in the areas of fine-motor control, motor programming, visual-spatial abilities, and coordination.

Fingertip Tapping requires a child to tap the tips of their index finger and thumb together as quickly as possible 32 times (Korkman et al., 1998). The second part of the task requires the child to tap the tip of their thumb against the tips of their other fingers eight times as quickly as possible. The task is purported to measure fine-motor control. The Imitating Hand Positions, another subtest within this domain, evaluates a child's ability to imitate hand positioning, such as pointing their thumb and little finger while keeping all other fingers in a fist. This task assesses a child's visuospatial and fine motor skills. Similarly, Visuomotor Precision assesses fine-motor control and visual attention by requiring the child to quickly draw lines inside a track that becomes more complex and curvy as the task progresses.

Another measure within the Sensorimotor Functions Domain, Manual Motor Sequences, evaluates a child's ability to replicate a series of manual motor movements demonstrated by the examiner (Korkman et al., 1998). This subtest discriminates difficulties with manual motor programming. The last subtest within this domain is Finger Discrimination. During this subtest a child's hand is covered from their view while the examiner touches the child's fingers. The child must then indicate which fingers were touched by the examiner. This subtest measures tactile discrimination.

Visual-Spatial Functions Domain

The Visual-Spatial Functions domain includes four subtests that measure different characteristics of visual-spatial relationships (Korkman et al., 1998). The subcomponents of visual perception include tasks that explore a child's ability to: recognize part-to-whole relationships, rotate objects mentally, assess line orientation, and copy two-dimensional figures. Specifically, the subtests Design Copying, Arrows, Block Construction, and Route Finding contribute to the overall construct of visuospatial processing.

Design Copying is a subtest within this domain that evaluates a child's ability to copy geometric designs of increasing complexity (Korkman et al., 1998). This measure identifies children with poor visuoconstructional abilities. Assessing a different aspect of visuospatial abilities, the Arrows subtest requires a child to look at several different arrows organized around a target and identify the arrow(s) that point to the center of the target. This subtest assesses visuospatial abilities and judgment of line orientation. Block Construction requires a child to use blocks to replicate structures that are presented to them in a two- or three-dimensional format (Korkman et al., 1998). This task evaluates a child's visuospatial abilities in the area of visuoconstruction. The last subtest within this domain is Route Finding. During this task, a child is presented a schematic map with a house that is the target. The child is then given a bigger map with more houses and streets and is asked to find the target house. This subtest is purported to measure visuospatial relationships and object orientation.

Memory and Learning Domain

The NEPSY included subtests that assessed several aspects of memory and learning (Korkman et al., 1998). Specifically, the subcomponents of learning and memory including: immediate memory for sentences, narrative memory, and immediate and delayed memory for faces, names, and lists. The following section will delineate the subtests within the Memory and Learning domain.

One of the subtests within this domain is Sentence Repetition (Korkman et al., 1998). During this subtest the child is asked to repeat sentences of varying lengths. This subtest assesses a child's verbal working memory. Another subtest within this domain, Narrative Memory, involves a child listening to a story and then retelling the story to the examiner. Additional questions can be asked to gather information omitted from the free recall portion of the task. This test can identify issues with verbal learning. Similarly, List Learning requires a child to learn a list of words over five trials. An interference word list is introduced after the five trials and the child is asked to recall the interference list one time, then the child recites the original word list. In List Learning Delayed, the child is asked to recall the original word list 25 to 35 minutes later. This task examines working memory and the ability to manage verbal interference.

Memory for Faces requires a child to view a series of faces while telling the examiner the gender of the child on the stimulus card (Korkman et al., 1998). Next, the child is presented three faces at a time in the stimulus manual while being asked to point to the face they have previously seen. Memory for Faces-Delayed is administered 15 to 25 minutes later and requires the child to point to the previously seen faces from the Memory for Faces stimulus book. This task provides information regarding a child's ability to recognize and recall previously seen faces.

During the Memory for Names subtest, the child views eight cards with drawings of children and the examiner offers a name for each child (Korkman et al., 1998). The cards are shuffled and then shown to the child again at which time they are required to recall the names of the children on the card. The child receives the same aforementioned learning trial three times. Next, in Memory for Names Delayed the child is asked to recall the names of each of the children on the cards presented earlier. This task is administered after a 25 to 35-minute time delay. This task is purported to measure a child's ability to learn and remember visual information with verbal labels. Additionally, the delayed component allows comparison of any differences between a child's immediate and short term memory.

Psychometric Properties of the NEPSY: Standardization, Reliability, and Validity

Preliminary normative data for the NEPSY was collected from a sample of 144 normal children aged 4 to 8 years old from the Helsinki area (Korkman, 1988). The reliability of the subtests was evaluated by the Kuder-Richardson formula (Anastasi, 1982). This measure of internal consistency is not widely utilized as it yields relatively low reliability coefficients; however, the NEPSY subtest reliability coefficients usually exceed .70 (Korkman, 1988). Additionally, interrater reliability was evaluated by having two examiners independent of one another, assess the performance of normal subjects. Next, the standardization of the United States version of the measure was completed with a sample of 1,000 3- to 12-year-old children (Korkman et al., 1998). The sample was diverse in terms of geography, ethnicity, and socio-economic status reflecting the population of the United States at that time. Reliability was assessed through the calculation of internal consistency, standard errors of measurement, stability coefficients of each subtest, and confidence intervals. Interrater reliability was calculated predominately by qualitative observation. Internal consistency was calculated for each age group for most subtests resulting in reliability coefficients between .70 and .90. Overall, the reliability measures indicated adequate to good reliability.

The NEPSY content and external validity was also thoroughly assessed by the authors of the measure (Korkman et al., 1998). A panel of experts including pediatric neuropsychologists and school psychologists reviewed the measure to evaluate the breadth and appropriateness of the test content. Six hundred children were administered the measure for validation. The results indicated that subtest scores correlated with other measures such as the Children's Memory Scale (CMS; Cohen, 1997), and others as expected. The NEPSY subtests were able to discriminate clinical groups from typically-developing children; and, a few validation studies were also conducted on various clinical groups (Korkman et al., 1998).

Clinical groups were comprised of children from the standardization group that corresponded to the clinical groups in terms of age, gender, race/ethnicity, and parent education level (Korkman et al., 2007b). These clinical groups included children with a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) without comorbidity (N = 51), children with an isolated diagnosis of specific reading disorder (N = 36), and high functioning children diagnosed with an Autism Spectrum Disorder (ASD; N = 28). The results from the clinical groups yielded expected outcomes. For example, children with a diagnosis of ADHD demonstrated widespread impairments on the NEPSY thus indicating attention may impact performance in general. Children with specific reading disorders performed poorly on tasks within the Language domain as well as verbal memory subtests. Finally, children with an ASD exhibited weaknesses on the following subtests: Design Fluency, Verbal Fluency, Visuomotor Precision, and Memory for Faces. The clinical validation studies provided further evidence of the NEPSY's usefulness and clinical validity.

Additionally, other studies were completed which provided indirect evidence of the clinical utility of the measure. Korkman et al. (2001) addressed the impact of age on the NEPSY concluding that neurocognitive development occurs more quickly between the ages of 5 to 8 than 9 to 12. The authors reported that their empirical work supported the purported developmental specificity of the NEPSY. Another study was completed by Mulenga, Ahonen, and Aro (2001) which compared the scores of Zambian children to children in the United States on various aspects of the measure. An important conclusion drawn from this study was that the NEPSY appeared to not have the cultural and linguistic biases found in many psychometric measures; thus, the measure was deemed appropriate to use with individuals of diverse cultural and linguistic backgrounds.

Also, Bandstra et al. (2002) conducted a study with the NEPSY to determine the impact of in utero cocaine use with language development in children. The NEPSY exhibited clinical validity due to its ability to document anticipated linguistic differences between the control group and the children with in utero cocaine exposure. Finally, Schmitt and Wodrich (2004) completed a validation study on the NEPSY yielding promising results as the NEPSY was able to distinguish children with scholastic issues and neurological conditions from an unimpaired group. This study provided further support of the clinical validity of the measure.

Factor Structure of the NEPSY

While examining the psychometric properties of the NEPSY is important, it is essential to also examine the underlying factor structure of the measure. There are two types of factor analysis procedures. Exploratory factor analysis procedures are based on statistical properties of the measure whereas confirmatory procedures are based on previous research and theory (Brown, 2006). The NEPSY's authors claimed that factor analysis was not an appropriate method by which to examine the structure of the NEPSY as the five domains were not conceptualized as independent factors (Korkman et al., 2007b); nevertheless, the domains do represent an intrinsic psychometric structure to the tool. Only two research articles that have studied the factor structure of the NEPSY could be located.

Stinnett et al. (2002) conducted a preliminary study on the underlying factor structure of the NEPSY utilizing the NEPSY standardization sample. In this study, an exploratory principle axis factor analysis was conducted utilizing a correlational matrix for the 5- to 12-year-old age group. The study yielded a one factor solution termed a language/comprehension factor that accounted for 24.9% of the variance. Stinnett et al. (2002) also examined 2, 3, and 4-factor solutions; however, these solutions provided several cross-loaded subtests. Theoretically, Korkman et al. (1998) could explain this finding due to the complex, interactive systems that underlie cognitive and motoric processes. However, some of the subtests that cross-loaded would theoretically not be anticipated to covary with each other. Stinnett and colleagues (2002) suggested a confirmatory factor analysis should be completed to provide further empirical confirmation of the measure.

Mosconi et al. (2008) conducted a study to further the understanding of the factor structure of the NEPSY. The study utilized the 14 core subtests of the NEPSY and Block Construction to complete a confirmatory factor analysis on the normative sample employing Analysis of Moment Structures Version 4.0 (AMOS; Arbuckle & Wothke, 1999). Mosconi et al. (2008) found that amongst the standardization sample of children aged 5 to 12 years, the proposed five-factor model was not a good fit for the data. Furthermore, the five-factor solution was a poor fit for children in the younger and older age groups with integrity problems amongst the Attention/Executive Function subtests. Due to these results, the authors attempted a four-factor solution leaving out the subtests from the Attention/Executive Function domain. This yielded robust results for the entire sample. However, this model was a poor fit for data from the 9- to 12-year-old age group. The four-factor solution was found to be quite simple with all subtests loading on their hypothesized domains for the younger groups only. These results supported the proposed conceptual model of the NEPSY aside from the Attention/Executive Function domain and for the oldest age group. Additionally, this study provided further evidence of an emergent factor structure for the NEPSY.

Development of the NEPSY-II

Revision of the NEPSY

The revision process of the 1998 NEPSY began in late 2003 with the authors reviewing research in neuropsychology, child development and child psychology (Korkman et al., 2007b). Additionally, the authors considered feedback about the measure from experts in the field of pediatric neuropsychology and psychologists using the measure in practice. Korkman et al. (2007b) articulated four primary goals in the NEPSY revision process.

First, the authors wanted to extend and advance the neurocognitive domains covered throughout the age span. The authors believe they accomplished this feat through the addition of new domains and subtests. As the field of neuropsychology progressed from 1998 to 2003, it was evident that executive function was an important aspect of neuropsychological functioning (DeLuca et al., 2003; Korkman et al., 2007b). Therefore, subtests that purportedly measured executive functioning (i.e., Animal Sorting, Clocks, and Inhibition) were included in the Attention/Executive Function domain of the NEPSY-II. Also, the authors recognized that the Visuospatial Processing domain was weak as it had fewer subtests than any other domain within the measure. Therefore, the authors added Geometric Puzzles and Picture Puzzles to further assess visuospatial skills and mental rotation of objects. Further, these two subtests contain no motoric input demands while still assessing a child's abilities in spatial relationships, picture deconstruction, and visual details. The Social Perception domain was formed to improve the assessment of children with ASD and other potential social deficits. The new subtests included in this domain were Affect Recognition and Theory of Mind.

The second goal of the revision was to improve the clinical and diagnostic utility of the measure (Korkman et al., 2007b). Expert critiques of the 1998 NEPSY stated that the global domain scores masked subtle neurocognitive deficits. To correct this issue, the authors removed the overall domain scores "in favor of the more clinically sensitive subtest-level scores" (Korkman et al., 2007b, p. 26). In scoring the measure, the clinician can utilize process scores to gather information regarding the types of errors a child is making which could provide additional clarity regarding diagnosis and intervention. Contrast scores were also created to allow for the comparison of a child's performance on a task with increasing complexity. More base rates are available to clinicians allowing for the comparison of behaviors between the child undergoing assessment and same-age peers. Furthermore, special studies were conducted with specific clinical populations to enhance the clinical utility of the measure. These ten clinical groups included children who are Deaf and Hard of Hearing and those with diagnoses of ADHD, Asperger's Disorder, ASD, Emotional Disturbance, Language Disorder, Mild Intellectual Disability, Mathematics Disorder, Reading Disorder, and Traumatic Brain Injury.

A third goal of the revision process was to improve the psychometric properties of the NEPSY-II (Korkman et al., 2007b). One step in improving the psychometric properties of the measure involved collecting normative data that were stratified based on demographic information obtained from the October 2003 United States Census Data (United States [US] Bureau of Census, 2004). The norming process will be discussed in greater detail in the literature review in the psychometric properties of the NEPSY-II section. The authors developed improved floors and ceilings for several subtests to ensure the measure accommodated children ages 3 to 16 (Korkman et al., 2007b). This goal was accomplished through adding easier and more difficult items to several of the subtests. Data were collected on children with mild intellectual disability establishing improved floors on several subtests. A number of concurrent reliability and validity studies were conducted which will be further described in the psychometric properties section of the NEPSY-II as well.

The final goal of the revision process was to increase usability of the measure and ease of administration (Korkman et al., 2007b). To accomplish this goal, flexible subtest administration was introduced to allow the clinician to reduce overall testing time by tailoring the battery to the assessment needs of the child. However, the authors proposed a general assessment battery to address common referral questions or instances when a child's deficit is unknown. Additionally, eight diagnostic referral batteries are provided based on the special populations studied during the test norming and validation processes. Clinicians may also choose to select subtests based on clinical, research, or child-specific needs.

Finally, the NEPSY-II authors enhanced the usability of the measure through the manner in which they organized the *Administration Manual* (Korkman et al., 2007a). The *Administration Manual* is organized by subtest in alphabetical order to increase the ease with which the examiner can find subtest instructions. The information in this manual covers only information necessary to administer and score subtest data thereby decreasing the size of and increasing the maneuverability of the manual. The authors also proposed a new role for the NEPSY-II stating it could be used by appropriately trained school psychologists to enhance the information gleaned from psychoeducational assessments.

NEPSY-II Development Phases

Korkman et al. (2007b) developed the NEPSY-II in three distinct phases: the pilot, tryout, and standardization phases. The pilot phase of the NEPSY-II began in 2004 with the revision of the NEPSY. During this period, new items were introduced and old items were revised. Further, the addition of a novel domain, Social Perception, was tested. The authors administered an early edition of the measure to 96 typically-developing children, 24 children with a diagnosis of Asperger's Disorder, and 46 children with a diagnosis of ADHD.

Next, the pilot version of the NEPSY-II comprised of 13 subtests was given to 109 children from across the United States (Korkman et al., 2007b). The children were representative of the United States population in terms of age, sex, race/ethnicity, and parent education. The authors encouraged examiners to offer feedback regarding the subtests, children's responses to the subtests, and qualitative behavioral observations. Information from this pilot study was carefully scrutinized to aid in the development and refinement of the NEPSY-II domains and subtests.

The tryout phase was the second distinctive phase of the NEPSY-II development which involved modifications based on the pilot study, review of the literature, and clinical experiences using the measure (Korkman et al., 2007b). The revisions in this phase included the elimination of subtests, such as Face Discrimination, along with the modification of subtests (i.e., Affect Recognition, Auditory Attention and Response Set, Comprehension of Instructions, Memory for Designs, Phonological Processing, Speeded Naming, Visuomotor Precision, and Word Repetition and Recall). Revisions also included the addition of new subtests developed for the NEPSY-II tryout phase. For instance, Inhibition and Animal Sorting were created for the Attention and Executive Function domain and Theory of Mind was added to the Social Perception domain.

The national tryout began in 2005 with the measure composed of 22 subtests administered to a sample of 205 typically-developing children ages 3 to 12 and 54 children with clinical diagnoses (Korkman et al., 2007b). The sample was diverse in terms of geographic region, parent education level, sex, age, and race/ethnicity. The data from this study was analyzed half-way through to assess the psychometric properties of the measure while also identifying administration and scoring issues. During this phase the authors considered extending the age range of the NEPSY-II to 16 years old.

Next, a mini pilot study with 45 adolescents was conducted to examine the feasibility of extending the NEPSY-II to adolescents (Korkman et al., 2007b). Final revisions to the NEPSY- II included: discarding subtests with poor reliabilities, addressing floor and ceiling issues, and modifying the administration and scoring procedures. Finally, Edith Kaplan, one of the authors of the *Delis-Kaplan Executive Function System* (D-KEFS; Delis, Kaplan, & Kramer, 2001) helped in the creation of the Clocks subtest for the Attention and Executive Function domain of the NEPSY-II.

With the completion of the pilot and tryout phase, the NEPSY-II underwent the standardization and validation phase from 2005 to 2006 (Korkman et al., 2007b). During the standardization phase, behavioral observations were added to several subtests along with modifications to several of the NEPSY-II subtests (see Table 3 for descriptions of subtest modifications during the standardization phase). The standardization battery was quite lengthy; and, as a result, subtests that were not altered from the NEPSY were reviewed for theoretical and psychometric issues. Renorming was not completed on subtests that were not expected to change due to the Flynn effect (Flynn, 1984) or changes in the population such as the Sensorimotor subtests. The standardization version of the NEPSY-II was comprised of 29 subtests and three delayed tasks. This version was administered to 1200 children between the ages of 3 through 16 (Korkman et al., 2007b). Additionally, testing data from 260 children with clinical diagnoses along with 1,060 concurrent validity cases were collected during this phase.

Table 3

Subtest Modifications in the Standardization Phase

Subtest Name	Modification
Animal Sorting	Stimuli Modified
Clocks	New Subtest Added
Auditory Attention/Response Set	Modified Based on Mini Pilot Study
Comprehension of Instructions	New Subtest Items Added
Recognition of Reversals	New Subtest Added
Phonological Processing	Deleted Items: Rhyming and Word Chain; New Floor Items Added
Arrows	New Items Added
Design Copy	New Items Added
Fingertip Tapping	Modified to Reduce Subtest Administration Time

After reviewing data gathered from the standardization and validation phase, the final subtest selections were made for each of the six domains (Korkman et al., 2007b). At this time, three of the standardization subtests were eliminated due to issues with validity or administration. Further modifications included process scores for specific components to some subtests. The final product contained 32 subtests and four delayed tasks. The subtests were separated into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuospatial Processing.

Review of the NEPSY-II

NEPSY-II Domain Descriptions

The domain of Attention and Executive Functioning consists of multi-faceted constructs that contain several overlapping processes (Korkman et al., 2007b). More specifically, this domain is composed of six tasks designed to assess the components of executive functioning and attention such as organizing and planning, self-monitoring, inhibition of automatic responses, problem solving with pictures, and the ability to change, maintain, and formulate a response set. The subtests of Animal Sorting, Auditory Attention and Response Set, Clocks, Design Fluency, Inhibition, and Statue comprise this domain.

The domain of Language comprises several subtests that examine the subcomponents of language such as phonological processing, receptive language, expressive language, and verbal semantic fluency (Korkman et al., 2007b). Specifically, this domain consists of seven tasks designed to assess constructs of expression of verbal/semantic knowledge, following multi-step commands, speech production, phonological awareness and processing, lexical access, and naming ability. The subtests within this domain are Body Part Naming and Identification, Comprehension of Instructions, Oromotor Sequences, Phonological Processing, Repetition of Nonsense Words, Speeded Naming, and Word Generation.

The NEPSY-II includes 11 subtests that assess different aspects of memory and learning (Korkman et al., 2007b). More specifically, the components of learning and memory contain: immediate memory for sentences, narrative memory with free recall, cued recall, and recognition conditions; repetition and recall of words presented with interference; and, immediate and delayed memory for abstract designs, faces, names, and lists. The subtests that comprise this domain are List Memory/List Memory Delayed, Memory for Designs/Memory for Designs Delayed, Memory for Faces/Memory for Faces Delayed, Memory for Names/Memory for Names Delayed, Narrative Memory, Sentence Repetition, and Word List Interference.

The Sensorimotor domain comprises several subtests developed to explore the components of sensorimotor functioning such as consecutive finger and hand movements, the ability to imitate hand positioning, and the use of a writing utensil with precision and speed (Korkman et al., 2007b). The subtests in this domain are Fingertip Tapping, Imitating Hand Positions, Manual Motor Sequences, and Visuomotor Precision

The Social Perception domain on the NEPSY-II utilizes two subtests designed to measure the subcomponents of social perception. The subcomponents of social perception are comprised of tasks that explore a child's ability to recognize facial affect in another person and understand another person's perspective. Specifically, the subtests Affect Recognition and Theory of Mind measure the construct of social perception.

The Visuospatial Processing domain on the NEPSY-II includes six subtests that measure different aspects of visual-spatial relationships (Korkman et al., 2007b). The components of visual perception include tasks that explore a child's ability to: recognize part-to-whole relationships, rotate objects mentally, assess line orientation, and copy two-dimensional figures. The subtests Arrows, Block Construction, Design Copying, Geometric Puzzles, Picture Puzzles, and Route Finding contribute to the overall domain of Visuospatial Processing.

Table 4 displays a comparison of the NEPSY to the NEPSY-II by subtests. More specifically, additions, deletions, and modifications are presented in the table to provide detailed information regarding each subtest. As stated previously, many of the NEPSY-II subtests cover a broader age range which is not displayed in this table. However, age ranges for each subtest are included in the individual subtest description in the methods section.

NEPSY-II Scoring and Classification of Performance

The NEPSY-II has four different types of scores (Korkman et al., 2007b). Primary scores are age-adjusted scaled scores with a mean of 10 and a standard deviation of three and are intended to represent the clinical aspect of the subtest. The second type of score is a process score. A process score evaluates specific abilities, error rates from a subtest, or skills. These scores can be reflected as scaled scores, cumulative percentages, or percentile ranks. The third type of score is a contrast score which is presented as scaled scores that can be compared statistically. These scores can then be designated as high and low abilities. Behavioral Observations represent the fourth type of score and account for behaviors that occur in clinical populations, but are not typically seen in normally-developing children. These scores are presented as cumulative percentages or percentile ranks. Table 5 provides information regarding the NEPSY-II scoring classification.

Table 4

Revisions in Subtest from the NEPSY to the NEPSY-II

Domain/Subtest	**Administration Modifications**	**New Test Items**	**Deleted from NEPSY-II**	**New Subtest**	**Scoring/Recording Modifications**	**Age Range**	**No Modifications**
<u>Attention/Executive Functioning</u>							
Animal Sorting				X			
Auditory Attention/Response Set	X			X		X	
Clocks				X			
Design Fluency							X
Inhibition				X			
Knock and Tap			X				
Statue					X	X	
Tower			X				
Visual Attention			X				
<u>Language</u>							
Body/Part Naming/Identification	X	X			X		
Comprehension of Instructions	X	X			X	X	
Oromotor Sequences							X
Phonological Processing	X	X			X	X	
Repetition Nonsense Words							X
Speeded Naming	X	X		X	X	X	
Word Generation					X	X	

(continued)

Domain/Subtest	Administration Modifications	New Test Items	Deleted from NEPSY-II	New Subtest	Scoring/Recording Modifications	Age Range	No Modifications
<u>Memory/Learning</u>							
List Memory					X		
List Memory/Delayed					X		
Memory for Designs				X			
Memory Designs/Delayed				X			
Memory for Faces	X	X			X	X	
Memory Faces/ Delayed	X	X			X	X	
Memory for Names						X	
MemoryNames/ Delayed						X	
Narrative Memory	X	X			X	X	
Sentence Repetition						X	
Word List Interference				X			
<u>Sensorimotor</u>							
Finger Discrimination			X				
Fingertip Tapping	X				X	X	
Imitating Hand Positions							X
Manual Motor Sequences							X
Visuomotor Precision	X	X			X		
<u>Social Perception</u>							
Affect Recognition				X			
Theory of Mind				X			
<u>Visuospatial Processing</u>							
Arrows	X	X			X	X	
Block Construction						X	
Design Copying		X			X	X	
Geometric Puzzles				X			
Picture Puzzles				X			
Route Finding							X

Notes. Korkman et al. (2007b).

Table 5

NEPSY-II Score Classifications

Standard Score	**Scaled Score**	**% Rank**	**Normative Classification**
>129	>16	>98%	Superior
121-129	15	92-98	Well Above Expected
111-120	13-14	76-91	Above Expected
90-110	8-12	25-75	At Expected
80-89	6-7	9-24	Borderline
70-79	4-5	2-8	Below Expected
<70	1-3	<2	Well Below Expected

Psychometric Properties of the NEPSY-II

Normative Sample

Korkman et al. (2007b) selected a sample of 200 examiners from across the United States to participate in the standardization and validation of the NEPSY-II. The NEPSY-II authors chose these examiners based upon the diversity of populations these practitioners had access to as well as their experience assessing children. The authors followed ethical research procedures including: parent consent forms, a confidential sampling matrix data base, and clear exclusionary criteria. The normative data reported in the NEPSY-II manual is comprised of children who were representative of the United States population and between the ages of 3 and 16. A stratified random sample was utilized to ensure that the normative sample reflected the United States population based on the 2003 census information provided by the United States Bureau of Census. The sample was not stratified based on sex, but instead was spilt in half with 50 percent male and 50 percent female.

The normative sample included 1,200 cases with 100 children in each of the 12 age groups ranging from 3 to 16 years old (Korkman et al., 2007b). In the 3 to 12 age range, 50 cases were collected in the first six months of the year and 50 cases collected in the last six months of the year. The ages of 13 to 14 were combined and ages 15 to 16 were combined to form two age groups with 100 cases in each. In terms of ethnicity/race, each of the age groups contained the proportions of Caucasians, African Americans, Hispanics, and other race/ethnic groups represented in the United States population based on the 2003 census survey. The parents of each of the children categorized their child's race as Caucasian, African American, Hispanic, or Other. The other category is comprised of Native American, Aleut, Pacific Islander, and Eskimo. Further, the sample was representative of the four major geographic regions of the United States (i.e., Northeast, Midwest, South, and West) and based on the proportion of children residing in each region. Finally, the sample was stratified based on each parent's self-report of their education level. For children living with both parents, an average of the two education levels was used. The four categories for education level included: 0 to 11 years, 12 years, 13 to 15 years, and 16 or more years of education.

The subtests were also normed using four different record forms created for the standardization process (Korkman et al., 2007b). Each form offered subtests in varying order with the exception of linked subtests such as Memory for Designs and Memory for Designs Delayed. Each one of the four forms was used to collect 20 percent to 30 percent of the data resulting in norming information that allows for flexibility in administration. Additionally, several scoring studies were conducted to refine the criteria used for scoring and to ensure greater scoring accuracy. Upon completion of the scoring studies, information obtained was used to create final scoring rules.

Reliability of the NEPSY-II

Test reliability is an indication of the extent to which a test offers a stable and precise measure of the underlying constructs (Anastasi & Urbina, 1997). More specifically, test reliability describes the accuracy, consistency, and stability of test scores through all circumstances. The NEPSY-II manual provides an abundance of information regarding reliability (Korkman et al., 2007b). The following section will delineate an overall description of the NEPSY-II's reliability. The methods section provides a more detailed description of specific subtest reliability.

The results of the NEPSY-II reliability studies indicate that most of the NEPSY-II subtests demonstrate adequate to high internal consistency (Korkman et al., 2007b). The subtests with the highest internal reliability include: Comprehension of Instructions, Design Copying, Fingertip Tapping, Imitating Hand Positions, List Memory, Memory for Names, Phonological Processing, Picture Puzzles, and Sentence Repetition. The lowest reliability coefficients were present in Response Set Total Correct, Inhibition Total Errors, Memory for Designs Spatial and Total Score, and Memory for Designs Delayed Total Score. Korkman et al. (2007b) suggest that the lower reliabilities on the aforementioned subtests were likely a result of practice effects. Additionally, a reliability study was conducted using a clinical group of 260 children with one of the following disorders: ADHD, Asperger's Disorder, Autistic Disorder, Emotional Disturbance, Deaf and Hard of Hearing, Language Disorder, Mathematics Disorder, Reading Disorder, Intellectually Disabled, and Traumatic Brain Injury (Korkman et al., 2007b). The reliability coefficients were high indicating that the NEPSY-II is a reliable instrument to assess children with clinical diagnoses.

The NEPSY-II manual provides further information regarding test-retest reliability (Korkman et al., 2007b). Test-retest reliability refers to the consistency of a measure across time (Gravetter & Forzano, 2009). A sample of 165 children was given the NEPSY-II on two separate occasions with a test-retest average time of 21 days (Korkman et al., 2007b). The results indicated that across all six age groups (3-4 years, 5-6 years, 7-8 years, 9-10 years, 11-12 years, and 13-16 years) adequate reliability was demonstrated. Also, to ensure interscorer agreement, all NEPSY-II protocols were double-scored by two independent scorers. The interscorer agreement on the NEPSY-II was very high ranging from 93 percent to 99 percent, thus indicating a very high degree of reliability between raters.

Validity of the NEPSY-II

Assessment validity refers to the ability of a measure to adequately sample the construct that is being measured (Gravetter & Forzano, 2009). The three major types of validity include: content, construct, and concurrent validity. The NEPSY-II manual provides information from multiple research studies designed to address each type of validity (Korkman et al., 2007b). The following section will delineate an overall description of the validity of the NEPSY-II. The methods section provides a more detailed description of specific subtest validity.

Content validity ensures that the subtests that comprise a measure sufficiently sample the behaviors included in the constructs the test is attempting to measure (Gravetter & Forzano, 2009). The NEPSY-II was created to provide a complete assessment of neuropsychological functioning in children (Korkman et al., 2007b). The NEPSY-II has a solid foundation in the neuropsychological assessment practices of A. R. Luria. The measure has been refined through multiple revisions based on a review of clinical research regarding neuropsychological development in children and feedback from experts in the field of pediatric neuropsychology. As described previously, the NEPSY-II development included data collections during the pilot, tryout, and standardization phases. The authors evaluated data and made modifications to the test to enhance the content validity of the NEPSY-II.

Construct validity refers to a scale's internal structure and ability of the scale to measure what it purports to measure (Gravetter & Forzano, 2009). The NEPSY-II manual provides a great deal of information regarding construct validity (Korkman et al., 2007b). Across the six domains of the measure, construct validity was classified as medium to high. Theoretically, the authors (2007b) contend that the subtests of the NEPSY-II comprise six functional domains. However, Korkman and colleagues (2007b) did not conduct a factor analysis on the NEPSY-II. Further, no factor analysis research has been conducted to examine the factor structure of the measure.

Concurrent validity refers to an examination of a measure's relationship to other measures that assess similar constructs (Gravetter & Forzano, 2009). The NEPSY-II manual provides extensive information regarding the measure's concurrent validity (Korkman et al., 2007b). A series of studies were conducted concurrently by Korkman and colleagues (2007b) within the standardization process to assess the NEPSY-II's relationship with measures of general cognitive abilities, academic achievement, neuropsychological functioning, and behavior. Also, studies were conducted with clinical groups to measure the validity of the NEPSY-II amongst children with diagnoses of ADHD, Reading Disorder, and Autisim Spectrun Disorder. These studies provided evidence that the NEPSY-II demonstrates adequate to good convergent, divergent, and clinical validity.

Strengths of the NEPSY-II

The NEPSY-II is one of a very few pediatric neuropsychological assessment batteries (Korkman et al., 2007b). The foundation of the NEPSY-II includes classic neuropsychological tasks that measure neuropsychological functions in children; therefore, it is easily understood by anyone with a neuropsychological background (Brooks, Sherman, & Strauss, 2010). Further, the NEPSY-II provides comprehensive coverage of neuropsychological domains which allows for impressive clinical utility. In particular, the Social domain allows for a standardized assessment that is especially helpful for the evaluation of ASDs.

Additionally, the NEPSY-II is a unique and impressive pediatric neuropsychological measure in that it allows for the comparison of performance across subtests utilizing co-normed subtests (Brooks, Sherman, & Strauss, 2010; Davis & Thompson, 2011). The comparison of subtest scores, as opposed to cluster scores, increases the specificity of the child's pattern of weaknesses and strengths (Davis & Matthews, 2010). These results influence the creation of specific interventions that could remediate some of a child's learning difficulties. Also, the NEPSY-II is the only neuropsychological measure for pediatrics that is conceptualized as a flexible battery complete with normative data compiled in a manner that reduces order effects (Brooks, Sherman, & Strauss, 2010). An additional strength of the NEPSY-II is the broad age range the measure covers. In particular, it is one of the few neuropsychological assessment tools that is normed for use with preschoolers. The upward extension of the NEPSY-II to include adolescents up to 16 years old provides a much needed tool as other neuropsychological measures have incomplete norms for the 13 to 16 age group. Further, several researchers believe the psychometric properties and conceptualization of some of the new subtests such as Inhibition are quite impressive (Brooks, Sherman, & Iverson, 2010; Davis & Matthews, 2010).

The NEPSY-II also demonstrates improved usability over other measures and its predecessor the NEPSY (Brooks, Sherman, & Strauss, 2010). These improvements include: an easy to use scoring program, improved subtest directions, brief yet comprehensive subtests, and increased usability of test materials/manual (Brooks, Sherman, & Strauss, 2010; Titley & D'Amato, 2008). Overall, the measure demonstrates moderate to high internal reliabilities and adequate test-retest reliabilities for most subtests, and strong sample sizes. Additionally, the technical manual provides an immense amount of important psychometric information.

Limitations of the NEPSY-II

The NEPSY-II has some limitations, which are present in all neuropsychological batteries. These limitations are imperative to discuss as they may impact the clinical interpretation of data obtained from the measure. Additionally, discussing the weaknesses of a measure often leads to further research that could influence test revisions or development of other measures.

One of the perceived weaknesses of the NEPSY-II is that it is considered complex to interpret even for a seasoned clinician (Titley & D'Amato, 2008). The NEPSY-II contains a large number of subtests and the test manual provides an extensive amount of psychometric information on each subtest. For instance, the NEPSY-II manual provides over 600 subtest intercorrelations (Korkman et al., 2007b). Understanding this amount of psychometric information could prove quite difficult for the average user attempting to draw conclusions regarding the strengths and weaknesses of the measure.

Scoring for this measure can be quite complex for some of the subtests due to the four different types of scores obtained along with behavioral observations. Several researchers recommend using the scoring software; however, the scoring printout provides a large number of scores, which can be complex to read and interpret (Brooks, Sherman, & Strauss, 2010; Davis & Matthews, 2010; Titley & D'Amato, 2008). For instance, a typical print out might include eight pages with 55 primary and process scores with the Attention and Executive Functions domain alone containing 29 scores.

Additionally, it is important, as with all neuropsychological batteries, for clinicians to avoid over-interpreting isolated low scores due to the high number of scores generated by the NEPSY-II (Brooks, Sherman, & Iverson, 2010).

The NEPSY-II provides referral batteries purported by the authors as guidelines to aid the examiner in subtest selection or for use in differential diagnosis (Korkman et al., 2007b). However, to date there has been no validation evidence of the clinical utility and sensitivity of these batteries for use in identifying specific clinical disorders or differentiating between clinical disorders (Brooks, Sherman, & Strauss, 2010). Therefore, more research needs to be conducted to determine if the author-proposed use for these referral batteries withstands empirical validation.

The NEPSY-II manual provides evidence of clinical validity through multiple research studies conducted with clinical populations (Korkman et al., 2007b). One of the limitations of the information provided is that the clinical samples do not include children with known neurological disorders (i.e., epilepsy, strokes, tumors, hydrocephalus). Although a small sample of children with traumatic brain injuries is included, this represents an extremely heterogeneous group. This limits the conclusions that can be drawn from this data as it may lack clinical sensitivity amongst the aforementioned pediatric populations. This is particularly unfortunate as this measure is designed for use by neuropsychologists (Brooks, Sherman, & Strauss, 2010). Further, the manual does not provide reliability and validity evidence of the measure's use with ethnic minority groups or other groups that differ from the normative sample.

Another critique of the measure is that the NESPY-II memory subtests do not provide distinctions in standard score performance between delayed free recall and delayed recognition. This could limit the usability of this data in certain clinical situations (Brooks, Sherman, & Strauss, 2010). This issue impacts several memory subtests on the NEPSY-II. Finally, the NEPSY-II manual provides no information regarding factor analysis. This information could have clarified for the user how to utilize subtests making up the NEPSY-II in his or her case conceptualization. Past studies on the NEPSY provided mixed results in terms of the number of factors present on the measure (Mosconi et al., 2008; Stinnett et al., 2002). Factor analysis could have been helpful in validating the domains presented in the manual (Brooks, Sherman, & Strauss, 2010).

Rationale and Purpose of the Current Study

The authors provide limited information in the manual regarding the underlying structure of the NEPSY-II (Korkman et al., 2007b). The NEPSY-II's 32 subtests and four delayed tasks are divided into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuopatial Processing. The authors claim that the subtests that comprise each domain may not be highly correlated with one another as they vary in terms of scoring emphasis, administration, stimulus presentation, and response type. Also, subtests across domains may be highly correlated as a result of crossover abilities and comparable methodology. Therefore, the authors emphasize that the domains are theoretically derived and are not based on statistical analyses.

As discussed previously, the measure maintains a foundation in the neuropsychological work of A. R. Luria, clinical research, and revisions to the measure over time. The manual does not report factor analysis data on a normative or clinical sample (Brooks, Sherman, & Strauss, 2010; Titley & D'Amato, 2008). Despite its widespread use within pediatric neuropsychology, at this time there have been few studies that provide an overall critique of the NEPSY-II. In addition, there have been no studies conducted that examine the underlying factor structure of the NEPSY-II. Further, several researchers have emphasized the need for research that examines the underlying factor structure of this measure due to its pervasive use within pediatric neuropsychology (Brooks, Sherman, & Strauss, 2010; Davis & Matthews, 2010; Titley & D'Amato, 2008). From a psychometric perspective, confirmatory factor analysis (CFA) is seen as a critical step in the validation of a measure (Cole, 1987). Specifically, when a CFA is conducted on a measure, the results often provide more rigorous support for the authors' theoretical positions while also contributing valuable supplemental information.

The purpose of this study was to examine the underlying factor structure of the NEPSY-II within a mixed-clinical, pediatric sample. A CFA was conducted on a modified five-factor model based on the theoretical factor structure of the Korkman et al. (2007b) model. The CFA utilized the content domains of: Attention and Executive Functioning, Language, Memory and Learning, Sensorimotor, and Visuospatial Processing. The Social Perception domain was excluded as the Theory of Mind subtest of this domain utilizes percentile rank ranges that are not comparable to other subtest scores. This study fills an important gap in the research of pediatric and school neuropsychology.

Summary

This literature review began with an in-depth discussion regarding the historical foundation of the NEPSY-II in Lurian theory. Next, the development of the NEPS and NEPSY were discussed with specific attention to test development, psychometric properties, and measure revision. Proposed revisions to the NEPSY provided a basis for the understanding of the evolution of the NEPSY-II (Korkman et al., 2007b). The NEPSY-II was delineated in terms of domain descriptions, modifications of the measure, the normative sample, psychometric properties, and clinical utility. Additionally, a critique of the strengths and weaknesses of the measure was included. The author proposed factor structure of the measure was described with evidence that further research on the measure is needed. Finally, the rationale and purpose for this study was outlined.

CHAPTER III

METHODS

This chapter presents the research study design used to examine the factor structure of the NEPSY-II (NESPY-II; Korkman et al., 2007b) within a mixed clinical sample of children and adolescents. The chapter describes the specific research questions posed in the study and outlines information regarding the participants, procedures, instrumentation, and data analysis techniques that were used.

Participants

The data utilized in this study are archival and were collected from case studies submitted to fulfill requirements for the KIDS, Inc. School Neuropsychology Post-Graduate Certification Program. The data that comprised the sample for this study were derived from a broader set of data collected from comprehensive neuropsychological evaluations conducted and submitted by student-clinicians of the School Neuropsychology Post-Graduate Certification Program. Individuals in the certification program submit three comprehensive pediatric (child and adolescent) neuropsychological cases that address a variety of suspected or known neurocognitive issues, such as Specific Learning Disability, ADHD, Traumatic Brain Injury, or ASD. The participant group for this study was comprised of children between the ages of five and sixteen due to the subtest floor and ceiling of the NEPSY-II. A total of 632 cases were culled for use in this study.

Procedures

KIDS, Inc.'s School Neuropsychology Post-Graduate Certification Program case studies were submitted with documentation of informed consent for evaluation and notice that the assessment information might be used for research purposes. Any case study with information indicating that the case was not to be used for research purposes was excluded from the broad data set. To maintain confidentiality, all data from each case was coded and separated from the actual case file. The broad data set was reviewed to determine which cases would be selected for this study. Only cases with NEPSY-II subtest scores were selected for use in this study.

Given that the data were collected from actual cases, rather than through a research protocol, not every case contained complete information for the required measure. Therefore, multiple imputation (MI) was used to account for the missing data within the data set. Imputation is a commonly used statistical method to address missing data (Baraldi & Enders, 2010; Bodner, 2006). There are a variety of imputation methods, but for the most part, the techniques can be divided into two distinct categories: stochastic and nonstochastic. Stochastic techniques include random observations or data points, whereas nonstochastic models do not. Multiple imputation (MI) is a stochastic imputation method that incorporates four steps. First, the statistician creates several different imputed data sets intended to approximate the original data set. Next, the analyses are carried out on each data set, with the parameter estimates (e.g., factor loadings, group mean differences, correlations, regression coefficients) and their standard errors saved for each data set. Finally, results are obtained by averaging the parameter estimates across these multiple analyses, which results in an unbiased parameter estimate. Due to the use of archival data, the inability to manipulate independent variables, and the use of multiple imputation, a non-experimental, correlational research design was utilized in the completed study (Gravetter & Forzano, 2009).

Measure

NEPSY: A Developmental Neuropsychological Assessment, Second Edition

The NEPSY-II, a revision of the NEPSY, was developed as a comprehensive battery to assess the neuropsychological development of preschool and school-age children between the ages of 3 and 16 (Korkman et al., 2007b). The original NEPSY included 27 subtests which were designed to assess complex cognitive abilities that are critical for learning. Each of the subtests were classified under five functional domains: Attention/Executive Functions, Language, Sensorimotor, Visuospatial, and Memory and Learning.

The NEPSY-II revision was intended to address weaknesses present in the original NEPSY and introduced five new subtests. The NEPSY-II is comprised of 32 subtests and four delayed tasks. The subtests are divided into six content domains: Attention and Executive Functioning, Language, Memory and Learning, Social Perception, Sensorimotor, and Visuospatial Processing. In the paragraphs below, each of the subtests from the NEPSY-II will be delineated by domain.

Attention and Executive Functioning

The domain of Attention and Executive Functioning is comprised of multi-faceted constructs that contain several overlapping processes (Korkman et al., 2007b). More specifically, this domain is comprised of six tasks designed to assess the subcomponents of executive functioning and attention such as organizing and planning, self-monitoring, inhibition of automatic responses, problem solving with pictures, and the ability to change, maintain, and formulate a response set.

The Animal Sorting task is new to the NEPSY-II; however, the task is based on common measures used in adult neuropsychological testing (e.g., Wisconsin Card Sorting Test). The 1998 version of the NEPSY included a more complicated version of this task, but the task was ultimately excluded from the final publication of the test. The Animal Sorting task requires a child to sort cards conceptually into two groups with four cards in each group. The task is purported to measure the child's ability to initiate, self-monitor, reason based on concepts, utilize cognitive flexibility, and understand semantics (Brooks, Sherman, & Strauss, 2010).

The Auditory Attention and Response Set subtest includes two separate tasks (Korkman et al., 2007b). Auditory Attention assesses the child's ability to sustain their attention and utilize their selective attention. This subtest can be used with children between the ages of 5 to 16 years. Response Set is a more cognitively complex task. The task is designed to assess a child's ability to shift while maintaining a new and complex set involving responding correctly to stimuli and inhibition of previously learned responses. Specifically, the child chooses the appropriate circle based on the auditory presentation of target words. This subtest can be utilized with children age 7 to 16. Some of the changes present in the NEPSY-II revision of this subtest include: both subtests have extended ceilings, children age five and six years are no longer given

Response Set, and the method of response has been modified to directly assess attention (Korkman et al., 2007b). Additionally, points are awarded only when the child responds within two seconds of the target word as opposed to the allowed three seconds in the original NEPSY. Further, the scores are not weighted, which de-emphasizes motor speed and finger dexterity on this measure, thus allowing for a purer measure of attention. Separate scores are provided for both measures as opposed to the combined score found on the original NEPSY. Another improvement includes cumulative percentages for off-task behaviors allowing the examiner to distinguish between inattentive/distracted behaviors or a child fidgeting in their chair. Overall, this subtest is purported to measure selective and sustained attention, response time, inhibition, and working memory (Brooks, Sherman, & Strauss, 2010).

The Clocks subtest is a new addition to the NEPSY-II and includes drawing and visual items (Korkman et al., 2007b). In the drawing items, the child engages in one of three different tasks: drawing the image of an analog clock in the response booklet, drawing the hands on the clock to demonstrate the time specified by the examiner, drawing the numbers on the analog clock of the specified time, or replicating a clock face in the response booklet. In the visual items, the child reads the time on the clock with or without clock numbers. The Clocks subtest is intended for children between the ages of 7 and 16. Historically, clock-drawing tasks were used within the adult population to help distinguish adults with acquired brain injury (Freedman et al., 1994). Edith Kaplan helped in the development of the Clocks subtest on the NEPSY-II, specifying both the administration and scoring instructions. The authors assert that the subtest measures planning, organization, visuospatial skills, and concept of time.

The Design Fluency subtest has remained largely unchanged since the publication of the original NEPSY (Korkman et al., 2007b). The task requires a child to draw unique designs using both structured and unstructured dot arrays in their response booklet. Design Fluency can be used with children between the ages of 5 and 12. This subtest is adapted from the Five-Point test by Regard, Straus, and Knapp (1982). Design Fluency is purported to measure a child's ability to initiate a task, produce a drawing, and demonstrate cognitive flexibility.

The Inhibition subtest is a new task for the attention and executive functioning domain on the NEPSY-II (Korkman et al., 2007b). During the Inhibition task, the child must look at a series of black and white arrows or shapes and state the shape, direction, or an alternate response based on the color of the shape or arrow. Historically, this test has established roots in the Stroop Test where an individual must suppress an overlearned verbal response to read a word like black that is written in red ink or to name the color of ink instead of reading the written word (Stroop, 1935). Thus, Inhibition employs the Stroop approach with non-reading items. The Inhibition task on the NEPSY-II is intended for use with children and adolescents between the ages of 5 and 16. The subtest is purported to measure processing speed, inhibition control, and cognitive flexibility. Statue is the last subtest within the attention and executive function domain (Korkman et al., 2007b). During the Statue subtest, the child is required to stand still like a statue with their eyes shut until the examiner states that the time is up. The examiner presents a variety of noise distractors that range from coughing to dropping their pen on the ground throughout the 75-second duration of the subtest. Both the NEPSY and NEPSY-II utilize the Statue subtest; however, on the NEPSY-II, the age range for Statue is 3-6 years as several other subtests on the NEPSY-II measure attention and executive function in older children. Additionally, on the NEPSY-II, percentile ranks are available for each type of error a child makes including: vocalization, body movement, and eye opening. The authors state that this subtest examines the child's ability to exhibit overall motor control through inhibiting excess psychomotor movements.

Language

The domain of Language contains several subtests developed to examine the subcomponents of language such as phonological processing, receptive language, expressive language, and verbal semantic fluency (Korkman et al., 2007b). More specifically, this domain is comprised of seven tasks designed to assess the following constructs: expression of verbal/sematic knowledge, ability to follow multi-step commands, speech production, phonological awareness and processing, lexical access, and naming ability.

Body Part Naming and Identification includes two separate tasks (Korkman et al., 2007b). In the first task, Body Part Naming, the child views a stimulus book that shows a picture of a child and names the parts of the body on the picture or on his/her own body. During the Identification task, the examiner names body parts aloud and the child points to the corresponding body parts on the figure. The Identification task assesses name recognition and receptive language, while the Body Part Naming task examines expressive language. This subtest is designed for children between the ages of three and four. The authors assert that this task assesses expressive language, knowledge of words, and vocabulary.

The Comprehension of Instructions subtest requires the child to point to particular stimuli to respond to verbal instructions (Korkman et al., 2007b). The instructions begin in a simple manner requesting students to point to rabbits of different sizes, colors, and facial expressions and then progress to more complex instructions such as pointing to a series of shapes in different sizes, colors, and positions. This subtest was utilized on the NEPSY; however, on the NEPSY-II, the items are increasingly difficult, thereby extending the age range for use with older adolescents. The Comprehension of Instructions can be administered to children between the ages of 3 and 16 years. The authors report that the subtest measures the child's receptive language abilities, semantic knowledge, and ability to follow multi-step directions.

In Oromotor Sequences, the child must repeat phonological sequences such as "scoobelly-doobelly" or tongue twisters like "she sells sea shells by the sea shore". The subtest can be utilized with children age 3 to 12. This subtest has remained the same since its use on the original NEPSY. The authors purport that this subtest identifies difficulties with speech production and motor programming (Korkman et al., 2007b).

The Phonological Processing subtest is comprised of two tasks that measure phonemic awareness (Korkman et al., 2007b). In Word Segment Recognition, the child must point to a particular picture that represents a word. As the complexity of this task increases, a word segment is presented orally and the child must point to a picture that represents the word segment. The second task is Phonological Segmentation, which requires the child to repeat a word and create a new word by omitting a phoneme or substituting that phoneme with a new phoneme. This task was a part of the original NEPSY; however, the NEPSY-II extended the task to include the entire range of 3 to 16 year-old children. This subtest is purported to measure phonological processing and awareness.

Repetition of Nonsense Words is a task that involves a child listening to nonsense words and then repeating these nonsense words to the examiner (Korkman et al., 2007b). For example, on basal items, the child is asked to point to kitchen and is shown pictures of children, chicken, and kitchen in the stimulus book. On more difficult items, the child is required to omit or change parts of words. The subtest can be used with children ages 5 to 16. This subtest remains unchanged from the NEPSY. Repetition of Nonsense Words is purported to measure a child's ability to articulate unfamiliar words and produce words phonetically.

Speeded Naming requires the child to name a series of colors and shapes, letters and numbers, or colors, shapes, and sizes in order as quickly as possible (Korkman et al., 2007b). This task can be utilized with children aged 3 to 16. The ceiling on this test has increased since the original NEPSY, thus, accommodating adolescents. Additionally, easier items were added that require a child to name color only, shape only, or both color and shape. The most difficult items on the test require older children to recite numbers and letters. Korkman et al. (2007b) assert that the subtest identifies difficulties with processing speed, naming, and expressive language.

Word Generation is comprised of two parts: Semantic Word Generation and Initial Letter Word Generation (Korkman et al., 2007b). Semantic Word Generation requires that the child name as many animals as possible within 60 seconds. Then, the child is asked to name as many food and drinks as they can within 60 seconds. On the Initial Letter Word Generation task, a child is asked to name as many words as possible that start with the letter F within a 60 second time period. Next, the child must do the same task with the letter S. Semantic Word Generation can be used with children age 3 to 16, but Initial Letter Word Generation can only be utilized with children aged 7 to 16. This test has not been modified from the original NEPSY; however, the name was changed from Verbal Fluency to Word Generation. Scoring has been altered from one scaled score combining Semantic Word Generation and Initial Letter Word Generation to separate scaled scores for Semantic Word Generation and Initial Letter Word Generation, as well as a contrast score comparing Semantic Word Generation to Initial Letter Word Generation. The authors of the NEPSY-II report that the Word Generation subtest measures a child's deficiencies in the areas of processing speed, expressive language, and speech initiation.

Memory and Learning

The NEPSY-II includes 11 subtests that assess various aspects of memory and learning (Korkman et al., 2007b). More specifically, the subcomponents of learning and memory measured include: immediate memory for sentences, narrative memory under free recall, cued recall, and recognition conditions, repetition and recall of words presented with interference, and immediate and delayed memory for abstract designs, faces, names, and lists. The following section will delineate each of the subtests within the Memory and Learning domain.

List Memory, formerly List Learning from the original NEPSY, requires a child to learn a list of words over five trials (Korkman et al., 2007b). An interference word list is introduced after the five trials and the child is asked to recall the interference list one time; then, the child recites the original word list. In List Memory Delayed, the child is asked to recall the original word list 25 to 35 minutes later. This subtest can be used with children age 7 to 12. No changes have been made to content, scoring, or administration of this subtest from the original NEPSY. One minor modification has been made to List Memory; that is, the examiner records the child's responses to the subtest verbatim, as opposed to marking an item on a checklist, thus allowing for more accurate responses and enhanced ability to gather qualitative information. These subtests are purported to identify difficulties with rote memory, verbal memory span, and issues with learning verbal material.

In Memory for Faces, a child views a series of faces while telling the examiner the gender of the child on the stimulus card to help focus their attention (Korkman et al., 2007b). Next, the child is presented three faces at a time in the stimulus manual while being asked to point to the face they have previously seen. Memory for Faces Delayed is administered 15 to 25 minutes later and requires the child to point to the previously seen faces from the Memory for Faces stimulus book. This subtest is appropriate for use with children aged 5 to 16, which is an upward extension from the original NEPSY.

During the revision process, extraneous details were removed from the pictures to create a pure measure of face memory. Also, a contrast score for Memory for Faces and Memory for Faces Delayed may be acquired. A cumulative percentage for frequency of unsolicited comments may be obtained as well. There are no longer scaled scores combining Memory for Faces and Memory for Faces Delayed. These tasks were established to identify poor face recognition and discrimination. During the Memory for Names subtest, the child views eight cards with drawings of children and the examiner provides a name for each child (Korkman et al., 2007b). The cards are shuffled and then shown to the child again at which time they are expected to recall the names of the children on each card. The child receives the same aforementioned learning trial three times. Next, in Memory for Names Delayed, the child is asked to recall the names of each of the children on the cards presented earlier. This task is administered after a 25 to 35 minute time delay. This subtest can be used with five-year old children; however, only six stimulus cards are presented instead of eight. These subtests are intended to measure ability to learn and recall visual information with verbal labels.

Sentence Repetition is a task in which the examiner reads sentences to a child and the child is asked to recall each sentence immediately after it is read (Korkman et al., 2007b). The sentences become increasingly longer as the subtest progresses. On the NEPSY-II, Sentence Repetition is only administered to children between the ages of three and six. The authors of the NEPSY-II state that this subtest assesses a child's verbal immediate memory.

Narrative Memory is a task that requires a child to listen to a complete story and then repeat that story (Korkman et al., 2007b). Then the child is asked questions to prompt details not included in their free recall of the story. The details, length, and difficulty of the stories increase with the child's age. The age range for Narrative Memory is 3 to 16 years. The story used in the original NEPSY was retained; however, the story was simplified and shortened. A simple and a more complex story were both added to this subtest to accommodate the lower and upper age ranges. All age ranges participate in both free and cued recall. Children age three to four listen to a short, simple story while viewing a picture representing the story. Five to ten year old children hear an intermediate story, 11 to 12 year olds listen to a shorter portion of a difficult and complex story with many details, and 13 to 16 year olds hear a long complex narrative. Additionally, recognition questions have been added to the first two stories to assess the child's retention of details. Modifications in the subtest directions have also enhanced the clarity of the task. Also, different types of scores have been added to this subtest. For example, a scaled score has been created to describe performances across free and cued recall. Percentile ranks are also provided for Recognition as well as a contrast score for Free and Cued Recall vs. Recognition for children age three to ten. A scaled score for free recall can be obtained for children between the ages of 5 and 16. Narrative Memory is purported to measure a child's comprehension, immediate memory for verbal information, and learning contextual and verbal information.

Memory for Designs is a new subtest for the Memory and Learning domain (Korkman et al., 2007b). On this subtest, a child is presented a stimulus with 4 to 10 designs on a page, and then the stimulus is removed from the child's view. The child then choses the designs from a set of cards and then places the stimulus cards on a grid in the same position as previously shown. Memory for Designs Delayed is administered 15 to 25 minutes later and the child must select 8 to 10 designs from a set of cards and put them on the grid in the same locations as viewed during the Memory for Designs subtest. The Memory for Designs subtest can be administered to children between the ages of 3 and 16; while the delayed portion can only be administered to children age 5 to 16. This subtest is reported to measure a child's difficulties learning and recalling visuospatial information.

Word List Interference is also a new subtest on the NEPSY-II (Korkman et al., 2007b). During this subtest, the child listens to two lists of words. The child recites each list back to the examiner immediately after it is read and then recalls both lists. The lists should hypothetically serve as an interference task for one another. The subtest can be utilized with children between the ages of 7 and 16. The subtest is purported to measure difficulty with verbal working memory and verbal interference.

Sensorimotor

The Sensorimotor domain comprises several subtests developed to examine the components of sensorimotor functioning such as consecutive finger and hand movements, the ability to imitate hand positioning, and the use of a writing utensil with precision and speed (Korkman et al., 2007b). More specifically, the subtests Fingertip Tapping, Imitating Hand Positions, Manual Motor Sequences, and Visuomotor Precision were designed to assess sensorimotor capabilities in children.

Fingertip Tapping contains two tasks that involve the child imitating a sequence of finger movements demonstrated by the examiner. This task is completed with the dominant and non-dominant hand. During the first task, the child continually taps their index finger on the pad of their thumb. The next task requires the child to copy a series of finger taps from their index finger to pinky finger. This subtest can be utilized with children between the ages of 5 and 16, which is an upward extension from the original NEPSY. This subtest has undergone scoring modifications as a part of the revision process. For example, the subtest includes separate percentile ranks for non-dominant and dominant hand repetitions as well as for dominant and non-dominant hand sequences. Also, the scoring allows for more comparisons between dominant and non-dominant hands and for hand repetitions verses hand sequences. Denckla (1974) developed the original version of this task, which was later modified for the original NEPSY. In his work, Denckla delineated motoric movement in finger taps with typically developing children between the ages of 5 and 11. Korkman et al. (2007b) report this subtest measures difficulties with motoric programming and control.

In the Imitating Hand Positions subtest, the child is asked to imitate and demonstrate a sequence of hand and finger positions modeled by the examiner (Korkman et al., 2007b). For instance, the child could be required to point a thumb and pinky finger outward while maintaining a fist with the rest of their hand. This subtest can be used with children between the ages of 3 and 12 years old. This subtest is theorized to identify a child's difficulty with fine motor control and visuospatial abilities.

In the Manual Motor Sequences subtest, the examiner models a sequence of hand movements and asks the child to replicate the hand movements sequence (Korkman et al., 2007b). For example, the child might be asked to tap their right knuckles on the table, tap their left knuckles on the table, tap their right palm, and then their left palm on the table. Children aged 3 to 12 can participate in this task. There have been no changes to this task on the NEPSY-II. Historically, this task was used by Luria in the neuropsychological assessment of brain injured patients (Christensen, 1984). This subtest is purported to measure problems with executing manual motor plans.

Visuomotor Precision requires the child to quickly draw lines inside a track that becomes more complex and curvy as the task progresses. The subtest is timed and if the child crosses the edges of a track, they receive an error. This subtest can be used with children between the ages of 3 and 12. The authors have incorporated three new tracks on the NEPSY-II to improve the floor of the subtest. Also, the directions given to the child have been modified to increase clarity and simplicity. This subtest now includes a scaled score for total completion time and percentile ranks for error totals and pencil lift totals. This task is reported to measure several areas including: visual attention, motoric control, coordination, and psychomotor processing speed.

Social Perception

The Social Perception domain is a new domain for the NEPSY-II that includes two subtests designed to measure subcomponents of social perception. The subcomponents of social perception include tasks that explore a child's ability to recognize facial affect in another person or to understand another person's perspective. Specifically, the subtests Affect Recognition and Theory of Mind measure the construct of social perception.

Affect Recognition is comprised of four tasks. During the first task, the child states whether or not the two stimulus photographs portray the same affect. The second task requires the child to choose two photographs, out of three or four photographs, that depict the same affect. On the third task, the child is shown a picture of a face at the top of the page and is asked to select a face from a row of four faces at the bottom of the page that matches the picture at the top of that page. On the last task, a child is shown a face briefly and is asked, from memory, to select two photographs that demonstrate the same emotions as the stimulus item. Separate error scores can be calculated for each of the emotions displayed on the stimulus cards. This task can be used with children between the ages of 3 and 16. This subtest is utilized to identify children that have trouble recognizing and discriminating between differences in facial affect.

The Theory of Mind subtest includes two tasks, the Verbal task and the Contextual task. On the Verbal task, the child is presented with different scenarios or pictures and asked to respond to questions regarding their understanding of another person's perspective. This task assesses the child's ability to comprehend the emotions, motives, and beliefs of another person that might be different from the child's own emotions, beliefs, etc.

During the Contextual task, the child views a picture of a social situation in which the face of the target child is not depicted. The child is then given four photographs that depict different emotions and is ask to select the photograph that reflects the appropriate affect of the target child. This task measures the child's ability to determine appropriate affect given a specific social context, to identify and recognize facial affect, and to understand how a specific social context elicits a particular emotion. This subtest can be used with children that are 3 to 16 years of age.

Visuospatial Processing

The Visuospatial Processing domain on the NEPSY-II includes six subtests that measure different aspects of visual spatial relationships (Korkman et al., 2007b). The subcomponents of visual perception include tasks that explore a child's ability to: recognize part to whole relationships, rotate objects mentally, assess line orientation, and copy two-dimensional figures. Specifically, the subtests Arrows, Block Construction, Design Copying, Geometric Puzzles, Picture Puzzles, and Route Finding contribute to the overall construct of visuospatial processing.

During the Arrows subtest, the child looks at several different arrows arranged around a target and selects the arrow or arrows that point to the center of the target. The new age range for Arrows is 5 to 16 years. There have been a few modifications to this subtest from its predecessor on the original NEPSY. For example, four easier items have been added where the child has to select just one arrow that points directly to the target. Moroever, existing test questions have been reordered and more advanced items have been added to extend the test ceiling. The Arrows subtest is purported to assess a child's ability to judge the orientation of lines and angles as well as their overall visuospatial abilities.

Block Construction requires a child to look at a two-dimensional picture and use blocks to create a three-dimensional replica of the picture found in the stimulus book. This task has been extended upward to cover the age range of 3 through 16 years. This task is thought to measure a child's difficulty with three-dimensional tasks and visuoconstructional abilities.

Design Copy is a subtest on the NEPSY-II that requires a child to copy progressively more complex geometric designs from the response booklet (Korkman et al., 2007b). This subtest can be utilized with children ages 3 to 16. Overall, this subtest measures a child's difficulties with two-dimensional drawing tasks.

The Route Finding subtest was a part of the original NEPSY and is currently found on the NEPSY-II (Korkman et al., 2007b). During this task, a child is shown a schematic map with a house that is the target. The child is given a bigger map with more houses and streets and is asked to find the target house. This task can be utilized with children age 5 to 12. No modifications have been made to this task since its introduction on the NEPSY.

Geometric Puzzles is a new subtest that has been added to the NEPSY-II. During this subtest, the child is shown a large grid with several shapes in that grid (Korkman et al., 2007b). On every item, the child matches two shapes outside the grid with two shapes in the grid. An examiner can use this task with a child age 3 to 16. This task measures a child's ability to rotate shapes mentally, attention to details, and visuospatial skills.

Picture Puzzles is another new subtest on the NEPSY-II. During this subtest, a child is shown a picture divided by a grid and four smaller pictures taken from pieces of the larger picture (Korkman et al., 2007b). Then, the child finds the location on the grid of the larger picture from which each of the smaller pictures was taken. This subtest is appropriate for use with children age 7 to 16. The purpose of this measure is to assess a child's difficulties with visual scanning, attention, and perception.

Subtests Utilized in the Analysis

In this study, ideally, all subtests would have been used in the analysis; however, several factors resulted in the removal of subtests. Some of the reasons for subtest removal included the following: scores used in the NEPSY-II that could not be converted to standard scores, not enough subjects given particular subtests, contrast scores that were not included across all subtests. For subtests that were included in the analysis, refer to Table 6.

Reliability and Validity of the NEPSY-II Subtests

The NEPSY-II manual provides an abundance of information regarding subtest reliability and validity. Internal reliability denotes the consistency in measurement of a given score. Overall, the internal reliability for the NESPY-II subtests is remarkable (Brooks, Sherman, & Strauss 2010; Korkman et al., 2007b). Across age groups, the internal reliability for each subtest ranges from adequate to very high. The manual provides information regarding reliability amongst a mixed clinical sample of children (Korkman et al., 2007b).

Internal reliability coefficients are provided across age groups with internal reliabilities measuring .8 or higher with the exception of Word List Interference Recall amongst 7 to 12 year olds. See Figure 2 for examples of internal reliability coefficients for the NEPSY- II primary and process scores for the clinical sample.

Table 6

NEPSY-II Domains and Subtests Used in the Data Analysis

Attention/ Executive Functioning	Language	Memory/ Learning	Sensorimotor	Social Perception	Visuospatial Processing
Animal Sorting-combined	Word Generation-Semantic total/Initial Letter total	List Memory	Visuomotor Precision	*could not be used due to percentile rank ranges that are not comparable across subtests	Arrows
Auditory Attention-combined Response Set-combined	Comprehension of Instructions	List Memory Delayed	Fingertip Tapping-Dominant hand		Block Construction
Clocks	Speeded Naming	Memory for Designs	Imitating Hand Positions		Design Copying-Process
Design Fluency	Phonological Processing	Memory for Designs Delayed			Geometric Puzzles
Inhibition-combined (part II) Inhibition-Switching-combined		Memory for Faces			Picture Puzzles
		Memory for Faces Delayed			
		Memory for Names			
		Memory for Names Delayed			
		Narrative Memory			
		Narrative Memory-Free Recall			

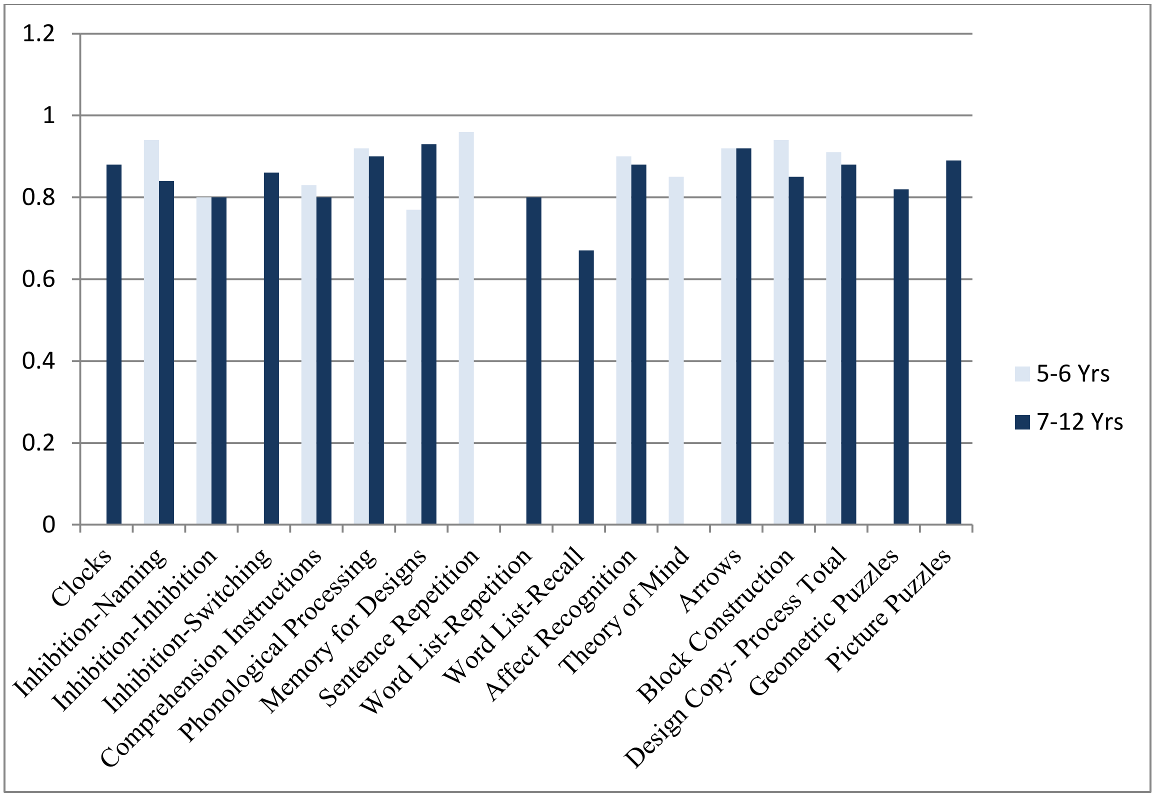

Figure 2. Internal reliability of the NEPSY-II primary and process scores for the clinical sample. Subtest abbreviation include: Word List-Repetition = Word- List Interference-Repetition and Word List Recall = Word-List Interference-Recall (Brooks, Sherman, & Strauss, 2010).

Test-retest reliability denotes the measure's ability to provide approximately the same measure of test performance over time. Generally, the test-retest reliability correlations for most subtests on the NEPSY-II amongst the clinical sample range from adequate to high. Word List Interference Recall has the lowest test-retest reliability among seven to 12 year olds among reliability coefficients from NEPSY-II primary and process scaled scores within a clinical sample. Table 7 shows the Test-Retest reliability coefficients for the NEPSY II primary and process scores for the clinical sample.

Test validity describes the degree to which a test measures what it purports to measure (Korkman et al., 2007b). The NEPSY-II manual provides extensive reports on content, construct, concurrent, and clinical validity. In terms of content validity, the NEPSY-II was reviewed with a special focus on the content and structure of the measure to confirm that the test included a range of appropriate content. Based on the aforementioned considerations, consumer feedback, and information from the pilot study, revisions to existing subtests were completed to address shortcomings in subtest content. Following the standardization phase, subtests were reexamined in terms of content, psychometric properties, and bias. Further, all subtests included in the NEPSY-II exhibit a strong theoretical foundation and evidence of validity.

Content validity indicates whether a scale measures or correlates with the theorized construct that it intends to measure. The correlation patterns between subtests on the NEPSY-II provide insight into the internal structure of the measure and the degree to which a subtest measures similar content when compared to another subtest (Korkman et al., 2007b). On the Attention and Executive Functioning domain subtests, medium to large intercorrelations were found between the different variations of the Inhibition subtest (e.g., Naming, Inhibition, and Switching). Also, medium correlations existed between Auditory Attention and Response Set and Clocks and Inhibition Total Errors. All other correlations in this domain were small to negligible.

In terms of the Language domain, Body Part Identification and Body Part Naming demonstrated a large intercorrelation, as shown (r = .72). Medium correlations were found between Word Generation, Semantic and Initial Letter, (r = .46) and

Comprehension of Instructions and Body Part Naming, Body Part Identification, and Phonological Processing.

In terms of the Memory and Learning domain, the Word List Interference Recall and Word List Interference have a medium correlation (r = .38). Narrative Memory shared a medium correlation with Sentence Repetition (r = .44) and Word List Recognition (r = .30). The remaining intercorrelations between the subtests in the Memory and Learning domain were small to negligible.

The Sensorimotor domain demonstrated medium to large correlations on the Finger Tapping subtest (i.e., Non-dominant Hand, Dominant Hand, Sequences, and Repetitions). Visuomotor precision did not correlate with the varied components of the Finger Tapping subtest (Korkman et al., 2007b). In the Social Perception Domain, Affect Recognition and Theory of Mind showed a small intercorrelation (r = .21). Finally, most of the Visuospatial Processing subtests indicated medium-sized intercorrelations.

Table 7

Test-Retest Reliability for NEPSY-II Primary and Process Scaled Scores

	Age Groups					
Domains and Subtest Scores	3–4	5–6	7–8	9–10	11–12	13–16
Attention and Executive Functioning						
Animal Sorting Total Correct Sorts		.59	.63	.73	.71	.59
Auditory Attention Total Correct			.42	.62	.58	
Response Set Total Correct			.84	.53	.58	
Clocks Total			.73	.70	.78	.64
Design Fluency Total		.59	.57	.68	.57	
Inhibition-Naming Total Completion Time		.81	.82	.74	.79	.87
Inhibition-Inhibition Total Completion Time		.79	.81	.66	.80	.82
Inhibition-Switching Total Completion Time			.82	.78	.75	.93
Inhibition Total Errors		.77	.66	.57	.33	.76
Statue Total			.81	.79		
Language						
Body Part Naming Total Score	.70					
Body Part Identification Total Score	.77					
Comprehension of Instructions Total	.82	.80	.79	.71	.84	.75
Phonological Processing Total	.60	.88	.82	.78	.80	.87
Repetition of Nonsense Words Total		.87	.70	.72	.65	
Speeded Naming Total Completion Time	.82	.72	.91	.85	.79	.89
Word Generation Semantic Total						.84
Word Generation Initial Letter						.54

(continued)

Domains and Subtest Scores	Age Groups 3–4	5–6	7–8	9–10	11–12	13–16
Memory and Learning						
List Memory and List Memory Delayed Total Correct			.60	.71	.64	
Memory for Designs Content	.44	.78	.81	.65	.75	.69
Memory for Designs Spatial	.64	.64	.69	.64	.63	.48
Memory for Designs Total	.62	.71	.83	.56	.69	.65
Memory for Designs Delayed Content		.64	.61	.60	.62	.82
Memory for Designs Delayed Spatial		.74	.73	.58	.65	.63
Memory for Designs Delayed Total		.76	.72	.51	.72	.60
Memory for Faces Total		.46	.53	.75	.57	.73
Memory for Faces Delayed		.59	.47	.69	.69	.82
Memory for Names Total						.67
Memory for Names Delayed Total						.53
Memory for Names and Memory for Names Delayed Total						.70
Narrative Memory Free/Cued Recall Total	.75	.72	.79	.65	.78	.83
Narrative Memory Free Recall Total		.61	.76	.61	.64	.76
Sentence Repetition Total	.74	.77				
Word List Interference Repetition Total			.62	.74	.73	.87
Word List Interference Recall Total			.89	.63	.62	.60

(continued)

	Age Groups					
Domains and Subtest Scores	3–4	5–6	7–8	9–10	11–12	13–16
Sensorimotor						
Imitating Hand Positions Total	.72	.71	.21	.52	.33	
Visuomotor Precision Tot Completion Time	.68	.60	.65	.81	.72	
Social Perception						
Affect Recognition Total Score	.61	.58	.50	.52	.55	.58
Theory of Mind Total Score	.70	.77				
Visuospatial Processing						
Arrows Total Score		.60	.62	.51	.65	.83
Block Construction Total Score	.62	.70	.77	.80	.76	.79
Design Copying Process Motor Score	.70	.51	.67	.69	.60	.69
Design Copying Process Global Score	.64	.67	.71	.52	.64	.74
Design Copying Process Local Score	.66	.52	.67	.57	.59	.62
Design Copying Process Total Score	.81	.74	.78	.62	.69	.75
Geometric Puzzles Total Score			.65	.63	.66	.89
Picture Puzzles Total Score			.79	.71	.76	.91

Note. These values are uncorrected Pearson correlations for Time 1 and 2. Acceptable or good correlations are ($r \geq .7$) and marginal retest correlations are (r = .60–69). Blank spaces in the chart reflect no uncorrected Pearson correlations were calculated for that age group on that particular subtest (Brooks, Sherman, & Strauss, 2010).

Concurrent validity examines the relationship between instruments purported to measure similar or identical constructs (Korkman et al., 2007b). The NEPSY-II manual provides information regarding concurrent validity in two sections. The first section compares the NEPSY-II to other known measures of academic achievement, cognitive ability, and neuropsychological functioning. The second section compares special group studies which support the validity of NEPSY-II scores with children with disorders such as ADHD, Reading Disorders, and ASD (Korkman et al., 2007b). A sample of 81 children within the 5 to 12 age range were administered the NEPSY-II and the Wechsler Individual Achievement Test-Second Edition (WIAT II; Wechsler, 2001). The correlations between the measures were strongest between Sentence Repetition and the WIAT-II composite scores. Additionally, strong correlations were noted between Phonological Processing, Narrative Memory, Clocks, Comprehension of Instructions, and WIAT-II composite scores.

Fifty-one children between the ages of 6 and 16 took the Wechsler Intelligence Scale for Children-Fourth Edition (WISC- IV; Wechsler, 2003) and the NEPSY-II. Language subtests from the NEPSY-II indicate medium to large correlations with the WISC-IV Verbal Comprehension Index (VCI; Korkman et al., 2007b; Wechsler, 2003). Medium correlations were found between the VCI and Animal Sorting, Narrative Memory, Word List Interference Repetition, and Picture Puzzles, thus demonstrating adequate construct overlap between the VCI and verbal skill subtests on the NEPSY-II. Further, the Visuospatial Processing subtests demonstrated medium to large correlations with the WISC-IV Perceptual Reasoning Index (PRI). The WISC-IV Processing Speed

Index (PSI) demonstrates medium-sized correlations with the NEPSY II Block Construction, Narrative Memory, Clocks, Language, Inhibition, Visuomotor Precision Combined Scaled score, Nondominant Hand Fingertip Tapping, and Word List Interference Recall.

The Wechsler Nonverbal Scale of Ability (WNV; Wechsler & Naglieri, 2006) and the NEPSY-II were given to a sample of 62 children between the ages of 4 and 16, resulting in strong correlations between the WNV four subtest full-scale score and the Visuospatial Processing domain from the NEPSY-II (Korkman et al., 2007b). The other NEPSY-II subtests indicated a medium correlation with the WNV. The NEPSY-II was also co-administered with the Differential Ability Scales-Second Edition (DAS-II; Elliot, 2007) to a group of 242 children aged 3 to 16 years old. Comprehension of Instructions and Sentence Repetition from the NEPSY-II had the strongest correlation with the DAS-II General Conceptual Ability composite score. Medium correlations were found between the NEPSY-II subtests of Memory for Designs, Clocks, Phonological Processing, Inhibition Switching, Speeded Naming, Animal Sorting, Narrative Memory, Social Perception, and Word List Interference Recall and the DAS-II General Conceptual Ability.

The NEPSY-II has also been compared with the Children's Memory Scale (CMS; Cohen, 1997) and the Delis-Kaplan Executive Functions Scale (D-KEFS; Delis et al., 2001) In the sample of 43 children between the ages of 5 and 16 who were administered both the CMS and the NEPSY-II, the highest correlations were found between the story tests on both measures (r = .50-.61). Forty-nine children between the ages of 9 and 16 years were given the NEPSY-II and four subtests from the D-KEFS. The NEPSY-II Visual Motor Precision Subtest was most highly correlated with the D-KEFS Trail Making Test and Design Fluency. Moderate correlations were noted between the Trail Making Test and Design Fluency with Picture Puzzles, Animal Sorting, Inhibition, and Block Construction. Furthermore, the D-KEFS Color Word Interference correlated most strongly with Inhibition on the NEPSY-II. Verbal Fluency on the D-KEFS correlated most with Word Generation and medium to high with subtests within the Language domain.

Another important aspect of validity is clinical validity, which examines the measure's sensitivity to identifying children with clinical issues (Korkman et al., 2007b). The NEPSY-II manual reports clinical studies with ten groups including: Traumatic Brain Injury, Asperger's Disorder, Intellectual Disability, Language Disorder, Reading Disorder, ADHD, Deaf and Hard of Hearing, and Emotionally Disturbed. The studies conducted compared clinical groups to a matched control sample based on age, parent education level, race/ethnicity, and sex. The two groups were given 22 to 32 subtests from the NEPSY-II. The results indicated that the NEPSY-II subtests are able to identify cognitive issues amongst clinical groups with the Attention and Executive Function and Language domains being the most sensitive to these clinical groups.

Research Rationale, Significance, and Question

This study was designed to address a dearth in the research regarding the NEPSY-II. Specifically, the NEPSY-II manual provides no factor analysis information and to date there have been no factor analysis studies conducted on this measure published in the literature. Therefore a Confirmatory Factor Analysis (CFA) of the NEPSY-II is a critical step in providing greater evidence of the validity of this measure (Cole, 1987). The primary research question for the study was as follows:

Is the underlying factor structure of the NEPSY-II in a mixed clinical sample of children best described by the following:

a. The theoretical model of neurocognitive functioning proposed by Korkman, Kirk, and Kemp.

b. An alternate conceptual model that provides a better fit with the data.

Data Analysis

Descriptive Statistics

Descriptive statistics were calculated on the demographic variables of age, gender, ethnicity, and broad diagnostic category. The normality distribution of the subscales was tested using a Kolmogorov-Smirnov test and outliers examined with descriptive statistics (Mertler & Vannatta, 2010). For the preliminary analyses, the Statistical Package for the Social Sciences (SPSS, 2007) version 16.0 was utilized.

The SPSS was also used to conduct bivariate correlations between scores on each subtest included in the study. A correlation matrix presenting correlation coefficients, significance levels, means, and standard deviations for all scores was created and examined (Weston & Gore, 2006). This analysis assisted in evaluating for the presence of multicollinearity among subtest scores. Variables described as multicollinear are highly correlated and thus redundant when included in statistical analyses. This condition is a problem for several statistical operations; thus, a score within pairs of scores discovered to be multicollinear was removed from the sample. In order to determine the multivariate differences between diagnostic group and the varying subscales of the WJ III COG, NEPSY -II, a series of Multivariate Analysis of Variance (MANOVAs) were conducted.

Primary Analysis

Structure Equation Modeling (SEM) utilizes many types of models to describe the relationships between latent variables, thus providing a quantitative test of a hypothesized theoretical model (Schumacker & Lomax, 2004). More specifically, various theoretical models can delineate constructs and how constructs relate to one another. For instance, latent constructs such as memory cannot be directly measured. Therefore, observable measures, such as tests, are developed to quantify latent variables. The goal of SEM is to determine if the sample data supports a hypothesized model.

Factor analysis (FA) is a statistical procedure that a researcher utilizes to determine which variables from a data set create distinct factors that denote an underlying process, yet are independent from one another (Tabachnick & Fidell, 2006). Procedures involving factor analysis create correlations or factor loadings between latent variables and observable variables (Mertler & Vannatta, 2010). The correlations that result from factor analysis are interpreted as Pearson correlation coefficients with a range from -1.00 to +1.00, indicating perfectly negative and positive correlations respectively. In factor analysis, communalities are produced, which describe the amount of variability that is explained by the latent variable.

Within the social sciences, factor analysis can be divided into two categories: exploratory and confirmatory (Tabachnick & Fidell, 2006). Exploratory factor analysis

(EFA) is typically utilized in the initial stages of research when the underlying structure of a measure is unknown. During an EFA, highly correlated variables are grouped together to form separate factors. The underlying structure is then described comprehensively through further research, statistical information, and theory.

In confirmatory factor analysis (CFA), a more sophisticated SEM procedure, the researcher tests their *a priori* knowledge regarding the latent or underlying processes in the data (Brown, 2006). This *a priori* knowledge is generally determined by theory or research. In the current study, a CFA was utilized to examine the Korkman et al. (2007b), conceptualization of the NEPSY-II as a measure with six distinct underlying factors. Five of the factors were utilized in the CFA, Attention and Executive Functioning, Language, Memory and Learning, Sensorimotor, and Visuospatial Processing.

When the CFA was conducted for this study, the following steps were utilized: model specification, model fitting, model evaluation, and model modification (Harrington, 2009). In model specification, the theoretical structure of the model, including the number of factors and path structure, is graphically indicated. Models contain both observable and latent variables (Mertler & Vannatta, 2010). Observable variables are defined as actual measurements (i.e., subtest scores from the NEPSY-II) while latent variables represent the underlying constructs of a measure. Then, relationships between factors and indicators are denoted through a diagram with single- or double-headed arrows (Brown, 2006). Correlation between factors is represented by double-headed arrows, while single-headed arrows designate the direct effects between factors and indicators. The paths utilized in these diagrams describe the theoretical structure of the measure. Additionally, each indicator in the diagram denotes the corresponding measurement error. Measurement error occurs during the CFA procedure as observed variables cannot perfectly represent latent variables; therefore, SEM software accounts for error (Tabachnick & Fidell, 2006).

The next step in the CFA procedure is model specification, which involves several steps (Brown, 2006). Latent variables found in the model do not possess a unit of measurement; therefore, a unit of measurement must be set or determined (Harrington, 2009). The variance of the factor is often set to 1.0 as this method of scaling is more consistent with SEM procedures. Next, an evaluation of the variances and covariance along with the ratio of indicator variance and covariance to the factor loadings occurred with the intent to categorize the model as under-, just-, or over-identified. Models are labeled under-identified when the number of freely estimated parameters exceeds the number of known parameters, thus the model cannot be tested as there are too many unknowns that could impact the model. Just-identified models possess zero degrees of freedom and the known parameters are equal to the unknown parameters; therefore, the model is a perfect fit and does not allow for testing. In contrast, an over-identified model contains fewer unknowns than knowns and the degrees of freedom are greater than zero. An over-identified model can be estimated and the goodness-of-fit statistic can be calculated. The current study included an over-identified model, as the factors associated with the model were correlated and error between indicators was uncorrelated.

In an effort to determine the number of factors that occur in a measure, factor extraction techniques are utilized in the CFA procedure (Brown, 2006; Mertler &

Vannatta, 2010). There are several different types of extraction techniques, with Maximum Likelihood (ML) being the most common extraction procedure. Broadly, the Maximum Likelihood procedure provides the best estimates for the model's parameters. This process occurs through multiple iterations until the maximum agreement of the selected model with the observed data is reached. One of the strengths of this method is that it produces standards of errors with each parameter of the model, thus allowing for precision and significance of these parameters. ML was utilized in this study for factor extraction.

By examining the goodness-of-fit indices, the researcher can determine the significance and efficacy of the models (Brown, 2006). The goodness-of-fit index is a measure of how well the theorized or specified model fits the observed data. There are several different types of fit-indices with each describing different aspects of the model fit (Harrington, 2009). Brown (2006) recommends the use of three fit indices: absolute fit indices, parsimony correction indices, and comparative fit indices.

The standardized root mean square residual (SRMR) index of absolute fit was utilized in this study as it is preferred over the two other methods of absolute fit indices, chi-square and root mean square residual (RMR; Harrington, 2009). The chi-square procedure is very sensitive to sample size and RMR leads to interpretation error as it is not standardized. SRMR provides a standardized measure of the difference between correlations predicted by the model and observed correlations. A perfect fit is represented by 0.0; therefore, smaller numbers indicate a better fit (Brown, 2006). The current study utilized the SRMR approach for evaluating the absolute fit of the model as well as chi-square, which is considered a necessary component for the goodness-of-fit evaluation. The parsimony correction indices emphasize the importance of the simplest theory for the interpretation of the data. The root mean square error of approximation (RMSEA) was utilized to assess parsimony correction (Brown, 2006). Models with poor parsimony are penalized and considered a poor fit with the data. RMSEA values close to .06 and below suggest a parsimonious model with good fit (Harrington, 2009). Finally, a comparative fit index (CFI) was utilized in this study. The CFI compares the fit between the null hypothesis and the observed data. CFI scores have a range of 0.0 to 1.0 with .95 and above representing a good fit.

Goodness-of-fit statistics offer information restricted to the global fit of the model; however, they provided no information regarding other aspects of goodness-of-fit (Brown, 2006). For instance, poor fit can occur due to factors such as: identifying too many or too few factors, selecting poor indicators, or incorrectly specifying the error measures. The goodness-of-fit statistics provide a global fit, thus ignoring local model fit.

In the current study, another fit index, a residual model, was utilized to ensure appropriate attention was given to the local fit of the model. This was essential to this study as the model is more complex; therefore, examining local fit became increasingly important. To address this issue, a residual matrix was used to provide detailed information regarding how well each variance and covariance was reproduced by the model's parameter estimates. The residuals were likened to *z* scores where zero represents a perfect fit. This study used a critical residual value of 2.58 due to the large sample size, which represents a significant z-score at the .01 alpha level.

Additional considerations that were examined when determining the model-of-fit were the statistical significance, size, and interpretability of the model. The first step in this process was to ensure the model made both statistical and practical sense. Statistically, the parameter estimates should not include out-of-range values; in other words, standardized correlation should not be greater than 1.0 and factor and indicator error variances should not include negative values. Further, from a practical perspective, the direction of the parameter estimates should support the prediction and theory. The standard-of -error of the parameter estimates was assessed to determine the appropriateness of the magnitude. A standard-of-error that is either too large or too small indicates that the model does not approximate the population parameters; thus, information drawn from the models may be flawed or inaccurate. The effect size was also measured to ensure that the practical significance of the model was met.

Model revisions were considered in this study. Commonly, model re-specification is considered to improve fit of the data (Brown, 2006). Based upon fit information (i.e., poor overall fit, poor reproduction of indicator relationships, or poor parameter estimates) from modification indices and practical justification, the model was revised with to improve the goodness-of-fit. Modification indices emphasis was on fixed parameters and how changes in parameters could potentially impact the goodness-of-fit indices like chi-square. Considerations regarding model modification occurred in a stepwise fashion where the largest modification and expected parameter change (EPC) value was obtained. All analyses related to the CFA were conducted in the Linear Structural Relationships (LISREL; Joreskog & Sorbom, 1993) 8.8 computer program.

Summary

This study was created to examine the factor structure of the NEPSY-II. Korkman, Kirk, and Kemp (2007b) purport that each of the subtests utilized in the NEPSY-II can be classified under six functional domains: Attention/Executive Functions, Language, Sensorimotor, Visuospatial, Social Perception, and Memory and Learning. The literature review provided indicates a dearth in research regarding the NEPSY-II and its factor structure. The study utilized a CFA to examine the underlying factor structure of the NEPSY-II.

CHAPTER IV

RESULTS

This chapter presents results of the statistical analyses. The chapter is divided into three sections with the first section providing descriptive statistics of all variables and bivariate relationships. The second section delineates the factor structure of the NEPSY-II data and aims at answering the research question. The last section of the chapter explored the influence of primary diagnosis on the factor structure of the NEPSY-II. The type I error (α) throughout this chapter is set at .05, unless otherwise noted in the chapter.

Preliminary Analysis

The purpose of this study was to examine the underlying factor structure of the NEPSY-II in a mixed clinical sample of children. A CFA was used to determine if the theoretical model proposed by Korkman and colleagues (2007b) provides the best fit with the observed data. A modified five-factor model was used as the Social Perception domain was removed from the measurement model because the scores from the Theory of Mind subtest were not in a format comparable to other subtest scores. For the purposes of factor analysis, a factor must have at least two subtests and with the removal of the Theory of Mind subtest the Social Perception factor was left with only one subtest. The data utilized in this study are archival and were collected from case studies submitted to fulfill requirements for the KIDS, Inc. School Neuropsychology Post-Graduate Program.

Prior to primary statistical analyses, missing data points were determined to be not missing at random. To increase amount of data used in the primary analyses, multiple imputation was used to estimate missing data. Given that data were collected from actual cases, rather than through a research protocol, not every case contained complete information for required measure. Therefore, multiple imputation (MI) was used to account for missing data within the data set. MI is a commonly used statistical method to address missing data and is a stochastic imputation method that incorporates four steps (Baraldi & Enders, 2010; Bodner, 2006). First, the statistician creates several different imputed data sets to approximate the original data set. Next, analyses are carried out on data sets with parameter estimates (e.g., factor loadings, group mean differences, correlations, regression coefficients) and their standard errors saved for each data set. The results are obtained by averaging parameter estimates across multiple analyses, which results in unbiased parameter estimate. Finally, data were examined for outliers. Extreme outliers, those that were extremely high compared to average scores, were removed.

Table 8 displays frequencies and percentages for the primary diagnostic demographic variables. The primary diagnostic category included participant's primary diagnoses only. The distribution of primary diagnostic categories, varied more so than other types of categorical variables, indicating a wide range of diagnoses. For example, the sample included 99 children (15.4%) with a learning disability, 26 children (4.1%) with a neurological impairment, 68 children (10.6%) with an ADD/ADHD diagnosis, 26 children (4.1%) with Autism, 23 children (3.6%) with an emotional disturbance, 18 children (2.8%) diagnosed with a general medical condition (OHI), 23 children (3.6%)

with other/multiple disabilities, 99 children (15.4%) with ADHD/other disabilities, and 250 children (39%) with unknown disabilities or undiagnosed.

To further explore the data, frequencies and percentages of general diagnostic *(GD)* demographic variables were included in Table 9. The *GD* variables are different from the primary diagnostic variables as a participant in the *GD* category diagnosed with multiple disabilities would be represented in each of their given diagnostic categories. For example, if a participant had a diagnosis of Learning Disability and ADHD, they would be included in frequencies for GD-Learning Disability and GD- ADHD. In terms of ethnicity, the sample included 268 children (41.8%) that were Caucasian, and 122 children (19.0%) were non-Caucasian. Racial information for 251 children (39.2%) was unavailable. Finally, the sample included 418 (65.2%) males and 220 (34.3%) females.

Table 8

Frequencies and Percentages for Primary Diagnostic Variables

	n	%
Primary Diagnosis recoded		
Learning Disability	99	15.4
Neurological Impairment (Acquired)	26	4.1
ADD/ADHD	68	10.6
Autism Spectrum	26	4.1
Emotional Disability	23	3.6
General Medical (OHI)	18	2.8
Other (Multiple Disabilities)	23	3.6
ADHD/Other Disability	99	15.4
Unknown/No Diagnosis	250	39.0
Missing	0	.0

Table 9

Frequencies and Percentages for Categorical Demographic Variables

	n	%
*Learning Disability		
No	453	70.7
Yes	188	29.3
*Neurological Impairment		
No	590	92.0
Yes	51	8.0
*ADD/ADHD		
No	542	84.6
Yes	99	15.4
*Autism		
No	589	91.9
Yes	52	8.1
*Emotional Disturbance		
No	565	88.1
Yes	76	11.9
*General Medical (OHI)		
No	583	91.0
Yes	58	9.0
*Other (Multiple Disabilities)		
No	597	93.1
Yes	44	6.9
*ADHD/Other Disability		
No	489	76.3
Yes	152	23.7
*Unknown/No Diagnosis		
No	575	89.7
Yes	66	10.3

(continued)

	n	%
Ethnicity RC		
Caucasian	268	41.8
Non-Caucasian	122	19.0
Missing	251	39.2
Sex		
Male	418	65.2
Female	220	34.3
Missing	3	.5

Note. * denotes *GD*

Table 10 displays descriptive statistics for the variable age, showing that children in this study ranged from 5-year-olds to 21-year-olds with a mean age of 10.81 (SD = 3.089).

Table 10

Means and Standard Deviations for Continuous Demographic Variables

	N	*M*	*SD*	Min	Max
Age recoded into whole numbers	632	10.81	3.09	5.00	21.00

Table 11 displays means and standard deviations for the NEPSY-II Subtest scores. All subtest scores ranged from 1 to 19, where on average students scored highest on Design Copy Process (M = 10.57, SD = 4.59) and Word Generation Semantic (M = 10.16, SD = 3.70).

Table 11

Means and Standard Deviations for NESPY II Subscale Scores

NEPSY II	*N*	*M*	*SD*	Min	Max
		Attention and Executive Functions			
Animal Sorting Combined	632	8.02	3.75	1.00	18.00
Auditory Attention (Combined)	632	7.97	3.75	1.00	18.00
AARS - Response Set (Combined)	632	7.05	3.84	1.00	18.00
Clocks	632	8.39	4.08	1.00	19.00
Design Fluency	632	7.92	3.97	1.00	19.00
Inhibition-Naming Combined - Part 1	632	7.73	3.72	1.00	18.00
Inhibition Combined - Part 2	632	7.17	3.61	1.00	19.00
		Language Functions			
Comprehension of Instructions	632	7.63	3.53	1.00	18.00
Phonological Processing	632	7.34	3.97	1.00	19.00
Speeded Naming	632	7.69	3.21	1.00	18.00
Word Generation Semantic Total	632	10.16	3.70	1.00	19.00
Word Generation Initial Letter Total	632	8.56	3.58	1.00	19.00
		Sensorimotor Functions			
Visuomotor Precision	632	8.28	3.58	1.00	19.00
Finger Tapping - Dominant Hand	632	8.23	3.36	1.00	14.00
Imitating Hand Positions	632	7.11	3.12	1.00	17.00

(continued)

NEPSY II	*N*	*M*	*SD*	Min	Max
		Memory and Learning Functions			
List Memory Delayed Total Correct	632	7.50	3.62	1.00	18.00
Memory for Designs	632	8.66	3.69	1.00	19.00
Memory for Designs (Delayed)	632	8.51	3.58	1.00	19.00
Memory for Faces	632	8.85	3.69	1.00	19.00
Memory for Faces (Delayed)	632	8.98	3.76	1.00	19.00
Memory for Names	632	9.16	3.68	1.00	19.00
Memory for Names Delayed	632	7.83	3.54	1.00	19.00
Narrative Memory	632	9.66	3.60	1.00	19.00
Narrative Memory Free Recall	632	9.44	3.58	1.00	19.00
Word List Interference Recall Total	632	7.56	3.69	1.00	18.00
		Social Perception Functions			
Affect Recognition	632	7.41	3.68	1.00	17.00
		Visuospatial Processing Functions			
Arrows	632	8.49	3.76	1.00	19.00
Block Construction	632	8.23	3.26	1.00	19.00
Design Copy Process	632	10.57	4.59	1.00	19.00
Geometric Puzzles	632	6.54	3.99	1.00	17.00
Picture Puzzles	632	8.54	3.55	1.00	18.00
Memory for Designs Immediate	632	8.31	3.86	1.00	19.00
Inhibition-Switching Combined	632	6.66	3.20	1.00	18.00

Relationships between Independent Variables

Pearson's product moment correlations were conducted to examine the relationship of subtest scores on the NEPSY-II. Table 12 displays the results of Pearson's product moment correlations. Due to the relatively large sample size, most of the correlations were considered statistically significant and are marked with asterisks in Table 12. In discussing the patterns of significant findings, the strength of the relationships will be used. According to Cohen (1988), absolute values of correlation coefficients ranging from .100 to .300 are considered weak, coefficients ranging from .300 to .500 are considered moderate, and coefficients above .500 are considered strong. Coefficients below .100 are generally considered non-meaningful, even if they are statistically significant ($p < .05$). The majority of the correlations between items in Table 12 were weak in strength (with coefficients between .100 and .300) and positive in direction indicating that higher scores on individual items tended to be weakly related to higher scores on the other items.

When looking at the overall pattern of the coefficients within constructs, correlations among attention and executive functioning items ranged from no meaningful relationship (r = .073) between Inhibition-Naming Combined Part 1 and Animal Sorting Combined, to strong (r = .519) between Inhibition-Combined Part 2 and Inhibition-naming Combined Part 1. More moderate size correlations were observed between the language items, coefficients ranging from .179 between Word Generation Semantic Total and Phonological Processing, to .527 between Word Generation Initial Letter and Word Generation Semantic Total.

Table 12

Pearson's Product Moment Correlation among NEPSY II Subscale Scores.

	NEPSY II	1	2	3	4
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)	.108 **			
3.	AARS - Response Set (Combined)	.116 **	.267 **		
4.	Clocks	.207 **	.283 **	.335 **	
5.	Design Fluency	.261 **	.160 **	.233 **	.075
6.	Inhibition-Naming Combined - Part 1	.073	.300 **	.136 **	.258 **
7.	Inhibition Combined - Part 2	.137 **	.243 **	.267 **	.321 **
	Language				
8.	Comprehension of Instructions	.341 **	.294 **	.178 **	.290 **
9.	Phonological Processing	.036	.150 **	.392 **	.196 **
10.	Speeded Naming	.196 **	.196 **	.191 **	.220 **
11.	Word Generation Semantic Total	.266 **	.124 **	.201 **	.285 **
12.	Word Generation Initial Letter Total	.215 **	.070	.284 **	.232 **
	Memory and Learning				
13.	List Memory Delayed Total Correct	.114 **	.115 **	.225 **	.204 **
14.	Memory for Designs	.047	.039	.004	-.008
15.	Memory for Designs (Delayed)	.071	.146 **	.156 **	.239 **
16.	Memory for Faces	.002	.039	.104 **	.176 **
17.	Memory for Faces (Delayed)	.076	.183 **	.081 *	.153 **
18.	Memory for Names	.090 *	.025	.035	.134 **
19.	Memory for Names (Delayed)	.121 **	.031	.153 **	.200 **
20.	Narrative Memory	.165 **	.034	.130 **	.319 **
21	Narrative Memory Free Recall	.105 **	.039	.094 *	.256 **
22.	Word List Interference Recall Total	.133 **	.118 **	.312 **	.286 **
	Sensorimotor				
23.	Visuomotor Precision	.150 **	.110 **	.267 **	.165 **
24.	Finger Tapping - Dominant Hand	.104 **	.147 **	-.101 *	.102 **
25.	Imitating Hand Positions	.109 **	.127 **	.000	.296 **
	Visuospatial Processing				
26.	Arrows	.161 **	.173 **	.129 **	.336 **
27.	Block Construction	.330 **	.118 **	.112 **	.387 **
28.	Design Copy Process	.183 **	.286 **	.243 **	.449 **
29.	Geometric Puzzles	.178 **	.051	.543 **	.182 **
30.	Picture Puzzles	.156 **	.165 **	.164 **	.306 **

Note. * $p < .05$, ** $p < .01$

Table 12, *continued*

	NEPSY II	5	6	7	8
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1	.009			
7.	Inhibition Combined - Part 2	.148 **	.519 **		
	Language				
8.	Comprehension of Instructions	.260 **	.272 **	.445 **	
9.	Phonological Processing	.132 **	.243 **	.240 **	.325 **
10.	Speeded Naming	.108 **	.371 **	.352 **	.323 **
11.	Word Generation Semantic Total	.143 **	.238 **	.265 **	.297 **
12.	Word Generation Initial Letter Total	.212 **	.249 **	.292 **	.344 **
	Memory and Learning				
13.	List Memory Delayed Total Correct	.247 **	.182 **	.211 **	.211 **
14.	Memory for Designs	.203 **	.074	.078 *	.184 **
15.	Memory for Designs (Delayed)	.200 **	.165 **	.271 **	.205 **
16.	Memory for Faces	-.077	.181 **	.223 **	-.012
17.	Memory for Faces (Delayed)	.031	.354 **	.304 **	.160 **
18.	Memory for Names	.025	.090 *	.091 *	.101 *
19.	Memory for Names (Delayed)	.044	.169 **	.185 **	.227 **
20.	Narrative Memory	-.021	.067	.097 *	.135 **
21.	Narrative Memory Free Recall	-.010	.080 *	.101 *	.164 **
22.	Word List Interference Recall Total	.253 **	.162 **	.248 **	.308 **
	Sensorimotor				
23.	Visuomotor Precision	.239 **	.217 **	.216 **	.201 **
24.	Finger Tapping - Dominant Hand	.074	.168 **	.095 *	.035
25.	Imitating Hand Positions	.056	.213 **	.156 **	.321 **
	Visuospatial Processing				
26.	Arrows	.211 **	.117 **	.232 **	.263 **
27.	Block Construction	.220 **	.183 **	.235 **	.361 **
28.	Design Copy Process	.208 **	.305 **	.394 **	.376 **
29.	Geometric Puzzles	.160 **	.085 *	.104 **	.136 **
30.	Picture Puzzles	.211 **	.285 **	.328 **	.272 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	9	10	11	12
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming	.193 **			
11.	Word Generation Semantic Total	.179 **	.213 **		
12.	Word Generation Initial Letter Total	.300 **	.244 **	.527 **	
	Memory and Learning				
13.	List Memory Delayed Total Correct	.202 **	.105 **	.284 **	.277 **
14.	Memory for Designs	.012	.070	.090 *	.122 **
15.	Memory for Designs (Delayed)	.242 **	.100 *	.299 **	.242 **
16.	Memory for Faces	-.001	.124 **	.135 **	.099 *
17.	Memory for Faces (Delayed)	.116 **	.187 **	.242 **	.123 **
18.	Memory for Names	.119 **	.074	.158 **	.097 *
19.	Memory for Names Delayed	.177 **	.150 **	.146 **	.161 **
20.	Narrative Memory	.146 **	.080 *	.174 **	.122 **
21.	Narrative Memory Free Recall	.176 **	.115 **	.156 **	.114 **
22.	Word List Interference Recall Total	.247 **	.136 **	.172 **	.291 **
	Sensorimotor				
23.	Visuomotor Precision	.006	.198 **	.101 *	.094 *
24.	Finger Tapping - Dominant Hand	-.094 *	.232 **	.032	.033
25.	Imitating Hand Positions	.043	.112 **	.188 **	.078 *
	Visuospatial Processing				
26.	Arrows	.277 **	.191 **	.217 **	.240 **
27.	Block Construction	.225 **	.112 **	.180 **	.149 **
28.	Design Copy Process	.238 **	.187 **	.264 **	.271 **
29.	Geometric Puzzles	.367 **	.137 **	.072	.099 *
30.	Picture Puzzles	.260 **	.224 **	.252 **	.268 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	13	14	15	16
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming				
11.	Word Generation Semantic Total				
12.	Word Generation Initial Letter Total				
	Memory and Learning				
13.	List Memory Delayed Total Correct				
14.	Memory for Designs	.445 **			
15.	Memory for Designs (Delayed)	.503 **	.475 **		
16.	Memory for Faces	.126 **	.064	.117 **	
17.	Memory for Faces (Delayed)	.208 **	.050	.197 **	.577 **
18.	Memory for Names	.034	.095 *	.068	.087 *
19.	Memory for Names Delayed	.265 **	.063	.158 **	.109 **
20.	Narrative Memory	.033	.091 *	.117 **	.118 **
21.	Narrative Memory Free Recall	.001	.082 *	.091 *	.052
22.	Word List Interference Recall Total	.098 *	-.004	.199 **	.314 **
	Sensorimotor				
23.	Visuomotor Precision	.068	.048	.044	.115 **
24.	Finger Tapping - Dominant Hand	.009	.224 **	.118 **	.041
25.	Imitating Hand Positions	-.049	.063	.175 **	.050
	Visuospatial Processing				
26.	Arrows	.143 **	.137 **	.271 **	.161 **
27.	Block Construction	.096 *	.235 **	.243 **	.086 *
28.	Design Copy Process	.233 **	.146 **	.289 **	.176 **
29.	Geometric Puzzles	.172 **	.005	.197 **	.110 **
30.	Picture Puzzles	.354 **	.226 **	.340 **	.258 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	17	18	19	20
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming				
11.	Word Generation Semantic Total				
12.	Word Generation Initial Letter Total				
	Memory and Learning				
13.	List Memory Delayed Total Correct				
14.	Memory for Designs				
15.	Memory for Designs (Delayed)				
16.	Memory for Faces				
17.	Memory for Faces (Delayed)				
18.	Memory for Names	.116 **			
19.	Memory for Names Delayed	.153 **	.320 **		
20.	Narrative Memory	.105 **	.770 **	.211 **	
21.	Narrative Memory Free Recall	.055	.821 **	.220 **	.926 **
22.	Word List Interference Recall Total	.170 **	.060	.136 **	.093 *
	Sensorimotor				
23.	Visuomotor Precision	.183 **	-.031	.090 *	.043
24.	Finger Tapping - Dominant Hand	.076	.074	.007	-.019
25.	Imitating Hand Positions	.090 *	-.018	.108 **	-.023
	Visuospatial Processing				
26.	Arrows	.240 **	.054	.128 **	.134 **
27.	Block Construction	.099 *	.054	.081 *	.198 **
28.	Design Copy Process	.280 **	.132 **	.196 **	.161 **
29.	Geometric Puzzles	.163 **	.054	.102 **	.074
30.	Picture Puzzles	.376 **	.116 **	.139 **	.139 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	21	22	23	24
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming				
11.	Word Generation Semantic Total				
12.	Word Generation Initial Letter Total				
	Memory and Learning				
13.	List Memory Delayed Total Correct				
14.	Memory for Designs				
15.	Memory for Designs (Delayed)				
16.	Memory for Faces				
17.	Memory for Faces (Delayed)				
18.	Memory for Names				
19.	Memory for Names Delayed				
20.	Narrative Memory				
21.	Narrative Memory Free Recall				
22.	Word List Interference Recall Total	.078 *			
	Sensorimotor				
23.	Visuomotor Precision	.056	.185 **		
24.	Finger Tapping - Dominant Hand	-.039	-.078 *	.122 **	
25.	Imitating Hand Positions	.007	.061	.170 **	.258 **
	Visuospatial Processing				
26.	Arrows	.090 *	.170 **	.176 **	.077
27.	Block Construction	.133 **	.158 **	.106 **	.074
28.	Design Copy Process	.139 **	.224 **	.314 **	.196 **
29.	Geometric Puzzles	.074	.217 **	.149 **	-.092 *
30.	Picture Puzzles	.102 **	.433 **	.154 **	.112 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	25	26	27	28
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming				
11.	Word Generation Semantic Total				
12.	Word Generation Initial Letter Total				
	Memory and Learning				
13.	List Memory Delayed Total Correct				
14.	Memory for Designs				
15.	Memory for Designs (Delayed)				
16.	Memory for Faces				
17.	Memory for Faces (Delayed)				
18.	Memory for Names				
19.	Memory for Names Delayed				
20.	Narrative Memory				
21.	Narrative Memory Free Recall				
22.	Word List Interference Recall Total				
	Sensorimotor				
23.	Visuomotor Precision				
24.	Finger Tapping - Dominant Hand				
25.	Imitating Hand Positions				
	Visuospatial Processing				
26.	Arrows	.260 **	.209 **		
27.	Block Construction	.172 **	.150 **	.363 **	
28.	Design Copy Process	.248 **	.157 **	.359 **	.364 **
29.	Geometric Puzzles	.026	.647 **	.276 **	.269 **
30.	Picture Puzzles	.295 **	.151 **	.459 **	.300 **

Note. * $p < .05$, ** $p < .01$.

Table 12, *continued*

	NEPSY II	29	30	31	32
	Attention and Executive Functioning				
1.	Animal Sorting Combined				
2.	Auditory Attention (Combined)				
3.	AARS - Response Set (Combined)				
4.	Clocks				
5.	Design Fluency				
6.	Inhibition-Naming Combined - Part 1				
7.	Inhibition Combined - Part 2				
	Language				
8.	Comprehension of Instructions				
9.	Phonological Processing				
10.	Speeded Naming				
11.	Word Generation Semantic Total				
12.	Word Generation Initial Letter Total				
	Memory and Learning				
13.	List Memory Delayed Total Correct				
14.	Memory for Designs				
15.	Memory for Designs (Delayed)				
16.	Memory for Faces				
17.	Memory for Faces (Delayed)				
18.	Memory for Names				
19.	Memory for Names Delayed				
20.	Narrative Memory				
21.	Narrative Memory Free Recall				
22.	Word List Interference Recall Total				
	Sensorimotor				
23.	Visuomotor Precision				
24.	Finger Tapping - Dominant Hand				
25.	Imitating Hand Positions				
	Visuospatial Processing				
26.	Arrows				
27.	Block Construction				
28.	Design Copy Process				
29.	Geometric Puzzles	.175 **			
30.	Picture Puzzles	.421 **	.301 **		

Note. * $p < .05$, ** $p < .01$.

In terms of memory and learning items, the magnitude of between-item correlations were more varied; ranging from coefficients showing no meaningful relationship (r = .001) between Narrative Memory Free Recall and List Memory Delayed Total Correct, to a very strong relationship (r = .926) between Narrative Memory Free Recall and Narrative Memory. Generally, correlations above .800 are considered indicators of multicollinearity meaning that the items are so strongly related that they can be considered conceptually equivalent. Weak correlations were observed among sensorimotor items, coefficients ranging from .170 to .258. And finally for the visuospatial processing items mostly moderate coefficients were observed ranging from .175 to .459 (Table 12).

Moreover, looking across the constructs, moderate and strong correlations were observed in particular between visuospatial processing items and items from other constructs. The Geometric Puzzles item showed a moderate correlation with Auditory Attention-Response Set Combined (r = .543). In summary, the majority of correlations were positive in direction and statistically significant indicating that higher scores on items were associated with higher scores on other items. Most coefficients were weak in strength although some moderate correlations were also found throughout the correlations. Very few strong correlations or negative correlations are shown between pairs of items (Table 12).

Primary Analysis

The theoretical model of neurocognitive functioning proposed by Korkman, Kirk, and Kemp (2007b) was tested using a measurement model, which is several confirmatory factor analyses conducted simultaneously. A modified five factor model was utilized due to the removal of the Social Perception domain as the scores from the Theory of Mind subtest were not in a format that was comparable to other subtest scores. Further, for the purposes of factor analysis, a factor must be made up of at least two subtests and with the removal of the Theory of Mind subtest the Social Perception factor had only one subtest remaining. The modified model had 5 conceptual factors, each made up of between 3 and 9 subtests from the NEPSY-II. Table 13 shows that the loading for each standardized path coefficient and *t*-value onto their respective theoretical construct was statistically significant (all *p*s < .001). Table 13 includes the term "set". In SEM modeling, a path is fixed going into each latent variable to allow for estimation. While a standardized coefficient for this path can be calculated, it cannot be tested for significance because it was set by the program and not estimated like the other paths. The term "set" in the table reflects these paths that were set by the program. All standardized path coefficients were in a positive direction, indicating that higher scores for each item were related to more attention and executive functioning, language, memory and learning, sensorimotor, and visuospatial processing. Although the items loaded well, the overall fit of the measurement model was not adequate, χ^2 (395) = 3909.68, adjusted χ^2 = 9.90, RMSEA = .119, NNFI = .621, CFI = .656. When using fit indices, it is important to utilize predetermined cutoff criteria that aid in determining significant values. For RMSEA cutoff values less than .08 and .06 are considered acceptable and for NNFI and CFI, cutoff values greater than .08 are acceptable (Browne & Cudeck, 1993; Hu & Bentler)

The reliabilities of the conceptual factors were assessed though examination of the composite reliabilities using the procedure suggested by Fornell and Larcker (1981). Composite reliabilities, which ranged from .457 to .727, suggested that children tended to respond similarly to items within several constructs (*attention and executive functioning*, *language*, *memory and learning*, and *visuospatial processing*), but children did not respond similarly in the *sensorimotor* construct. Additionally, the average variance explained (AVE) values were computed for each theoretical construct. None of the 5 AVE values were above the minimum of .500 suggested by Fornell and Larcker (1981). Finally, discriminant validity was assessed for each theoretical construct by comparing the highest shared variance (HSV), which is the square of the strongest correlation between the theoretical construct in question and the other 4 constructs, with the AVE value (Fornell & Larcker, 1981). Discriminant validity is considered adequate when the HSV for each construct is a smaller value than its corresponding AVE value. In the proposed model, no discriminant validity was shown. For all constructs, the HSV was larger than the AVE.

Together, the results suggest that although the NEPSY-II items were positively related to each other, the proposed model showed more variance between theoretical constructs than within the constructs. This interpretation is underscored by the relatively strong correlations among the 5 latent constructs in Model 1 (see Table 14). Only the correlation between the *sensorimotor* construct and the *memory and learning* construct was weak to moderate (.293). The correlations for the *attention and executive functioning* construct with the *language* construct (.902) and with the *visuospatial processing* construct (.798) were especially strong, indicating that these items may not be unique constructs.

Table 13

Parameters of the Measurement Model, Standardized Path Coefficient, t-*Values, Composite Reliability, Average Variance Extracted, and Highest Shared Variance for MODEL 1*

NEPSY II	Attention and Executive Functioning		Language		Memory and Learning		Sensorimotor		Visuospatial Processing	
	Path	*t*	Path	*t*	Path	*t*	Path	*t*	Path	*t*
Animal Sorting Combined	.352	set	- -	- -	- -	- -	- -	- -	- -	- -
Auditory Attention (Combined)	.408	6.56	- -	- -	- -	- -	- -	- -	- -	- -
AARS - Response Set (Combined)	.452	6.87	- -	- -	- -	- -	- -	- -	- -	- -
Clocks	.553	7.44	- -	- -	- -	- -	- -	- -	- -	- -
Design Fluency	.346	6.00	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition-Naming Combined - Part 1	.535	7.35	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition Combined - Part 2	.661	7.85	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition-Switching Combined	.419	6.64	- -	- -	- -	- -	- -	- -	- -	- -
Comprehension of Instructions	- -	- -	.659	set	- -	- -	- -	- -	- -	- -
Phonological Processing	- -	- -	.478	10.10	- -	- -	- -	- -	- -	- -
Speeded Naming	- -	- -	.474	10.02	- -	- -	- -	- -	- -	- -

Note. All *t*-values are significant at $\alpha = .001$.

Table 13, *continued*

NEPSY II	Attention and Executive Functioning		Language		Memory and Learning		Sensorimotor		Visuospatial Processing	
	Path	*t*	Path	*t*	Path	*t*	Path	*t*	Path	*t*
Word Generation Semantic Total	- -	- -	.537	11.17	- -	- -	- -	- -	- -	- -
Word Generation Initial Letter Total	- -	- -	.574	11.80	- -	- -	- -	- -	- -	- -
Memory for Designs	- -	- -	- -	- -	.549	set	- -	- -	- -	- -
Memory for Designs (Delayed)	- -	- -	- -	- -	.825	13.88	- -	- -	- -	- -
Memory for Faces	- -	- -	- -	- -	.190	4.39	- -	- -	- -	- -
Memory for Faces (Delayed)	- -	- -	- -	- -	.276	6.21	- -	- -	- -	- -
Memory for Names	- -	- -	- -	- -	.188	4.35	- -	- -	- -	- -
Memory for Names Delayed	- -	- -	- -	- -	.256	5.79	- -	- -	- -	- -
Narrative Memory	- -	- -	- -	- -	.224	5.12	- -	- -	- -	- -
Narrative Memory Free Recall	- -	- -	- -	- -	.195	4.49	- -	- -	- -	- -
Memory for Designs – Immediate	- -	- -	- -	- -	.902	14.09	- -	- -	- -	- -

Note. All *t*-values are significant at $\alpha = .001$.

Table 13, *continued*

NEPSY II	Attention and Executive Functioning Path	*t*	Language Path	*t*	Memory and Learning Path	*t*	Sensorimotor Path	*t*	Visuospatial Processing Path	*t*
Visuomotor Precision	- -	- -	- -	- -	- -	- -	.433	set	- -	- -
Finger Tapping - Dominant Hand	- -	- -	- -	- -	- -	- -	.321	5.05	- -	- -
Imitating Hand Positions	- -	- -	- -	- -	- -	- -	.517	6.40	- -	- -
Arrows	- -	- -	- -	- -	- -	- -	- -	- -	.599	set
Block Construction	- -	- -	- -	- -	- -	- -	- -	- -	.533	10.69
Design Copy Process	- -	- -	- -	- -	- -	- -	- -	- -	.667	12.57
Geometric Puzzles	- -	- -	- -	- -	- -	- -	- -	- -	.388	8.23
Picture Puzzles	- -	- -	- -	- -	- -	- -	- -	- -	.675	12.67
Composite Reliability	.727		.719		.697		.457		.723	
AVE	.258		.343		.271		.225		.350	
HSV	.814		.814		.375		.491		.637	

Note. All *t*-values are significant at $\alpha = .001$.

Table 14

Correlations Among Latent Constructs in MODEL 1

	Attention and Executive Functioning	Language	Memory and Learning	Sensorimotor
Language	.902			
Memory and Learning	.521	.480		
Sensorimotor	.633	.523	.293	
Visuospatial Processing	.798	.727	.612	.701

Due to the poor fit of the five-factor modified model, a slightly modified measurement model was also presented based on modifications to Model 1 suggested by Lisrel 8.80 to reduce the chi-square value and produce a better fitting model (see Figure 3). Two types of modifications were executed: (a) items within theoretical constructs were allowed to correlate with each other, and (b) items with weak standardized path coefficients were removed from the model. Modifications were executed and tested one at a time to assess the effect of the modification on the model. As such, the items removed from Model 1, are not necessarily those with the lowest standardized path coefficients in Model 1. Each modification led to an adjustment of the standardized path coefficients (See Figure 4).

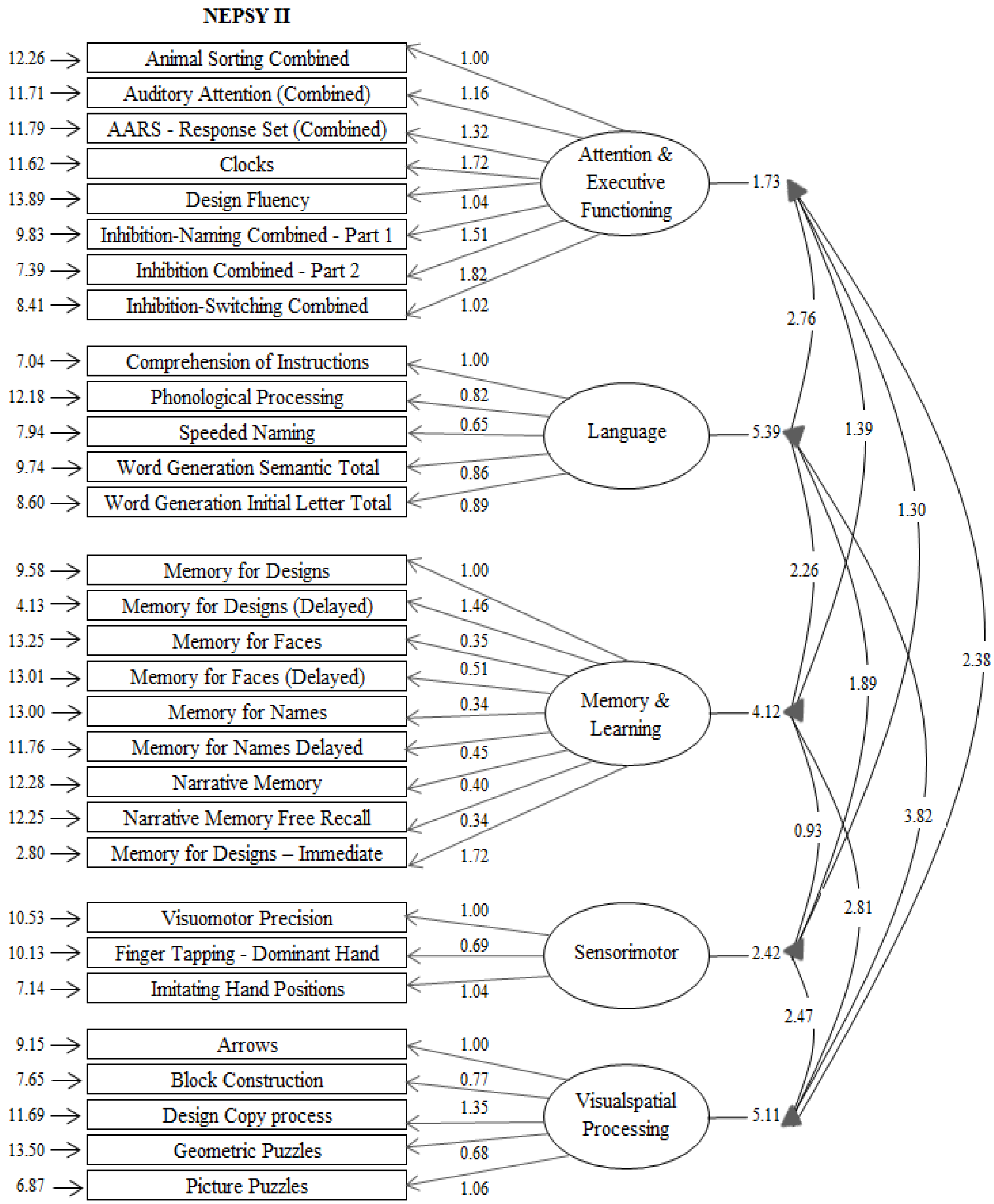

Figure 3. Model 1.

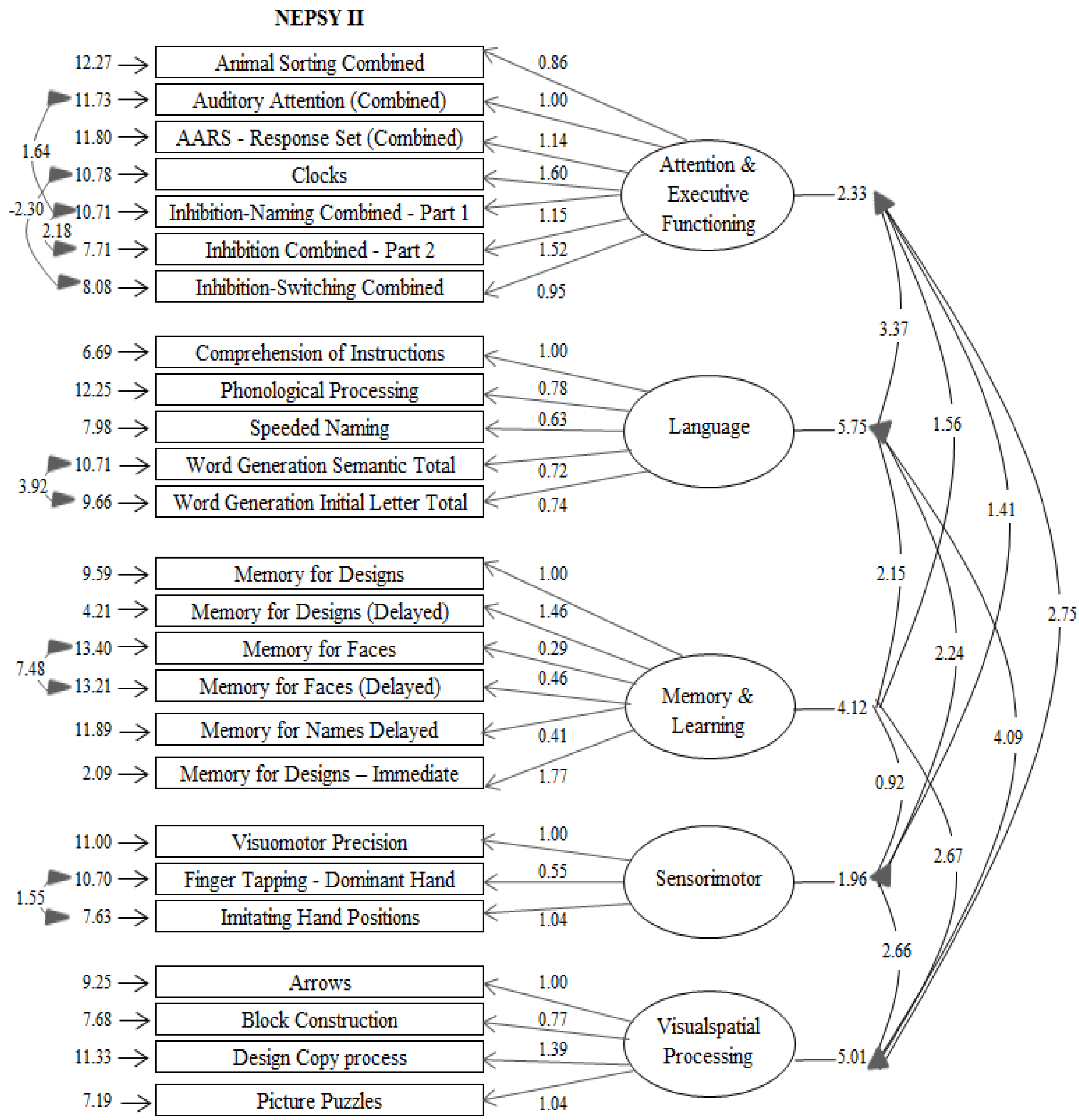

Figure 4. Adjusted model of model 1.

The path coefficients and *t*-values for the modified model, Model 2, are shown in Table 15. The items removed from the model included *Design Fluency*, *Memory for Names*, *Narrative Memory,* and N*arrative Memory Free Recall*. Moreover, the errors for *Auditory Attention Combined* and *Inhibition-Naming Combined - Part 1*; *Clocks* and *Inhibition-Switching Combined*; *Inhibition-Naming Combined - Part 1* and *Inhibition Combined - Part 2*; *Word Generation Semantic Total* and *Word Generation Initial Letter Total* ; *Memory for Faces* and *Memory for Faces Delayed*; and *Finger Tapping Dominant Hand* and *Imitating Hand Positions* were allowed to correlate. As in Model 1, the standardized path coefficients were all in the positive direction and statistically significant (all *p*s < .001), indicating that higher scores on the items were associated with higher scores on their associated theoretical construct.

Model fit was minimally adequate, χ^2 (259) = 1315.15, adjusted χ^2 = 5.08, RMSEA = .080, NNFI = .854, CFI = .874, and further modification did not result in a better fitting model. Modifications in which items were moved from one theoretical construct to another was not conducted and considered outside the scope of the current research topic of evaluating and suggesting modifications to the theoretical model of neurocognitive functioning proposed by Korkman, Kirk, and Kemp (2007b). Reliability and discriminant validity were evaluated with Model 2 using the methods and procedures suggested by Fornell and Larcker (1981). Similar to Model 1, Model 2 analysis revealed one inadequate composite reliability for *sensorimotor* (.373), and adequate reliabilities for the other constructs which ranged from .691 to .719.

Table 15

Parameters of the Measurement Model, Standardized Path Coefficient, t*-Values, Composite Reliability, Average Variance Extracted, and Highest Shared Variance for MODEL 2*

NEPSY II	Attention and Executive Functioning		Language		Memory and Learning		Sensorimotor		Visuospatial Processing	
	Path	*t*	Path	*t*	Path	*t*	Path	*t*	Path	*t*
Animal Sorting Combined	.351	6.49	- -	- -	- -	- -	- -	- -	- -	- -
Auditory Attention (Combined)	.407	Set	- -	- -	- -	- -	- -	- -	- -	- -
AARS - Response Set (Combined)	.451	7.53	- -	- -	- -	- -	- -	- -	- -	- -
Clocks	.597	8.53	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition-Naming Combined - Part 1	.473	8.31	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition Combined - Part 2	.642	8.82	- -	- -	- -	- -	- -	- -	- -	- -
Inhibition-Switching Combined	.455	7.49	- -	- -	- -	- -	- -	- -	- -	- -
Comprehension of Instructions	- -	- -	.680	set	- -	- -	- -	- -	- -	- -
Phonological Processing	- -	- -	.473	10.07	- -	- -	- -	- -	- -	- -
Speeded Naming	- -	- -	.469	9.99	- -	- -	- -	- -	- -	- -
Word Generation Semantic Total	- -	- -	.467	9.90	- -	- -	- -	- -	- -	- -

Note. All *t*-values are significant at $\alpha = .001$.

Table 15, *continued*

NEPSY II	Attention and Executive Functioning		Language		Memory and Learning		Sensorimotor		Visuospatial Processing	
	Path	*t*	Path	*t*	Path	*t*	Path	*t*	Path	*t*
Word Generation Initial Letter Total	- -	- -	.497	10.49	- -	- -	- -	- -	- -	- -
Memory for Designs	- -	- -	- -	- -	.548	set	- -	- -	- -	- -
Memory for Designs (Delayed)	- -	- -	- -	- -	.821	14.04	- -	- -	- -	- -
Memory for Faces	- -	- -	- -	- -	.159	3.73	- -	- -	- -	- -
Memory for Faces (Delayed)	- -	- -	- -	- -	.248	5.69	- -	- -	- -	- -
Memory for Names Delayed	- -	- -	- -	- -	.235	5.40	- -	- -	- -	- -
Memory for Designs – Immediate	- -	- -	- -	- -	.928	14.13	- -	- -	- -	- -
Visuomotor Precision	- -	- -	- -	- -	- -	- -	.389	set	- -	- -
Finger Tapping - Dominant Hand	- -	- -	- -	- -	- -	- -	.230	3.97	- -	- -
Imitating Hand Positions	- -	- -	- -	- -	- -	- -	.466	6.25	- -	- -
Arrows	- -	- -	- -	- -	- -	- -	- -	- -	.593	set

Note. All *t*-values are significant at $\alpha = .001$.

Table 15, *continued*

NEPSY II	Attention and Executive Functioning Path	*t*	Language Path	*t*	Memory and Learning Path	*t*	Sensorimotor Path	*t*	Visuospatial Processing Path	*t*
Block Construction	- -	- -	- -	- -	- -	- -	- -	- -	.530	10.57
Design Copy Process	- -	- -	- -	- -	- -	- -	- -	- -	.680	12.59
Picture Puzzles	- -	- -	- -	- -	- -	- -	- -	- -	.656	12.31
Composite Reliability	.718		.691		.707		.373		.719	
AVE	.274		.314		.356		.176		.392	
HSV	.848		.848		.345		.723		.723	

Note. All *t*-values are significant at α = .001.

Although the reliability was somewhat stronger for the *sensorimotor* construct compared to Model 1, the low reliability suggests that children did not tend to respond similarly to items within that construct. Additionally, the average variance explained (AVE) values were computed for each theoretical construct. None of the 5 AVE values were above the minimum of .500 suggested by Fornell and Larcker (1981).

Finally, discriminant validity was assessed for each theoretical construct by comparing the highest shared variance (HSV) with the AVE value (Fornell & Larcker, 1981). In the proposed model, no discriminant validity was shown based on the finding that all HSV values being higher than the corresponding AVE values. Taken together, the results again suggest that although the NEPSY-II items were positively related to each other, the proposed model showed more variance between theoretical constructs that within the constructs. This interpretation is underscored by the relatively strong correlations among the 5 latent constructs in Model 2, which are shown in Table 16. All correlations were greater than .300. The correlations for the constructs of *attention and executive function* with the *language* construct (.921) and with the *visuospatial processing* construct (.806), and the correlation between visuospatial processing and sensorimotor (.850) were especially strong, indicating that these measures may not be unique constructs (see Figure 4).

Table 16

Correlations among Latent Constructs in MODEL 2

	Attention and Executive Functioning	Language	Memory and Learning	Sensorimotor
Language	.921			
Memory and Learning	.503	.442		
Sensorimotor	.663	.668	.325	
Visuospatial Processing	.806	.762	.587	.850

Relationships between Demographic Variables

Characteristics of sample relationships between demographic variables are displayed in tables throughout this section. The tables are referenced in the text with brief in-text descriptions. Table 17 displays bivariate relationships between ethnicity and other categorical demographic variables including the general diagnostic category.

Table 17

Frequencies and Percentages for Demographic Variables by Ethnicity

	Ethnicity RC					
	Caucasian		Non-Caucasian			
	n	%	*n*	%	χ^2	*p*
Sex					.08	.784
Male	173	64.6	77	63.1		
Female	95	35.4	45	36.9		
Learning Disability					2.33	.127
No	194	72.4	79	64.8		
Yes	74	27.6	43	35.2		

Table 17, *continued*

	Ethnicity RC					
	Caucasian		Non-Caucasian			
	n	%	*n*	%	χ^2	*p*
Neurological Impairment					.13	.714
No	250	93.3	115	94.3		
Yes	18	6.7	7	5.7		
ADD/ADHD					1.37	.242
No	226	84.3	97	79.5		
Yes	42	15.7	25	20.5		
Autism					.28	.597
No	246	91.8	110	90.2		
Yes	22	8.2	12	9.8		
Emotional Disturbance					8.34	.004
No	221	82.5	114	93.4		
Yes	47	17.5	8	6.6		
General Medical (OHI)					.28	.597
No	246	91.8	110	90.2		
Yes	22	8.2	12	9.8		
Other (Multiple Disabilities)					.00	.953
No	250	93.3	114	93.4		
Yes	18	6.7	8	6.6		
ADHD/Other Disability					5.05	.025
No	212	79.1	108	88.5		
Yes	56	20.9	14	11.5		
Unknown/No Diagnosis					2.41	.121
No	234	87.3	113	92.6		
Yes	34	12.7	9	7.4		

Similarly, Table 18 displays bivariate relationships between sex and other categorical demographic variables.

Table 18

Frequencies and Percentages for Demographic Variables by Sex

	Sex					
	Male		Female			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					.08	.784
Caucasian	173	69.2	95	67.9		
Non-Caucasian	77	30.8	45	32.1		
Learning Disability					4.95	.026
No	307	73.4	143	65.0		
Yes	111	26.6	77	35.0		
Neurological Impairment					.55	.458
No	387	92.6	200	90.9		
Yes	31	7.4	20	9.1		
ADD/ADHD					.07	.793
No	352	84.2	187	85.0		
Yes	66	15.8	33	15.0		
Autism					3.26	.071
No	378	90.4	208	94.5		
Yes	40	9.6	12	5.5		
Emotional Disturbance					2.22	.136
No	374	89.5	188	85.5		
Yes	44	10.5	32	14.5		
General Medical (OHI)					3.02	.082
No	386	92.3	194	88.2		
Yes	32	7.7	26	11.8		
Other (Multiple Disabilities)					.36	.548
No	391	93.5	203	92.3		
Yes	27	6.5	17	7.7		

Table 18, *continued*

	Sex					
	Male		Female			
	n	%	*n*	%	χ^2	*p*
ADHD/Other Disability					4.15	.042
No	308	73.7	178	80.9		
Yes	110	26.3	42	19.1		
Unknown/No Diagnosis					.04	.840
No	376	90.0	199	90.5		
Yes	42	10.0	21	9.5		

In Tables 19–27 bivariate relationships between specific diagnostic categories and other categorical variables are reported. The label *GD* used in the table stands for General Diagnostic, which represents all a participants given diagnoses. These general diagnoses variables are used in this study to examine relationships with NEPSY II measures.

Table 19

Frequencies and Percentages for Demographic Variables by GD- Learning Disability

	Learning Disability					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					2.33	.127
Caucasian	194	71.1	74	63.2		
Non-Caucasian	79	28.9	43	36.8		
Sex					4.95	.026
Male	307	68.2	111	59.0		
Female	143	31.8	77	41.0		

Table 19, *continued*

	Learning Disability					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Neurological Impairment					4.98	.026
No	410	90.5	180	95.7		
Yes	43	9.5	8	4.3		
ADD/ADHD					20.89	< .001
No	364	80.4	178	94.7		
Yes	89	19.6	10	5.3		
Autism					1.07	.302
No	413	91.2	176	93.6		
Yes	40	8.8	12	6.4		
Emotional Disturbance					.99	.319
No	403	89.0	162	86.2		
Yes	50	11.0	26	13.8		
General Medical (OHI)					.09	.760
No	411	90.7	172	91.5		
Yes	42	9.3	16	8.5		
Other (Multiple Disabilities)					5.61	.018
No	415	91.6	182	96.8		
Yes	38	8.4	6	3.2		
ADHD/Other Disability					49.75	< .001
No	311	68.7	178	94.7		
Yes	142	31.3	10	5.3		
Unknown/No Diagnosis					30.54	< .001
No	387	85.4	188	100.0		
Yes	66	14.6	0	0.0		

Table 20

Frequencies and Percentages for Demographic Variables by GD-Neurological Impairment

	Neurological Impairment					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					.13	.714
Caucasian	250	68.5	18	72.0		
Non-Caucasian	115	31.5	7	28.0		
Sex					.55	.458
Male	387	65.9	31	60.8		
Female	200	34.1	20	39.2		
Learning Disability					4.98	.026
No	410	69.5	43	84.3		
Yes	180	30.5	8	15.7		
ADD/ADHD					3.88	.049
No	494	83.7	48	94.1		
Yes	96	16.3	3	5.9		
Autism					2.81	.094
No	539	91.4	50	98.0		
Yes	51	8.6	1	2.0		
Emotional Disturbance					.22	.636
No	519	88.0	46	90.2		
Yes	71	12.0	5	9.8		
General Medical (OHI)					3.38	.066
No	533	90.3	50	98.0		
Yes	57	9.7	1	2.0		
Other (Multiple Disabilities)					.08	.773
No	549	93.1	48	94.1		
Yes	41	6.9	3	5.9		
ADHD/Other Disability					4.37	.037
No	444	75.3	45	88.2		
Yes	146	24.7	6	11.8		
Unknown/No Diagnosis					6.36	.012
No	524	88.8	51	100.0		
Yes	66	11.2	0	0.0		

Table 21

Frequencies and Percentages for Demographic Variables by GD-ADD/ADHD

	ADD/ADHD					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					1.37	.242
Caucasian	226	70.0	42	62.7		
Non-Caucasian	97	30.0	25	37.3		
Sex					.07	.793
Male	352	65.3	66	66.7		
Female	187	34.7	33	33.3		
Learning Disability					20.89	< .001
No	364	67.2	89	89.9		
Yes	178	32.8	10	10.1		
Neurological Impairment					3.88	.049
No	494	91.1	96	97.0		
Yes	48	8.9	3	3.0		
Autism					.66	.416
No	496	91.5	93	93.9		
Yes	46	8.5	6	6.1		
Emotional Disturbance					3.76	.052
No	472	87.1	93	93.9		
Yes	70	12.9	6	6.1		
General Medical (OHI)					3.57	.059
No	488	90.0	95	96.0		
Yes	54	10.0	4	4.0		

Table 21, *continued*

	ADD/ADHD					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Other (Multiple Disabilities)					6.28	.012
No	499	92.1	98	99.0		
Yes	43	7.9	1	1.0		
ADHD/Other Disability					36.39	< .001
No	390	72.0	99	100.0		
Yes	152	28.0	0	0.0		
Unknown/No Diagnosis					13.44	< .001
No	476	87.8	99	100.0		
Yes	66	12.2	0	0.0		

Table 22

Frequencies and Percentages for Demographic Variables by GD-Autism

	Autism					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					.28	.597
Caucasian	246	69.1	22	64.7		
Non-Caucasian	110	30.9	12	35.3		
Sex					3.26	.071
Male	378	64.5	40	76.9		
Female	208	35.5	12	23.1		
Learning Disability					1.07	.302
No	413	70.1	40	76.9		
Yes	176	29.9	12	23.1		

Table 22, *continued*

	Autism					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Neurological Impairment					2.81	.094
No	539	91.5	51	98.1		
Yes	50	8.5	1	1.9		
ADD/ADHD					.66	.416
No	496	84.2	46	88.5		
Yes	93	15.8	6	11.5		
Emotional Disturbance					.94	.333
No	517	87.8	48	92.3		
Yes	72	12.2	4	7.7		
General Medical (OHI)					.74	.390
No	534	90.7	49	94.2		
Yes	55	9.3	3	5.8		
Other (Multiple Disabilities)					2.16	.142
No	546	92.7	51	98.1		
Yes	43	7.3	1	1.9		
ADHD/Other Disability					10.07	.002
No	440	74.7	49	94.2		
Yes	149	25.3	3	5.8		
Unknown/No Diagnosis					6.50	.011
No	523	88.8	52	100.0		
Yes	66	11.2	0	0.0		

Table 23

Frequencies and Percentages for Demographic Variables by GD-Emotional Disturbance

	Emotional Disturbance					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					8.34	.004
Caucasian	221	66.0	47	85.5		
Non-Caucasian	114	34.0	8	14.5		
Sex					2.22	.136
Male	374	66.5	44	57.9		
Female	188	33.5	32	42.1		
Learning Disability					.99	.319
No	403	71.3	50	65.8		
Yes	162	28.7	26	34.2		
Neurological Impairment					.22	.636
No	519	91.9	71	93.4		
Yes	46	8.1	5	6.6		
ADD/ADHD					3.76	.052
No	472	83.5	70	92.1		
Yes	93	16.5	6	7.9		
Autism					.94	.333
No	517	91.5	72	94.7		
Yes	48	8.5	4	5.3		
General Medical (OHI)					.82	.366
No	516	91.3	67	88.2		
Yes	49	8.7	9	11.8		
Other (Multiple Disabilities)					1.15	.284
No	524	92.7	73	96.1		
Yes	41	7.3	3	3.9		

Table 23, *continued*

	Emotional Disturbance					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
ADHD/Other Disability					4.07	.044
No	424	75.0	65	85.5		
Yes	141	25.0	11	14.5		
Unknown/No Diagnosis					9.90	.002
No	499	88.3	76	100.0		
Yes	66	11.7	0	0.0		

Table 24

Frequencies and Percentages for Demographic Variables by GD-General Medical (OHI)

	General Medical (OHI)					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					.28	.597
Caucasian	246	69.1	22	64.7		
Non-Caucasian	110	30.9	12	35.3		
Sex					3.02	.082
Male	386	66.6	32	55.2		
Female	194	33.4	26	44.8		
Learning Disability					.09	.760
No	411	70.5	42	72.4		
Yes	172	29.5	16	27.6		

Table 24, *continued*

	General Medical (OHI)					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Neurological Impairment					3.38	.066
No	533	91.4	57	98.3		
Yes	50	8.6	1	1.7		
ADD/ADHD					3.57	.059
No	488	83.7	54	93.1		
Yes	95	16.3	4	6.9		
Autism					.74	.390
No	534	91.6	55	94.8		
Yes	49	8.4	3	5.2		
Emotional Disturbance					.82	.366
No	516	88.5	49	84.5		
Yes	67	11.5	9	15.5		
Other (Multiple Disabilities)					1.16	.281
No	541	92.8	56	96.6		
Yes	42	7.2	2	3.4		
ADHD/Other Disability					.06	.807
No	444	76.2	45	77.6		
Yes	139	23.8	13	22.4		
Unknown/No Diagnosis					7.32	.007
No	517	88.7	58	100.0		
Yes	66	11.3	0	0.0		

Table 25

Frequencies and Percentages for Demographic Variables by GD-Other (Multiple Disabilities)

	Other (Multiple Disabilities)					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					.00	.953
Caucasian	250	68.7	18	69.2		
Non-Caucasian	114	31.3	8	30.8		
Sex					.36	.548
Male	391	65.8	27	61.4		
Female	203	34.2	17	38.6		
Learning Disability					5.61	.018
No	415	69.5	38	86.4		
Yes	182	30.5	6	13.6		
Neurological Impairment					.08	.773
No	549	92.0	41	93.2		
Yes	48	8.0	3	6.8		
ADD/ADHD					6.28	.012
No	499	83.6	43	97.7		
Yes	98	16.4	1	2.3		
Autism					2.16	.142
No	546	91.5	43	97.7		
Yes	51	8.5	1	2.3		
Emotional Disturbance					1.15	.284
No	524	87.8	41	93.2		
Yes	73	12.2	3	6.8		

Table 25, *continued*

	Other (Multiple Disabilities)					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
General Medical (OHI)					1.16	.281
No	541	90.6	42	95.5		
Yes	56	9.4	2	4.5		
ADHD/Other Disability					2.65	.103
No	451	75.5	38	86.4		
Yes	146	24.5	6	13.6		
Unknown/No Diagnosis					5.42	.020
No	531	88.9	44	100.0		
Yes	66	11.1	0	0.0		

Table 26

Frequencies and Percentages for Demographic Variables by GD-ADHD/other disability

	ADHD/Other Disability					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					5.05	.025
Caucasian	212	66.3	56	80.0		
Non-Caucasian	108	33.8	14	20.0		
Sex					4.15	.042
Male	308	63.4	110	72.4		
Female	178	36.6	42	27.6		

Table 26, *continued*

Frequencies and Percentages for Demographic Variables by GD-ADHD/other disability

	ADHD/Other Disability					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Learning Disability					49.75	< .001
No	311	63.6	142	93.4		
Yes	178	36.4	10	6.6		
Neurological Impairment					4.37	.037
No	444	90.8	146	96.1		
Yes	45	9.2	6	3.9		
ADD/ADHD					36.39	< .001
No	390	79.8	152	100.0		
Yes	99	20.2	0	0.0		
Autism					10.07	.002
No	440	90.0	149	98.0		
Yes	49	10.0	3	2.0		
Emotional Disturbance					4.07	.044
No	424	86.7	141	92.8		
Yes	65	13.3	11	7.2		
General Medical (OHI)					.06	.807
No	444	90.8	139	91.4		
Yes	45	9.2	13	8.6		
Other (Multiple Disabilities)					2.65	.103
No	451	92.2	146	96.1		
Yes	38	7.8	6	3.9		
Unknown/No Diagnosis					22.87	< .001
No	423	86.5	152	100.0		
Yes	66	13.5	0	0.0		

Table 27

Frequencies and Percentages for Demographic Variables by GD-Unknown/No Diagnosis

	Unknown/No Diagnosis					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Ethnicity RC					2.41	.121
Caucasian	234	67.4	34	79.1		
Non-Caucasian	113	32.6	9	20.9		
Sex					.04	.840
Male	376	65.4	42	66.7		
Female	199	34.6	21	33.3		
Learning Disability					30.54	< .001
No	387	67.3	66	100.0		
Yes	188	32.7	0	0.0		
Neurological Impairment					6.36	.012
No	524	91.1	66	100.0		
Yes	51	8.9	0	0.0		
ADD/ADHD					13.44	< .001
No	476	82.8	66	100.0		
Yes	99	17.2	0	0.0		
Autism					6.50	.011
No	523	91.0	66	100.0		
Yes	52	9.0	0	0.0		
Emotional Disturbance					9.90	.002
No	499	86.8	66	100.0		
Yes	76	13.2	0	0.0		
General Medical (OHI)					7.32	.007
No	517	89.9	66	100.0		
Yes	58	10.1	0	0.0		

Table 27, *continued*

Frequencies and Percentages for Demographic Variables by GD-Unknown/No Diagnosis

	Unknown/No Diagnosis					
	No		Yes			
	n	%	*n*	%	χ^2	*p*
Other (Multiple Disabilities)					5.42	.020
No	531	92.3	66	100.0		
Yes	44	7.7	0	0.0		
ADHD/Other Disability					22.87	< .001
No	423	73.6	66	100.0		
Yes	152	26.4	0	0.0		

Finally, Table 28 displays means and standard deviations for the variable age by demographic and general diagnostic variables. As displayed, a significant difference between the two means was observed for the variables neurological impairment, $F(1, 634) = 19.005$, $p < .001$, and emotional disturbance, $F(1, 634) = 9.426$, $p < .001$). Individuals in the sample with a diagnosis of neurological impairment were significantly older (M = 12.59, SD = 3.25) than individuals without a diagnosis of neurological impairment (M = 10.65, SD = 3.03). Similarly, individuals with a diagnosis of emotional disturbance were significantly older (M = 11.83, SD = 3.09) than individuals not diagnosed with an emotional disturbance (M = 10.67, SD = 3.07).

Table 28

Means and Standard Deviations for Age by Demographic and General Diagnostic Variables

	n	*M*	*SD*	*F*	*p*
Ethnicity				.47	.494
Caucasian	266	10.97	3.24		
Non-Caucasian	122	11.21	3.27		
Sex				.84	.361
Male	416	10.72	3.02		
Female	220	10.96	3.21		
GD-Learning Disability				2.03	.155
No	449	10.69	3.05		
Yes	187	11.07	3.16		
GD-Neurological Impairment				19.01	< .001
No	585	10.65	3.03		
Yes	51	12.59	3.25		
GD-ADD/ADHD				3.83	.051
No	538	10.91	3.10		
Yes	98	10.24	2.97		
GD-Autism				1.71	.192
No	584	10.85	3.08		
Yes	52	10.27	3.18		
GD-Emotional Disturbance				9.43	.002
No	561	10.67	3.07		
Yes	75	11.83	3.09		
GD-General Medical (OHI)				1.64	.201
No	578	10.85	3.10		
Yes	58	10.31	3.00		

Table 28, *continued*

Means and Standard Deviations for Age by Demographic and General Diagnostic Variables

	n	*M*	*SD*	*F*	*p*
GD-Other (Multiple Disabilities)				1.68	.196
No	592	10.76	3.06		
Yes	44	11.39	3.43		
GD-ADHD/Other Disability				.10	.755
No	484	10.83	3.17		
Yes	152	10.74	2.84		
GD-Unknown/No Diagnosis				.27	.607
No	574	10.83	3.11		
Yes	62	10.61	2.88		

Relationships between Demographic Variables and Independent Variables

The following section delineates the results of independent samples *t*-tests that were conducted to compare the means of NEPSY-II subtest scores between demographic variables. The independent samples t-test was utilized as it looks at differences in means based on a between subject factor with only two levels. Table 29 displays the results of independent samples t-tests that were conducted to compare the means of NEPSY-II subtest scores between females and males. Results revealed that on the Animal Sorting Combined, females (M = 8.79, SD = 3.74) scored higher than did males (M = 7.61, SD = 3.70), t = 3.80, p < .001. On the Auditory Attention – Response Set Combined, females (M = 7.67, SD = 4.03) scored higher than did males (M = 6.74, SD = 3.70), t = 2.92, p = .004. On Inhibition-Naming Combined – part 1, females (M = 8.23, SD = 3.71) again scored significantly higher than did males (*M* = 7.44, *SD* = 3.70), *t* = 2.56, *p* = .011. Females (*M* = 10.70, *SD* = 3.54) also scored higher on Word Generation Semantic Total than did males (*M* = 9.84, *SD* = 3.74), *t* = 2.82, *p* = .005. On Memory for Names, females (*M* = 9.67, *SD* = 3.73) scored higher than did males (*M* = 8.90, *SD* = 3.64), *t* = 2.51, *p* = .012. On Visuomotor Precision, females (*M* = 8.99, *SD* = 3.60) scored higher than did males (*M* = 7.89, *SD* = 3.53), *t* = 3.72, *p* < .001.

Results revealed that on Phonological Processing, males (*M* = 7.86, *SD* = 4.01) scored higher than did females (*M* = 6.40, *SD* = 3.70), *t* = 4.49, *p* < .001. On Memory for Designs Delayed, males (*M* = 8.79, *SD* = 3.66) scored significantly higher than did females (*M* = 7.92, *SD* = 3.38), *t* = 2.94, *p* = .003. On Arrows, males (*M* = 9.09, *SD* = 3.66) scored significantly higher than did females (*M* = 7.32, *SD* = 3.67), *t* = 5.80, *p* < .001. On Block Construction, males (*M* = 8.41, *SD* = 3.18) scored significantly higher than did females (*M* = 7.85, *SD* = 3.39), *t* = 2.08, *p* = .038. On Design Copy Process, males (*M* = 10.90, *SD* = 4.49) scored higher than did females (*M* = 9.92, *SD* = 4.72), *t* = 2.57, *p* = .010. On Picture Puzzles, males (*M* = 8.80, *SD* = 3.59) scored significantly higher than did females (*M* = 8.02, *SD* = 3.45), *t* = 2.67, *p* = .008. Males (*M* = 6.97, *SD* = 3.23) also scores higher on Inhibition-Switching Combined than did females (*M* = 6.06, *SD* = 3.08), *t* = 3.42, *p* = .001, see Table 29.

Table 29

Means and Standard Deviations for NEPSY II Subscale Scores by Sex

NEPSY II	*n*	*M*	*SD*	*F*	*p*
Animal Sorting Combined				3.797	< .001
Male	418	7.61	3.70		
Female	220	8.79	3.74		
Auditory Attention (Combined)				.472	.637
Male	418	7.92	3.78		
Female	220	8.06	3.70		
AARS - Response Set (Combined)				2.920	.004
Male	418	6.74	3.70		
Female	220	7.67	4.03		
Clocks				1.060	.290
Male	418	8.24	3.96		
Female	220	8.60	4.32		
Design Fluency				.820	.413
Male	418	8.01	4.03		
Female	220	7.74	3.85		
Inhibition-Naming Combined - Part 1				2.560	.011
Male	418	7.44	3.70		
Female	220	8.23	3.71		
Inhibition Combined - Part 2				.389	.697
Male	418	7.11	3.65		
Female	220	7.23	3.53		
Comprehension of Instructions				.627	.531
Male	418	7.69	3.58		
Female	220	7.51	3.45		
Phonological Processing				4.490	< .001
Male	418	7.86	4.01		
Female	220	6.40	3.70		

Note. Ψ Equal variances not assumed statistics reported.

Table 29, *continued*

NEPSY II	*n*	*M*	*SD*	*F*	*p*
Speeded Naming				.830	.407
Male	418	7.60	3.19		
Female	220	7.82	3.26		
Word Generation Semantic Total				2.821	.005
Male	418	9.84	3.74		
Female	220	10.70	3.54		
Word Generation Initial Letter Total				1.667	.096
Male	418	8.38	3.62		
Female	220	8.88	3.50		
List Memory Delayed Total Correct				.621	.535
Male	418	7.57	3.70		
Female	220	7.39	3.50		
Memory for Designs				1.608	.108
Male	418	8.85	3.69		
Female	220	8.35	3.66		
Memory for Designs (Delayed)				2.943	.003
Male	418	8.79	3.66		
Female	220	7.92	3.38		
Memory for Faces				.770	.441
Male	418	8.92	3.75		
Female	220	8.69	3.58		
Memory for Faces (Delayed)				.380	.704
Male	418	8.93	3.83		
Female	220	9.05	3.67		
Memory for Names				2.509	.012
Male	418	8.90	3.64		
Female	220	9.67	3.73		

Note. Ψ Equal variances not assumed statistics reported

Table 29, *continued*

NEPSY II	*n*	*M*	*SD*	*F*	*p*
Memory for Names Delayed				.335	.738
Male	418	7.79	3.59		
Female	220	7.89	3.47		
Narrative Memory				.066	.947
Male	418	9.65	3.54		
Female	220	9.67	3.73		
Narrative Memory Free Recall				.947	.344
Male	418	9.35	3.54		
Female	220	9.63	3.66		
Word List Interference Recall Total$^{\Psi}$				.266	.790
Male	418	7.58	3.81		
Female	220	7.50	3.43		
Visuomotor Precision				3.722	< .001
Male	418	7.89	3.53		
Female	220	8.99	3.60		
Finger Tapping - Dominant Hand				.190	.849
Male	418	8.21	3.33		
Female	220	8.26	3.42		
Imitating Hand Positions				1.536	.125
Male	418	7.25	3.09		
Female	220	6.85	3.17		
Affect Recognition				1.215	.225
Male	418	7.30	3.64		
Female	220	7.67	3.73		
Arrows				5.798	< .001
Male	418	9.09	3.66		
Female	220	7.32	3.67		
Block Construction				2.082	.038
Male	418	8.41	3.18		
Female	220	7.85	3.39		

Note. Ψ Equal variances not assumed statistics reported.

Table 29, *continued*

NEPSY II	*n*	*M*	*SD*	*F*	*p*
Design Copy Process				2.573	.010
Male	418	10.90	4.49		
Female	220	9.92	4.72		
Geometric Puzzles				1.720	.086
Male	418	6.76	4.07		
Female	220	6.19	3.79		
Picture Puzzles				2.666	.008
Male	418	8.80	3.59		
Female	220	8.02	3.45		
Memory for Designs Immediate				1.336	.182
Male	418	8.45	3.85		
Female	220	8.02	3.87		
Inhibition-Switching Combined				3.420	.001
Male	418	6.97	3.23		
Female	220	6.06	3.08		

Note. Ψ Equal variances not assumed statistics reported.

Table 30 displays results of independent samples *t*-tests that were conducted to compare the means of NEPSY-II subtest scores between Caucasians and non-Caucasians. Results revealed that on Auditory Attention Combined, Caucasians (M = 8.60, SD = 3.82) scored significantly higher than did non-Caucasians (M = 7.39, SD = 3.41), t = 3.13, p = .002. On Clocks, Caucasians (M = 8.77, SD = 4.17) scored significantly higher than did non-Caucasians (M = 7.81, SD = 3.99), t = 2.14, p = .033. On Inhibition Combined – part 2, Caucasians (M = 7.72, SD = 3.60) scored significantly higher than did non-Caucasians

(M = 6.66, SD = 3.05), t = 3.01, p = .003. On Comprehension of Instructions, Caucasians (M = 8.30, SD = 3.56) scored significantly higher than did non-Caucasians (M = 6.69, SD = 3.16), t = 4.29, p < .001. On Narrative Memory, Caucasians (M = 10.28, SD = 3.62) scored significantly higher than did non-Caucasians (M = 9.31, SD = 3.76), t = 2.43, p = .016. On Narrative Memory Free Recall, Caucasians (M = 10.02, SD = 3.60) scored significantly higher than did non-Caucasians (M = 9.16, SD = 3.57), t = 2.18, p = .030. On Picture Puzzles, Caucasians (M = 8.97, SD = 3.54) scored significantly higher than did non-Caucasians (M = 8.06, SD = 3.54), t = 2.35, p = .019. Finally, Caucasians (M = 6.72, SD = 3.12) also scored significantly higher on Inhibition-Switching Combined than did non-Caucasians (M = 5.90, SD = 2.90), t = 2.45, p = .015.

Table 30

Means and Standard Deviations for NEPSY II Subscale Scores by Ethnicity

NEPSY II	*n*	*M*	*SD*	*t*	*p*
Animal Sorting Combined				1.300	.194
Caucasian	268	8.32	3.71		
Non-Caucasian	122	7.80	3.69		
Auditory Attention (Combined)$^{\Psi}$				3.128	.002
Caucasian	268	8.60	3.82		
Non-Caucasian	122	7.39	3.41		
AARS - Response Set (Combined)				.013	.989
Caucasian	268	6.56	4.02		
Non-Caucasian	122	6.57	3.97		
Clocks				2.137	.033
Caucasian	268	8.77	4.17		
Non-Caucasian	122	7.81	3.99		

Note. Ψ Equal variances not assumed statistics reported.

Table 30, *continued*

NEPSY II	*n*	*M*	*SD*	*t*	*p*
Design Fluency				1.150	.251
Caucasian	268	7.87	3.90		
Non-Caucasian	122	7.37	4.16		
Inhibition-Naming Combined - Part 1				.588	.557
Caucasian	268	7.82	3.72		
Non-Caucasian	122	8.06	3.59		
Inhibition Combined - Part 2$^{\Psi}$				3.014	.003
Caucasian	268	7.72	3.60		
Non-Caucasian	122	6.66	3.05		
Comprehension of Instructions				4.292	< .001
Caucasian	268	8.30	3.56		
Non-Caucasian	122	6.69	3.16		
Phonological Processing				1.109	.268
Caucasian	268	7.13	3.87		
Non-Caucasian	122	6.66	3.73		
Speeded Naming				1.880	.061
Caucasian	268	8.00	3.20		
Non-Caucasian	122	7.32	3.50		
Word Generation Semantic Total				1.388	.166
Caucasian	268	10.63	3.75		
Non-Caucasian	122	10.07	3.60		
Word Generation Initial Letter Total				.156	.876
Caucasian	268	8.72	3.67		
Non-Caucasian	122	8.66	3.17		
List Memory Delayed Total Correct				.719	.473
Caucasian	268	7.46	3.53		
Non-Caucasian	122	7.19	3.42		
Memory for Designs				1.415	.158
Caucasian	268	8.96	3.62		
Non-Caucasian	122	8.41	3.40		

Note. Ψ Equal variances not assumed statistics reported.

Table 30, *continued*

NEPSY II	*n*	*M*	*SD*	*t*	*p*
Memory for Designs (Delayed)				1.474	.141
Caucasian	268	8.61	3.56		
Non-Caucasian	122	8.04	3.44		
Memory for Faces				1.329	.185
Caucasian	268	8.68	3.57		
Non-Caucasian	122	9.21	3.84		
Memory for Faces (Delayed)				1.338	.182
Caucasian	268	8.99	3.76		
Non-Caucasian	122	9.55	3.92		
Memory for Names				.767	.443
Caucasian	268	9.70	3.85		
Non-Caucasian	122	9.38	3.77		
Memory for Names Delayed				.537	.592
Caucasian	268	7.85	3.54		
Non-Caucasian	122	8.07	3.73		
Narrative Memory				2.428	.016
Caucasian	268	10.28	3.62		
Non-Caucasian	122	9.31	3.76		
Narrative Memory Free Recall				2.179	.030
Caucasian	268	10.02	3.60		
Non-Caucasian	122	9.16	3.57		
Word List Interference Recall Total				1.826	.069
Caucasian	268	7.71	3.68		
Non-Caucasian	122	6.98	3.47		
Visuomotor Precision				1.268	.206
Caucasian	268	8.40	3.51		
Non-Caucasian	122	7.91	3.67		

Note. Ψ Equal variances not assumed statistics reported.

Table 30, *continued*

NEPSY II	*n*	*M*	*SD*	*t*	*p*
Finger Tapping - Dominant Hand				.584	.560
Caucasian	268	8.37	3.32		
Non-Caucasian	122	8.58	3.37		
Imitating Hand Positions				.270	.787
Caucasian	268	7.37	3.23		
Non-Caucasian	122	7.47	3.11		
Affect Recognition				.060	.952
Caucasian	268	6.91	3.84		
Non-Caucasian	122	6.89	3.83		
Arrows				1.802	.072
Caucasian	268	8.80	3.71		
Non-Caucasian	122	8.07	3.76		
Block Construction				1.935	.054
Caucasian	268	8.35	3.20		
Non-Caucasian	122	7.69	2.92		
Design Copy Process				.540	.590
Caucasian	268	10.78	4.82		
Non-Caucasian	122	10.50	4.37		
Geometric Puzzles				.013	.990
Caucasian	268	5.74	4.11		
Non-Caucasian	122	5.73	3.88		
Picture Puzzles				2.353	.019
Caucasian	268	8.97	3.54		
Non-Caucasian	122	8.06	3.54		
Memory for Designs Immediate				1.495	.136
Caucasian	268	8.53	3.90		
Non-Caucasian	122	7.91	3.64		
Inhibition-Switching Combined				2.453	.015
Caucasian	268	6.72	3.12		
Non-Caucasian	122	5.90	2.90		

Note. Ψ Equal variances not assumed statistics reported.

Table 31 displays means and standard deviations for the NEPSY-II subscales based on levels of the variable primary diagnosis. A multivariate analysis of variance (MANOVA) model, a statistical procedure comparing multivariate means of several groups, was conducted to identify statistically significant differences between diagnostic groups. The post hoc Tukey method was utilized to find means that were significantly different from each other. As identified in Table 31, a significant multivariate effect was evident F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Univariate tests were conducted to identify significant difference based on diagnosis observed on all of the NEPSY-II subscales. The univariate F tests were significant for the following NEPSY-II subtest scores: Phonological Processing F (8, 623) = 2.83, $p = .004$, partial $\eta^2 = .035$, Speeded Naming F (8, 623) = 2.91, $p = .003$, partial $\eta^2 = .036$, Memory for Faces (delayed) F(8, 623) = 2.21, $p = .025$, partial $\eta^2 = .028$, Word List Interference Recall F (8, 623) = 2.15, $p = .030$, partial $\eta^2 = .027$, Visuomotor Precision F (8, 623) = 2.24, $p = .023$, partial $\eta^2 = .028$, Arrows F(8, 623) = 3.25, $p = .001$, partial $\eta^2 = .040$, Design Copy Process F (8, 623) = 3.20, $p = .001$, partial $\eta^2 = .039$, and Picture Puzzles F(8, 623) = 2.05, $p = .038$, partial $\eta^2 = .026$.

Post-hoc Tukey tests of mean differences showed that on Phonological Processing, participants diagnosed with ADD/ADHD scored significantly higher than participants not diagnosed (8.75 compared to 6.80, $p = .009$). On Speeded Naming those individuals diagnosed with a learning disability scored significantly higher than those with ADHD/Other disabilities (8.31 compared to 6.69, $p = .003$). On Memory for Faces-Delayed, individuals diagnosed with ADD/ADHD scored significantly higher than individuals diagnosed with other disabilities (9.84 compared to 6.87, $p = .028$); In terms of the Arrows subtest, individuals with an emotional disability scored significantly higher than individuals with an acquired neurological impairment (10.09 compared to 6.62, $p = .032$) and other disabilities (10.09 compared to 6.48, $p = .029$) Also, individuals with other disabilities scored significantly lower than participants with ADD/ADHD (6.48 compared to 9.46, $p = .027$) on the Arrows subtest. On Design Copy Process, individuals with learning disabilities scored significantly higher than participants with other disabilities (10.94 compared to 7.61, $p = .041$). Additionally, individuals diagnosed with ADD/ADHD scored significantly higher than participants with other disabilities (11.57 compared to 7.61, $p = .009$) and participants with an emotional disability scored significantly higher than participants with general medical (13.09 compared to 8.44, $p = .032$) and other disabilities (13.09 compared to 7.61, $p = .002$). Finally, on Picture Puzzles, participants within the other disabilities category scored significantly lower than participants with ADD/ADHD (6.30 compared to 9.29, $p = .014$) and participants within the ADHD/Other disability (6.30 compared to 8.89, $p = .043$). Table 31 reflects these distinctions with superscripts. If a particular mean has a superscript “a” then it is not significantly different from any other mean which is also indicated by the superscript “a”; however, if one of the means does not have the superscript “a”, then it is significantly different. For example, Phonological Processing ADD/ADHD differs from Unknown/No Diagnosis; but no other pairwise comparisons are significant. This pattern applies to superscripts “b” and “c” as well.

Table 31

Means and Standard Deviations for the NEPSY-II Subscales by Primary Diagnosis

	n	*M*	*SD*	*F*	*p*
NEPSY II Animal Sorting Combined				1.45	.172
Learning Disability	99	8.51	3.90		
Neurological Impairment (Acquired)	26	6.12	3.68		
ADD/ADHD	68	8.06	3.57		
Autism Spectrum	26	7.77	4.12		
Emotional Disability	23	8.87	3.68		
General Medical (OHI)	18	7.72	3.21		
Other (Multiple Disabilities)	23	7.17	3.60		
ADHD/Other disability	99	8.30	3.54		
Unknown/No Diagnosis	250	8.01	3.79		
NEPSY II Auditory Attention (Combined)				1.15	.325
Learning Disability	99	8.29	3.27		
Neurological Impairment (Acquired)	26	7.31	4.29		
ADD/ADHD	68	7.71	4.20		
Autism Spectrum	26	7.23	3.17		
Emotional Disability	23	9.43	3.59		
General Medical (OHI)	18	6.56	4.29		
Other (Multiple Disabilities)	23	8.04	3.89		
ADHD/Other disability	99	8.15	3.54		
Unknown/No Diagnosis	250	8.02	3.82		
NEPSY II AARS - Response Set (Combined)				1.62	.116
Learning Disability	99	8.20	3.98		
Neurological Impairment (Acquired)	26	7.23	3.64		
ADD/ADHD	68	7.31	3.76		
Autism Spectrum	26	6.46	3.69		
Emotional Disability	23	6.83	3.66		
General Medical (OHI)	18	6.67	3.55		
Other (Multiple Disabilities)	23	6.04	3.47		
ADHD/Other disability	99	6.78	3.85		
Unknown/No Diagnosis	250	6.85	3.89		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Clocks				1.56	.133
Learning Disability	99	8.81	4.14		
Neurological Impairment (Acquired)	26	6.88	4.22		
ADD/ADHD	68	8.56	4.34		
Autism Spectrum	26	8.04	4.99		
Emotional Disability	23	10.26	3.43		
General Medical (OHI)	18	7.22	3.74		
Other (Multiple Disabilities)	23	7.43	4.36		
ADHD/Other disability	99	8.38	4.01		
Unknown/No Diagnosis	250	8.44	3.94		
NEPSY II Design Fluency				.95	.474
Learning Disability	99	8.26	3.93		
Neurological Impairment (Acquired)	26	7.35	4.21		
ADD/ADHD	68	8.37	4.24		
Autism Spectrum	26	8.50	3.76		
Emotional Disability	23	7.83	2.98		
General Medical (OHI)	18	6.61	4.09		
Other (Multiple Disabilities)	23	6.61	3.92		
ADHD/Other disability	99	8.15	3.85		
Unknown/No Diagnosis	250	7.84	4.03		
NEPSY II Inhibition-Naming Combined - Part 1				1.11	.352
Learning Disability	99	8.03	3.81		
Neurological Impairment (Acquired)	26	8.00	3.95		
ADD/ADHD	68	8.46	3.78		
Autism Spectrum	26	7.96	3.50		
Emotional Disability	23	8.00	3.30		
General Medical (OHI)	18	7.72	3.63		
Other (Multiple Disabilities)	23	6.65	3.04		
ADHD/Other disability	99	7.05	3.62		
Unknown/No Diagnosis	250	7.69	3.77		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Inhibition Combined - Part 2				1.12	.348
Learning Disability	99	7.70	3.52		
Neurological Impairment (Acquired)	26	6.81	3.78		
ADD/ADHD	68	7.76	3.74		
Autism Spectrum	26	7.69	3.80		
Emotional Disability	23	7.70	3.23		
General Medical (OHI)	18	7.06	4.04		
Other (Multiple Disabilities)	23	6.65	3.41		
ADHD/Other disability	99	6.58	3.14		
Unknown/No Diagnosis	250	7.00	3.78		
NEPSY II Comprehension of Instructions				1.58	.127
Learning Disability	99	7.69	3.30		
Neurological Impairment (Acquired)	26	6.54	2.60		
ADD/ADHD	68	8.00	3.69		
Autism Spectrum	26	8.15	4.07		
Emotional Disability	23	9.52	3.15		
General Medical (OHI)	18	7.33	2.74		
Other (Multiple Disabilities)	23	6.91	3.63		
ADHD/Other disability	99	7.89	3.48		
Unknown/No Diagnosis	250	7.46	3.64		
NEPSY II Phonological Processing				2.83	.004
Learning Disability	99	7.06 [ab]	3.76		
Neurological Impairment (Acquired)	26	6.27 [ab]	3.28		
ADD/ADHD	68	8.75 [a]	3.93		
Autism Spectrum	26	7.31 [ab]	4.02		
Emotional Disability	23	7.91 [ab]	4.38		
General Medical (OHI)	18	8.44 [ab]	2.73		
Other (Multiple Disabilities)	23	7.13 [ab]	3.75		
ADHD/Other disability	99	8.20 [ab]	4.10		
Unknown/No Diagnosis	250	6.80 [b]	4.02		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Speeded Naming				2.91	.003
Learning Disability	99	8.31 ^{ab}	3.19		
Neurological Impairment (Acquired)	26	7.46 ^{abc}	2.72		
ADD/ADHD	68	8.65 ^{b}	3.01		
Autism Spectrum	26	8.00 ^{abc}	3.41		
Emotional Disability	23	8.22 ^{abc}	2.39		
General Medical (OHI)	18	8.50 ^{abc}	2.75		
Other (Multiple Disabilities)	23	7.65 ^{abc}	3.13		
ADHD/Other disability	99	6.69 ^{c}	3.08		
Unknown/No Diagnosis	250	7.49 ^{abc}	3.32		
NEPSY II Word Generation Semantic Total				.68	.713
Learning Disability	99	10.54	3.55		
Neurological Impairment (Acquired)	26	9.50	3.65		
ADD/ADHD	68	10.66	3.66		
Autism Spectrum	26	9.81	3.27		
Emotional Disability	23	10.96	4.36		
General Medical (OHI)	18	10.17	3.40		
Other (Multiple Disabilities)	23	9.91	4.32		
ADHD/Other disability	99	9.80	3.57		
Unknown/No Diagnosis	250	10.14	3.78		
NEPSY II Word Generation Initial Letter Total				.66	.724
Learning Disability	99	8.64	3.43		
Neurological Impairment (Acquired)	26	8.35	2.90		
ADD/ADHD	68	8.82	3.19		
Autism Spectrum	26	8.35	3.39		
Emotional Disability	23	8.00	4.16		
General Medical (OHI)	18	9.44	3.13		
Other (Multiple Disabilities)	23	7.61	4.22		
ADHD/Other disability	99	8.99	3.88		
Unknown/No Diagnosis	250	8.50	3.63		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II List Memory Delayed Total Correct				.98	.451
Learning Disability	99	8.07	3.65		
Neurological Impairment (Acquired)	26	7.08	3.52		
ADD/ADHD	68	7.54	3.48		
Autism Spectrum	26	7.08	3.35		
Emotional Disability	23	8.74	3.70		
General Medical (OHI)	18	7.22	3.56		
Other (Multiple Disabilities)	23	6.61	3.39		
ADHD/Other disability	99	7.30	3.73		
Unknown/No Diagnosis	250	7.39	3.70		
NEPSY II Memory for Designs				1.02	.419
Learning Disability	99	8.80	3.30		
Neurological Impairment (Acquired)	26	7.08	3.87		
ADD/ADHD	68	8.71	3.30		
Autism Spectrum	26	8.00	3.62		
Emotional Disability	23	9.04	3.76		
General Medical (OHI)	18	9.56	2.77		
Other (Multiple Disabilities)	23	8.39	3.56		
ADHD/Other disability	99	9.02	4.12		
Unknown/No Diagnosis	250	8.60	3.83		
NEPSY II Memory for Designs (Delayed)				1.74	.085
Learning Disability	99	8.67	3.66		
Neurological Impairment (Acquired)	26	6.85	3.02		
ADD/ADHD	68	9.34	3.82		
Autism Spectrum	26	7.88	4.24		
Emotional Disability	23	8.13	3.82		
General Medical (OHI)	18	7.33	2.38		
Other (Multiple Disabilities)	23	7.65	3.58		
ADHD/Other disability	99	8.46	3.60		
Unknown/No Diagnosis	250	8.61	3.50		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Memory for Faces				.90	.516
Learning Disability	99	9.22	4.11		
Neurological Impairment (Acquired)	26	9.54	4.54		
ADD/ADHD	68	9.16	3.37		
Autism Spectrum	26	9.19	3.30		
Emotional Disability	23	7.96	3.46		
General Medical (OHI)	18	8.56	3.00		
Other (Multiple Disabilities)	23	7.87	3.89		
ADHD/Other disability	99	8.38	3.23		
Unknown/No Diagnosis	250	8.85	3.80		
NEPSY II Memory for Faces (Delayed)				2.21	.025
Learning Disability	99	9.55	3.49		
Neurological Impairment (Acquired)	26	9.15	3.81		
ADD/ADHD	68	9.84	3.57		
Autism Spectrum	26	9.19	2.97		
Emotional Disability	23	9.35	4.11		
General Medical (OHI)	18	8.39	3.48		
Other (Multiple Disabilities)	23	6.87	3.52		
ADHD/Other disability	99	8.27	3.61		
Unknown/No Diagnosis	250	8.93	3.95		
NEPSY II Memory for Names				1.13	.342
Learning Disability	99	8.97	3.78		
Neurological Impairment (Acquired)	26	8.50	3.01		
ADD/ADHD	68	10.19	3.60		
Autism Spectrum	26	8.54	3.51		
Emotional Disability	23	9.61	3.50		
General Medical (OHI)	18	8.50	3.43		
Other (Multiple Disabilities)	23	9.78	4.05		
ADHD/Other disability	99	8.99	3.58		
Unknown/No Diagnosis	250	9.14	3.75		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Memory for Names Delayed				1.72	.091
Learning Disability	99	7.55	3.75		
Neurological Impairment (Acquired)	26	7.08	3.33		
ADD/ADHD	68	8.65	3.05		
Autism Spectrum	26	8.42	3.55		
Emotional Disability	23	9.22	3.57		
General Medical (OHI)	18	8.72	3.74		
Other (Multiple Disabilities)	23	7.96	3.84		
ADHD/Other disability	99	8.03	3.07		
Unknown/No Diagnosis	250	7.48	3.70		
NEPSY II Narrative Memory				1.32	.230
Learning Disability	99	9.70	3.37		
Neurological Impairment (Acquired)	26	8.38	2.73		
ADD/ADHD	68	10.43	3.66		
Autism Spectrum	26	8.69	3.06		
Emotional Disability	23	9.43	3.15		
General Medical (OHI)	18	8.67	3.38		
Other (Multiple Disabilities)	23	10.22	3.78		
ADHD/Other disability	99	9.64	3.66		
Unknown/No Diagnosis	250	9.78	3.78		
NEPSY II Narrative Memory Free Recall				1.43	.183
Learning Disability	99	9.30	3.28		
Neurological Impairment (Acquired)	26	8.38	2.12		
ADD/ADHD	68	10.40	3.67		
Autism Spectrum	26	8.77	3.10		
Emotional Disability	23	9.30	3.38		
General Medical (OHI)	18	8.67	3.36		
Other (Multiple Disabilities)	23	10.48	3.88		
ADHD/Other disability	99	9.64	3.67		
Unknown/No Diagnosis	250	9.40	3.74		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Word List Interference Recall Total				2.15	.030
Learning Disability	99	8.49	3.89		
Neurological Impairment (Acquired)	26	6.81	3.35		
ADD/ADHD	68	7.91	3.21		
Autism Spectrum	26	7.46	3.43		
Emotional Disability	23	7.04	4.05		
General Medical (OHI)	18	7.11	2.93		
Other (Multiple Disabilities)	23	5.87	3.92		
ADHD/Other disability	99	6.90	3.45		
Unknown/No Diagnosis	250	7.66	3.81		
NEPSY II Visuomotor Precision				2.24	.023
Learning Disability	99	8.85	3.73		
Neurological Impairment (Acquired)	26	6.81	3.62		
ADD/ADHD	68	9.06	3.77		
Autism Spectrum	26	8.23	3.33		
Emotional Disability	23	9.61	3.16		
General Medical (OHI)	18	7.89	3.71		
Other (Multiple Disabilities)	23	6.96	4.07		
ADHD/Other disability	99	7.96	3.19		
Unknown/No Diagnosis	250	8.13	3.59		
NEPSY II Finger Tapping - Dominant Hand				1.31	.236
Learning Disability	99	8.70	3.33		
Neurological Impairment (Acquired)	26	9.00	3.61		
ADD/ADHD	68	8.47	3.20		
Autism Spectrum	26	8.81	3.14		
Emotional Disability	23	8.78	3.15		
General Medical (OHI)	18	7.72	2.37		
Other (Multiple Disabilities)	23	7.61	3.79		
ADHD/Other disability	99	8.35	3.34		
Unknown/No Diagnosis	250	7.80	3.44		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*	*SD*	*F*	*p*
NEPSY II Imitating Hand Positions				1.54	.142
Learning Disability	99	7.06	3.12		
Neurological Impairment (Acquired)	26	6.08	3.02		
ADD/ADHD	68	7.59	3.40		
Autism Spectrum	26	7.69	2.87		
Emotional Disability	23	7.61	3.65		
General Medical (OHI)	18	6.78	3.14		
Other (Multiple Disabilities)	23	5.91	3.36		
ADHD/Other disability	99	7.58	3.03		
Unknown/No Diagnosis	250	6.98	3.01		
NEPSY II Affect Recognition				1.46	.168
Learning Disability	99	8.29	3.89		
Neurological Impairment (Acquired)	26	7.38	3.34		
ADD/ADHD	68	7.49	3.65		
Autism Spectrum	26	6.38	4.13		
Emotional Disability	23	7.65	3.63		
General Medical (OHI)	18	7.44	3.11		
Other (Multiple Disabilities)	23	6.39	2.97		
ADHD/Other disability	99	7.70	3.70		
Unknown/No Diagnosis	250	7.14	3.64		
NEPSY II Arrows				3.25	.001
Learning Disability	99	8.49^{a}	3.44		
Neurological Impairment (Acquired)	26	6.62^{ab}	3.03		
ADD/ADHD	68	9.46^{ac}	3.51		
Autism Spectrum	26	7.27^{a}	3.54		
Emotional Disability	23	10.09^{ac}	3.01		
General Medical (OHI)	18	8.06^{a}	3.67		
Other (Multiple Disabilities)	23	6.48^{ab}	3.49		
ADHD/Other disability	99	8.84^{a}	4.05		
Unknown/No Diagnosis	250	8.53^{a}	3.91		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*		*SD*	*F*	*p*
NEPSY-II Block Construction					1.73	.088
Learning Disability	99	7.88		3.13		
Neurological Impairment (Acquired)	26	6.69		3.37		
ADD/ADHD	68	8.54		3.10		
Autism Spectrum	26	8.46		3.51		
Emotional Disability	23	8.96		3.34		
General Medical (OHI)	18	7.22		2.39		
Other (Multiple Disabilities)	23	8.00		3.28		
ADHD/Other disability	99	8.81		2.92		
Unknown/No Diagnosis	250	8.24		3.46		
NEPSY-II Design Copy process					3.20	.001
Learning Disability	99	10.94	ac	4.42		
Neurological Impairment (Acquired)	26	10.92	abc	4.93		
ADD/ADHD	68	11.57	ac	4.55		
Autism Spectrum	26	10.08	abc	4.54		
Emotional Disability	23	13.09	ac	4.53		
General Medical (OHI)	18	8.44	ab	3.90		
Other (Multiple Disabilities)	23	7.61	b	4.19		
ADHD/Other disability	99	10.48	abc	4.55		
Unknown/No Diagnosis	250	10.45	abc	4.58		
NEPSY II Geometric Puzzles					1.17	.317
Learning Disability	99	7.26		3.95		
Neurological Impairment (Acquired)	26	6.92		3.21		
ADD/ADHD	68	7.31		4.10		
Autism Spectrum	26	5.96		3.16		
Emotional Disability	23	6.30		3.59		
General Medical (OHI)	18	5.89		3.66		
Other (Multiple Disabilities)	23	5.91		3.67		
ADHD/Other disability	99	6.60		3.84		
Unknown/No Diagnosis	250	6.22		4.24		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Table 31, *continued*

	n	*M*		*SD*	*F*	*p*
NEPSY II Picture Puzzles					2.05	.038
Learning Disability	99	8.43	a	3.52		
Neurological Impairment (Acquired)	26	7.58	a	3.62		
ADD/ADHD	68	9.29	ab	3.59		
Autism Spectrum	26	8.69	a	3.02		
Emotional Disability	23	9.17	a	3.65		
General Medical (OHI)	18	8.17	a	2.94		
Other (Multiple Disabilities)	23	6.30	ac	2.84		
ADHD/Other disability	99	8.89	ab	3.18		
Unknown/No Diagnosis	250	8.46	a	3.76		
NEPSY II Memory for Designs Immediate					1.18	.310
Learning Disability	99	8.56		3.94		
Neurological Impairment (Acquired)	26	7.27		3.34		
ADD/ADHD	68	8.96		4.14		
Autism Spectrum	26	7.77		3.88		
Emotional Disability	23	8.30		3.80		
General Medical (OHI)	18	8.11		3.10		
Other (Multiple Disabilities)	23	6.65		3.45		
ADHD/Other disability	99	8.08		3.94		
Unknown/No Diagnosis	250	8.40		3.88		
NEPSY II Inhibition-Switching Combined					1.17	.313
Learning Disability	99	6.69		3.53		
Neurological Impairment (Acquired)	26	6.46		3.61		
ADD/ADHD	68	6.53		3.20		
Autism Spectrum	26	5.92		3.02		
Emotional Disability	23	5.96		2.95		
General Medical (OHI)	18	6.61		2.93		
Other (Multiple Disabilities)	23	6.30		3.59		
ADHD/Other disability	99	7.45		2.93		
Unknown/No Diagnosis	250	6.56		3.11		

Note. Multivariate F (264, 4622) = 1.34, $p < .001$, partial $\eta^2 = .069$. Means with different superscripts differ, $p < .05$; post hoc comparisons were completed using the Tukey method.

Summary

This chapter presented the results of the statistical analyses and is divided into three sections. The first section provides preliminary statistical analyses including descriptive statistics. The second section describes the factor structure of the NEPSY-II data utilizing a modified five-factor model based on the theoretical model proposed by Korkman and colleagues (2007b) represented by Model 1, which indicated a poor fit with the observed data. A slightly modified measurement model was presented based on modifications to Model 1 suggested by Lisrel 8.80 to reduce the χ^2 value, thus producing a better fitting model (Model 2). Model 2 was an adjusted version of Model 1 and provided a marginally acceptable fit with the observed data, representing an improvement over Model 1. The third section explored the impact of the diagnostic groups on the factor structure of the NEPSY-II.

CHAPTER V

DISCUSSION

The current study evaluated the underlying factor structure of the NEPSY-II in a mixed clinical sample of children. A CFA was used to determine if a modified five-factor model based on the Korkman and colleagues (2007b) model provided the best fit with the data. The modified five-factor model indicated a poor fit; however, an adjusted version of the model provided a marginally acceptable fit. The remainder of this chapter highlights the implications for practice, limitations of the study, and suggestions for future research.

Purpose and Goal

The purpose of this study was to examine the underlying factor structure of the NEPSY-II within a mixed clinical sample. A CFA was utilized on a modified five-factor model based on the theoretical factor structure of Korkman, et al. (2007b) with the content domains of: Attention and Executive Functioning, Language, Memory and Learning, Sensorimotor, and Visuospatial Processing. The NEPSY-II is used extensively within pediatric neuropsychology; however, at this time there are less than five studies that evaluate the NEPSY-II and no studies conducted that assess the underlying factor structure of the measure. Further, many researchers have discussed the dearth of research that examines the factor structure of the NEPSY-II, which is problematic as it is used pervasively within pediatric neuropsychology (Brooks, Sherman, & Strauss, 2010; Davis & Matthews, 2010; Titley & D'Amato, 2008). From a psychometric perspective confirmatory factor analysis (CFA) is viewed as a crucial step in the validation of assessment tools (Cole, 1987). Further, when a CFA is performed on an assessment tool the results frequently provide greater empirical support for the authors' theoretical framework. Thus, the current study addressed a dearth in the pediatric neuropsychological assessment literature.

Summary of Results

Preliminary Analysis

The preliminary analyses were conducted to obtain a comprehensive knowledge of the data, which were then used to determine aspects of the demographic data that needed to be accounted for in the primary analysis. The results of these analyses indicated that more than half of the sample was comprised of boys. This was expected due to more assessment referrals made for school-age boys in comparison to girls (Hassett, 2010). Further, a large number of participants had at least one clinical diagnosis, with a specific Learning Disability (LD) representing the largest category of clinical diagnosis. This finding was not surprising given that LD characterizes the most common disability among children seeking educational services (Fletcher, Lyon, Fuchs, & Barnes, 2007). The ethnicities for much of the sample were unknown; however, a large percentage of known ethnicities identified as Caucasian. This finding is understandable given that individuals that identify as Caucasian represent the largest ethnic group in the United States (retrieved from www.census.gov).

Multivariate analyses examined relationships between demographic variables with findings of significant relationships across multiple diagnostic categories. The following section will highlight the most compelling findings. In terms of age, there was a significant relationship with neurological impairment where participants with a diagnosis of neurological impairment were, on average, older than participants without a diagnosis of neurological impairment. Also, a significant relationship was found with emotional disturbance where participants with a diagnosis of emotional disturbance were, on average, older than individuals not diagnosed with an emotional disturbance. The findings related to age may be understood as clinicians may be hesitant to make significant diagnostic impressions in young children due to the variability in typical early development. The diagnostic criteria is often more vague in younger children with symptoms often becoming more pronounced with age (Cuevas et al., 2014).

In terms of sex, a significant relationship was discovered with learning disability where a greater proportion of female participants were diagnosed with a learning disability compared to male participants. The literature on learning disabilities does not support this finding; therefore, it may be due to a unique difference in this sample (Fletcher et al., 2007). Additionally, a significant relationship was found with ADHD/other disability where a greater proportion of male participants were diagnosed with ADHD/other disability compared to female participants. This finding is consistent with previous research studies that stated ADHD is typically 2.3 times more common in boys than girls (Bauermeister et al., 2007).

Through the analysis of ethnicity variables a significant relationship with emotional disturbance was uncovered where a greater proportion of participants with emotional disturbance were Caucasian compared to non-Caucasian. The body of research on ethnicity and diagnosis of emotional disturbance typically found that non-Caucasian individuals are diagnosed with emotional disturbance at higher rates when compared to Caucasian students (Hosp & Reschly, 2004). This body of research also reported that low socioeconomic status (SES) is a predictor of children obtaining the label of emotional disturbance. SES was not included in this study, although SES could have contributed to this finding in the study.

A relationship was found between neurological impairment and learning disability where a greater proportion of participants with a learning disability were also diagnosed with a neurological impairment compared to participants without a learning disability. The literature on neurologic impairment discussed the association between learning disabilities and neurological impairment citing that learning disabilities can be precursors to more serious neurological impairments (Rourke, 1995).

The following section describes the relationships between the independent variables. There were numerous relationships between the independent variables on the NEPSY-II. These findings are consistent with prior neuropsychological research that posits neuropsychological tasks represent complex and overlapping processes that may depend on several subprocesses (Gazzaniga, Ivry, Mangun, & Steven, 1998; Korkman, 1999). Further, these findings support the NEPSY-II authors' assertion that the subtests that comprise each domain may not be highly correlated with one another as they vary in terms of stimulus presentation, administration, response type, and scoring emphasis. Also, subtests across domains could be highly correlated as a result of comparable methodology and crossover abilities (Korkman et al., 2007b).

When looking at the overall pattern of the coefficients within constructs, correlations among attention and executive functioning items ranged from no meaningful relationship between Inhibition-Naming Combined Part 1 and Animal Sorting Combined, to strong relationships between Inhibition-Combined Part 2 and Inhibition-Naming Combined part 1. Moderate size correlations were observed between the language items, such as Word Generation Semantic Total and Phonological Processing and between Word Generation Initial Letter and Word Generation Semantic Total. In terms of memory and learning items, the magnitude of between-item correlations were more varied; ranging from coefficients showing no meaningful relationship such as Narrative Memory Free Recall and List Memory delayed total correct, to a very strong relationship between Narrative Memory Free Recall and Narrative Memory. In summary, the moderate to strong correlations between different aspects of the same task (i.e., Word Generation Initial Letter and Word Generation Semantic Total) is not unexpected as these tasks are essentially measuring similar constructs or skills. Weak correlations were observed among sensorimotor items. In terms of visuospatial processing, items had mostly moderate relationships. In conclusion, the majority of correlations were positive in direction and statistically significant, although, a few strong correlations or negative correlations were noted between pairs of items.

Primary Analysis

The primary analyses were completed to address the primary research question in this study, which was to examine the underlying factor structure of the NEPSY-II in a mixed clinical sample of children. A CFA was utilized to determine if the modified five-factor model based on the theoretical model proposed by Korkman and colleagues (2007b) provided the best fit with the data.

The theoretical model proposed by Korkman and colleagues (2007b) was tested using a measurement model, which required that several confirmatory factor analyses were conducted simultaneously. All standardized path coefficients were in a positive direction, which indicated that higher scores for each item were related to more attention and executive functioning, language, memory and learning, sensorimotor, and visuospatial processing. The items loaded adequately; however, the overall fit of the measurement model was not adequate. The reliabilities of the conceptual factors were examined through an investigation of the composite reliabilities. This analysis exposed inadequate composite reliabilities suggesting that children did not seem to respond similarly to items within the same construct. Additionally, the average variance explained (AVE) values were computed for each theoretical construct resulting in values below the minimum requirement. Finally, discriminant validity was assessed for each theoretical construct by comparing the highest shared variance (HSV). These results indicate that although the NEPSY-II items were positively related to one other, the proposed model demonstrated more variance between theoretical constructs than within the constructs. Only the correlation between the sensorimotor construct and the memory and learning construct was weak to moderate. The correlations for the constructs of attention and executive function with the language construct and with the visuospatial processing construct were strong, indicating that these may not be distinctive constructs. As a result of the poor model fit, Model 2 was introduced as an adjusted version of the original model. This model was different from the original as Design Fluency, Memory for Names, Narrative Memory, and Narrative Memory Free Recall were omitted and the errors of some of the items were allowed to correlate. Similar to Model 1, the standardized path coefficients were all in the positive direction and statistically significant, thus demonstrating that higher scores on the items were associated with higher scores on their associated theoretical construct. The model fit was minimally adequate and further modification did not result in a better fitting model.

Reliability and discriminant validity were evaluated with Model 2 and similar to Model 1, Model 2 analysis exposed inadequate composite reliabilities. The average variance explained (AVE) values were computed for each theoretical construct resulting in values below the minimum suggested by Fornell and Larcker (1981). Finally, discriminant validity was assessed with results indicating that no discriminant validity was shown based on all HSV values being higher than corresponding AVE values. These results indicate that NEPSY-II items were positively related to each other; however, the proposed model showed more variance between theoretical constructs than within the constructs. All correlations among latent constructs in Model 2 were greater than .300. Correlations were especially strong for constructs of attention and executive function with language construct and visuospatial processing construct, with the correlation between visuospatial processing and sensorimotor, indicating that these may not be distinctive constructs. These modifications were atheoretical in nature and based on Lisrel 8.80 modification with Model 2 indicating a marginally acceptable global and local fit. Therefore Model 2 did demonstrate an improved global and local fit over Model 1.

Exploratory Analyses

Independent samples t-tests were conducted to compare the means of NEPSY-II subtest scores between Caucasians and non-Caucasians and revealed that Caucasians scored significantly higher than did non-Caucasians on Auditory Attention Combined, Clocks, Inhibition Combined – part 2, and Inhibition-Switching Combined. These finding are consistent with other studies that have established that race and ethnicity impact performance on tasks of executive function (Fournier, Canas, Sevadjian, Miller, & Maricle, 2012). Caucasians also scored significantly higher than non-Caucasians on Comprehension of Instructions, Narrative Memory, Narrative Memory Free Recall, and Picture Puzzles, which indicates that ethnicity and race may also impact performance on measures of language, memory and learning, and visuospatial processing. These findings represent the importance of further neuropsychological research addressing the impact of culture, ethnicity, and race on neurocognitive functioning.

Independent samples t-tests were also conducted to compare the means of NEPSY-II subtest scores between sex. Generally, females tended to outperform males on tasks of executive functioning such as superior performances on Animal Sorting-Combined, Auditory Attention-Response Set, and Inhibition Naming. This finding was consistent with current research which also found that girls outperformed boys on tasks of executive functioning (Wiebe, Espy, & Charak, 2008). These finding should be interpreted with some caution due to unique aspects of this sample, such as higher number of male participants diagnosed with ADHD, which could impact the results reported in this study. Overall, males tended to outperform females on visuospatial tasks such as Block Construction, Design Copy, Arrows, and Picture Puzzles. The research in neuropsychological development in children has reported similar findings as well in terms of visuospatial performance differences between boys and girls (Kramer, Ellenberg, Leonard, & Share, 1996). Additionally, there is established literature that acknowledges that neurocognitive ability differences between boys and girls are both biologically and socially influenced; thus, differences in performance cannot be attributed to sex differences alone. The interplay between biological, social, and environmental contributions most likely contributed to the findings in this study.

A MANOVA was conducted to identify statistically significant differences between primary diagnostic groups. Children with ADD/ADHD were found to outperform children with other disabilities across several neurocognitive measures. These findings further substantiated that ADD/ADHD deficits may have a profound impact on executive functioning and attention while sparing functioning in other neurocognitive domains, particularly when compared to children with other clinical disorders (Bauermeister et al., 2007). Participants diagnosed with ADD/ADHD scored significantly higher than participants diagnosed with other disabilities on Memory for Faces Delayed, Picture Puzzles, Arrows, Design Copy Process, and Phonological Processing. In contrast, children diagnosed with learning disability scored significantly higher than those with ADHD/Other on Speeded Naming. Although Speeded Naming does not directly measure attention it does require sustained attention; thus, children diagnosed with ADD/ADHD may perform poorly when compared with other clinical groups on this measure. These results were consistent with the special group study results presented in the NEPSY-II clinical and interpretative manual regarding the performance of individuals with ADHD (Korkman et al., 2007b).

Another significant finding was that participants with emotional disability scored significantly higher on Arrows than participants with general medical and other disabilities. This finding is consistent with the literature on pediatric chronic illness as these groups tend to have a variety of neurocognitive weaknesses and may present with an uneven neurocognitive profile (Castillo, 2008). Participants with learning disabilities also scored significantly higher on Design Copy Process than participants with other disabilities. This finding may be due to the broad group of children included in the learning disability category in this study. For example, it is possible that the sample contained more children with only math or reading disabilities; therefore, their performance on tasks of visual-spatial processing were less impaired than other diagnostic groups (Fletcher et al., 2007).

Implications for the Field of Pediatric and School Neuropsychology

The NEPSY-II was designed for use among pediatric populations in both school and clinical settings; therefore, the findings of the current study have implications for both areas of practice. The preliminary analyses and a CFA were conducted on the NEPSY-II with a mixed-clinical sample. It is important to note that the NEPSY-II authors' predictions were consistent with the findings in the preliminary analyses. For example, the authors predict that the subtests comprising each domain may not be highly correlated with one another and that subtests across domains could be highly correlated. Further, the authors specified that the domains of the NEPSY-II were theoretically derived and were not based on statistical analyses. From a statistical perspective, these statements appear accurate along with the evidence that the modified five-factor model, based on the Korkman and colleagues (2007b) theoretical model, indicated a poor fit with the data and that the further modified model demonstrated only a marginally acceptable fit. However, factor analysis procedures are considered to be a critical step when developing an assessment measure (Cole, 1987; Floyd & Widaman, 1995).

While the authors appreciate the complexity and utility of their measure it is essential that clinicians comprehend the use and limitations of the measure conceptually. As such, it is important to understand that neuropsychological researchers posit that neurocognitive tasks represent complex and overlapping processes that may depend on several subprocesses (Gazzaniga et al., 1998; Korkman, 1999). Therefore, when practitioners utilize the NEPSY-II it is imperative to avoid drawing conclusions based on a child's performance on one or two subtests given the overlap between neurocognitive constructs and the inability of the NEPSY-II to provide clean measures of specific neurocognitive constructs. This caution is especially critical given the high correlations between the domains of attention and executive function with the language construct and with the visuospatial processing construct and correlation between visuospatial processing and sensorimotor. Given that these tasks overlap considerably they should not be considered pure measures on the constructs they are purported to measure.

Another implication/consideration of this study is that only one theoretical model was examined. There could be other neurocognitive models in existence that would provide a better global and local fit with the observed data. A critical first step in assessment development is to evaluate the underlying structure of a measure; however, this procedure had not been completed by the NEPSY-II authors or any other researchers in the field of neuropsychology (Cole, 1987; Floyd & Widaman, 1995). As a result of this preliminary research completion, other researchers have the opportunity to examine other models that may more adequately describe neurocognitive constructs in children.

Another consideration in the current study was the composition of the sample population. The population was comprised of individuals with mixed-clinical diagnoses and overall was a heterogeneous sample. The Korkman and colleagues (2007b) six-factor conceptual model may have demonstrated an adequate fit with a different sample population. For example, a population containing neurotypical children or a homogenous sample may have provided an improvement between the observed data, as well as the local and global fit of the Korkman and colleagues (2007b) six-factor conceptual model.

Limitations

A number of methodological issues related to the study design warrant discussion considering their potential impact on the overall study. Specifically, threats to internal, external, and statistical conclusion validity will be delineated. Internal validity describes the study's ability to provide a clear conclusion regarding the relationship of the constructs measured (Gravetter & Forzano, 2009). For this particular study, one threat to internal validity involved the use of a CFA analysis. The CFA analysis uses an a priori theory with a specified data set. There are several other factor structures that were not tested that could potentially be utilized to explain the data. Although the Korkman and colleagues (2007b) factor structure may explain the data well, there could be other unspecified factor structures that explain the data equally well. Thus, the internal validity of the study is limited due to the one theorized factor structure being examined. In order to rectify this issue, local and global aspects of fit were studied to assess the efficacy of the Korkman and colleagues (2007b) factor structure.

External validity denotes the generalizability of the study, meaning the results from the sample extend to the population of interest. The sample utilized in the study was comprised of individuals with different clinical diagnoses, thus producing a sample that is not likely to be representative of the general population. Therefore, the results of the study may not approximate other samples drawn from the general population. Nevertheless, it is imperative to restate that the sample associated with the study represented both demographic and geographic diversity, which positively impacted the generalizability of the study.

This study used archival data collected from professionals administering individualized school neuropsychological evaluations to a wide range of children. Therefore, the occurrence of missing data was expected as the professionals were able to select particular subtests from the NEPSY-II to administer to the participants. This subtest selection may have impacted the study's statistical analysis and outcomes. Additional consequences of the individualized batteries given to participants included missing data, as the data set did not include all subtest scores from the NEPSY-II for each participant. If only the complete cases were used, valuable data would have been lost by removing incomplete cases. Additional consequences of the individualized batteries given to participants included missing data, as the data set may not include all subtest scores from the NEPSY-II for each participant. If only the complete cases were used, valuable data may be lost by removing incomplete cases. This is of particular concern in this study as missing data were missing not at random (MNAR). Additionally, when listwise deletion is utilized, methodical differences between the complete cases and incomplete cases may not be detected. Further, deletion methods would have ultimately reduced statistical conclusion validity and may have produced bias in parameter estimates. To minimize these consequences, MI is recommended in the literature and was utilized to manage missing data in the data set being utilized for the study (Allison, 2003). This technique involves the statistical imputation of likely values for the missing data (Gravetter & Forzano, 2009).

Statistical conclusion validity refers to the ability of the study's findings to create accurate conclusions regarding the variables utilized in the study (Gravetter & Forzano, 2009). One of the majors concerns within this type of validity is the statistical power (Aberson, 2010). Therefore, other studies with poor statistical conclusion validity most often have poor statistical power. Statistical power is defined as the ability to find a relationship between variables of interest when the relationship does, in fact, exist. Sample sizes have a major impact on statistical power; therefore, deletion methods threaten overall statistical conclusion validity. Although the proposed study had an adequate sample size, low statistical power was still concerning. While there is not clear consensus on the issue of sample size, the structural equation modeling (SEM) literature provides the most helpful guidance suggesting a sample size of greater than 200 cases; however, this recommendation is subject to change due to model complexity (Brown, 2006). This study was complex because of the number of factors and indicators, thus it was possible that low power may have influenced the results. To account for these issues, the sample size for this study was 632 cases and numerous fit indices that are not sensitive to sample size were examined.

Recommendations for Future Research

This study provided a critical step in understanding the underlying factor structure of the NEPSY-II. The NEPSY-II is a commonly used pediatric neuropsychological measure, yet limited research has been conducted on the NEPSY-II. Consequently, the current study provides essential information on the NEPSY-II from a psychometric perspective as a CFA is regarded as a crucial step in the validation of an assessment tool (Cole, 1987). Confirmatory Factor Analysis can provide more empirical support for the authors' theoretical positions or help with revisions to the conceptual model of the measure. Given that this study is the only CFA on the widely used NEPSY-II, replication of this study is critical in substantiating the results of this study as well as producing valuable information that could be utilized in a NEPSY-II revision. Another proposed study could include separate CFA's by sex and ethnicity to ascertain if the Korkman and colleagues (2007b) conceptual model is a better fit with specific populations (i.e. girls, boys, Caucasian, African Americans, etc.). From past studies there is evidence of ethnic and sex differences regarding performance on the NEPSY-II (Fournier et al., 2012)

Moreover, a study comparing the Korkman and colleagues (2007b) six-factor model with other models of neurocognitive functioning, such as Miller's (2013) Integrated School Neuropsychological Model (SNP)/Cattell-Horn-Carroll (CHC), could be an important step in determining the model that offers the best explanations for the observed pediatric neurocognitive data. This type of study could represent important developments in the field of pediatric and school neuropsychology as professionals could have an improved conceptual understanding of their neuropsychological assessment tools. Additionally, revisions to neurocognitive measures based on this type of study could produce more precise tools to assess neurocognitive functioning in the pediatric population.

Summary

In conclusion, the objective of the current study was to examine the underlying factor structure of the NEPSY-II. The analysis served as a step in the validation of the authors' proposed six-factor model. The results indicated the author-proposed model was an inadequate fit with the data with a modified model demonstrating a slightly more adequate fit. This chapter provided a review of the preliminary and primary analyses. The interpretations of the finding were discussed with an emphasis on the complexity of neurocognitive constructs, and the importance of using the NEPSY-II along with other clinical data to develop a diagnostic impression of a child. Therefore, future research on the NEPSY-II should include a replication of this study along with examining the author-proposed model in comparison with other neurocognitive models to determine which model represents the best fit with the data.

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