PRELIMINARY VALIDATION OF THE NEUROPSYCHOLOGICAL PROCESSING CONCERNS CHECKLIST

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To the Dean of the Graduate School:

I am submitting herewith a dissertation written by Heather N. Arduengo entitled "Preliminary Validation of the Neuropsychological Processing Concerns Checklist." I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor in Philosophy with a major in School Psychology.

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ABSTRACT

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When conducting a comprehensive neuropsychological evaluation, determining a starting point can be challenging. Referral questions are often vague, and parent or teacher concerns can be ambiguous. Thus, there is a need for a tool that allows parents and teachers to identify their concerns while also providing a framework for school neuropsychologists. The Neuropsychological Processing Concerns Checklist (NPCC; Miller, 2007) was developed with the intent to provide professionals with a framework to organize neuropsychological assessment, interpretation, and intervention. The NPCC includes seven neuropsychological functions including: sensorimotor functions, attention problems, language functions, memory and learning functions, executive functions, and speed and efficiency of cognitive processing. Academic functions within the area of reading, writing, and mathematics are also included in the NPCC to give professionals more information about academic concerns. The purpose of this study was to determine the factor structure of the NPCC. The data used in this study was excerpted from archival data from case studies submitted as part of KIDS Inc. School Neuropsychology Post Graduate Certification Program. Exploratory factor analyses were conducted for both parent and teacher responses to evaluate the factor structure of the NPCC with the prime intent of exploring how Miller's (2007) proposed theoretical model is explained by the instrument's items. Results revealed a factor structure that contained 19 factors. Of these factors, there were constructs similar to Miller's (2007) model as well as other narrower constructs within a broader neuropsychological domain for both parent and teacher raters.

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CHAPTER I

INTRODUCTION

Neuropsychology has traditionally been defined as the study of brain-behavior relationships (Fiorello, Hale, Decker, & Coleman, 2010) and emphasizes the application of knowledge of brain functions to patterns of behavior (D'Amato, 1990). With the knowledge base of medicine, psychology, and the basic sciences expanding at an increasing rate, clinicians are becoming more specialized (Lezak, Howieson, & Loring, 2004). This growth over the past several decades has led to a number of related subspecialty areas, including pediatric neuropsychology, school neuropsychology, geriatric neuropsychology, forensic neuropsychology, and rehabilitation neuropsychology (D'Amato & Hartlage, 2008). The application of neuropsychological research to education has evolved into an emerging specialty area of school neuropsychology.

School neuropsychologists who have specialized training in school psychology and pediatric neuropsychology are able to offer a wide range of services, with neuropsychological assessment being one of them. School neuropsychological evaluations often include measures of academic achievement, social-emotional functioning, and general intellectual ability similar to psychoeducational evaluations, but also include measures of neurocognitive constructs such as sensory-motor functioning, language, attention, visual-spatial functioning, learning and memory, executive functioning, and speed and efficiency of cognitive processing (Miller, 2010). The goal of a neuropsychological evaluation is not necessarily to qualify a child for special education, but to provide an overview of the child's cognitive strengths and weaknesses which can be used to help determine how that particular student learns and to modify intervention strategies accordingly (Miller, 2007). This leads to the need for models to conceptualize assessment, as well as instruments to guide assessment choices.

When a child is referred for a school neuropsychological evaluation, case conceptualization can be difficult. Therefore, it is important to a have a conceptual model to guide assessment and intervention practices. Three models have influenced the practice of school neuropsychology: Lurian theory, the Cattell-Horn-Carroll (CHC) model, and the process assessment approach (Miller, 2010). Lurian theory was derived from the clinical practice and research of A. R. Luria, and postulates that the brain operates hierarchically in three ways (Languis & Miller, 1992). Unit One serves an arousal and attention function, allowing one to focus and direct attention. Unit Two is the sensory input and integration unit, and is responsible for the reception, analysis, and storage of information. Unit Three is the executive planning and organization unit. This theory suggests that without adequate functioning of the first unit, cognitive functioning within the second and third unit is likely to be impaired.

CHC theory has strongly influenced the field of cognitive assessment (Newton & McGrew, 2010) and also influences the practice of school psychology and school neuropsychology. The CHC theory posits nine broad areas of cognitive functioning. The broad categories labeled as neurocognitive constructs are: Crystallized Intelligence or Comprehension/Knowledge (*Gc*), Long-Term Storage and Retrieval (*Glr*), Visual-Spatial

Abilities (*Gv*), Auditory Processing (*Ga*), Fluid Intelligence/Reasoning (*Gf*), Cognitive Processing Speed (*Gs*), Short-Term Memory (*Gsm*), Quantitative Reasoning (*Gq*), and Academic Reading and Writing (*Grw*). Quantitative Reasoning as well as Academic Reading and Writing do not pertain to the current study; thus will not be discussed in further detail. Not only has the CHC theory been influential to psychometric testing (Flanagan & Harrison, 2005), but it provides another framework for school psychologists for assessing the overall cognitive functioning of a child.

The third theory that guides assessment in school neuropsychology is the process assessment approach. This approach derives from the idea that how a person arrives at a particular answer is as important as the test score itself (Milberg, Hebben, & Kaplan, 1996). The importance of considering an individual's process gained attention as clinical observations became formalized and as new assessment methods were constructed with requirements that the examiner directly quantify such observations (Baron, 2004). These qualitative behaviors provide school neuropsychologists with concrete information about strategies the child is using during the task.

In 2007, a comprehensive model was introduced by Miller that provides a framework for both school neuropsychological assessment and intervention, and incorporates aspects of the three previously mentioned theories. In Miller's (2007) model, a number of neurocognitive constructs are identified including: sensorimotor functions, attentional processes, visual-spatial processes, language processes, memory and learning processes, executive functions, speed and efficiency of processing, general intellectual functioning, academic achievement, and social-emotional functioning. These neurocognitive constructs are often assessed in school neuropsychological evaluations; thus his model is useful for school neuropsychologists. When conducting a comprehensive neuropsychological evaluation, determining a starting point can be challenging for school neuropsychologists (Miller, 2007). Referral questions are often vague, and parent or teacher concerns for the student can be ambiguous. Thus, there is a need for a tool that allows parents or teachers to identify their concerns for the student while also providing a framework for school neuropsychologists. Very few instruments list concerns for school-aged children, specifically relating to neuropsychological constructs and academic achievement. Only one other instrument, the Psychological Processing Checklist (PPC; Swerdlik, Swerdlik, & Kahn, 2003) lists concerns related to processing difficulties. This scale, completed by teachers, is designed to measure psychological processing difficulties of children. However, this checklist has only been normed with children in grades kindergarten to fifth grade in the state of Illinois. Because of these limitations, the PPC has limited generalizability.

Miller (2007) developed the Neuropsychological Processing Concerns Checklist (NPCC) with the intent to provide professionals with a framework to organize neuropsychological assessment, interpretation, and intervention. The NPCC includes seven areas derived from Miller's (2007) school neuropsychological conceptual model: sensorimotor functions, attention problems, language functions, memory and learning functions, executive functions, and speed and efficiency of cognitive processing. Academic functions in the areas of reading, writing, and mathematics are also included in the NPCC to give professionals more information about academic concerns. The NPCC is a rating scale given to teachers, as well as parents, in the effort to gather more information about the child from the parent or teacher's perspective.

The NPCC was developed with Miller's (2007) school neuropsychological conceptual model as its foundation. Miller believes sensory-motor functioning, as well as attentional processes, serve as the baseline for all behavior; therefore, these two constructs are listed first within the NPCC. The first section of the NPCC is the Sensorimotor Functions section, with its various subsections including motor functioning, tactile/olfaction functioning, visual functioning, and auditory functioning. Visual-spatial functioning is included within this section as it is closely aligned with many sensory-motor processes. Attention Problems is the second section of the NPCC and is divided into five subcomponents: focused or selective attention, sustained attention, shifting attention, divided attention, and attentional capacity. Language Functions follow the attention section within the NPCC, and is broken into four sections. The four subsections within the Language section are articulation, phonological processing, receptive language, and expressive language. The fourth section of the NPCC is the Memory and Learning Functions section, divided into four subsections: short-term memory, active working memory, long term memory, and general learning. Following the memory section is Executive Functions, which is broken into two subsections: problem solving, planning, and organizing, and behavioral/emotional regulation. Speed and Efficiency of Cognitive Processing is the last neurocognitive section of the NPCC.

The last three sections of the NPCC are related to academic functioning in the areas of reading, writing, and mathematics. These are listed last as academic achievement is impacted by cognitive processing. For example, the first academic section, Academic Functions: Reading, follows the cognitive processing section and is divided into attention functions, phonological processing and fluency functions, comprehension/memory functions, and attitudinal issues. The next section, Academic Functions: Writing has four subsections: graphomotor output functions, spatial production functions, expressive language functions, and attitudinal issues. Academic Functions: Mathematics is listed last in the NPCC. This section includes attentional functions related to math, computational knowledge, mathematical reasoning/comprehension, and attitudinal issues.

Rationale, Purpose, and Significance of the Study

The NPCC can be a valuable tool for school neuropsychologists in helping identify concerns of parents and teachers. To increase its usefulness, it is important that the checklist is a valid measure of identifying concerns of neuropsychological processes. According to the *Standards for Educational and Psychological Testing*, validity is the most fundamental consideration in developing and evaluating tests (Goodwin & Leech, 2003). Therefore, it is imperative to assess the validity of the NPCC.

The purpose of the current study is to determine the validity of the NPCC, and to demonstrate that the items listed in the NPCC statistically measure what Miller intended for them to measure. Further, the items in the NPCC were developed based on each neuropsychological construct and are thought to cluster together. For example, items related to attention are thought to cluster together, items related to memory are thought to cluster together, and items related to language are thought to cluster together. Therefore, it is expected that six factors will be produced, with each factor representing one of the identified neuropsychological constructs.

Research Question

Based upon the preceding discussion, the following research question is proposed: What is the factor structure of the Neuropsychological Processing Concerns Checklist (NPCC)?

CHAPTER II

REVIEW OF THE LITERATURE

Traditionally, neuropsychology has been defined as the study of brain-behavior relationships (Fiorello, et al., 2010). More specifically, neuropsychology emphasizes the application of knowledge of brain functions to patterns of behavior (D'Amato, 1990). A wide variety of assessment procedures have been designed to allow neuropsychologists to make inferences about the brain. The single test approach dominated the field of neuropsychology from 1900 to 1950, wherein practitioners during this period differentiated patients with brain damage from other groups using a single measure (Miller, 2007). In this approach, a single fixed battery of tests comprised of a standard set of instruments that had been validated though extensive research on both normal control and various patient populations was the standard of practice (Koziol & Budding, 2011). An advantage of this method was that patients were administered the exact same battery, allowing practitioners to differentiate performance based on neuropsychological behaviors and neuroanatomical correlates. A disadvantage of the fixed battery approach is that it cannot be individualized for the patient or the suspected neuropsychological deficit. Therefore, in the 1960s and 1970s, a group of clinicians began investigating the variations in cognitive performance across clinical populations using a flexible test battery designed to answer their questions. The flexible battery, as opposed to the fixed battery approach, has numerous advantages in that tests can be chosen based on the referral questions allowing the practitioner to bypass assessment in areas that are not a concern (Koziol & Budding, 2011). More recently, there has been a shift toward theoretically-driven assessment, in which practitioners use a conceptual framework of neuropsychological functioning to devise an assessment battery that draws tests from a number of tests batteries and that answers a particular referral question (Miller, 2007). The increase in knowledge of brain-behavior relationships, as well as cognitive and neuropsychological functioning, is now driving how practitioners approach assessment. This requires expertise from the practitioner. For example, to assess attention, the practitioner needs to have an understanding of how attentional networks are organized within the brain and recognize which tests evaluate those attentional functions appropriately (Koziol & Budding, 2011).

Historically, neuropsychological assessment was generally conducted in clinical settings; however, with the knowledge base of medicine, psychology, and the basic sciences expanding at an increasing rate, clinicians are becoming more specialized (Lezak et al., 2004). This growth over the past several decades has led to a number of related subspecialties, including pediatric neuropsychology, school neuropsychology, geriatric neuropsychology, forensic neuropsychology, and rehabilitation neuropsychology (D'Amato & Hartlage, 2008). It has become evident, for example, that neuropsychology has many applications for school psychologists working in the schools (Decker, 2008). Many disabilities common to childhood, such as learning disabilities, traumatic brain injuries, and attention deficit hyperactivity disorder, are known to be correlated with numerous biological variables, including genetics, neurological development, and functional brain activation patterns (Fiorello, et al., 2010), which has led to the emerging specialty area of school neuropsychology. School neuropsychology is a step beyond general neuropsychology, as well as general school psychology, as it focuses on the neuropsychological aspects of children within the school. As a result, school neuropsychologists are able to offer a wide range of services, with specialized assessment being one of them. A comprehensive neuropsychological evaluation assesses a broader variety of constructs than a typical psychoeducational evaluation. For instance, school neuropsychological evaluations often include measures of academic achievement, social-emotional functioning, and general intellectual ability similar to psychoeducational evaluations, but also include measures of neurocognitive constructs such as sensory-motor functioning, language, attention, visual-spatial functioning, learning and memory, executive functioning, and speed and efficiency of cognitive processing (Miller, 2010). The goal of a school neuropsychological evaluation is not necessarily to qualify a child for special education, but to provide an overview of the child's cognitive strengths and weaknesses which can be used to determine how a particular student learns and to modify intervention strategies accordingly (Miller, 2007).

Theories that Guide Assessment

When a child is referred for a school neuropsychological evaluation, case conceptualization can be difficult. Therefore, it is important to have a conceptual model to guide assessment and intervention practices. There are three models that have guided practice in school neuropsychology: Lurian theory, the Cattell-Horn-Carroll (CHC) model, and the process assessment approach (Miller, 2010).

Lurian theory was derived from the clinical practice and research of A. R. Luria. Luria's theory divides the brain into three major brain regions: Block One consists of the lower brain stem structures, Block Two comprises the posterior cerebral cortex, and Block Three comprises the anterior cerebral cortex. These regions are conceptualized to make unique contributions to neuropsychological functioning (Soper & Horton, 2011). More specifically, according to Soper and Horton, Block One maintains the general tone and consistent energy supply of the cerebral cortex, whereas the area posterior to the central sulcus in Block Two encodes sensory stimuli in a way that the incoming information can be processed by other regions of the cerebral cortex. Block Three, the area anterior to the central sulcus, initiates, produces, monitors, and evaluates behavioral motor responses. Luria further divided Block Two into three functional units necessary for any type of mental activity: Unit One, the arousal and attention unit; Unit Two, the sensory input and integration unit; and Unit Three, the executive planning and organization unit (Languis & Miller, 1992). Lurian theory is hierarchical in nature, suggesting that without adequate functioning of the first unit, cognitive functioning within the second and third units is likely to be impaired. Das (1988) emphasizes that these three units are also intercorrelated and supports his argument by providing an example of the brain processes involved in drawing a circle. Without appropriate arousal or attention, an individual could not even begin to draw a circle. The individual must also be able to process the information it takes to draw a circle. Such information includes the ability to monitor whether or not the circle is drawn in the right direction, or processing whether or not the lines are in fact completing a circle. Lastly, the individual must be aware that each small movement with the pencil is actually part of a larger plan: to successfully create a circle. This example illustrates the brain processes involved in a simple task, and alludes to the fact that brain processes become more complex as the task required by the individual also becomes complex.

Understanding the hierarchical nature of cognitive functioning allows for better assessment of an individual because the school neuropsychologist has a framework for assessing basic brain functioning before assessing higher order functioning. A wide variety of assessments, have been created with Luria's approach in mind, for example, the Kaufman Assessment Battery for Children-Second Edition (KABC II: Kaufman & Kaufman, 2004) and the NEPSY-II (Korkman, Kirk, & Kemp, 2007)

The Cattell-Horn-Carroll theory, better known as CHC theory, is another theory that guides practice in school neuropsychology as it assesses several areas of cognitive functioning. In the early 1900s, cognitive functioning was conceptualized as a unitary factor, often referred to as intelligence. Researchers, such as Charles Spearman, believed intelligence was best understood in terms of a single general factor, which he labeled "*g*" (Sternberg, 2005). While many researchers supported Spearman's theory, others believed that intelligence could not be explained by a single factor, but as a combination of several factors.

With this notion in mind, John Horn and Raymond Cattell developed what is most commonly known as the Cattell-Horn *Gf-Gc* model (Flanagan & Harrison, 2005). This model proposed two parts of intelligence: 1) fluid intelligence (*Gf*) and 2) crystallized intelligence (*Gc*). A few years later, John B. Carroll constructed a model of intelligence that was comprised of three strata: Stratum I included many narrow or specific abilities used in combination to form the broad abilities of the second strata; Stratum II, included broad abilities such as fluid intelligence, crystallized intelligence (also referred to as Comprehension/Knowledge), memory and learning, visual perception, auditory perception, retrieval ability, and processing speed; and Stratum III, which included a single general intelligence similar to Spearman's *g* (Flanagan & Harrison, 2005; Sternberg, 2005). The CHC theory is an integration of Cattell-Horn's *Gf-Gc* model and Carroll's three-stratum model, and assesses nine broad areas of cognitive functioning.

The broad categories labeled as neurocognitive constructs of the CHC theory are: Crystallized Intelligence or Comprehension/Knowledge (*Gc*), Long-Term Storage and Retrieval (*Glr*), Visual-Spatial Abilities (*Gv*), Auditory Processing (*Ga*), Fluid Intelligence/Reasoning (*Gf*), Cognitive Processing Speed (*Gs*), Short-Term Memory (*Gsm*), Quantitative Reasoning (*Gq*), and Academic Reading and Writing (*Grw*). Quantitative Reasoning and Academic Reading and Writing do not pertain to the research question and will not be discussed in further detail. The following descriptions of the remaining seven broad categories are adapted from Flanagan and Harrison (2005).

The *Gc* domain is primarily a store of verbal or language-based knowledge. This includes declarative and procedural knowledge, and is acquired through general and educational life experiences. Academic skills, such as reading, writing, and mathematics generally fall within the *Gc* domain as they involve learned knowledge and skills. The *Gf* domain, on the other hand, involves the use of mental operations to solve problems that cannot be performed automatically. Some mental operations include concept formation, classification, generating and testing hypotheses, problem solving, and transforming information. Inductive and deductive reasoning are generally considered indicators of *Gf*. The broad ability of *Glr* consists of the ability to store and consolidate new information in long-term memory, and retrieve that information at a later time. The *Gv* domain, according to Flanagan and Harrison, represents a collection of different abilities that emphasize processes involved in the generation, storage, retrieval, and transformation of visual images. Tasks that measure this broad ability include mentally reversing, or rotating shapes in space.

Abilities involved in discriminating patterns in sounds, as well as abilities to analyze, manipulate, comprehend, and synthesize sound elements, compose the *Ga* domain. The broad CHC ability of *Gs* consists of the ability to automatically and fluently perform easy cognitive tasks, especially when high mental attention or focused concentration is required. An example of a task that measures processing speed would be to rapidly calculate basic arithmetic problems. Last but not least, the *Gsm* domain involves the ability to apprehend and maintain awareness of different parts of information within short-term memory. While the CHC theory calls this factor short-term memory, it appears to be more a measure of working memory in that the majority of *Gsm* tasks require some sort of manipulation of the information presented to the child during testing.

Not only has the CHC theory been influential to psychometric testing (Flanagan & Harrison, 2005), but it provides another framework for school psychologists for assessing the overall cognitive functioning of a child. Each broad cluster provides specific information about a child's overall intellectual functioning. A number of tests use the CHC theory as their theoretical foundation. For example, the Woodcock-Johnson III Tests of Cognitive Abilities (WJ III COG: McGrew, Schrank, & Woodcock, 2007), the Wechsler series of tests (WISC –IV: Wechsler, 2003; WAIS-IV: Wechsler, 2008), the Stanford Binet-Fifth Edition (SB5: Roid, 2003), and the Kaufman Assessment Battery for Children-2nd Edition (KABC-II) each incorporate aspects of the CHC theory within their assessments.

The third theory that guides assessment in school neuropsychology is the process assessment approach. This approach began as the Boston Process Approach in 1986, but is currently called the process assessment approach (Miller, 2010). This approach derives from the idea that how a person arrives at a particular answer is as important as the test score itself. The importance of considering an individual's process gained attention as clinical observations became formalized and as new assessment methods were constructed with requirements that the examiner directly quantify such observations (Baron, 2004). These qualitative behaviors provide school neuropsychologists with concrete information about strategies the child is using during the task. For example, does a child use his fingers to help him solve math problems? Self-correction errors are another example of a behavior that provides the examiner with qualitative information. A child who is able to recognize he or she made an error and correct the answer without any cues from the examiner shows good self-monitoring skills, a good skill to have academically. The Delis-Kaplan Executive Function System, or the D-KEFS (Delis, Kaplan, & Kramer, 2001) and the NEPSY-II are tests that incorporate the process assessment approach and have included ways to quantify certain behavioral observations in the assessment.

A Model for School Neuropsychology

In 2007, Miller introduced a comprehensive school neuropsychological conceptual model that incorporates aspects of the previously mentioned theories. Similar to Luria's hierarchical theory, Miller's (2007) conceptual model states sensory-motor functions and attentional processing serve as the essential building blocks for the other higher-order cognitive functions. Many of the areas of cognitive functioning delineated in CHC theory are also a part of Miller's conceptual model, including but not limited to visual-spatial abilities, short-term memory, and processing speed. Additionally, qualitative behaviors are taken into consideration in Miller's model as they can help explain how an individual derives a particular solution. Miller's conceptual model provides a framework for school neuropsychological assessment and intervention, and incorporates neurocognitive constructs including: sensorimotor functions, attentional processes, visual-spatial processes, language processes, memory and learning processes, executive functions, speed and efficiency of processing, general intellectual functioning, academic achievement, and social-emotional functioning. Each of the areas within the conceptual model will be described in greater detail in the following sections.

Sensory-Motor Functioning

Generally, the term *sensory-motor* in neuropsychology involves an assessment of basic input and output functions (Decker & Davis, 2010). These functions are typically more complex than reflexes, but not complex enough to require effortful reasoning or problem solving. Sensory functions encompass our ability to process information from our senses: sights, sounds, touch, and smells. Motor functions, on the other hand, include fine motor skills (i.e., picking up or manipulating various objects, or holding a pencil correctly) as well as gross motor skills (i.e., effectively and fluently walking, running, jumping, or riding a bike).

Sensory-motor functions, along with attentional processes according to Miller (2007), serve as the baseline of all higher order processes. Similar to the Lurian theory, without appropriate arousal from the senses, higher order processes cannot occur. The ability to learn, according to Hendrix (2010), depends upon the quality of sensory experiences and the individual's capacity to process sensory information. For example, some children are over stimulated by sensory input. Lights may be brighter or sounds may be louder to them. These stimulations can be uncomfortable, or even painful, for these children. For example, children on the autism spectrum often complain about the texture of their clothing and can be picky about the clothes they wear. Other children, on the other hand, may be under stimulated, such that they are unable to feel pain at the same level as most children. These differences in sensory input affect how a child learns about his or her environment, which also plays a role in how the child behaves within the environment. Motor functioning also plays a role in a child's overall learning and behavior (Miller, 2007). For example, the inability to hold a pencil correctly, which impacts how a child performs in school, may be an observable behavior that provides evidence for an underlying motor deficit. Understanding a child's sensory-motor functioning will allow professionals to rule out whether or not an underlying sensory-motor deficit is impeding their ability to be successful academically.

Various parts of the brain are responsible for sensory-motor functioning. According to Carter (2009), the primary visual cortex is located in the striate cortex of the occipital lobe, whereas the primary auditory cortex is located in the superior part of the temporal lobe. The primary somatosensory cortex, which regulates the sense of touch, pain, and temperature, is located in the postcentral gyrus. The frontal regions of the cortex are involved in planning movement, whereas the premotor cortex is involved in learning and executing complex movements. The cerebellum plays an important role in motor coordination. Damage to any part of the sensory pathways or motor cortex can cause a variety of impairments (Miller, 2007).

There are a number of disorders that include sensory or motor deficits. According to the American Psychiatric Association's Diagnostic and Statistical Manual for Mental Disorders, Text Revision (*DSM-IV-TR*; APA, 2000), such disorders include Developmental Coordination Disorder (DCD), Nonverbal Learning Disability (NVLD), Attention-Deficit/Hyperactivity Disorder (ADHD) or Autism Spectrum Disorder. Children with DCD typically have difficulties walking or running, and often have visual-spatial processing deficits. DCD is sometimes used as an overarching term describing any condition with primary motor planning and execution deficits (Hertza & Estes, 2011). Children with NVLD tend to also have visual-spatial deficits. Sensory-motor impairments may be secondary symptoms for children with ADHD, as some children with ADHD have difficulties with motor control. Some children on the autism spectrum have sensory-integration issues as well as gross and fine motor problems (Miller, 2010; Piek & Dyck, 2004).

The Dean-Woodcock Sensory-Motor Battery (DWSMB; Dean & Woodcock, 2003), the sensorimotor core of the NEPSY-II, the Beery-Buktenica Visual Motor Integration Test, Sixth Edition (VMI; Beery, Buktenica, & Beery, 2010), and the Bender-Gestalt, Second Edition (Brannigan & Decker, 2003) are tests that assess various aspects of sensory, motor, or both sensory and motor functioning. It is important to assess sensory-motor aspects of a child's overall functioning as one of the exclusionary criteria for learning disabilities is sensory-motor impairment (IDEA, 2004). Because sensory and motor problems need to be ruled out prior to identifying a child with a learning disability (as well as many other disabilities), it is helpful for parents and teachers to highlight their concerns in these areas.

Attention

Attention, like sensory-motor functioning, also serves as a baseline for all higher-order processes. Without attention, a child will not learn, let alone retain, information. In order to regulate behavior and to complete tasks such as schoolwork, it is necessary to be able to attend to the environment. Although attention has been the focus of significant research, there is still no clear or universal definition for attention (Goldstein, Jansen, & Naglieri, 2011). A study by Picano, Klusman, Hornbestel, and Moulton (1992) described three factors of attention. The first factor involved skills related to visual motor scanning and shifting, with divided attention serving as a key component in such processes. The second factor reflected immediate attention and conceptual tracking, while the third factor reflected sustained effortful processing. A neuropsychological model of attention, developed by Mirsky, Anthony, Duncan, Ahearn, and Kellam (1991) is composed of five concepts of attention: the ability to focus, execute, sustain, encode, and shift. *Focus*, according to Mirsky and his colleagues, refers to the ability to select a target from an array. The *execute* element is often paired with the *focus* element, and refers to the act of performing a task. *Sustain*, on the other hand, requires an individual to be able to stay on task in a vigilant manner, and the *shift* element relates to the ability to change attentive focus in a flexible and adaptive manner. Finally, *encode* refers to the capacity to hold information briefly in the mind while performing some other cognitive action on it. Mirsky's model forms the foundation of Miller's (2007, 2010) model as Miller views attention as a multifaceted construct that can be divided into five subcomponents: focused or selective attention, sustained attention, shifting attention, divided attention, and attentional capacity.

Focused or selective attention often requires concentrated attention in order to comprehend the information (Mirsky, Pascualcara, Duncan, & French, 1999). For example, learning the multiple steps to solve a complicated math problem involves selectively attending to each step in order to successfully calculate the solution and move on to the next step in the equation. Sustained attention is the ability to maintain attention over a prolonged period of time, whereas shifting attention is the ability to consciously redirect, or shift, attention to another task. It is important for students to be able to maintain their attention to the task on hand long enough to comprehend the material. Similarly, it is important for children to be able to shift their attention as the classroom is often full of distractors. A student should be able to redirect their attention back to the task at hand even when briefly distracted from extraneous sources. Divided attention is the ability to pay attention to a variety of different tasks at once (Goldstein, 2011). The act of being in the classroom often requires divided attention. To effectively attend in a classroom, the student must be able to pay attention to the teacher, ignore other students, as well as read information presented on the chalkboard, and write any notes on their own piece of paper. The last subcomponent of attention is attentional capacity, which refers to the limit of an individual's attention.

Because attention is multifaceted, various parts of the brain, rather than one specific region, are involved with attention. For example, the function of selective attention is thought to be shared by the superior temporal and inferior parietal cortices, as well as by structures that comprise the corpus striatum (Mirsky, 1996). Further, according to Mirsky, sustained attention involves the thalamic and brain stem structures, whereas shifting attention involves the prefrontal cortex, including the anterior cingulate gyrus. Identification of the brain structures involved in attention has been shown through research involving attention deficit disorders. For example, research with individuals who have attention deficit hyperactivity disorder (ADHD) has shown that the main cortices implicated in ADHD include the prefrontal cortex, specifically the dorsolateral prefrontal and interior prefrontal cortices, and their associated frontal-subcortical circuit structures, including the striatum and the thalamus (Hale et al., 2010). Further, numerous structural magnetic reasoning imaging (MRI) studies have reported smaller regions of the prefrontal cortex in children with ADHD (Halperin & Healey, 2010).

Given the complexity of attention, it is clear that children with attentional issues have difficulties in school as inattention affects many areas of cognitive functioning. Deficits in attention lead to difficulties completing school work, paying attention to the task on-hand, and/or following rules. Research has shown, for example, that children with ADHD generally perform one standard deviation lower than children without ADHD on cognitive functioning and pre-academic achievement measures (DuPaul, McGoey, Eckert, & VanBrakle, 2001). Therefore, it is important to understand the areas of attention a child may have difficulties with in order to determine how to help them succeed academically, behaviorally, and socially.

There are a wide range of assessments that measure aspects of attention. The Test of Everyday Attention for Children (TEA-CH: Manly, Robertson, Anderson, & Nimmo-Smith, 1999) is a battery of nine subtests designed to assess the various components of attention in children. The NEPSY-II, D-KEFS, WISC-IV, and WJ III COG also have subtests that measure aspects of attention. Continuous performance tests, such as the Conners' Continuous Performance Test-II (Conners, 2000), often measure aspects of sustained attention. In addition, there are a number of behavioral rating scales that assess for the behavioral manifestations of attentional processing disorders, such as the Brown Attention-Deficit Disorder Scales (BADDS; Brown, 2001) and the Attention Deficit Disorders Evaluation Scale, 3rd edition (ADDES; McCarney, 2004).

Visual-Spatial Processes

Visual-spatial skills have historically been an important component of neuropsychological assessment (Decker, Carboni, & Englund, 2011). Further, Decker and his colleagues state these skills are important because they assess abilities involved in everyday living, have a particular developmental trajectory, and represent a fairly distinct set of skills. In addition, a number of developmental and neurological conditions can be related to visual-spatial deficits. Visual-spatial processing is a broad cognitive process that has many subcomponents; however, according to many researchers there is a lack of understanding of the term despite well-documented clinical syndromes involving visual-spatial deficits (Baron, 2004; Decker et al., 2011; Miller, 2007). According to Decker and colleagues (2011), one of the reasons for the diversity in terminology is related to the fact that visual-spatial measures are some of the oldest measures in psychology. Unfortunately, despite the growing body of research and evolving theories, the terminology remains the same. Terms that have been commonly associated with visual-spatial processes include visual perception and visual-spatial thinking. In addition, a review of tests designed to measure aspects of visual-spatial processing also demonstrates the lack of terminology for describing the tasks involved in the visual-spatial construct (Decker et al., 2011). For example, some researchers believe visual-spatial functioning is closely aligned with sensory-motor functioning, which will be discussed in more detail in the section that identifies tests designed to measure visual-spatial functioning.

One aspect of visual-spatial processing is visual perception, or how one perceives information visually. According to Bezrukikh and Terebova (2009), the first stage of visual perception consists of detecting an object and differentiating its characteristics from other objects within the visual field. The next stage is verifying the perceived image with other images stored in memory. This evaluation of the match between the image and the images stored in memory allows the subject to perform categorization, and also allows the individual to make decisions about what he or she has perceived. Relating this notion to children and the school setting, a child must be able to perceive the information presented to him or her in the classroom and be able to compare that information with other information stored in memory. In addition, the development and maintenance of good handwriting requires visual perceptual skills. A child must be able to combine and integrate lines to form letters, which are then combined to form words. The ability to do these tasks requires the child to perceive the relationship between the objects as a whole as well as the parts that make up the whole object. Without perception, learning can be difficult. Therefore, measures of visual-spatial skills should also be included in school neuropsychological evaluations as they are essential for academic success (Miller, 2007).

Visual-spatial thinking, as opposed to visual perception, reflects processes that are involved in the understanding of visual images (Greenspan, 2003). Some of these processes include spatial perception, or determining where objects are with respect to one's own body orientation; mental rotation, or being able to mentally rotate objects in space; and spatial visualization, which involves mental manipulation of spatially presented information (Caldera, Culp, O'Brien, Truglio, Alvarez, & Huston, 1999). Academic weakness can often be explained when a child exhibits difficulties in visual-spatial thinking. For example, there are many visual components in math, including graphs, charts, and maps that may be difficult for children with visual-spatial problems to interpret.

Depending on the function and aspect of visual-spatial processing, different parts of the brain are involved. Visual perception, which takes place in the visual association cortex, is divided into two pathways in the brain, the ventral stream and the dorsal stream (Carlson, 2007). The ventral stream is involved with object recognition, whereas the dorsal stream is involved with the location of objects. According to Carlson, damage to the inferior temporal cortex, part of the ventral stream, can cause agnosia and disrupts the ability to discriminate between different visual stimuli. In addition, it impairs the ability to perceive and recognize different kinds of visual information. Individuals with damage to this region have normal vision, but are unable to recognize everyday objects like scissors, light bulbs, or even faces of friends or relatives. Other studies of visual-spatial performance from individuals with brain damage have provided further information about visual-spatial functioning. The right hemisphere of the brain appears to be involved in the properties that help individuals understand the global or whole stimulus, whereas the left hemisphere is more important in the analysis of the smaller parts of the stimulus (Baron, 2004; Decker et al., 2011). This understanding of the neuroanatomy of visual-spatial skills has important implications for school psychologists and other school personnel as it is important to understand the root of a child's difficulties in school. If a child is not learning because he or she cannot recognize the information presented to him or her on the page, then modifications to his or her curriculum are necessary.

Disorders that have visual-spatial processing deficits associated with them include autism, attention deficit hyperactivity disorder, learning disabilities, schizophrenia, and nonverbal learning disability (Decker et al., 2011). To assess for these deficits, there are a number of tests used to measure visual-spatial functioning for school-aged children. For example, the KABC-II as well as the WISC-IV each have four subtests that are designed to measure visual processing. The SB5 and the NESPY-II also have subtests that measure similar aspects of visual-spatial processing. The Beery-Buktenica Visual Motor Integration Test, Sixth Edition (VMI) was developed as a measure to identify individuals with visual-perceptual abilities. However, this test also requires motor skills to copy the design. Because of this notion, some researchers consider visual-spatial tasks and motor tasks to be closely related (Decker et al., 2011; Miller, 2007).

Language

Language skills are also essential for a child to achieve academic success (Miller, 2007) and can be divided into several different components. Language, at the basic level, is made up of individual phonemes. Phonemes are the shortest segments of speech (Goldstein, 2011). For example, the word *cat* has three phonemes, /c/, /a/, /t/. If a phoneme is changed, the meaning of the word is also changed. Substituting the phoneme /b/ for the /c/ phoneme in the previous example changes the word *cat* to *bat*. Phonological processing involves detecting and discriminating differences in phonemes and is important in the development and understanding of language.

Language, in a broader sense, can be divided into two types, receptive language and expressive language (McLaughlin, 2011). Receptive and expressive language is an individual's ability to comprehend or communicate language, respectively. Good listening comprehension, or receptive language, is important for learning. If a child is unable to understand the material presented to him or her, learning cannot occur.

Similarly, oral expression, or expressive language, is an important skill for academic success because so much of learning involves the ability to verbalize information. Disorders of receptive and expressive language are evident in the schools and the term specific language impairment is often used to label school-aged children who have a language disability (Wiig, 2011).

Language is a lateralized function, with the vast majority of people having the main language areas on the left side of the brain (Carter, 2009). Further, language processing mainly occurs in Broca's and Wernicke's areas of the brain. According to Carter, words are comprehended within Wernicke's area, whereas they are articulated within Broca's area. Damage to either of these areas often results in deficits in language. For example, damage to Broca's area disrupts the ability to speak, and causes a disorder characterized by slow, laborious, and nonfluent speech (Carlson, 2007). Damage to Wernicke's area of the brain causes poor speech comprehension and production of meaningless speech. Damage to Wernicke's area affects receptive language, whereas damage to Broca's area often results in expressive aphasia.

There are a wide variety of tests used to measure aspects of language, including phonological processing, as well as expressive and receptive language. Typically speech and language pathologists assess speech and language development in children within the schools; however, school neuropsychologists have training in assessments that can aid in the assessment of language. Additionally, a school neuropsychologist's expertise in brain-behavior relationships can aid in the identification and treatment of language disorders. Tests of intellectual functioning containing a language component include the

NEPSY-II, WJ III COG, and the WISC-IV. These three tests measure language to some degree even though they are not specifically measures of language. A wide variety of narrower assessments that measure language are available as well. The Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgensen, & Rashotte, 1999) is an example of a test designed to assess for phonological ability. The Peabody Picture Vocabulary Test – Fourth Edition (PPVT-4; Dunn & Dunn, 2006) measures receptive language in children, and the Oral and Written Language Scales: Oral Expression (OWLS-OE; Carrow-Woolfolk, 1995) measures expressive language.

Memory

In Miller's (2007) model, learning is included within the memory section. However, learning is a complex process and requires a lengthy discussion to adequately discuss its components; therefore, the construct of learning will not be discussed further. Additionally, learning appears to be a result of other neuropsychological constructs rather than a neuropsychological construct itself. More specifically, each neuropsychological process is an important component for learning. For example, one must perceive the information in order to pay attention to it, and one must attend to the information before it can be remembered. This implies that memory is important for learning.

Memory is "the processes involved in retaining, retrieving, and using information about stimuli, images, events, ideas, and skills after the original information is no longer present" (Goldstein, 2011, p. 116). Much of what we know about memory is derived from research conducted by Atkinson and Shiffrin. Atkinson and Shiffrin (1968) proposed a modal model of memory, which included three major structural features of memory: sensory memory, short-term memory, and long-term memory. Sensory memory is the initial stage which holds all visual or auditory incoming information, but only holds information for seconds to fractions of a second. If the information is not attended to, the information is lost quickly. However, if attention occurred, information enters short-term memory. Short-term memory has a limited capacity, usually five to nine items, for about 15-30 seconds. Information can be held within short-term memory longer if the information is rehearsed. If the information is memorized, then it moves into long-term memory. An unlimited amount of information can be stored in long-term memory for years, even decades.

A component often associated with short-term memory is working memory. While Atkinson and Shiffrin's model can explain some aspects of memory, later theories have proposed that short-term memory is just one aspect of the more general working memory system (Miller, 2010). Working memory can be defined as "a limited capacity system for temporary storage and manipulation of information for complex tasks such as comprehension, learning, and reasoning" (Goldstein, 2011, p.131). The most frequently cited research model of working memory derives from the work of Baddeley and Hitch back in 1974 (Baddeley & Hitch, 1994). According to Baddeley (2003), working memory used to be explained by a three-component model comprised of a control system, the central executive, and two storage systems, the visuospatial sketchpad and the phonological loop. The basic structure of this model has remained supported in the literature; however, Baddeley has emphasized changes to the model since its introduction in 1974 as it has evolved into a model that emphasizes working memory rather than simply replacing the earlier models of short-term memory with working memory (Baddeley, 2003). The central executive regulates information flow through working memory by focusing, dividing, or shifting attention to the other components of the model. The phonological loop as a whole deals with verbal or more specifically, phonological, information. It is comprised of the phonological store, which remembers speech sounds in their temporal order, and the articulatory processor, which repeats speech sounds in a loop to prevent decay. The visuospatial sketchpad, on the other hand, is concerned with visual or spatial tasks, such as remembering shapes and colors of objects, as well as the location or speed of objects in space. The final component of Baddeley's (2003) model is the episodic buffer, which was later added to the model to account for the interaction working memory has with long-term memory. The episodic buffer is assumed to be dedicated to linking information together to form integrated units of visual, spatial, and verbal information within memory.

Understanding memory is important for psychologists working in the schools as memory is crucial to learning. Students are provided with large amounts of information in their classrooms; therefore, working memory skills are important as students must be able to mentally manipulate the information for successful comprehension. Children with lower working memory abilities can have difficulties in school. For example, according to Alloway, Gathercole, Kirkwood, and Elliott (2009), children with lower working memory struggled with tests of learning and verbal ability. They also were judged by their teachers to have short attention spans, high levels of distractibility, problems in monitoring the quality of their work, and difficulties in generating new solutions to problems. Being able to maintain and recall information from long-term memory is also important for school personnel to understand as learning is increased if a child is able to link newly learned information to prior knowledge. The storage and retrieval of information from long-term memory relates to the *Glr* construct within the CHC theory (Flanagan & Harrison, 2005). There are three different forms of long-term memories: semantic, episodic, and procedural. Semantic memories, according to Goldstein (2008) involve all of one's knowledge of facts and objects. Episodic memories, on the other hand, include personal events in a temporal context. In other words, episodic memories are various episodes of a person's life. It involves "mental time travel" as a person is able to travel back in time to reconnect with the events that occurred in the past (Goldstein, 2008, p. 187). Procedural memories are one's memories for how to do things, such as how to ride a bike or play a musical instrument.

Various brain structures are important to memory. Carter (2009) lists a number of structures responsible for the different aspects of memory. Memory appears to be distributed across the entire brain, rather than being localized like other neuropsychological processes. For example, emotional memories may be stored in the amygdala, whereas the putamen is associated with procedural skills. The frontal lobe is connected to working memory, and the parietal lobe is associated with spatial memories. Research involving individuals with damage to various parts of the brain adds further support to resulting memory and learning difficulties after brain damage. For example, learning and memory deficits were caused by a lesion in the medial area of the left putamen in a child who injured the left side of his head when he was hit by a car at the age of 13 (Shu et al., 2009).

There are also a large number of test batteries that measure aspects of memory in children. Larger test batteries, such as the KABC-II, SB5, NEPSY-II, WISC-IV, and WJ III COG each contain subtests that measure aspects of memory, such as long-term retrieval, memory capacity, and working memory. In addition to these tests, there are a number of stand-alone tests as well. The Test of Memory and Learning, Second Edition (TOMAL-II), for example, is a comprehensive test designed to assess various aspects of memory and learning in children (Reynolds & Voress, 2007). The Wide Range Assessment of Memory and Learning, Second Edition (WRAML-2), designed by Sheslow and Adams (2003), is another test designed to measure aspects of memory in children.

Executive Functions

While there is no universally accepted definition of executive functioning, some researchers define executive functioning as "an umbrella-type concept for the complex set of cognitive processes that underlie flexible, goal-directed responses to novel or difficult situations" (Visu-Petra, Benga, & Miclea, 2007, p. 586). In other words, it is a term used to describe processes that allow an individual to be flexible to his or her environment and engage in deliberate, goal-directed, thought and action (Scope, Empson & McHale, 2010). Executive functioning processes include planning, organizing, and problem solving, as well as the ability to regulate behavior. Historically, it has been argued that executive functioning emerged during late childhood and adolescence;

however, current research has described sequential improvements of executive functioning throughout childhood (Anderson, 2002). Passler, Isaac, and Hynd (1985) have shown that children as young as six years are able to exhibit strategic and planful behavior. Other studies provide support for a developmental stage of executive functioning, with the first developmental stage beginning in early childhood (around the age 6-8), a second in middle childhood (around age 9-12), and the final stage in early adolescence (Brocki & Bohlin, 2004; Welsh, Pennington, & Groisser, 1991).

Executive functioning, in relation to how Miller (2007) conceptualizes it, can be separated into two areas, a cognitive component including problem solving, planning, and organizing, and a behavioral and emotional regulation component. Individuals who have difficulty solving problems, making or completing plans, or have organizational difficulties exhibit executive functioning deficits within the cognitive domain. Individuals who demonstrate signs of hyperactivity, irritability, impulsivity, or those who cannot empathize with others exhibit executive functioning difficulties regulating their behaviors or emotions (Gyurak et al., 2009).

Neuropsychological evidence suggests the executive functioning skills may be largely mediated by the prefrontal cortex of the brain (Anderson, 2001). These cerebral regions are relatively immature during childhood, which further supports the developmental notion of executive functioning as argued by Welsh and colleagues. Deficits in executive functioning have been associated with Attention-Deficit/Hyperactivity Disorder, Obsessive-Compulsive Disorder, and Schizophrenia (Miller, 2007).

Executive functioning is related to school achievement in a number of ways. Executive functioning skills, such as self-regulation, organization, and cognitive flexibility, are skills needed to be successful in the classroom. Academic, social, or behavioral difficulties can all arise from a child who has difficulties with executive functioning. For example, the inability to maintain attention, control behavior, manage time, or set priorities are all examples of executive dysfunction and can result in failing to turn in homework, inability to initiate or complete long-term assignments, or difficulties regulating emotion (Maricle, Johnson, & Avirett, 2010), each of which can lead to poor academic achievement. Thus, it can be helpful to have a list that identifies these areas of difficulty related to executive functioning for parents and teachers with the intent to provide practitioners with a better idea of the child's cognitive functioning in order to develop interventions to help the child academically and behaviorally. Executive functioning is assessed in a number of tests, including the D-KEFS, WJ III COG, and NEPSY-II. For example, some of the subtests in the D-KEFS measures planning, and others measure cognitive flexibility. Similarly, the NEPSY-II has subtests that also measure these aspects as well as others that measure behavioral regulation aspects of executive functioning.

Speed and Efficiency of Processing

Researchers throughout history have been interested in the complexity of the brain processes being used when performing various tasks (Sternberg, 2005). One of the ways researchers measured the complexity of a certain task was to examine the time it took an individual to complete the task. These experiments were important because they illustrated that mental responses cannot be measured directly, but are inferred from the participant's behavior (Goldstein, 2008). Reaction time was the terminology used by researchers in the past; however, currently, the time it takes an individual to complete a certain task is currently described as processing speed (Flanagan & Harrison, 2005), cognitive efficiency (Woodcock, Schrank, Mather, & McGrew, 2007), or cognitive fluency (Unkelbach, 2006).

Conceptualizations vary depending on the term used. For example, processing speed, according to Flanagan and Harrison (2005), is "the ability to perform simple cognitive tasks quickly and fluently over a sustained period of time" (p. 285), whereas cognitive efficiency, as measured in the WJ III COG (Woodcock, Schrank, Mather, & McGrew, 2007), is considered a combination of processing speed and short-term memory. Cognitive fluency, on the other hand, measures the ability to perform tasks quickly and effortlessly (Unkelbach, 2006). Behavioral examples of speed and efficiency of cognitive processing may include the time it takes a child to complete his or her homework, tests, or school assignments. It also includes how well a child can perform under time constraints, as well as how quickly and accurately he or she can recall information.

The neuroanatomical bases of processing speed, cognitive efficiency, and cognitive fluency are not fully understood. According to Miller (2007), the speed of information processing has a close relationship with myelination within the brain. Other researchers have supported this idea in studies that demonstrated that children with traumatic brain injury, especially those whose injuries resulted in tearing of the myelin sheath, often show deficits in processing speed (Battistone, Woltz, & Clark, 2008). Regardless of the specific term used, processing information quickly is thought to free up cognitive resources within the brain so that higher-level thinking can occur (Roivainen, 2011). In addition, developmental research has shown that as children mature, their processing speed increases (Fry & Hale, 2000). The ability to process information quickly is important for successful academic achievement. According to Benner, Allor, and Mooney (2008) adequate processing speed enables learners to perform simple tasks, such as word reading or basic math computation without conscious effort, which then allows the learner to focus more attention on complex tasks of comprehending text or solving math problems.

There are a number of tests that measure the speed and efficiency of cognitive processing in children. For example, many tests have tasks that require the examiner to calculate the time it takes for the child to complete a particular task. The D-KEFS, the NEPSY-II, the WISC-IV, and the WJ III COG each contain several tests in which completion time is calculated. The D-KEFS, the NEPSY-II, the WISC-IV, and the processing speed cluster of the WJ III COG each have subtests that measure processing speed. The WJ III COG also has a cognitive efficiency cluster designed to measure cognitive efficiency, as well as a cognitive fluency cluster designed to measure cognitive fluency.

The Neuropsychological Processing Concerns Checklist (NPCC)

While the previously mentioned neurocognitive constructs are often assessed in school neuropsychological evaluations, determining a starting point for a comprehensive school neuropsychological evaluation can be challenging. Referral questions are often vague, and parent or teacher concerns for the student can be ambiguous. Thus, there is a need for a tool that allows parents or teachers to identify their concerns for the student while also providing a framework for school psychologists. Very few instruments list concerns for school-aged children, specifically relating to neuropsychological constructs and academic achievement. Only one other instrument, the Psychological Processing Checklist (PPC; Swerdlik et al., 2003) lists concerns related to processing difficulties in nine categories. The PPC is a rating scale completed by teachers and is designed to measure psychological processing difficulties of children in kindergarten through grade five in the state of Illinois. Because of these limitations, the PPC is not very useful.

The NPCC designed by Miller (2007) integrates the essential neurocognitive constructs and was developed with the intent to provide professionals with a framework to organize neuropsychological assessment, interpretation, and intervention. The NPCC includes seven areas derived from Miller's (2007) school neuropsychological conceptual model: sensorimotor functions, attention problems, language functions, memory and learning functions, executive functions, and speed and efficiency of cognitive processing. Academic functions in the areas of reading, writing, and mathematics are also included to provide information regarding academics. The NPCC is given to teachers, as well as parents, in the effort to gather more information about the child from the parent or teacher's perspective. A copy of the NPCC is located in the Appendix at the end of the current paper.

The NPCC was developed by Miller (2007) with his school neuropsychological conceptual model as its foundation. Sensory-motor functioning, as well as attentional processing, is listed at the beginning of the NPCC as Miller believes these constructs serve as the baseline for all behavior. The first section of the NPCC is the Sensorimotor Functions section, and it includes motor functioning, tactile/olfaction functioning, visual functioning, and auditory functioning subsections. Another subsection, visual-spatial functioning is also included within this section as it closely aligns with many sensory-motor processes, according to Miller. For example, many individuals who have disorders with sensory-motor functioning also have difficulties with visual-spatial functioning. Developmental Coordination Disorder and Nonverbal Learning Disability are two examples. Attention Problems is the second section of the NPCC, and it is divided into five subcomponents: focused or selective attention, sustained attention, shifting attention, divided attention, and attentional capacity. The third section is the Language Functions section, and it is broken into four sections: articulation, phonological processing, receptive language, and expressive language. The fourth section of the NPCC is the Memory and Learning Functions section, which is divided into four subsections: short-term memory, active working memory, long term memory, and general learning. The next section is Executive Functions, which is broken into two subsections: problem solving, planning, and organizing, and behavioral/emotional regulation. Speed and Efficiency of Cognitive Processing is the last neurocognitive section as all of the previously mentioned neurocognitive constructs can affect an individual's cognitive processing.

The last three sections of the NPCC are related to academic functioning, specifically in the areas of reading, writing, and mathematics. These are listed at the end as an individual's cognitive processing affects his or her academic achievement. Academic Functions: Reading is listed first after the cognitive processing section. This section is divided into attention functions, phonological processing and fluency functions, comprehension/memory functions, and attitudinal issues. The next section, Academic Functions: Writing consists of four subsections: graphomotor output functions, spatial production functions, expressive language functions, and attitudinal issues. Finally, the Academic Functions: Mathematics is listed at the end of NPCC and includes the subsections of attentional functions related to math, computational knowledge, mathematical reasoning/comprehension, and attitudinal issues.

Conclusion

Neuropsychological evaluations are more complex than traditional psychoeducational or psychological evaluations as they assess a wider variety of constructs (Miller, 2010). Additionally, neuropsychological functioning is complex as evidenced by the vast amount of research within the field. Because of these complexities, a tool that can help identify potential areas of concern can be advantageous for school neuropsychologists when conducting a neuropsychological evaluation as it would narrow down the referral question and highlight the areas in need of assessment.

The NPCC can be a valuable tool in helping identify concerns of parents and teachers. To increase its usefulness, it is important that the checklist is a valid measure of identifying concerns of neuropsychological processes. Therefore, the first step to ensure the NPCC is a useful tool is to validate it to provide statistical evidence that it measures what Miller designed for it to measure. In doing this, factor analysis can be used to reveal underlying interrelationships among the items of the NPCC, which can then be interpreted in conceptual terms.

CHAPTER III

METHOD

This study was designed to explore the factor structure, validity, and reliability of the Neuropsychological Processing Concerns Checklist (NPCC). This chapter also includes information about participants, instrumentation, and procedures for analyzing the data.

The data used in this study were excerpted from archival data collected from on-going case studies submitted by students in the School Neuropsychology Post-Graduate Certification Program from satellite training sites located across the United States between the years of 2001 and 2010. Cases analyzed include parent and teacher responses of the NPCC. To ensure confidentiality, the data from each case was coded and separated from the actual case file. Any case which included the consent forms stating that the data should not be used for research purposes was excluded from the archival data set. The archival data was reviewed to determine which cases could be used for this study. Cases with complete NPCC scores and cases where missing NPCC data had been imputed were selected for use in the study. With imputed data, the statistical software predicted the odds of choosing an answer based on the other answers provided within the individual case. In other words, the software looked for a consistent pattern within each case, and estimated a score based on the characteristics of the response pattern. Due to the use of archival data and an inability to manipulate independent variables, a non-experimental research design was used in this study.

Participants

Participants in this study were picked from a larger clinical sample resulting in a total sample of 956 individuals ranging in age from three to twenty-one. The participants were selected from a clinical sample of archival case studies submitted by students in the School Neuropsychology Post-Graduate Certification Program from various satellite training sites across the United States. Only case studies with NPCC data were included in this study. The data consisted of 955 parent responses and 936 teacher responses. Demographic data for this study were aggregated to describe gender, ethnicity, and general diagnostic categories of each case (i.e., learning disability, language disability, intellectual disability, autism spectrum, emotional disturbance, or general medical condition).

Instrumentation

The NPCC was developed with the intent to provide professionals with a framework to organize neuropsychological assessment, interpretation, and intervention. This 130-item checklist includes a wide variety of behaviors categorized into seven neuropsychological constructs using the framework of Miller's (2007) school neuropsychological conceptual model. The NPCC was intended to be completed by teachers and parents to gather information about the child from the parent or teacher's perspective. Parent and teacher respondents were asked to rate the child's behaviors observed in the past six months using a four-point Likert-type scale with descriptors ranging from 0=Not Observed (i.e., behavior not observed in this child), 1=Mild (i.e., behavior occasionally observed in this child), 2=Moderate (i.e., behavior frequently observed in this child), and 3=Severe (i.e., almost always observed in this child). A brief definition of each descriptor, included in parentheses, was provided for the rater to use as a guideline for reporting how often the specified behavior was observed in the child. Behaviors listed in the NPCC are categorized into seven neuropsychological constructs including: a) sensorimotor functions, b) attention problems, c) language functions, d) memory and learning functions, e) executive functions, f) speed and efficiency of cognitive processing, and g) academic functions (i.e., reading, writing, mathematics).

According to Miller (personal communication, February 10, 2011), the NPCC items were developed based on a comprehensive review of the literature, followed by a rigorous review by experts. Items on the NPCC are not summed into sections nor are they used to generate composite scores. The hypothesized seven neuropsychological constructs, the subsections within each construct, and each item by section are listed in Table 1 located on the next page. The NPCC can be found in Appendix 1.

Rationale and Significance of Study

Goodwin and Leech (2003) reported that according to the *Standards for Educational and Psychological Testing*, validity is the most fundamental consideration in developing and evaluating tests. Therefore, it is important to assess the validity of the NPCC. The purpose of validating the NPCC was to ensure its items measure the neuropsychological constructs they were designed to measure. Further, the items in the NPCC were developed based on each of the neuropsychological construct proposed by

Miller (2007), which are thought to cluster together to offer a conceptual framework that explains how individual items cluster together. For example, it was anticipated that items related to attention will cluster together, items related to memory will cluster together, and items related to language will cluster together.

Procedures for Analyzing the Data

Data analyses were conducted with the Statistical Package for the Social Sciences (SPSS), version 19, a popular statistics software package. Descriptive statistics were calculated for gender, race/ethnicity, and diagnostic category to gain insight into the population obtained from the archival data set. Frequencies were also measured to examine any trends in parent and teacher responses on the NPCC. Parents and teachers responses were analyzed separately as they are separate groups with separate perceptions, and thus they may view the same child differently.

Table 1

The Neuropsychological Processing Concerns Checklist with Item Numbers

First-order Factors: Neuropsychological Construct	Second-order Factors: Narrow Construct	# of Items
Sensorimotor Functions		
	Motor Functioning	8
	Tactile/Olfaction Functioning	4
Attention Problems		
	Focused or Selective Attention	5
	Sustained Attention	5
	Shifting Attention	5
	Divided Attention	5
	Attentional Capacity	5
Language Functioning		

Table 1, cont.	
Articulation	3
Phonological Processing	3
Receptive Language	2
Expressive Language	4
Memory and Learning Functions	
Short Term Memory	5
Active Working Memory	4
Long Term Memory	6
General Learning	3
Executive Functions	
Problem Solving, Planning, & Organizing	7
Behavioral/Emotional Regulation	8
Speed & Efficiency of Cognitive Processing	
Processing Speed, Cognitive Efficiency, & Cognitive Fluency	7
Academic Functions: Reading	
Reading: Attention Functions	3
Reading: Phonological Processing & Fluency Functions	3
Reading: Comprehension/Memory Functions	2
Reading: Attitudinal Issues	3
Academic Functions: Writing	
Writing: Graphomotor Output Functions	9
Writing: Spatial Production Functions	2
Writing: Expressive Language Functions	7
Writing: Attitudinal Issues	2
Academic Functions: Mathematics	
Mathematics: Attentional Functions	2
Mathematics: Computational Knowledge	2
Mathematics: Mathematical Reasoning/Comprehension	2
Mathematics: Attitudinal Issues	2

Two individual principal components exploratory factor analyses (EFA) with varimax rotation were conducted on the total combined sample of parent raters (n = 955) and teacher raters (n = 936) to assess whether the factor structure of the NPCC offers support for Miller's (2007) proposed theoretical model. Using the Kaiser method, factors that produced an eigenvalue greater than one were used to determine the number of factors to be retained. After extraction, the decision made about the number of factors to retain for rotation included using the orthogonal varimax rotation. The goal of rotating factors was to simplify and clarify the data structure. Orthogonal rotations maintain uncorrelated relationships among factors, while oblique rotations allow factors to become correlated with each other (DeCoster, 1998). The last step consisted of interpreting the factor structure to determine which items to keep and which items to exclude.

After the exploratory factor analysis was conducted and factors were identified, internal consistency estimates of reliability were computed for each subscale of the NPCC. Internal consistency was evaluated utilizing Cronbach's Alpha. In addition, two separate multiple analysis of variance (MANOVA) tests were also used to determine if there was any statistical significance between the broad diagnoses of each individual case, as well as between parent and teacher raters.

CHAPTER IV

RESULTS

In this chapter, the statistical findings of the study are presented. This consists of a detailed discussion of the descriptive and statistical findings as well as related tables. The results of the frequency analyses, exploratory factor analyses, reliability estimates, and MANOVAs are provided.

Descriptive Information

Data regarding the study's sample are displayed in Table 2. The participants in this study consisted of 956 individuals ranging in age from three to twenty-one. The participants were selected from a larger clinical sample of archival case studies submitted by students in the School Neuropsychology Post-Graduate Certification Program from various satellite training sites across the United States. Only case studies with NPCC data were included in this study. For the participants included in the study, there were 955 parent raters and 936 teacher raters. Of the 956 individuals included in this study, 47% were males (*n*=449) and 52.1% were females (*n*=498). Nine percent of the participants (*n*=9) did not have a gender listed. Of the 956 participants, 66.5% were Caucasian/European American (*n*=370), 10.1% were Black/African American (*n*=56), 10.8% were Asian American/Pacific Islander (*n*=60), 8.1% were Hispanic/Latino(a) (*n*=45), 1.6% were Native American (*n*=9), and 2.9% were identified as Other (*n*=16). There were 400 participants that did not have an ethnicity listed. The data used in the current study was derived from a clinical population; thus the majority of the participants were not typically developing individuals. Diagnostic categories of the participants included 19.2% identified as an individual with a Learning Disability (LD; *n*=183), 1.9% identified as an individual with a Language Disability (*n*=18), 0.9% identified as an individual with an Intellectual Disability (ID; *n*=9), 8.1% identified as an individual with an Acquired Neurological Impairment (*n*=77), 12% identified as an individual with Attention Deficit Hyperactivity Disorder (ADHD; *n*=115), 4.8% identified as an individual with an Autism Spectrum (AU) disorder (*n*=46), 3.2% identified as an individual with an Emotional Disability (ED; *n*=31), 3.0% identified as an individual with a General Medical condition (OHI; *n*=29), and 0.5% identified as an individual with Deafness (*n*=5). Diagnostic labels for individuals with two or more diagnoses, included 8.9% of the participants identified as individuals with LD/ADHD (*n*=85), 0.9% identified as individuals with Neurological Impairment/ADHD (*n*=9), 0.6% identified as individuals with AU/ADHD (*n*=6), 3% identified as individuals with ED/ADHD (*n*=29), 0.7% identified as individuals with General Medical/ADHD (*n*=7), and 5.2% were coded as Other for individuals with three or more diagnoses (*n*=50). Although cases with two or more diagnoses could have been grouped together as one category of multiple diagnoses, the author chose to keep them separate as each group represents a specific population with a specific set of skills and deficits. There were 250 participants that did not have a diagnosis listed. It is important to note that the clinical diagnoses used in the study are not representative of the frequency of diagnoses in the general population. Instead, the clinical sample is more neurologically-based given the neuropsychological basis of the program that data was obtained from.

Table 2

Participant Demographics

Characteristic	N	%
Gender		
Female	498	52.1
Male	449	47.0
Ethnicity		
Caucasian/European American	370	66.5
Black/African American	56	10.1
Asian American/Pacific Islander	60	10.8
Hispanic/Latino(a)	45	8.1
Other	16	2.9
Native American	9	1.6
Broad Diagnosis		
Learning Disability (LD)	183	19.2
ADHD	115	12.0
LD/ADHD	85	8.9
Neurological Impairment (Acquired)	77	8.1
Other (Multiple Disabilities)	50	5.2
Autism Spectrum	46	4.8
Emotional Disability (ED)	31	3.2
ED/ADHD	29	3.0
General Medical	29	3.0
Language Disability	18	1.9
Neurological Impairment/ADHD	9	0.9
Intellectual Disability	9	0.9
General Medical/ADHD	7	0.7
Autism/ADHD	6	0.6
Deaf	5	0.5

Note: ADHD=Attention Deficit Hyperactivity Disorder; ADD=Attention Deficit Disorder

Factor Analysis

To answer the question involving the factor structure of the NPCC with a clinical sample, two individual principal components exploratory factor analyses (EFA) with varimax rotation were conducted on the total combined sample of parent raters and teacher raters using SPSS. Factor analysis is a statistical procedure meant to study the correlations among a set of variables (Fabrigar, Wegener, MacCallum, & Strahan, 1999). There are several factor extraction techniques, although the most commonly used approaches are principal components analysis (PCA) and factor analysis (Stevens, 1992). In both PCA and factor analysis, linear combinations of the original variables are produced, and the first combination accounts for the largest amount of variance in the sample (Mertler & Vannatta, 2005). According to Mertler and Vannatta, principal components analysis is usually the preferred method of factor extraction as all sources of variability are analyzed, and its goal is to extract the maximum variance from the data set. In other words, PCA uses the variance to determine the number of factors that best fit the data. It examines the percentage of the total variance explained by each factor. The total variance is the sum of the variance for each variable. The most widely used criterion for determining how many factors to retain are eigenvalues greater than one (Mertler & Vannatta, 2005); thus components whose eigenvalues were greater than one were used to determine the number of factors to be retained in the current study.

Once the number of factors being extracted is determined, the next step is to rotate the extracted factors (Fabrigar et al., 1999). Rotated solutions can be oblique or orthogonal. Orthogonal rotations maintain uncorrelated relationships among factors, while oblique rotations allow factors to become correlated with each other (DeCoster, 1998). The varimax rotation, which is generally accepted as the best analytic orthogonal rotation technique, was used as it allows the factors to be linearly related and uncorrelated with each other (Mertler & Vannatta, 2005). The varimax method attempts to minimize the number of variables that have high loadings on a factor while maintaining the orthogonal nature of the factors (Dien, 2010). When the factors are uncorrelated with each other as they are in orthogonal rotations, the factor loadings are the correlations between the factor and the variables (Dien, 2010). In orthogonal rotation, the correlations between the factors are uniformly zero and are easier to interpret (Newton, 2001). Factor pattern coefficients exceeding .3 and .4 are often considered meaningful (Floyd & Widaman, 1995). More specifically, Tabachnick and Fidell (2001) argue that variables with a loading of .32 and above should only be interpreted. Therefore, in the current study, coefficients equaling .32 and greater were considered meaningful.

After these decisions were made, the factor structure was analyzed. In Miller's (2007) theoretical model of the NPCC, there were six hypothetical neurocognitive constructs: sensorimotor functions, attention problems, language functions, memory and learning functions, executive functions, and speed and efficiency of cognitive processing. There are also the academic sections, with one section each devoted for reading, writing, and mathematics. These academic sections were not included in the analyses with the neurocognitive constructs as several researchers have shown that an individual's neurocognitive profile serves as a predictor of academic functioning (Fay et al., 2009;

Johnson, Wolke, Hennessy, & Marlow, 2011; Sogawa et al., 2010). Therefore, it is likely that academic items would have strongly correlated with certain items within the neurocognitive sections. The academic sections were analyzed separately and are discussed later in this chapter. Table 3 presents the NPCC items with a corresponding label. The NPCC item labels are included in future tables for a more detailed understanding of which items are included into each factor. Several factors were revealed in the factor analyses of the neurocognitive items. For parent raters, a total of 19 factors were retained, with these factors accounting for 68.3% of the variance. The first factor accounted for 9.86% of the variance, the second factor accounted for 6.54% of the variance, and the third factor accounted for 6.05% of the variance. The fourth factor accounted for 5.27% of the variance, the fifth factor accounted for 5.04% of the variance, the sixth factor accounted for 3.85% of the variance, the seventh factor accounted for 3.27%, the eighth factor accounted for 3.14% of the variance, and the ninth factor accounted for 3.09% of the variance. For factors 10 through 15, the variance accounted for each factor was 2.93%, 2.73%, 2.55%, 2.50%, 2.39%, and 2.28%, respectively. These 15 factors resulted in at least four coefficients greater than .32, and they account for 61.49% of the total variance of 68.30%. The remaining four factors consisted of two coefficients greater than .32. Refer to Table 4 for the factor structure matrix for parent raters.

Table 3

Example of NPCC Items

Label	Item
SM1	Motor Functioning - Muscle weakness or paralysis
SM2	Motor Functioning - Muscle tightness or spasticity
SM3	Motor Functioning - Clumsy or awkward body movements
SM4	Motor Functioning - Walking or posture difficulties
SM5	Motor Functioning - Odd movements (e.g., hand flapping)
SM6	Motor Functioning - Involuntary or repetitive movements
SM7	Motor Functioning - Difficulty with dressing (e.g., buttoning & zippering)
SM8	Motor Functioning - Poor fine motor skills (e.g., using a pencil)
SM9	Tactile-Olfaction - Overly sensitive to touch, light, or noise
SM10	Tactile-Olfaction - Complains of loss of sensation (e.g., numbness)
SM11	Tactile-Olfaction - Less sensitive to pain and changes in temperature
SM12	Tactile-Olfaction - Difficulty smelling or tasting foods
SM13	Visual Functioning - Cannot identify basic colors (color blind)
SM14	Visual Functioning - Complains of visual problems (e.g., cannot see close or far)
SM15	Visual Functioning - Difficulty recognizing objects
SM16	Auditory Functioning - Hearing acuity problems
SM17	Auditory Functioning - Does not like loud noises
SM18	Auditory Functioning - Difficulty with simple sound discrimination
SM19	Auditory Functioning - Difficulty with pitch discrimination
SM20	Visual-Spatial Functioning - Drawing or copying difficulties
SM21	Visual-Spatial Functioning - Difficulties with puzzles
SM22	Visual-Spatial Functioning - Confusion with directions (e.g., gets lost easily)
SM23	Visual-Spatial Functioning - Shows right-left confusion or directions (up-down)
SM24	Visual-Spatial Functioning - Ignores one side of the page while drawing or reading
AP1	Focus/Selective - Easily distracted by sounds, sights, or physical sensations
AP2	Focus/Selective - Inattentive to details or makes careless mistakes
AP3	Focus/Selective - Does not know where to start when given a task
AP4	Sustained - Difficulty paying attention for a long period of time
AP5	Sustained - Mind appears to go blank or loses train of thought
AP6	Sustained - Seems to lose place in an academic task (e.g., reading)
AP7	Shifting - Difficulty stopping one activity and starting another
AP8	Shifting - Gets stuck on one activity (e.g., playing a video game)
AP9	Shifting - Apply a different set of rules or skills to an assignment
AP10	Divided - Difficulty attending to more than one thing at a time

Table 3, cont.	
AP11	Divided - Does not seem to hear anything else while watching T.V.
AP12	Divided - Easily becomes absorbed into one task (e.g., video game)
AP13	Attentional Capacity - Stops performing tasks that contain too many details
AP14	Attentional Capacity - Avoids activities that require a lot of mental effort
AP15	Attentional Capacity - Seems to get overwhelmed with difficult tasks
LF1	Articulation - Omits sounds
LF2	Articulation - Substitutes sounds
LF3	Articulation - Distorts sounds (e.g., slurring, stuttering)
LF4	Phonological Processing - Difficulty with blending of sounds to form words
LF5	Phonological Processing - Difficulty with basic rhyming activities
LF6	Phonological Processing - Difficulty with sound discrimination
LF7	Receptive Language - Trouble understanding what others are saying
LF8	Receptive Language - Does not do well with verbal directions
LF9	Expressive Language - Difficulty finding the right word to say
LF10	Expressive Language - Limited amount of speech
LF11	Expressive Language - Slow labored speech
LF12	Expressive Language - Odd or unusual language or vocal sounds
ML1	Short Term Memory - Frequently asks for repetitions of instructions/explanations
ML2	Short Term Memory - Lacks rehearsal strategies while listening/studying
ML3	Short Term Memory - Seems not to know things right after they are presented
ML4	Short Term Memory - Trouble following multiple step directions
ML5	Short Term Memory - Problems copying from the board and/or taking notes
ML6	Active Working Memory - Loses track of steps/forgets what they are doing amid task
ML7	Active Working Memory - Loses place in the middle of solving a math problem
ML8	Active Working Memory - Loses train of thought while writing
ML9	Active Working Memory - Trouble summarizing narrative or text material
ML10	Long Term Memory - Trouble remembering facts or procedures in mathematics
ML11	Long Term Memory - Difficulty answering questions of facts quickly
ML12	Long Term Memory - Gets frustrated while trying to convey thoughts on paper
ML13	Long Term Memory - Forgets what happened days or weeks ago
ML14	Long Term Memory - Forgets where personal items or school work were left
ML15	Long Term Memory - Forgets to turn in homework assignments
ML16	General Learning - Difficulty learning verbal information
ML17	General Learning - Difficulty learning visual information
ML18	General Learning - Difficulty integrating verbal and visual information

Table 3, cont.	
EF1	Prob Solve, Plan, and Org - Difficulty learning new concepts or activities
EF2	Prob Solve, Plan, and Org - Difficulty solving problems that a younger child can do
EF3	Prob Solve, Plan, and Org - Makes the same kinds of errors over and over
EF4	Prob Solve, Plan, and Org - Quickly becomes frustrated and gives up easily
EF5	Prob Solve, Plan, and Org - Trouble making plans
EF6	Prob Solve, Plan, and Org - Trouble completing plans
EF7	Prob Solve, Plan, and Org - Difficulty with organizational skills
EF8	Behavioral/Emotional - Appears to be under-motivated to perform or behave
EF9	Behavioral/Emotional - Has trouble getting started with tasks
EF10	Behavioral/Emotional - Demonstrates signs of over activity (hyperactivity)
EF11	Behavioral/Emotional - Demonstrates signs of impulsivity
EF12	Behavioral/Emotional - Trouble following rules
EF13	Behavioral/Emotional - Demonstrates signs of irritability
EF14	Behavioral/Emotional - Lack of common sense or judgment
EF15	Behavioral/Emotional - Cannot empathize with the feelings of others
CF1	Speed, Efficiency, and Fluency - Takes longer to complete tasks than others the same age
CF2	Speed, Efficiency, and Fluency - Slow reading that makes comprehension difficult
CF3	Speed, Efficiency, and Fluency - Homework takes too long to complete
CF4	Speed, Efficiency, and Fluency - Requires extra time to complete tests
CF5	Speed, Efficiency, and Fluency - Responds slowly when asked questions
CF6	Speed, Efficiency, and Fluency - Does well on timed tests
CF7	Speed, Efficiency, and Fluency - Recalls information accurately and quickly
R1	Reading: Attention Functions – Appears distracted while reading
R2	Reading: Attention Functions – Misses important details while reading
R3	Reading: Attention Functions – Loses track of his/her reading place
R4	Reading: Phonological Processing – Trouble sounding out words
R5	Reading: Phonological Processing – Can't remember words without sounding them out
R6	Reading: Phonological Processing – Reads very slowly
R7	Reading: Comprehension – Difficulty understanding what is read
R8	Reading: Comprehension – Difficulty identifying main elements of the story
R9	Reading: Attitudinal Issues – Indicates boredom with reading
R10	Reading: Attitudinal Issues – Appears anxious/uptight/nervous while reading
R11	Reading: Attitudinal Issues – Avoids reading activities
W1	Writing: Graphomotor Output – Trouble forming letters and words

Table 3, cont.	
W2	Writing: Graphomotor Output – Presses too hard with the pencil/pen while writing
W3	Writing: Graphomotor Output – Presses too soft with the pencil/pen while writing
W4	Writing: Graphomotor Output – Others have difficulty reading what the child has written
W5	Writing: Graphomotor Output – Difficulty holding the pencil or pen correctly
W6	Writing: Graphomotor Output – Shows preference for printing over cursive writing
W7	Writing: Graphomotor Output – Writes overly large letters and words
W8	Writing: Graphomotor Output – Writes overly small letters and words
W9	Writing: Graphomotor Output – Takes a long time to write
W10	Writing: Spatial Production – Demonstrates uneven spacing between words and letters
W11	Writing: Spatial Production – Trouble staying on the lines
W12	Writing: Expressive Language – Loses train of thought while writing
W13	Writing: Expressive Language – Limited vocabulary for age; uses lots of easy words
W14	Writing: Expressive Language – Difficulty putting ideas into words
W15	Writing: Expressive Language – Uses simple sentence structure and lacks variety
W16	Writing: Expressive Language – Produces poor spelling in writing
W17	Writing: Expressive Language – Poor grammar in writing
W18	Writing: Expressive Language – Has trouble coming up with topics to write about
W19	Writing: Attitudinal Issues – Appears anxious/uptight/nervous while writing
W20	Writing: Attitudinal Issues – Avoids writing activities
M1	Math: Attentional Issues – Makes careless mistakes while solving math problems
M2	Math: Attentional Issues – Does not always pay attention to the math problem signs
M3	Math: Computational Knowledge – Knowledge of basic math facts not at grade level
M4	Mathematics: Computational Knowledge – Exhibits procedural deficits in math
M6	Mathematics: Mathematical Reasoning/Comprehension – Difficulty solving story problems
M7	Mathematics: Mathematical Reasoning/Comprehension – Difficulty with qualitative concepts (i.e., bigger than)
M8	Mathematics: Attitudinal Issues – Appears anxious/uptight/nervous when working with math
M9	Mathematics: Attitudinal Issues – Avoids math activities

The factors produced from teacher raters produced similar results. Refer to Table 5 for the rotated factor loading matrix for teacher raters. A total of 19 factors were also retained. Together, the 19 factors for teacher raters accounted for 69.91% of the variance. The first factor accounted for 11.65% of the variance, the second factor accounted for

6.96% of the variance, and the third factor accounted for 6.60% of the variance. The fourth factor accounted for 5.96% of the variance, the fifth factor accounted for 4.64% of the variance, the sixth factor accounted for 4.36% of the variance, the seventh factor accounted for 3.50% of the variance, the eighth factor accounted for 3.44% of the variance, and the ninth factor accounted for 3.33% of the variance. For factors 10 through 17, the variance accounted for each factor was 2.59%, 2.18%, 2.08%, 2.06%, 1.95%, 1.93%, 1.82%, and 1.65%, respectively. Each of these factors had at least three coefficients greater than .32 whereas the last two factors had only two coefficients. The total variance explained by the factors with at least three coefficients greater than .32 was 66.71%. Table 6 presents the eigenvalues and amount of variance explained for both parent and teacher raters.

Interestingly, the first three factors from both parent and teacher raters resulted in similar patterns, with many of the same items loading onto the same factors. For example, the first factor for both parent and teacher raters included items with the strongest factor pattern coefficients on many of the items related to memory. Additional items from executive functioning, attention, cognitive efficiency, and visual-spatial functioning also produced meaningful coefficients on this factor. Therefore, the first factor appears to be a broad construct of memory. The second factor largely consisted of items related to attention in a broad sense. For the third factor, items included in this factor for both parent and teacher raters were generally related to executive functioning. These results suggest that there is a similar underlying structure between parents and teachers as the first three, and strongest, factors are quite analogous to each other.

Several of the remaining factors had some overarching similarities. For example, items related to phonological processing and articulation were the fourth factor for parents and the fifth factor for teachers. Items related to shifting and divided attention were the sixth factor for parents and the ninth factor for teachers. The seventh factor for parents and the sixth factor for teachers included items related to processing speed. Lastly, items related to expressive language were the eleventh factor for parents and the seventh factor for teachers. The remaining factors consisted of item loadings that were unique between raters. In addition, these factors only consisted of a few meaningful item loadings and accounted for a small percentage of the overall variance. Factors and item loadings are discussed in more detail in the following chapter.

Table 4

Rotated Factor Loading Matrix for Parent Raters on Neurocognitive Items

Item	Factor																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SM1	.050	.185	.070	.037	.308	.038	-.085	.060	.081	.152	.036	.055	.137	.026	.039	**.726**	-.048	-.013	-.001
SM2	-.013	.005	-.020	.098	**.655**	.023	-.134	-.014	.157	.070	.036	.073	-.040	.014	.319	.195	-.278	.037	.006
SM3	-.021	.114	.044	.187	**.339**	.053	-.018	.203	.129	.291	.134	-.080	.178	-.083	**.358**	.219	.185	.107	.191
SM4	-.060	.069	.012	.101	.300	.227	-.033	.021	.126	.102	-.167	.083	.005	.073	**.673**	.174	.076	.045	.083
SM5	.006	.027	.069	.032	.077	-.099	-.016	.051	-.130	.043	.148	.028	.118	.017	**.751**	-.042	-.012	-.019	-.020
SM6	.145	.005	.040	.056	**.460**	.121	.078	-.007	-.042	**.320**	.116	.228	-.095	.106	.144	.040	-.174	.111	**.365**
SM7	.058	.148	.041	.168	.140	-.073	.139	.147	-.087	.078	.162	.114	**.432**	-.088	**.322**	.014	-.022	-.130	**.486**
SM8	-.117	.013	.050	.256	.071	-.019	-.018	-.021	.050	**.674**	.212	.040	.299	-.045	-.013	.065	.111	-.085	.130
SM9	.043	.105	.150	.067	.278	.065	.102	.048	-.053	-.031	.171	.092	.181	.059	.058	**.728**	.031	.049	.001
SM10	-.012	.063	-.085	.274	.093	-.048	-.011	.072	-.036	**.732**	.077	-.003	.156	.036	.149	.159	.019	-.034	.026
SM11	.068	-.033	-.036	.062	.273	.055	.035	.062	-.178	**.799**	-.026	.006	-.017	.112	.052	-.088	-.108	.137	-.086
SM12	.000	.082	.015	.084	**.682**	-.027	-.057	.319	.149	.041	.108	.009	.137	.039	.107	.155	-.061	-.052	-.099
SM13	.028	.012	-.001	.172	**.741**	-.046	-.004	.197	-.057	.087	.071	.042	.180	.036	-.031	-.054	.050	-.010	.018
SM14	.074	-.001	.151	.214	**.619**	.121	.144	.304	-.022	.039	.061	-.027	.165	-.122	.106	.188	.198	-.015	.008
SM15	.073	.087	.085	.139	**.709**	.028	.067	.109	-.005	.158	.100	.176	.119	-.124	.001	.161	.160	.015	.071
SM16	-.012	.007	.008	.071	.210	.179	.029	.193	.093	.096	.052	-.037	**.709**	-.011	.060	.214	.025	.008	.050
SM17	-.012	-.012	.034	.129	.235	.100	-.046	.004	.054	.180	-.085	.047	**.752**	.068	.085	.084	-.013	.095	-.044
SM18	.067	.070	.093	.110	**.382**	.080	.007	**.527**	-.127	-.132	.170	-.013	**.325**	-.015	.033	.153	.003	-.171	-.170
SM19	.043	.076	.182	.139	.205	.010	-.012	**.692**	.006	-.083	-.028	.171	.100	.067	.031	.069	-.015	-.025	-.104
SM20	.137	.141	-.006	.124	.281	-.123	.023	**.614**	.122	.055	.054	.107	.076	-.037	.133	.045	.176	.048	.158
SM21	.237	.119	-.056	.105	**.335**	.038	.093	**.581**	-.093	.299	-.017	-.010	-.022	.061	-.027	-.061	-.105	.191	.109
SM22	**.421**	.087	.002	.190	.054	.180	.004	**.391**	.112	.222	.062	-.101	-.065	.066	.029	.042	.060	**.333**	-.028
SM23	**.364**	.059	.022	.315	.146	.096	-.040	**.482**	.008	.142	.226	-.005	.045	-.022	.034	-.073	-.056	-.099	.137
SM24	.148	.102	-.001	.157	.177	.042	-.051	.259	.047	.193	.237	-.078	**.387**	-.098	**.387**	-.032	-.065	-.252	.069
AP1	.154	**.638**	.213	.080	.083	.248	.095	.169	-.015	.095	.030	.064	.025	.025	.130	.182	.048	.109	-.136
AP2	.156	**.593**	.114	-.003	.024	.199	.154	.227	.283	.027	-.049	.082	.004	-.124	.088	.072	.068	.016	-.076
AP3	**.367**	**.539**	.227	-.054	-.012	.212	.090	.145	.074	.038	.130	.099	.056	.011	-.107	-.082	-.040	.031	-.074
AP4	.232	**.667**	.246	-.036	-.088	.195	.093	.079	.150	.107	-.032	.042	.078	.007	.074	.133	-.054	-.028	.065

Table 4, cont.

AP5	**.344**	**.610**	.099	-.004	-.058	.131	-.003	.047	.070	.149	.155	-.011	-.071	.224	.033	.044	.222	.028	-.011
AP6	.260	**.696**	.050	-.024	-.013	.053	.079	-.035	.139	.011	.116	-.005	-.033	.080	.097	.056	.313	-.108	.001
AP7	.219	**.381**	.274	.054	.058	**.500**	-.036	-.019	-.086	.055	.059	.002	-.001	.204	.017	.076	.181	.140	-.072
AP8	.202	.197	.177	-.058	.037	**.752**	.027	.029	.055	.007	.080	-.022	.017	.094	.015	.054	.061	.103	-.076
AP9	.283	.295	.255	.062	.090	**.484**	.036	.047	-.016	.150	.066	.072	-.031	.147	.033	-.015	.177	.058	.008
AP10	**.333**	**.471**	.108	.031	-.072	**.455**	-.018	-.001	.146	-.098	.085	.005	.103	.103	.187	-.017	.060	.220	-.014
AP11	.038	**.410**	.048	.012	.002	**.630**	.026	-.045	.119	-.014	.033	.081	.149	-.082	-.037	.059	-.169	-.032	.059
AP12	.084	.309	.069	-.091	.022	**.726**	.074	.036	.059	-.079	.014	-.026	.160	.033	-.008	.006	-.120	-.046	.096
AP13	.300	**.653**	.130	.110	.068	.169	.182	.072	.063	-.079	-.097	.125	.008	.021	-.124	.088	-.146	.102	.040
AP14	.214	**.704**	.134	.083	.180	.172	.121	-.024	-.017	-.038	-.067	.114	-.054	.020	-.089	-.084	-.137	.065	.130
AP15	.254	**.649**	.184	.133	.121	.117	.257	-.015	.017	-.099	.024	.097	.031	.159	.059	.048	-.026	.012	.086
LF1	.012	.012	.030	**.759**	.073	-.045	-.006	.036	.050	.113	.222	.030	.181	.078	-.081	-.058	-.031	.038	.056
LF2	-.067	.020	-.037	**.735**	.125	.075	-.039	.045	.076	.046	.223	-.019	.020	.095	.131	-.010	-.034	-.044	-.052
LF3	.023	-.030	.029	**.656**	**.335**	.061	-.029	.017	.010	.036	.249	-.086	.089	.054	.095	-.071	.103	.038	.048
LF4	.119	.024	.033	**.775**	-.026	.033	.119	.136	-.074	.131	-.201	.146	-.020	-.051	-.109	.082	-.033	.085	.077
LF5	.104	.058	.082	**.763**	.071	-.113	.079	.172	-.132	.107	.115	.106	.040	-.089	.091	.013	.002	-.037	-.102
LF6	.071	.092	-.023	**.820**	.129	-.101	.047	.065	-.041	.045	-.056	.112	-.032	-.050	.053	.122	.063	.026	.043
LF7	.059	.169	.008	**.322**	.152	-.014	.032	-.019	.079	-.017	**.560**	.158	.170	.023	.005	.012	.080	.300	.112
LF8	.264	.239	.190	.120	.066	.152	-.010	.009	.084	.088	.254	.143	.044	.010	-.027	.046	-.051	**.625**	-.025
LF9	.217	.072	-.017	.242	.035	.249	.111	.133	.073	.090	**.481**	-.040	-.178	.010	.027	.245	.152	.020	.194
LF10	.084	-.050	.096	.297	.274	.119	.132	.133	-.022	.170	**.632**	.099	-.049	-.051	.073	.098	-.186	-.030	.009
LF11	.013	-.011	.014	**.358**	.269	.002	.091	.094	.101	.183	**.577**	.007	.082	-.128	.167	.145	-.088	.123	-.153
LF12	.038	-.043	-.023	**.403**	**.466**	.255	.098	-.017	.169	.124	.056	-.150	.199	.008	.138	.209	.104	.118	.019
ML1	**.735**	.175	.061	.048	.003	.038	.121	.022	-.008	.056	-.036	-.102	-.021	-.052	-.071	.107	-.087	.106	.004
ML2	**.661**	.212	.130	.114	.073	.144	.053	-.054	.125	-.034	-.117	.074	.031	-.102	.081	-.108	.101	-.039	.155
ML3	**.709**	.108	.048	.072	-.026	-.011	.118	.055	.103	-.001	.080	.081	.068	.025	-.064	-.049	-.015	.059	.032
ML4	**.628**	**.322**	.146	.031	.043	.015	.125	.089	.067	-.008	.055	.021	.140	-.135	.080	.014	.044	.255	.000
ML5	**.334**	.253	-.009	.101	.157	-.004	.028	.116	.213	-.062	-.159	.172	.039	.104	.059	.008	**.485**	-.061	-.049
ML6	**.770**	.214	.087	-.006	-.099	.138	.050	.126	.083	-.076	-.024	.061	.008	.025	.013	.033	.095	.173	-.066
ML7	**.757**	.074	.099	-.033	.023	.095	.112	.207	-.062	-.002	.031	.128	.036	.203	-.013	-.172	.072	.045	-.002
ML8	**.680**	.216	.019	.104	-.070	.098	.122	.112	.175	.036	-.037	.071	.032	.018	.181	.152	-.030	-.014	.007
ML9	**.653**	.134	.031	-.031	.001	.116	.218	.008	.074	-.014	.092	.159	-.069	.015	-.011	.164	-.093	-.062	-.007
ML10	**.655**	.111	-.011	-.025	.140	.117	.072	.087	-.034	-.052	.016	.209	-.133	**.328**	.054	-.237	.043	-.044	-.043
ML11	**.632**	.142	.006	.013	.136	-.055	.008	.035	.108	-.089	.138	.286	-.010	.090	-.094	.145	.031	-.061	-.016

Table 4, cont.

ML12	**.381**	.222	.155	.069	.015	.028	.239	.050	-.017	-.053	-.047	**.488**	.033	.065	.173	.077	-.168	-.059	-.304
ML13	**.527**	.166	.113	.026	.257	.061	-.050	-.167	.102	.248	.163	-.035	-.080	-.057	-.023	.098	.007	-.199	.013
ML14	**.457**	.168	.219	.055	.086	**.325**	-.029	-.019	.289	.089	-.120	.062	.001	.045	.003	.011	.181	-.284	-.072
ML15	**.459**	.083	.174	-.049	.153	**.388**	-.011	-.039	.142	.146	-.092	.083	-.027	.134	-.007	-.072	.139	-.235	-.108
ML16	**.393**	.131	.080	.133	.115	.111	.083	.021	.048	-.085	.094	**.566**	-.025	-.080	.009	-.010	.170	.206	-.005
ML17	.230	.127	.160	.143	.089	-.041	.073	.153	.163	.147	.032	**.730**	.021	-.007	.031	.054	-.036	.018	.054
ML18	**.492**	.135	.091	.084	.092	.045	.109	.064	.056	-.039	.078	**.625**	.020	-.087	.023	.083	.065	-.011	.133
EF1	**.410**	.110	.225	-.012	.004	.096	.138	.084	.300	.065	.018	.159	-.175	**.401**	-.083	.112	-.106	.136	.228
EF2	**.393**	.033	**.365**	.053	-.138	-.057	.181	**.322**	.256	.073	.190	.067	-.018	.228	-.068	-.002	-.007	.082	.163
EF3	**.362**	.124	**.408**	.041	-.053	-.014	.006	.090	**.492**	-.010	.101	.134	.061	.170	-.034	-.037	-.061	.003	.060
EF4	.289	.289	**.365**	.023	-.004	.003	.012	.081	.306	-.060	.073	.158	.170	.141	.002	.077	**-.338**	-.062	-.068
EF5	.244	.186	.255	-.031	.122	.086	.098	-.002	**.681**	-.107	.087	.097	.044	.031	-.033	.023	.101	.058	-.035
EF6	.225	.202	**.399**	-.016	.085	.082	.132	-.023	**.647**	-.036	.079	.025	.002	.038	-.056	.075	.129	-.023	-.017
EF7	**.343**	.068	**.344**	-.110	.050	.218	.153	.029	**.470**	-.080	-.145	.042	.135	.155	.032	-.018	-.157	.160	.121
EF8	-.005	.157	**.603**	-.037	.004	.008	.190	-.009	.313	-.007	.014	.204	.041	-.126	-.004	-.023	-.072	-.003	-.210
EF9	.233	.198	**.451**	-.090	.059	.202	.235	.000	**.457**	-.104	-.018	.040	.142	-.111	.100	-.056	-.071	-.013	-.088
EF10	.105	.129	**.715**	.088	-.056	.136	.142	.050	-.064	-.029	-.143	.041	.042	.081	.151	.049	.101	.075	.205
EF11	.064	.238	**.716**	.068	.029	.116	.068	.048	.148	-.123	-.141	-.001	.073	-.048	.079	.189	.223	-.064	.008
EF12	.011	.204	**.771**	.023	-.038	.205	.048	.070	.107	.138	-.059	-.039	-.018	.126	.001	-.005	-.042	-.029	-.158
EF13	.127	.202	**.647**	-.064	-.028	-.058	.144	.001	.137	.002	.103	.122	-.020	.111	-.059	.098	-.203	.021	-.106
EF14	.144	.097	**.712**	.037	.180	.184	.119	.016	.114	-.080	.084	.025	-.074	.070	-.104	.054	.139	.028	.070
EF15	.090	-.011	**.695**	.014	.144	.007	.012	.047	.048	.033	.230	.042	.006	.216	.085	-.065	-.111	.096	.159
CF1	.261	.222	.183	.096	-.016	.077	**.644**	.186	.168	.058	.025	.025	.022	.101	.101	-.122	.226	-.016	-.037
CF2	.131	.143	.206	.189	-.113	-.007	**.683**	-.047	.093	.066	-.013	.203	.009	.036	-.032	.132	-.133	.029	.047
CF3	.218	.294	.216	.012	.103	.005	**.683**	-.021	.143	-.040	.033	.061	-.029	.179	.073	.008	.086	-.017	-.133
CF4	.304	.155	.125	-.026	.119	.060	**.663**	.027	.025	-.046	.114	.040	-.054	.280	-.156	-.004	-.027	-.037	.159
CF5	**.381**	.133	.179	-.042	-.019	.043	**.509**	-.046	-.043	-.015	.277	-.011	.071	.263	-.140	-.061	-.073	.118	.079
CF6	.091	.041	.156	.003	.030	.082	.195	.021	.053	.039	-.024	-.036	-.006	**.782**	.014	.030	.031	-.078	.001
CF7	.044	.183	.213	.026	-.134	.112	.235	.017	.032	.061	-.070	-.081	.079	**.607**	.054	.036	.011	.099	-.056

Table 5

Rotated Factor Loading Matrix for Teacher Raters on Neurocognitive Items

Item	Factor																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SM1	.087	.024	.075	.231	.064	-.105	.037	.340	.174	.230	.276	.153	-.009	.007	.097	**.534**	.121	.185	.036
SM2	.106	.073	-.101	.202	.041	.006	.179	.160	.020	.060	**.428**	.013	.009	-.103	-.020	.155	-.090	**.511**	.115
SM3	.025	.174	.041	.072	.098	-.081	.084	**.365**	.032	-.042	**.692**	-.002	.052	-.031	.113	.170	-.012	-.031	.030
SM4	-.015	-.034	.032	.125	.008	.019	.013	-.054	.021	.054	**.806**	.084	-.009	.033	-.119	.007	.025	.050	-.056
SM5	.102	-.067	.089	.207	.118	.006	.059	.074	-.050	.029	.033	**.755**	.031	-.082	-.037	.076	-.111	.040	.002
SM6	.042	.087	.094	.175	-.072	.120	.053	**.443**	-.003	.051	.006	.280	-.013	.081	.088	.079	.027	**.559**	-.061
SM7	-.060	-.028	.053	.262	-.031	.194	.108	.273	-.013	.150	.127	**.581**	-.046	.178	.072	-.054	.212	.177	-.078
SM8	.017	.049	.028	**.794**	.100	.044	.124	.085	-.075	-.006	.100	.077	.023	-.081	-.035	-.028	.020	.065	.063
SM9	.142	-.038	.067	**.322**	.044	-.014	.017	.202	.206	.182	.203	-.021	.010	-.020	-.083	**.587**	-.036	.159	-.024
SM10	-.024	.057	.018	**.657**	**.341**	.039	.075	.056	-.002	.082	.070	.130	.103	.149	.039	.127	.204	.038	.054
SM11	-.013	.089	-.009	**.795**	.153	.020	.097	.028	-.032	.102	.024	-.105	-.030	.133	.077	.034	.120	.085	-.028
SM12	.049	.038	.033	.225	.063	-.149	.066	**.598**	.022	.169	.154	.170	-.060	-.018	.090	.151	-.002	.257	.289
SM13	-.096	-.029	.001	.061	.126	-.107	.027	**.653**	.062	-.047	.206	.298	.166	.035	.145	.027	.187	-.049	.118
SM14	.046	.022	.081	.264	.037	.101	.111	**.673**	.170	.300	-.033	-.081	-.087	-.045	-.091	.100	-.068	-.005	-.112
SM15	.034	-.021	.001	**.374**	-.021	.104	.093	**.773**	.107	.119	-.017	.002	-.035	-.033	-.027	-.033	-.063	.070	-.109
SM16	.037	.003	.091	**.634**	.106	-.047	.073	.295	.108	.079	.042	.111	.035	-.057	-.064	.130	-.273	.081	-.001
SM17	.035	.119	.115	**.706**	.085	.006	.032	.200	.077	-.082	-.033	.042	.049	.048	-.032	.058	-.042	-.066	-.004
SM18	.088	.065	.058	**.619**	.095	.048	-.007	.227	.066	.122	.145	**.380**	-.055	-.086	-.060	-.065	-.065	-.273	.000
SM19	.079	.149	.121	.193	.022	.165	.067	.146	-.042	**.679**	.012	-.005	.002	-.170	.023	.134	-.017	-.067	.091
SM20	.168	.132	.032	.079	.142	-.094	.049	.193	.042	**.702**	.075	.078	.142	.119	-.026	.038	-.002	.071	-.098
SM21	.141	.030	.006	**.409**	.014	-.117	.219	.085	.122	**.396**	.015	.211	.010	.213	-.050	.045	-.014	.225	-.024
SM22	**.362**	.047	.168	.144	-.029	.037	.219	.117	.230	.273	-.139	.110	-.018	.095	-.103	.120	.051	-.070	.063
SM23	.208	.088	-.021	.277	.244	-.045	.186	.173	.169	.293	.034	.256	-.194	.097	.152	.121	.171	.060	.220
SM24	.066	.038	.027	**.534**	.122	-.091	.143	.096	.103	**.333**	-.109	**.334**	-.151	.139	.047	.040	.160	.137	.177
AP1	.215	**.759**	.198	.161	.038	.001	.022	-.036	.098	.085	.104	-.047	-.099	.001	.054	.036	-.031	-.017	-.078
AP2	**.331**	**.689**	.152	.181	.111	.028	-.072	-.032	-.034	.135	.020	-.082	.126	.070	-.015	-.060	-.012	.112	-.052
AP3	**.400**	**.556**	.103	-.004	.014	.194	.114	.084	.136	.010	.020	.149	**.330**	-.066	.023	.154	.013	-.072	.032
AP4	.287	**.756**	.206	.005	.056	.133	.019	.031	.094	.120	.060	-.054	.016	.132	-.003	-.029	-.003	-.011	-.001

Table 5, cont.

AP5	**.421**	**.687**	.022	.025	.032	.119	.118	.054	.140	-.076	.030	.053	-.028	.016	.069	.003	.005	.001	.185
AP6	**.463**	**.612**	.106	.028	.084	.140	.096	.060	.165	-.030	-.155	.045	-.024	.108	.050	-.064	.018	-.009	.017
AP7	.247	**.451**	.255	-.026	-.011	.007	.014	.129	**.568**	-.023	.049	-.025	.009	-.082	.009	-.062	-.007	-.028	.177
AP8	.173	.234	.242	.005	-.003	.119	.089	.082	**.749**	.028	.067	-.041	-.019	-.023	-.030	-.021	.083	-.050	.097
AP9	.211	.168	.246	.050	-.005	.005	.036	.200	**.594**	.012	-.032	-.048	.121	.103	.014	-.049	.040	.057	.050
AP10	**.341**	**.579**	.210	.036	.074	.282	.102	.087	.276	.027	.012	-.004	.048	.066	-.017	.039	.060	.072	.114
AP11	.113	.049	.090	**.495**	.154	-.019	.010	.057	**.442**	-.006	.078	.046	.025	.030	.106	.217	-.112	.135	-.234
AP12	.070	.102	.176	.103	-.058	.067	.062	-.014	**.761**	.047	.003	.043	.080	.040	.007	.188	-.009	-.004	-.110
AP13	**.420**	**.533**	.144	.085	.132	.020	.030	-.067	.138	.203	-.033	-.041	.422	.087	.019	-.010	.038	.124	.035
AP14	**.383**	**.534**	.204	.035	.064	.026	.013	-.019	.135	.075	.045	.035	**.547**	.039	.111	-.003	.012	-.050	-.023
AP15	**.380**	**.528**	.109	.070	.072	.116	.062	-.067	.140	.127	-.008	-.053	**.531**	-.014	.075	.062	.029	.010	-.007
LF1	.087	.100	-.013	.250	**.723**	-.057	.263	.076	-.014	.039	.077	.001	-.013	-.005	.025	-.033	**-.339**	.070	.029
LF2	.053	.121	.093	.290	**.666**	.063	.300	.108	.014	.022	.039	.019	.053	-.060	-.012	.031	-.242	.084	.139
LF3	.113	.053	.040	.195	**.572**	-.082	.303	.129	.017	.127	.205	-.097	-.074	-.132	.004	-.021	-.297	.026	-.075
LF4	.110	.044	-.112	.078	**.806**	-.051	.164	.007	-.047	.091	-.030	.027	.007	.020	.086	-.005	.081	-.049	-.106
LF5	.194	.035	.054	.219	**.739**	.106	.065	-.029	.027	.015	.041	.069	.067	.083	-.009	.142	.211	-.061	.115
LF6	.116	.060	-.005	.097	**.840**	.117	.043	-.025	-.013	-.020	-.041	.081	.001	.123	-.073	-.025	.180	-.029	-.037
LF7	.176	.177	.086	.171	.191	.105	**.620**	.214	.021	.098	.028	.025	.143	.186	-.046	.042	.202	-.053	-.002
LF8	.251	**.321**	.014	.063	.195	.046	**.375**	.072	.060	.100	.017	-.049	.190	.234	-.085	-.200	.115	-.290	.055
LF9	.240	.117	.043	-.022	.298	.085	**.709**	-.027	.060	.002	.004	.060	-.013	.123	-.061	.080	-.014	-.044	-.073
LF10	.100	.003	.133	.256	.159	.080	**.699**	.099	.041	-.037	-.005	.110	.027	.027	.089	.012	-.019	.167	-.033
LF11	.133	-.034	-.028	.189	.277	.019	**.656**	.083	.096	.139	.101	.020	-.070	-.186	.121	-.042	-.060	.089	.161
LF12	.043	.015	.117	**.489**	.134	.102	**.455**	-.103	.046	.212	.142	-.055	-.026	-.142	.026	-.070	-.015	-.033	.120
ML1	**.476**	**.323**	.140	.085	.057	.122	.013	-.127	.022	.039	-.076	.058	.096	-.133	-.002	.033	.229	.201	.171
ML2	**.653**	.224	.139	-.053	.061	-.029	.141	-.036	.166	-.061	.018	.122	.069	.166	.115	-.137	.018	.064	-.041
ML3	**.688**	**.333**	.111	.060	.069	.091	.124	.016	.049	-.088	.031	.090	.109	.128	.075	-.102	.057	-.161	-.112
ML4	**.636**	**.459**	.112	.120	-.002	.152	.064	-.044	.089	.065	-.001	-.023	.140	.058	-.031	-.070	.005	.001	.039
ML5	**.638**	.203	.095	-.090	.065	.198	-.060	.043	.106	**.325**	.068	.089	-.014	-.032	.085	-.104	-.096	.024	.078
ML6	**.672**	**.334**	.164	.095	.024	.164	.082	-.027	.106	.081	.050	.010	-.056	-.092	-.051	.145	.010	.051	.119
ML7	**.714**	.095	.161	.053	.031	.124	-.080	-.003	.093	.187	-.013	.099	-.098	-.003	-.002	.038	.092	-.120	.134
ML8	**.598**	**.356**	.078	-.054	.142	.173	.103	-.003	.157	.187	.087	.056	-.027	-.144	-.047	-.001	-.108	-.020	.059
ML9	**.676**	.259	-.020	.035	.047	.177	.158	-.059	.066	-.014	-.015	-.011	.050	.054	.042	-.059	-.147	.142	-.011
ML10	**.696**	.076	.025	.010	.038	-.083	.003	.031	-.042	.218	.028	.027	.086	.179	.241	-.004	-.082	-.096	-.187
ML11	**.726**	.181	.049	.092	.158	-.050	.029	.015	-.022	.016	.067	-.197	-.023	.146	.089	-.035	-.089	.028	.021

Table 5, cont.

ML12	**.464**	.202	.090	-.081	.133	.091	.023	-.071	.235	.178	.290	-.005	.236	-.090	.008	-.166	.004	.134	.025
ML13	**.465**	-.029	.126	.167	.190	.131	.247	.086	.171	-.103	.020	.003	-.064	-.037	.007	.019	**.411**	-.090	-.119
ML14	**.481**	.133	.244	.079	.004	.106	.057	.101	.290	.181	.124	-.089	-.099	-.111	-.108	-.142	**.409**	-.047	.074
ML15	**.442**	.081	.283	-.022	-.058	.172	.006	.150	.098	-.044	.080	-.111	-.001	.009	-.107	**-.419**	.271	.174	.000
ML16	**.697**	.196	.048	-.027	.074	.123	.195	.088	.014	-.072	-.028	-.047	.162	-.003	.099	.207	-.015	.007	-.051
ML17	**.649**	.028	.148	.056	.192	.231	.094	.091	.013	.040	-.070	.009	.084	.037	-.038	.284	.238	.097	.073
ML18	**.690**	.101	.115	.032	.071	.283	.106	.081	.071	-.110	-.106	.084	.129	.137	-.064	.160	.168	.095	.102
EF1	**.463**	.237	.201	.097	.060	.309	.121	.068	.057	-.084	.031	-.006	.089	**.535**	.083	.029	-.093	-.081	.018
EF2	**.372**	.080	**.368**	.002	.085	**.353**	.082	-.023	.040	.103	-.048	.083	.024	**.390**	.013	.008	-.004	-.080	.158
EF3	**.354**	.179	.256	.161	.177	.166	.034	-.108	.054	.036	-.028	-.022	.006	**.590**	-.050	-.029	.042	.051	.076
EF4	.179	.156	**.450**	.054	-.010	**.342**	-.002	.056	.231	.077	.118	.014	**.418**	.144	-.023	.000	-.142	-.142	.178
EF5	**.365**	.260	**.402**	.210	-.006	.211	.081	.100	.036	-.009	-.078	-.059	.147	.221	.131	-.013	-.044	-.020	**.438**
EF6	**.349**	.190	**.514**	.107	.003	.173	.069	-.064	.082	.049	-.085	-.089	.110	.191	.017	-.042	.012	.084	**.463**
EF7	.189	.212	**.390**	.095	-.117	**.473**	-.065	.004	.087	.115	-.045	-.071	.093	.204	-.274	-.098	-.051	.099	.114
EF8	.156	.072	**.540**	-.076	-.092	**.352**	.053	.047	.134	-.055	.013	.042	**.320**	.199	.045	-.199	-.127	.115	.040
EF9	**.334**	**.345**	**.360**	.058	-.094	**.383**	.054	.083	.109	.007	.138	-.058	.285	.111	.018	.005	-.105	.081	.217
EF10	.078	.249	**.743**	.063	.087	.083	-.074	-.075	.068	.077	-.062	.042	-.206	-.030	.038	.054	.096	.100	-.109
EF11	.023	.165	**.812**	-.009	.028	.113	-.058	.013	.054	.127	.029	.037	-.105	.089	-.085	-.027	.055	.067	-.131
EF12	.123	.173	**.781**	.029	.019	.059	.087	.073	.164	-.062	-.003	.047	.048	.162	.048	-.080	.022	-.036	.064
EF13	.075	.026	**.700**	.017	.007	.082	.054	.069	.203	.078	.114	-.057	.161	-.080	.183	.066	.053	-.014	.016
EF14	.267	.183	**.724**	.077	.005	.043	.115	.044	.059	-.059	.009	.054	-.009	-.030	.085	.073	.055	-.136	.066
EF15	.130	-.020	**.738**	.153	-.078	.027	.116	-.008	.150	.035	-.005	.077	.149	-.029	.113	.068	-.098	-.011	.069
CF1	.316	.316	.172	-.038	.027	**.681**	.109	.006	.138	.013	.084	-.082	-.049	.067	.114	.019	-.023	.020	.065
CF2	.196	.045	.009	-.042	.247	**.647**	.026	-.055	.003	-.023	-.106	.212	.113	-.007	.124	-.027	.171	-.066	.012
CF3	.195	-.024	.243	.025	-.059	**.660**	.081	.114	.002	.044	-.036	-.034	.015	.028	.161	-.209	.029	.142	-.235
CF4	.308	.222	.150	.095	.008	**.697**	.073	-.057	.047	.029	.002	.017	.017	.035	.191	.107	.024	-.034	.062
CF5	**.407**	.234	.144	-.014	.027	**.457**	.230	.000	.008	-.154	.026	.065	-.108	.124	.241	.055	-.058	-.048	.264
CF6	.151	.017	.190	.050	.043	.237	-.071	-.005	.053	.000	.000	-.034	.075	.073	**.711**	-.141	.031	.031	.171
CF7	.139	.106	.138	-.042	-.028	.196	.118	.080	-.037	-.002	-.070	.033	-.008	-.066	**.744**	.127	-.045	.024	-.110

Table 6

Variance Explained for Parent and Teacher Raters on Neurocognitive Items

	Parent			Teacher		
Factor	Eigenvalue	Variance %	Cumulative Variance %	Eigenvalue	Variance %	Cumulative Variance %
1	8.97	9.86	9.86	10.61	11.65	11.65
2	5.95	6.54	16.4	6.33	6.96	18.61
3	5.50	6.05	22.45	6.00	6.60	25.21
4	4.79	5.27	27.72	5.42	5.96	31.17
5	4.58	5.04	32.76	4.22	4.64	35.81
6	3.50	3.85	36.64	3.96	4.36	40.16
7	2.97	3.27	39.87	3.19	3.50	43.67
8	2.86	3.14	43.01	3.13	3.44	47.11
9	2.82	3.09	46.11	3.03	3.33	50.44
10	2.66	2.93	49.03	2.36	2.59	53.04
11	2.48	2.73	51.76	1.98	2.18	55.21
12	2.32	2.55	54.31	1.89	2.08	57.30
13	2.28	2.50	56.82	1.88	2:06	59.36
14	2.17	2.39	59.20	1.78	1.95	61.31
15	2.08	2.28	61.49	1.76	1.93	63.24
16	2.00	2.20	63.68	1.65	1.82	65.06
17	1.52	1.67	65.35	1.50	1.65	66.70
18	1.45	1.60	66.95	1.47	1.62	68.32
19	1.23	1.35	68.30	1.44	1.58	69.91

The academic components of the NPCC were also analyzed. Table 7 lists the rotated factor loading matrix for the academic items, and Table 8 lists the eigenvalues and total amount of variance explained for both parent and teacher raters. For parent raters, seven factors were retained as they produced eigenvalues greater than one. The first factor accounted for 14.9% of the variance, the second factor accounted for 12.49% of the variance, and the third factor accounted for 12.06% of the variance; together the seven factors for parent raters accounted for 67.24% of the variance. For teacher raters, a total of seven factors were also retained. The first factor accounted for 13.99% of the variance, the second factor accounted for 10.7% of the variance, and the third factor accounted for 10.0% of the variance; together, the seven factors for teacher raters accounted for 66.85% of the variance.

Like the neurocognitive constructs, there were some similar patterns produced between parents and teachers, and there were some that were different. The first factor for both raters was similar and included all of the items related to math, suggesting that the first factor represents a broad construct of mathematics. Items representing the spatial production of writing loaded onto the second factor for teachers, whereas it was the third factor for parents. In addition, the parent factor also included items related to one's attitude toward writing. Items loading on the third factor for teachers included reading as it relates to attention and memory. The fourth factor for teachers included items that appear to represent written expression while the fifth factor consisted of items that appear to represent phonological processing/awareness. Finally, the sixth factor for teachers encompasses a construct related to attitudes toward reading and writing, and the seventh factor appeared to be related to the physical characteristics of one's writing.

For parents, there was more overlap in the items loadings. For example, reading and writing items loaded onto the same factor, which suggests that parents view the academic components of reading and writing differently than teachers. The second factor represented memory problems related to reading, missing details while reading, and difficulties with writing expression, whereas the third factor represented the spatial production of writing, as well as the attitudinal issues related to writing. The fourth factor included items related to phonological processing/awareness. The fifth factor appears to represent attitudinal issues related to reading. Lastly, the sixth factor and seventh factor for parents included items that relate to the physical characteristic of one's writing and how others perceive that person's writing.

For both parents and teachers, there were a number of meaningful reading and writing items that loaded onto more than one factor. Items related to math, however, loaded strongly onto one factor. Only a few math items loaded onto other factors. This suggests that both parents and teachers consider reading and writing to be interconnected. Discussions about the academic factors and the item loadings are discussed in more detail in the following chapter.

Reliability

Internal consistency estimates of reliability were computed for all of the neurocognitive items of the NPCC to determine the consistency of results across the items within each neurocognitive section. According to Sattler (2001), internal consistency reliability assesses the degree to which different portions of the same test are related to each another or consistently measure the same thing. This means factors of a test that measures a particular construct should have high internal consistency reliability. Cronbach's Alpha is the most widely used measure of internal consistency reliability (Mertler & Vannatta, 2005). These computations were done to ensure each item was reliable and produced consistent scores each time the NPCC was given to raters. Internal consistency was evaluated utilizing Cronbach's Alpha, and all of the neurocognitive items were considered to be highly reliable for parent raters (α = .959), as well as for teacher raters (α = .965). Refer to Table 9 for the reliability for both raters. An analysis of the items for both parent and teacher raters did not reveal any statistically significant increase in reliability; therefore, no neurocognitive items were removed from the NPCC.

Multivariate Analysis of Variance

Multivariate analysis of variance (MANOVA) is designed to test the significance of group differences using multiple dependent variables (Mertler & Vannatta, 2005). Therefore, two one-way MANOVAs were conducted to determine if there were any differences between the broad diagnostic categories of participants and how parents and teachers rated their observations of a particular child on the neurocognitive constructs of the NPCC. The rationale for conducting MANOVAs with broad diagnoses only was to determine whether or not parent and teacher raters responded differently when different diagnostic features (i.e., sensory-motor functioning, attentional problems, executive functioning, etc.) are present in a child. These diagnostic features are representative of an individual meeting criterion for a particular diagnosis (APA, 2000); therefore, differences between demographic features such as race, gender, and age were not conducted as part of the current study. In addition, research has shown that an individual's neurocognitive profile provides evidence for various disorders or deficits. For example, research has continually shown that individuals with autism often have difficulties with sensory processing and motor control (APA, 2000; Dawson & Watling, 2000; Lang, 2010). Therefore, parents and teachers are likely to observe individuals presenting with characteristics of autism higher on items relating to sensory-motor functioning.

Similarly, individuals with ADHD are likely to be rated higher on measures of attention, executive functioning, and some aspects of memory. Various researchers have demonstrated individuals with ADHD often have deficits with response inhibition, working memory, and planning (Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010).

Prior to the MANOVA tests, items within each of the six neurocognitive constructs designed by Miller (2007) were summed together to form a total score. As there were a different number of items for each neurocognitive construct, a mean was calculated so scores could be compared with each other. Because there were six neurocognitive constructs on the NPCC, six total mean scores were calculated. These mean total scores for each neurocognitive construct were considered to be the dependent variables, whereas the broad diagnosis was considered to be the independent variable. Additionally, some of the broad diagnostic groups were combined to create larger sample sizes that could be more easily compared. The first diagnostic group consisted of individuals with a Learning Disability (n=184). The second group consisted of individuals with Intellectual Disability, Neurological Impairment, General Medical, Deafness, and Language Disorder (n=138). These diagnoses were grouped together as the number of individuals in each diagnostic group alone was too small to analyze separately. The third group consisted of individuals with ADD/ADHD (n=115). The fourth group consisted of individuals on the Autism Spectrum (n=46), and the fifth group consisted of individuals with Emotional Disability (n=31). The sixth group consisted of individuals with more than one diagnosis and included the broad diagnostic groups of Other

(Multiple Disabilities), LD and ADHD, Autism and ADHD, Emotional Disturbance and ADHD, and General Medical and ADHD (n=186). The seventh, and final group consisted of individuals with no diagnosis (n=256). Table 10 lists the frequency and percentage of individuals in each diagnostic group used for the MANOVAs.

MANOVA results revealed significant differences for parent raters among the broad diagnosis on the dependent variables, Wilks' Λ=.910, $F(36, 4143.76)=2.51$, $p<.05$. Significant differences were also revealed for teacher raters, Wilks' Λ=.935, $F(36, 4060.329)=1.732$, $p<.05$. Refer to Table 11 for the results of the MANOVA for both raters. This suggests that there are differences in the way parents and teachers perceive children in terms of the diagnostic characteristics they exhibit in the classroom and at home.

Table 7

Rotated Factor Loading Matrix for Parent and Teacher Raters on Academic Items

	Parent							Teacher						
Item	1	2	3	4	5	6	7	1	2	3	4	5	6	7
R1	0.188	0.319	0.037	0.315	**0.482**	0.042	**0.363**	0.121	0.084	**0.587**	0.004	**0.325**	**0.350**	0.077
R2	0.230	**0.549**	-0.025	0.119	**0.441**	-0.022	0.319	0.204	0.020	**0.702**	**0.336**	0.262	0.125	0.088
R3	**0.333**	0.234	0.073	**0.377**	**0.394**	0.135	**0.407**	0.206	0.188	**0.627**	0.158	**0.409**	0.151	0.062
R4	0.061	0.208	0.142	**0.825**	0.134	0.087	0.089	0.071	0.157	0.171	0.150	**0.831**	0.117	0.062
R5	0.171	0.184	0.177	**0.741**	0.217	0.079	0.050	0.215	0.140	0.234	0.168	**0.693**	0.099	0.137
R6	0.082	0.270	0.036	**0.790**	0.288	0.079	0.106	-0.013	0.046	0.319	0.140	**0.777**	0.140	0.083
R7	0.250	**0.630**	-0.178	0.190	**0.324**	0.150	0.182	0.215	0.103	**0.754**	0.227	0.204	0.117	0.070
R8	0.249	**0.622**	-0.116	0.156	**0.374**	0.183	0.218	0.228	0.103	**0.734**	0.300	0.101	0.135	0.063
R9	0.169	0.290	0.085	0.106	**0.767**	0.110	-0.006	0.155	0.001	**0.385**	0.058	0.097	**0.675**	0.190
R10	0.144	0.087	0.231	0.517	**0.604**	0.176	-0.057	0.056	-0.019	0.093	0.048	**0.495**	**0.613**	0.205
R11	0.102	0.148	0.215	0.289	**0.746**	0.024	0.013	0.104	0.030	0.277	0.066	**0.469**	**0.638**	0.006
W1	0.277	0.101	**0.506**	**0.393**	-0.039	**0.321**	0.062	0.181	**0.632**	0.068	0.188	0.161	0.212	0.185
W2	**0.329**	0.033	**0.491**	0.262	0.105	**0.424**	-0.120	0.187	0.296	-0.024	0.067	0.120	0.138	**0.585**
W3	0.022	0.110	0.090	-0.017	0.038	**0.745**	0.259	-0.150	**0.356**	0.224	0.058	0.111	0.013	**0.514**
W4	0.027	0.008	**0.394**	0.270	0.047	0.244	**0.541**	0.044	**0.654**	-0.068	0.132	**0.372**	0.233	0.136
W5	0.215	0.082	0.242	0.158	0.033	**0.695**	-0.004	0.102	**0.465**	0.008	-0.009	0.079	0.017	**0.606**
W6	0.280	0.112	**0.368**	0.004	0.168	0.267	-0.148	0.134	0.080	-0.191	**0.529**	-0.020	0.130	**0.460**
W7	0.253	0.108	**0.599**	0.217	-0.004	0.309	0.091	0.129	**0.558**	0.038	0.083	0.031	0.017	**0.366**
W8	0.182	0.104	0.279	0.058	0.184	**0.559**	0.029	0.099	0.131	0.155	0.006	0.058	0.145	**0.655**
W9	0.130	0.198	**0.457**	0.061	0.038	0.165	**0.620**	0.295	**0.492**	0.168	**0.349**	0.158	0.193	0.063
W10	0.236	0.050	**0.671**	0.279	-0.130	0.278	0.228	0.196	**0.815**	0.146	0.192	0.041	-0.028	0.173
W11	0.221	0.010	**0.660**	0.266	-0.038	**0.393**	0.142	0.172	**0.819**	0.159	0.103	0.025	-0.026	0.291
W12	0.220	**0.325**	**0.593**	0.167	0.108	0.067	0.202	0.298	0.295	**0.355**	**0.429**	0.126	0.286	0.123
W13	0.102	**0.750**	0.145	0.157	0.128	0.163	0.050	0.230	0.125	**0.375**	**0.525**	**0.373**	0.037	-0.007
W14	0.174	**0.693**	**0.375**	0.178	0.055	-0.033	0.087	0.253	0.149	**0.333**	**0.728**	0.153	0.062	0.017
W15	0.202	**0.729**	0.280	0.259	0.073	0.070	-0.063	0.206	0.181	**0.371**	**0.716**	0.183	0.127	0.104
W16	0.074	**0.380**	**0.397**	**0.557**	0.027	-0.021	0.143	0.075	0.279	0.127	**0.546**	**0.566**	0.081	0.011

Table 7, cont.

	Parent							Teacher						
Item	1	2	3	4	5	6	7	1	2	3	4	5	6	7
W17	0.291	**0.659**	0.263	0.298	0.046	0.085	0.041	0.180	0.298	0.269	**0.626**	**0.332**	0.066	-0.028
W18	0.146	**0.679**	**0.432**	0.018	0.228	0.069	-0.111	0.201	0.284	**0.378**	**0.536**	0.075	**0.352**	-0.047
W19	0.034	0.232	**0.727**	-0.005	**0.352**	0.045	0.071	0.136	0.284	0.037	**0.344**	0.046	**0.623**	0.228
W20	0.047	0.318	**0.640**	-0.055	**0.384**	0.004	0.095	0.120	**0.485**	0.194	**0.320**	0.016	**0.561**	-0.066
M1	**0.782**	0.203	0.198	0.039	0.151	-0.022	0.165	**0.751**	0.106	0.127	0.191	0.059	0.118	0.047
M2	**0.746**	0.141	0.160	0.052	0.111	-0.034	0.247	**0.756**	0.203	0.180	0.144	-0.082	0.147	-0.076
M3	**0.748**	0.190	0.083	0.199	-0.003	0.127	0.071	**0.823**	0.025	0.086	0.214	0.173	-0.010	0.156
M4	**0.851**	0.173	0.053	0.131	0.024	0.120	0.114	**0.855**	0.036	0.118	0.198	0.060	-0.057	0.127
M5	**0.631**	**0.471**	0.088	0.073	0.102	0.008	0.028	**0.692**	-0.014	0.155	**0.386**	0.091	0.001	0.157
M6	**0.699**	0.160	0.112	0.175	0.041	**0.321**	-0.050	**0.737**	0.182	0.242	0.057	0.113	-0.092	0.032
M7	**0.805**	0.054	0.188	0.008	0.156	0.112	-0.092	**0.637**	0.211	0.022	-0.045	0.089	0.285	0.102
M8	**0.793**	0.082	0.177	0.018	0.161	0.190	-0.072	**0.733**	0.198	0.082	-0.046	0.025	**0.323**	-0.031

Table 8

Variance Explained for Parent and Teacher Raters on Academic Items

Factor	Parent Eigenvalue	Parent Variance %	Parent Cumulative Variance %	Teacher Eigenvalue	Teacher Variance %	Teacher Cumulative Variance %
1	5.81	14.90	14.90	5.46	13.99	13.99
2	4.87	12.49	27.39	4.17	10.70	24.70
3	4.70	12.06	39.44	3.90	10.00	34.70
4	3.71	9.50	48.95	3.88	9.94	44.64
5	3.04	7.80	56.75	3.60	9.22	53.86
6	2.49	6.39	63.14	2.85	7.29	61.15
7	1.60	4.09	67.24	2.23	5.70	66.85

Table 9

Reliability

Rater	Cronbach's	N of Items
Parent	.959	91
Teacher	.965	91

Table 10

Participant Demographics for MANOVAs

Diagnostic Group	**# of Participants**	**Percentage**
No Diagnosis	256	26.8
Multiple Disabilities	186	19.5
Learning Disability (LD)	184	19.2
General Medical	138	14.4
ADD/ADHD	115	12.0
Autism Spectrum	46	4.8
Emotional Disability	31	3.2

Table 11

Multivariate Analysis of Variance

Rater	Value	F	Hypothesis df	Error df	Significance	η^2
Parent	.910	2.513	36.000	4143.76	.000	.016
Teacher	.935	1.732	36.000	4060.33	.004	.011

Post-hoc pairwise comparisons were also conducted to determine where the differences were for each rater. For parents, significant differences were found between the ADD/ADHD and General Medical groups, as well as the General Medical and No Diagnosis groups for the Sensory-Motor section. Within the Attention section for parent raters, significant differences were found between the Learning Disability and ADD/ADHD groups, as well as the Learning Disability and Multiple Disabilities groups. Within the Memory section for parents, significant differences were found between the Multiple Disabilities and the No Diagnosis groups. For the Executive Functioning group for parent raters, significant differences were found between the ADHD and Learning Disability groups, as well as the Learning Disability and Multiple Disabilities groups. No significant differences were found with the Language or the Cognitive Efficiency section for parent raters.

For teachers, significant differences were only found between the Learning Disability and General Medical groups, as well as the No Diagnosis and General Medical groups for the Sensory-Motor section. No significant differences were found within the Attention section, the Language section, the Memory section, the Executive Functioning section, or the Cognitive Efficiency section for teacher raters. Means and standard deviations from the MANOVAs are located on Table 12. Pairwise comparison results are located in Table 13.

Table 12

MANOVA Means and Standard Deviations

Dependent Variable	**Mean**	**SD**
Parent Raters		
Sensory-Motor	.442	.014
Attention	1.328	.025
Language	.605	.018
Memory and Learning	1.105	.023
Executive Functioning	1.163	.022
Cognitive Efficiency	1.374	.025
Teacher Raters		
Sensory-Motor	.354	.012
Attention	1.292	.025
Language	.647	.020
Memory and Learning	1.241	.024
Executive Functioning	1.236	.024
Cognitive Efficiency	1.369	.026

Table 13

Pairwise Comparison Results

	Mean	Significance
Parent Raters		
Sensory-Motor		
General Medical and ADD/ADHD	.136	.021
No Diagnosis and General Medical	.123	.008
Attention		
Learning Disability and ADD/ADHD	-.236	.020
Multiple Disabilities and Learning Disability	-.260	.001
Memory and Learning		
Multiple Disabilities and No Diagnosis	.182	.014
Executive Functioning		
Learning Disability and ADD/ADHD	-.224	.010
Multiple Disabilities and Learning Disability	-.177	.033
Teacher Raters		
Sensory-Motor		
Learning Disability and General Medical	.104	.039
No Diagnosis and General Medical	.117	.004

Summary

The purpose of this study was to examine the factor structure of the NPCC. Initial descriptive statistics were analyzed to obtain more information regarding the demographics and clinical make-up of the sample. Demographic information considered important included gender, ethnicity, and broad diagnosis. To answer the question regarding the factor structure of the NPCC, two exploratory factor analyses were conducted on the neurocognitive constructs as well as the academic constructs of reading, writing, and mathematics. It was hypothesized that six factors would be produced from the neurocognitive section, with each factor representing the neurocognitive construct intended by Miller (2007). Parent and teacher raters were analyzed separately, and several factors were produced. Results revealed a factor structure that contained some constructs similar to Miller's (2007) school neuropsychology conceptual model as well as narrower constructs within a broader neuropsychological domain for both parent and teacher raters. Nineteen factors were retained using Kaiser's method. Parent and teacher raters produced some factors that were strikingly similar. There were other factors, however, that contained some of the same underlying structure but yielded different item loadings. Factor analysis of the academic items resulted in seven factors retained for both parent and teacher raters. Items from the academic area of mathematics loaded onto a strong and independent factor for both parents and teachers. For reading and writing, there was overlap and differences among raters. Possible reasons for the differences are discussed in more detail in the next chapter.

CHAPTER V

DISCUSSION

The field of neuropsychology has grown over the past several decades as the knowledge base of medicine, psychology, and the basic sciences has expanded (Lezak et al., 2004). School neuropsychology has emerged as a specialty area for the application of neuropsychology within the schools (Miller, 2007). Therefore, there is a tremendous need and interest to extend neuropsychology in the schools by school psychologists (D'Amato, 1990). School neuropsychological evaluations go beyond traditional psychoeducational evaluations as they assess a wider variety of constructs (Miller, 2010). This results in a more comprehensive and complex assessment of a particular child. The literature reviewed as part of the current study demonstrated that there is a need for a tool that will provide school neuropsychologists with a framework for assessment while also allowing parents and teachers to identify their concerns for a particular student. The NPCC, created by Miller (2007), is a useful tool as it integrates neuropsychology as it relates to the school setting. In addition, it allows professionals to gather more information about a particular child from a parent or teacher's perspective.

To ensure the usefulness of the NPCC, the current study explored the validity of the NPCC in order to provide statistical evidence that the checklist measures the neuropsychological constructs Miller (2007) intended for it to measure.

Summary and Interpretation of the Results

Factors for Neurocognitive Constructs

Miller (2007) designed the NPCC to include six neurocognitive constructs; sensorimotor functions, attention problems, language functions, memory and learning functions, executive functions, and speed and efficiency of cognitive processing. It was hypothesized that the results would yield six factors. Instead, factor analyses produced several factors, and the decision was made to retain 19 factors for both parent and teacher raters. Table 14 lists the factors and the corresponding neurocognitive labels based on the item loadings.

The first three factors for both parents and teachers appear to partially support the study's hypothesis as the factors represent three broad constructs similar to the ones proposed by Miller (2007). The first three factors included one construct related to memory, one construct related to attention, and one construct related to executive functioning. All memory and learning items from teacher raters, and all but one memory and learning item for parent raters were included in the first factor. Miscellaneous executive functioning, attention, and visual-spatial items were also included but did not load onto the factor as strongly as the memory items. Refer to Table 15 for items and their factor pattern coefficients for the first factor.

Table 14

NPCC Factors with Corresponding Neurocognitive Label

Factor	Parent	Teacher
1	General Memory	General Memory
2	Broad Attention	Broad Attention
3	Executive Functioning	Executive Functioning
4	Phonological Processing/Articulation	General Sensory-Motor (1)
5	General Sensory-Motor Functioning	Phonological Processing/Articulation
6	Shifting/Divided Attention	Processing Speed
7	Processing Speed	Expressive Language
8	Visual/Auditory Discrimination	Motor and Visual-Spatial Functioning
9	Organization and Initiation of Tasks	Shifting and Divided Attention
10	Fine Motor and Tactile Functioning	Visual/Auditory Discrimination
11	Expressive Language	Gross Motor Functioning (1)
12	General Learning	General Sensory-Motor (2)
13	Auditory Functioning, Sensory-Motor	Attentional Capacity
14	Long-term Retrieval/Cognitive Efficiency	Problem Solving
15	Gross Motor Functioning	Long-term Retrieval/Processing Speed
16	Muscle Weakness/Sensory Sensitivity	Muscle Weakness/Sensory Sensitivity
17	Difficulties taking notes/Frustrated easily	Long-term Memory
18	Receptive Language	Gross Motor Functioning (2)
19	General Motor Functioning	Planning

Based on these results, the first factor represents memory as a broad construct. Therefore, the items within the memory section of the NPCC do not necessarily need to be further divided into the subsections of short-term memory, active working memory, or long-term memory. The items loading strongly onto this factor (i.e., memory items) suggest that parents and teachers do not view a child's memory problems in specific terms. Instead, they view a child's poor memory as a general memory problem rather than a problem with short-term memory, working memory, or long-term memory. It would, then, be the goal of the school neuropsychologist to investigate the various components of memory, or other neuropsychological functions, to determine the specific cause of a child's poor memory. For other items loading onto this factor, the ambiguous wording could explain the reason these items did not load onto the factors Miller (2007) intended. For example, item EF1 (i.e., Difficulty learning new concepts or activities) and item AP6 (i.e., Seems to lose place in an academic task [e.g., reading]) can be interpreted as behavioral manifestation of a memory problem.

The second factor for both parent and teacher raters was similar and included many items within the attention domain. While the literature review presented several models of attention where attention was viewed as a multifaceted construct (Mirsky et al., 1991; Miller, 2007), parent and teacher ratings produced one broad attention factor that appear to represent attention as it relates to an individual's attentional capacity as well as their ability to focus or sustain their attention. Table 16 lists the items and the factor pattern coefficients for the second factor. Meaningful items that loaded onto this factor that Miller (2007) intended to represent a different construct tended to be ambiguous and could easily be interpreted as a behavioral manifestation of attentional problems. Interestingly, the majority of the items related to shifting attention and divided attention either loaded or cross-loaded onto a separate factor for both parents and teachers. This suggests that parents and teachers view attention in two different ways: attention in a broad sense and attention as it relates to how a child is able to shift or divide his or her attention among tasks.

Table 15

General Memory Factor

Label	Item	Teacher	Parent
ML11	Difficulty answering questions of facts quickly	**.726**	**.632**
ML7	Loses place in the middle of solving a math problem	**.714**	**.757**
ML16	Difficulty learning verbal information	**.697**	**.393**
ML10	Trouble remembering facts or procedures in mathematics	**.696**	**.655**
ML18	Difficulty integrating verbal and visual information	**.690**	**.492**
ML3	Seems not to know things right after they are presented	**.688**	**.709**
ML9	Trouble summarizing narrative or text material	**.676**	**.653**
ML6	Loses track of steps/forgets what they are doing amid task	**.672**	**.770**
ML2	Lacks rehearsal strategies while listening/studying	**.653**	**.661**
ML17	Difficulty learning visual information	**.649**	.230
ML5	Problems coping from the board and/or taking notes	**.638**	**.334**
ML4	Trouble following multiple step directions	**.636**	**.628**
ML8	Loses train of thought while writing	**.598**	**.680**
ML14	Forgets where personal items or school work were left	**.481**	**.457**
ML1	Frequently asks for repetitions of instructions/explanations	**.476**	**.735**
ML13	Forgets what happened days or weeks ago	**.465**	**.527**
ML12	Gets frustrated while trying to convey thoughts on paper	**.464**	**.381**
AP6	Seems to lose place in an academic task (e.g., reading)	**.463**	.260
EF1	Difficulty learning new concepts or activities	**.463**	**.410**
ML15	Forgets to turn in homework assignments	**.442**	**.459**
AP5	Mind appears to go blank or loses train of thought	**.421**	**.344**
AP13	Stops performing tasks that contain too many details	**.420**	.300
CF5	Responds slowly when asked questions	**.407**	**.381**
AP3	Does not know where to start when given a task	**.400**	**.367**

Table 16

General Attention Factor

Label	Item	Teacher	Parent
AP1	Easily distracted by sounds, sights, or physical sensations	**.759**	**.638**
AP4	Difficulty paying attention for a long period of time	**.756**	**.667**
AP2	Inattentive to details or makes careless mistakes	**.689**	**.593**
AP5	Mind appears to go blank or loses train of thought	**.687**	**.610**
AP6	Seems to lose place in an academic task (e.g., reading)	**.612**	**.696**
AP10	Difficulty attending to more than one thing at a time	**.579**	**.471**
AP3	Does not know where to start when given a task	**.556**	**.539**
AP14	Avoids activities that require a lot of mental effort	**.534**	**.704**
AP13	Stops performing tasks that contain too many details	**.533**	**.653**
AP15	Seems to get overwhelmed with difficult tasks	**.528**	**.649**
ML4	Trouble following multiple step directions	**.459**	**.322**
AP7	Difficulty stopping one activity and starting another	**.451**	**.381**
ML8	Loses train of thought while writing	**.356**	.216
EF9	Has trouble getting started with tasks	**.345**	.198
ML6	Loses track of steps/forgets what they are doing amid task	**.334**	.214
ML3	Seems not to know things right after they are presented	**.333**	.108
ML1	Frequently asks for repetitions of instructions/explanations	**.323**	.175
LF8	Does not do well with verbal directions	**.321**	.239
AP11	Does not seem to hear anything else while watching T.V.	.049	**.410**

The third factor for both parent and teacher ratings appears to represent a broad construct of executive functioning. Teacher ratings produced a slightly stronger construct, and this may be related to the fact that executive functioning plays an important role in learning (St. Clair-Thompson & Gathercole, 2006), and deficits become more apparent in academic settings. The interconnected nature of executive functioning may also explain why nearly all of the executive functioning items clustered together. For example, difficulties in one's ability to regulate his or her behaviors can also lead to difficulties with problem solving, planning, and organization. McClelland et al. (2007) supports this notion as their research provides evidence for improved academic achievement as executive functioning skills mature. In their research, they state children become more successful in regulating their classroom behavior, which includes paying attention, remembering instructions, and completing tasks, as they learn to focus their attention and develop inhibitory control (McClelland et al., 2007). Table 17 lists the items and their corresponding factor pattern coefficients for the third factor.

Table 17

General Executive Functioning Factor

Label	Item	Teacher	Parent
EF11	Demonstrates signs of impulsivity	**.812**	**.716**
EF12	Trouble following rules	**.781**	**.771**
EF10	Demonstrates signs of over activity (hyperactivity)	**.743**	**.715**
EF15	Cannot empathize with the feelings of others	**.738**	**.695**
EF14	Lack of common sense or judgment	**.724**	**.712**
EF13	Demonstrates signs of irritability	**.700**	**.647**
EF8	Appears to be under-motivated to perform or behave	**.540**	**.603**
EF6	Trouble completing plans	**.514**	**.399**
EF4	Quickly becomes frustrated and gives up easily	**.450**	**.365**
EF5	Trouble making plans	**.402**	.255
EF7	Difficulty with organizational skills	**.390**	**.344**
EF2	Difficulty solving problems that a younger child can do	**.368**	**.365**
EF9	Has trouble getting started with tasks	**.360**	**.451**
EF3	Makes the same kinds of errors over and over	.256	**.408**

Six of the remaining ten factors produced similarities in the item loadings among parents and teachers, but the amount of variance explained by the factors were different and warrants discussion. For example, the fourth factor for parents is related to language, whereas the fourth factor for teachers is related to sensory-motor functioning. The fifth factor for parents was related to sensory-motor functioning, and the fifth factor for teachers represented language as it pertains to phonological awareness and articulation. While the underlying constructs are the same, the factor loadings are weighted differently between raters. These subtle differences are likely related to the idea that parents and teachers perceive the child differently based on the context surrounding them. Certain behaviors become more apparent at home while others are more apparent in the classroom. For example, a child's processing speed, or ability to complete tasks quickly and efficiently, is likely to be noticed more in structured situations, such as the classroom. This explains why the factor with items related to processing speed accounted for more of the variance in teacher raters.

While the variance for some of these factors is different between raters, many of the same items loaded similarly between parents and teachers. For instance, items related to phonological awareness and articulation loaded together for both raters. Refer to Table 18 for items and factor pattern coefficients for this factor. While item SM10 (i.e., Complains of loss of sensation [e.g., numbness]) loaded onto this factor for teachers, it loaded more strongly onto another factor that appears to represent sensory-motor functioning.

Table 18

Phonological Awareness/Articulation Factor

Label	Item	Teacher	Parent
LF6	Difficulty with sound discrimination	**.840**	**.820**
LF4	Difficulty with blending of sounds to form words	**.806**	**.775**
LF5	Difficulty with basic rhyming activities	**.739**	**.763**
LF1	Omits sounds	**.723**	**.759**
LF2	Substitutes sounds	**.666**	**.735**
LF3	Distorts sounds (e.g., slurring, stuttering)	**.572**	**.656**
SM10	Complains of loss of sensation (e.g., numbness)	**.341**	.274
LF11	Slow labored speech	.277	**.358**

This factor for teachers resulted in only items related to shifting and divided attention, whereas two items related to long-term memory were included into this factor for parents. Parents typically observe their child in contexts outside the school setting. In addition, these two items (i.e., ML14 and ML15) are ambiguous. Therefore, parents may perceive these two items as behaviors related to one's ability to shift or divide their attention between tasks.

The next factor that produced a similar underlying construct but included different items appears to represent processing speed. For teachers, however, items related to executive functioning were also included into this factor, whereas this was not the case for parents. Table 19 lists the item loadings and factor pattern coefficients for this factor. The items related to executive functioning for teachers are likely to have loaded onto this factor for a couple of reasons. As mentioned previously, executive functioning behaviors are likely to be observed in more structured settings. Additionally, these executive functioning items not only loaded onto this factor but several other factors as well. Executive functions include an umbrella of cognitive processes including self-regulation, planning, and problem solving, but it can also include working memory and attentional processes as well (Scope et al., 2010). Therefore, it is not surprising that these executive functioning items loaded onto this factor as well as other factors.

Table 19

Shifting/Divided Attention Factor

Label	Item	Teacher	Parent
AP8	Gets stuck on one activity (e.g., playing a video game)	**.752**	**.749**
AP12	Easily becomes absorbed into one task (e.g., video game)	**.726**	**.761**
AP11	Does not seem to hear anything else while watching T.V.	**.630**	**.442**
AP7	Difficulty stopping one activity and starting another	**.500**	**.568**
AP9	Apply a different set of rules or skills to an assignment	**.484**	**.594**
AP10	Difficulty attending to more than one thing at a time	**.455**	.276
ML14	Forgets where personal items or school work were left	.290	**.325**
ML15	Forgets to turn in homework assignments	.098	**.388**

Table 20

Processing Speed Factor

Label	Item	Teacher	Parent
CF4	Requires extra time to complete tests	**.697**	**.663**
CF1	Takes longer to complete tasks than others the same age	**.681**	**.644**
CF3	Homework takes too long to complete	**.660**	**.683**
CF2	Slow reading that makes comprehension difficult	**.647**	**.683**
EF7	Difficulty with organizational skills	**.473**	.153
CF5	Responds slowly when asked questions	**.457**	**.509**
EF9	Has trouble getting started with tasks	**.383**	.235
EF2	Difficulty solving problems that a younger child can do	**.353**	.181
EF8	Appears to be under-motivated to perform or behave	**.352**	.190
EF4	Quickly becomes frustrated and gives up easily	**.342**	.012

There were two other factors that also revealed similar underlying constructs. One factor appears to be related to an individual's ability to discriminate between visual and verbal information, and the other appears to the related to how an individual is able to express themselves through language. Table 21 presents the items and factor pattern coefficients for these two factors. This factor was stronger, in terms of the variance accounted by this factor as well as the number of items that loaded onto this factor, for parents than it was for teachers. For the factor representing expressive language, teachers had stronger item loadings. Teachers are around children and may have a better understanding of the development of language in children, which can explain why teachers rated higher on items related to expressive language.

Table 21

Visual/Verbal Discrimination and Expressive Language Factors

Label	Item	Teacher	Parent
Visual and Verbal Discrimination			
SM20	Drawing or copying difficulties	**.702**	**.614**
SM19	Difficulty with pitch discrimination	**.679**	**.692**
SM21	Difficulties with puzzles	**.396**	**.581**
SM24	Ignores one side of the page while drawing or reading	**.333**	.259
ML5	Problems coping from the board and/or taking notes	**.325**	.116
SM23	Shows right-left confusion or directions (up-down)	.293	**.482**
SM22	Confusion with directions (e.g., gets lost easily)	.273	**.391**
SM18	Difficulty with simple sound discrimination	.122	**.527**
EF2	Difficulty solving problems that a younger child can do	.103	**.322**
Expressive Language			
LF9	Difficulty finding the right word to say	**.709**	**.481**
LF10	Limited amount of speech	**.699**	**.632**
LF11	Slow labored speech	**.656**	**.577**
LF7	Trouble understanding what others are saying	**.620**	**.560**
LF12	Odd or unusual language or vocal sounds	**.455**	.056
LF8	Does not do well with verbal directions	**.375**	.254

The remaining ten factors resulted in different overarching constructs between the two raters. In addition, most of these factors accounted for 5% or less of the overall variance. For teachers, some of these factors resulted in more than one factor with the same underlying construct. For example, there were two general sensory-motor factors as well as two factors with items related to gross motor functioning. Small percentages of overall variance and few item loadings consumed the majority of the remaining factors for parent raters as well. Only one item, SM23 (i.e., Shows right-left confusion or directions [up-down]) did not load onto any factor for teachers. All items loaded onto at least one factor for parents. While item SM23 could have been thrown out because it did not produce any meaningful factor pattern coefficients for teacher raters, removal of this item would result in two different versions of the NPCC.

Factors for Academic Constructs

Factor analysis of the academic items revealed math items loading onto one factor and reading and writing items overlapping across the remaining factors. Table 22 lists the NPCC items and their corresponding academic label based on the item loadings. More specifically, all of the items related to math loaded strongly onto the first factor for both parents and teachers. Table 23 presents the items and the factor loadings for parents and teachers on the mathematics academic domain. Many reading and writing items, on the other hand, loaded across several different factors. These cross loadings provide further evidence that reading and writing are interconnected, and the skills needed for one academic area are also beneficial for the other.

Results also revealed factor loadings were not as well-defined for parents as they were for teachers. This suggests that not only is there more overlap between reading and writing items, but teachers are able to differentiate the two academic areas better than parents. For example, the second factor for parents included items related to reading comprehension as well as items related to written expression. This was not the case for teachers. Instead, teacher factor loadings produced two separate factors for written expression and reading. Similarly, items related to the physical characteristics of one's writing loaded onto two separate factors for parents whereas it was only one for teachers. In addition, more items from parent raters loaded onto multiple factors. Teacher raters did not have as many items loading onto more than one factor. These differences could be contributed to the fact that teachers have a better understanding of academic skills given their training and experience in working with children in the schools.

Table 22

NPCC Factors with Corresponding Academic Label

Factor	Parent	Teacher
1	Mathematics	Mathematics
2	Reading Memory/Written Expression	Spatial Production of Writing
3	Spatial Production/Attitudes of Writing	Reading Attention and Memory
4	Phonological Awareness	Written Expression
5	Reading Attitudes	Phonological Awareness
6	Physical Characteristics of Writing (1)	Reading and Writing Attitudes
7	Physical Characteristics of Writing (2)	Physical Characteristics of Writing

Reliability

Internal consistency estimates of reliability were computed for the neurocognitive items to determine the consistency of results across the items within each neurocognitive section. These computations were conducted to ensure each item of the NPCC was reliable and produced consistent scores each time the NPCC was given to parents and teachers. If an item was considered to be unreliable, the item would be removed from the NPCC; therefore, increasing the overall reliability of the NPCC. Results suggested this was not the case for the NPCC. An analysis of the items for both parents and teachers did not reveal any statistically significant increase in reliability if an item was removed.

Table 23

Mathematics Factor

Label	Item	Teacher	Parent
M4	Computational Knowledge – Exhibits procedural deficits in math (i.e., regrouping)	**0.855**	**0.851**
M3	Computational Knowledge – Knowledge of basic math facts not at grade level	**0.823**	**0.748**
M2	Attentional Issues – Does not always pay attention to the math problem signs	**0.756**	**0.746**
M1	Attentional Issues – Makes careless mistakes while solving math problems	**0.751**	**0.782**
M6	Mathematical Reasoning/Comprehension – Difficulty with qualitative concepts (i.e., bigger than)	**0.737**	**0.699**
M8	Attitudinal Issues – Avoids math activities	**0.733**	**0.793**
M5	Mathematical Reasoning/Comprehension – Difficulty solving story problems	**0.692**	**0.631**
M7	Attitudinal Issues – Appears anxious/uptight/nervous when working with math	**0.637**	**0.805**
R3	Attention Functions – Loses track of his/her reading place	0.206	**0.333**
W2	Graphomotor Output – Presses too hard with the pencil/pen while writing	0.187	**0.329**

Multivariate Analysis of Variance

MANOVA results revealed significant differences for parent and teacher raters among the broad diagnoses, which suggest that there are differences in the way parents and teachers perceive children in terms of the diagnostic characteristics they exhibit in the classroom and at home. In general, this is an advantage as it allows school neuropsychologists to gather more information about behaviors observed at home and at school. The DSM-IV-TR (APA, 2000), which is used as a diagnostic tool by many professionals, includes diagnostic features of various disorders that are often behavioral in nature. Therefore, the behaviors observed by parents and teachers can provide additional information to the problems a child is experiencing at school regardless of the child's disability.

Implications for Practice

There are some implications the current study has for practice within the field of school psychology. First, when gathering information from parents or teachers, it is important to consider the context in which the rater typically observes the child. Results from the current study suggest that parents and teachers may rate a child a particular way given the behaviors that are more observable in structured settings as opposed to less structured settings. In addition, higher-order cognitive skills, such as executive functioning, may not be as apparent until the demands of the child's cognitive load are challenged. For example, executive functioning deficits are likely to become more apparent during complex problem solving tasks when planning and organizational skills are needed.

The ways parents and teachers perceive and define each neurocognitive construct may also have affected how they rated individuals on the NPCC. For example, the way a parent defines memory may be different than the way a teacher defines memory. These definitional inconsistencies could also explain the similar but subtle differences between parent and teacher raters.

Assumptions and Limitations

While each aspect of the current study was taken into careful consideration in order to produce quality research, there were assumptions that were made in the current study that need to be addressed. The use of archival data is advantageous in many aspects; however, there are some issues that could have affected the results by using an existing data set. Detecting errors, for instance, in the original data collection can be difficult. The author assumed that the NPCC data was collected accurately, as well as entered into the database correctly. Individuals who wrote the case study reports that contained NPCC data were supervised, and data entry by graduate students was reviewed at random intervals to ensure accurate data entry. Therefore, it was assumed that the quality of the data was good and validly measured the clinical childhood population. Another assumption was that clinical diagnoses of the participants were correct and consistent. While diagnoses sometimes fall on the clinical judgment of the practitioner, it was assumed that consistent diagnostic criteria were used.

There were also some limitations that are noteworthy. The use of a clinical data set posed some concerns. The responses from parent and teachers could have been different in a data set taken from a normal population. Ratings may not have been as severe, which affects the data set as a whole and can result in different factor loadings than those produced from a clinical data set. The calculation of descriptive statistics in the current study allowed the researcher to identify which clinical populations were included in the data set. Because a clinical data set was used, careful consideration should be taken before the results are applied to other populations.

The use of imputed data also needs to be noted. It was determined that imputed data was used in the current study, and it is important to note that this data was an alteration of the original data set. Lastly, the decision made to run statistical analyses on parent and teacher ratings separately also warrants attention. Parents and teacher ratings could have been analyzed together, and it is likely that a different factor structure would have been produced. Various researchers, however, have demonstrated that parents and teachers produce similar broad results but differ when specific aspects are analyzed (Hines & Paulson, 2006; Lowe & Chapparo, 2010; Murray, Ruble, Willis, & Molloy, 2009). By running parent and teacher raters separately, the results from the current study also support this notion with three strong broad factors, similar item loadings on other factors, and subtle differences on the remaining factors. With academic items included in the NPCC, and the differences in the resulting factor loadings between parents and teachers, analyzing parents and teachers separately appears to be more beneficial.

Recommendations for Future Research

The current study was the first to examine the factor structure of the NPCC. Therefore, exploratory factor analyses were used as the latent variable structure was unknown. Because results from the current study are exploratory in nature and revealed factors measuring different aspects of a broad construct (i.e., attention or executive functioning), future research should examine the differences in the factor structure using confirmatory factor analysis. It is possible that the smaller constructs (i.e., planning, organization and initiation of tasks) from the current study would merge together and produce a broader construct (i.e., general executive functioning) when the data is forced to a certain number of factors. Additionally, items that were considered meaningful, yet only accounted for a small percentage of the variance, may load onto one of the stronger factors when the data is forced into a more rigid structure.

Another recommendation for future research is to measure the relationship between constructs revealed in the current study with assessments that measure that particular construct. For example, the first and strongest factor for parent and teacher raters represented a broad construct of memory. Future research may want to incorporate assessments that measure memory and determine if there is any relationship between the way a child is rated on the memory section of the NPCC and the way the child performs on tasks that measure memory.

Factor analyses of the neurocognitive and academic items suggest that there are differences in the way parents and teachers rate a child on the NPCC. Future research may want to examine this notion and investigate possible reasons for those differences. One possible reason may include confirmation bias from the raters. Research has shown that individuals can be susceptible in seeking information that is consistent with their beliefs (Hall, Ashley, Bramlett, Dielmann, & Murphy, 2004). It would be interesting to determine whether or not parents or teachers rate a child a particular way based on their preconceived notions of the child's disability. Results from Hall et al. (2004) also found that negative symptom formats on questionnaires and ratings scales generated bias that led to an increased percentage of children meeting diagnostic criteria for ADHD. Many of the items on the NPCC are written in a negative format. Therefore, future research may want to examine differences among raters using positive and negative symptoms formats to determine if the format of the NPCC leads parents and teachers to rate a child more severely.

Conclusion

The current study examined the factor structure and assessed the validity of the NPCC. This 130-item checklist was designed to measure a wide variety of behaviors that were categorized into seven neuropsychological constructs as proposed by Miller's (2007) school neuropsychological conceptual model. To test the study's hypotheses, correlations, factor analysis, and reliability estimates were used. Results revealed a factor structure that contained 19 constructs with some factors similar to Miller's (2007) model as well as additional factors representing narrower constructs within a broader neuropsychological domain for both parent and teacher raters.

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APPENDIX

The Neuropsychological Processing Concerns Checklist

Neuropsychological Processing Concerns Checklist for School-Aged Children & Youth

Student's Demographic Information

Student's Name:		Today's Date:	
Street Address:			
City:	State:	Zip Code:	
Student's Age:	Date of Birth:	Sex (circle one): Male Female	
Student's School:		Current Grade:	
Student's Ethnicity:		Primary Language Spoken at Home:	
Parent/Guardian's Name:			
Parent/Guardian's Address (if different from student's):			
City:	State:	Zip Code:	
Parent/Guardian's Phone #s –	Home:	Work:	Cell:

Reasons for Referral

Who referred the student?
From (Institution/Affiliation or Professional or Parent/Guardian):
Why was the student referred?
List specific questions to be addressed by this evaluation:
Are there any scheduled IEP meetings coming up that would require a completed report for this evaluation? If yes, what is the approximate date of the next IEP meeting?

Respondent Information

Respondent's Name:		
Relationship to student: ☐ Mother ☐ Father ☐ Teacher ☐ Other – specify:		
Street Address:		
City:	State:	Zip Code:
Day Telephone:	Evening Telephone:	

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Sensorimotor Functions	Not Observed	Mild	Moderate	Severe
Motor Functioning **Circle right (R), left (L) or both right & left (B) as applicable**				
• Muscle weakness or paralysis. (R L B)				
• Muscle tightness or spasticity. (R L B)				
• Clumsy or awkward body movements. (R L B)				
• Walking or posture difficulties.				
• Odd movements (e.g., hand flapping). (R L B) Specify:				
• Involuntary or repetitive movements. (R L B) Specify:				
• Difficulty with dressing (e.g., buttoning & zippering).				
• Poor fine motor skills (e.g., using a pencil). (R L B)				
Tactile/Olfaction Functioning				
• Overly sensitive to touch, light, or noise.				
• Complains of loss of sensation (e.g., numbness). (R L B)				
• Less sensitive to pain and changes in temperature.				
• Difficulty smelling or tasting foods.				
Visual Functioning				
• Cannot identify basic colors (color blind).				
• Complains of visual problems (e.g., cannot see close or far)				
• Difficulty recognizing objects.				
Auditory Functioning				
• Hearing acuity problems (R L B)				
• Does not like loud noises.				
• Difficulty with simple sound discrimination. (R L B)				
• Difficulty with pitch discrimination (tone deaf) (R L B)				
Visual-Spatial Functioning				
• Drawing or copying difficulties				
• Difficulties with puzzles.				
• Confusion with directions (e.g., gets lost easily).				
• Shows right-left confusion or directions (up-down).				
• Ignores one side of the page while drawing or reading.				

Examples of sensorimotor concerns observed.

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.

Mild – behavior occasionally observed in this child.

Moderate – behavior frequently observed in this child.

Severe – behavior almost always observed in this child.

Attention Problems	Not Observed	Mild	Moderate	Severe
Focused or Selective Attention				
• Easily distracted by sounds, sights, or physical sensations.				
• Inattentive to details or makes careless mistakes.				
• Does not know where to start when given a task.				
Sustained Attention				
• Difficulty paying attention for a long period of time.				
• Mind appears to go blank or loses train of thought.				
• Seems to lose place in an academic task (e.g., reading).				
Shifting Attention				
• Difficulty stopping one activity and starting another.				
• Gets stuck on one activity (e.g., playing video games).				
• Apply a different set of rules or skills to an assignment.				
Divided Attention				
• Difficulty attending to more than one thing at a time.				
• Does not seem to hear anything else while watching TV.				
• Easily becomes absorbed into one task (e.g., video game).				
Attentional Capacity				
• Stops performing tasks that contain too many details.				
• Avoids activities that require a lot of mental effort.				
• Seems to get overwhelmed with difficult tasks.				

Examples of attentional concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Language Functions	Not Observed	Mild	Moderate	Severe
Articulation				
• Omits sounds.				
• Substitutes sounds.				
• Distorts sounds (e.g., slurring, stuttering).				
Phonological Processing				
• Difficulty with blending of sounds to form words.				
• Difficulty with basic rhyming activities.				
• Difficulty with sound discrimination.				
Receptive Language				
• Trouble understanding what others are saying.				
• Does not do well with verbal directions.				
Expressive Language				
• Difficulty finding the right word to say.				
• Limited amount of speech.				
• Slow labored speech.				
• Odd or unusual language or vocal sounds.				

Examples of language concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Memory and Learning Functions	Not Observed	Mild	Moderate	Severe
Short Term Memory				
• Frequently asks for repetitions of instructions/explanations.				
• Lacks rehearsal strategies while listening/studying.				
• Seems not to know things right after they are presented.				
• Trouble following multiple step directions.				
• Problems copying from the board and/or taking notes.				
Active Working Memory				
• Loses track of steps/forgets what they are doing amid task.				
• Loses place in the middle of solving a math problem.				
• Loses train of thought while writing.				
• Trouble summarizing narrative or text material.				
Long Term Memory				
• Trouble remembering facts or procedures in mathematics.				
• Difficulty answering questions of facts quickly.				
• Gets frustrated while trying to convey thoughts on paper.				
• Forgets what happened days or weeks ago.				
• Forgets where personal items or school work were left.				
• Forgets to turn in homework assignments.				
General Learning				
• Difficulty learning verbal information.				
• Difficulty learning visual information.				
• Difficulty integrating verbal and visual information.				

Examples of memory and learning concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below)

Not observed – behavior not observed in this child

Mild – behavior occasionally observed in this child.

Moderate – behavior frequently observed in this child.

Severe – behavior almost always observed in this child.

Executive Functions	Not Observed	Mild	Moderate	Severe
Problem Solving, Planning, & Organizing				
• Difficulty learning new concepts or activities.				
• Difficulty solving problems that a younger child can do.				
• Makes the same kinds of errors over and over.				
• Quickly becomes frustrated and gives up easily.				
• Trouble making plans.				
• Trouble completing plans.				
• Difficulty with organizational skills.				
Behavioral / Emotional Regulation				
• Appears to be under-motivated to perform or behave.				
• Has trouble getting started with tasks.				
• Demonstrates signs of over activity (hyperactivity).				
• Demonstrates signs of impulsivity.				
• Trouble following rules.				
• Demonstrates signs of irritability.				
• Lack of common sense or judgment.				
• Cannot empathize with the feelings of others.				

Examples of executive functioning concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Speed & Efficiency of Cognitive Processing	Not Observed	Mild	Moderate	Severe
Processing Speed, Cognitive Efficiency, & Cognitive Fluency				
• Takes longer to complete tasks than others the same age.				
• Slow reading that makes comprehension difficult.				
• Homework takes too long to complete.				
• Requires extra time to complete tests.				
• Responds slowly when asked questions.				
• Does well on timed tests.				
• Recalls information accurately and quickly.				

Examples of weak cognitive efficiency, cognitive fluency, or slow processing speed concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Academic Functions: Reading	Not Observed	Mild	Moderate	Severe
Reading: Attention Functions				
• Appears distracted while reading.				
• Misses important details while reading.				
• Loses track of his/her reading place.				
Reading: Phonological Processing & Fluency Functions				
• Trouble sounding out words.				
• Can't remember words without sounding them out.				
• Reads very slowly.				
Reading: Comprehension/Memory Functions				
• Difficulty understanding what is read.				
• Difficulty identifying main elements of a story.				
Reading: Attitudinal Issues				
• Indicates boredom with reading				
• Appears anxious/uptight/nervous while reading.				
• Avoids reading activities.				

Examples of reading concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below).

Not observed – behavior not observed in this child.
Mild – behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Academic Functions: Writing	Not Observed	Mild	Moderate	Severe
Writing: Graphomotor Output Functions				
• Trouble forming letters and words.				
• Presses too hard with the pencil/pen while writing.				
• Presses too soft with the pencil/pen while writing.				
• Others have difficulty reading what the child has written.				
• Difficulty holding the pencil or pen correctly.				
• Shows preference for printing over cursive writing.				
• Writes overly large letters and words.				
• Writes overly small letters and words.				
• Takes a long time to write.				
Writing: Spatial Production Functions				
• Demonstrates uneven spacing between words and letters.				
• Trouble staying on the lines.				
Writing: Expressive Language Functions				
• Loses train of thought while writing.				
• Limited vocabulary for age; uses lots of easy words.				
• Difficulty putting ideas into words.				
• Uses simple sentence structure & lacks variety.				
• Produces poor spelling in writing.				
• Poor grammar in writing.				
• Has trouble coming up with topics to write about.				
Writing: Attitudinal Issues				
• Appears anxious/uptight/nervous while writing				
• Avoids writing activities				

Examples of writing concerns observed:

For each behavior listed below, put a check mark in the "Not Observed" column if the behavior has not been observed in the past six months for this child. If the behavior has been observed during the past six months, put a check mark in one of the three columns marked Mild, Moderate, or Severe (see descriptors below)

Not observed -- behavior not observed in this child.
Mild -- behavior occasionally observed in this child.
Moderate – behavior frequently observed in this child.
Severe – behavior almost always observed in this child.

Academic Functions: Mathematics	Not Observed	Mild	Moderate	Severe
Mathematics: Attentional Functions				
• Makes careless mistakes while solving math problems.				
• Does not always pay attention to the math problems signs.				
Mathematics: Computational Knowledge				
• Knowledge of basic math facts not at grade/age level.				
• Exhibits procedural deficits in math (e g., regrouping).				
Mathematics: Mathematical Reasoning/Comprehension				
• Difficulty solving story problems.				
• Difficulty with qualitative concepts (e g , bigger than).				
Math: Attitudinal Issues				
• Appears anxious/uptight/nervous when working with math.				
• Avoids math activities.				

Examples of math concerns observed: