

Cognitive Assessment System: Redefining Intelligence From a Neuropsychological Perspective

Jack A. Naglieri and Tulio M. Otero

INTRODUCTION

Pediatric neuropsychology has become an important field for understanding and treating developmental, psychiatric, psychosocial, and learning disorders. By addressing both brain functions and environmental factors intrinsic in complex behaviors, such as thinking, reasoning, planning, and the variety of executive capacities, clinicians are able to offer needed services to children with a variety of learning, psychiatric, and developmental disorders. Brain-behavior relationships are investigated by neuropsychologists by interpreting several aspects of an individual's cognitive, language, emotional, social, and motor behavior. Standardized instruments are used by neuropsychologists to collect information and derive inferences about brain-behavior relationships. Technology, such as magnetic resonance imaging (MRI), functional MRI (fMRI), positron emission tomography, computerized tomography, and diffusion tensor imaging, has reduced the need for neuropsychological tests to localize and access brain damage. Neuropsychological tests, however, play an important role in identifying the cognitive processes, or abilities, necessary for effective thinking, learning, and behaving, while also allowing for judgments regarding the integrity of the brain. Traditional neuropsychological testing and evaluation takes a cortical-centric approach to understanding brain-behavior relationships. Neuropsychological tests can also be utilized as one way to assess the integrity of cortical-subcortical functional networks such as the frontostriatal system among others (Koziol, 2009). In fact, we believe both cortical and subcortical networks are important for basic neuropsychological processes to manifest efficiently.

A review of a neuropsychological test compendiums reveal that many tests are not based on well-developed neuropsychological theory and often use only a small number of subjects in the normative samples (Strauss, Sherman, & Spreen, 2006). Alexander Luria advocated for a theory-driven, observational-oriented, and flexible approach to assessment (Witsken, Stoeckel, & D'Amato, in press). A conceptualization of human cognitive functioning like the one described by Luria can guide the development of neuropsychological assessment tools.

Such tools should not only evaluate the underlying processes necessary for efficient thinking and behavior but also provide for the development of effective interventions and address the question of prognosis.

FROM NEUROPSYCHOLOGY THEORY TO ASSESSMENT

Luria's theoretical account of dynamic brain function is perhaps one of the most complete (Lewandowski & Scott, 2008). Luria conceptualized four interconnected levels of brain-behavior relationships and neurocognitive disorders that the clinician needs to know: the structure of the brain, the functional organization based on structure, syndromes and impairments arising in brain disorders, and clinical methods of assessment (Korkman, 1999). His theoretical formulations, methods, and ideas are articulated in works such as *Higher cortical functions in man* (1966, 1980) and *The Working Brain* (1973). Luria viewed the brain as a functional mosaic, the parts of which interact in different combinations to subservise cognitive processing (Luria, 1973). There is no area of the brain that functions without input from other areas; thus, integration is a key principle of brain function within the Lurian framework. Cognition and behavior then result from an interaction of complex brain activity across various areas. Luria's (1966, 1973, 1980) research on the functional aspects of brain structures formed the basis for the development of the planning, attention, simultaneous, successive processing (PASS) theory, initially described by Das, Naglieri, and Kirby (1994) and operationalized by Naglieri and Das (1997a) in the *Cognitive Assessment System* (CAS).

In the Lurian framework, cognitive functions, such as attention, executive functions, language, sensory perception, motor function, visuospatial facilities, and learning and memory, are complex capacities. They are composed of flexible and interactive subcomponents that are mediated by equally flexible, interactive, neural networks (Luria, 1962, 1980). These cognitive functions could be conceptualized as three separate but connected "functional units" that provide four basic psychological processes. The three brain systems are referred to as

“functional” units because the neuropsychological mechanisms work in separate but interrelated systems. In other words, multiple brain systems mediate complex cognitive functions. For example, multiple brain regions interact to mediate attentional processes (Mirsky, 1996). The executive functions subserved by the third functional unit, as described by Luria, regulate the attentional processes of the first functional unit in sustaining the appropriate level of arousal and vigilance necessary for the detection and selection of relevant details from the environment. Consider the case of response inhibition; the executive function of inhibition allows a student to resist or inhibit responding to salient, but irrelevant details on a task. Response inhibition allows the student to sustain focus, over time, on task-relevant features.

The brain systems described earlier are consistent with the four psychological processes identified by the PASS theory (Naglieri & Das, 1997b). Luria (1973) stated “each form of conscious activity is always a complex functional system and takes place through the combined working of all three brain units, each of which makes its own contribution” (p. 99). In other words, the four processes form a “working constellation” (Luria, 1966, p. 70) of cognitive activity. Thus, a child or an adult can use different combinations of the four psychological processes in conjunction with his/her knowledge and skills to perform a task. Although effective functioning is achieved through the appropriate combination of all processes as demanded by the task, each process is not equally involved in every task. For example, reading comprehension may predominately involve one process, while reading decoding can be strongly dominated by another (Das et al., 1994). Or, basic math calculation may require more of one process, while math reasoning tasks may require a different cognitive process. For example, learning basic math calculation operations may initially require a basic step-by-step approach. Understanding math reasoning problems, however, requires holding multiple elements of the task in memory, surveying the elements and making decisions about these elements before solving the problem. Das and Naglieri and their colleagues used Luria’s work as a blueprint for defining the basic neuropsychological processes that underlie human performance (Naglieri, 2003). Their efforts represent for the first time that a specific researched neuropsychological theory was used to provide an alternative conceptualization of human intelligence.

THREE FUNCTIONAL UNITS DESCRIBED

Luria (1973) provided considerable evidence for the neuropsychological processes associated with each of the three functional units and their association with specific regions of the brain. Briefly stated, these three functional units have been used by Naglieri and Das (1997b) as the basis of planning (third functional unit), attention (first

unit), and simultaneous and successive (second unit) cognitive processes. According to Luria, the brainstem, the diencephalon, and the medial regions of the cortex are the primary locations for the first of the three functional units of the brain, the Attention-Arousal system (Luria, 1973). This unit is composed specifically of the midbrain, medulla, thalamus, and hypothalamus. These structures work in concert to maintain the appropriate cortical tone. Recent formulations of these regions suggest that some structures at the level of diencephalic and medial regions have reciprocal connections to the cortex through a variety of subcortical circuitries potentially influencing a wide range of behaviors (Koziol, 2009).

Attention is a basic component of intelligent behavior involving allocation of resources and effort. Arousal, attention, effort, and capacity are concepts that have a complex relationship and importance for understanding behavior. When a person is required to pay attention to only one dimension of a multidimensional stimulus array, inhibition of responding to other (often more salient) stimuli and the allocation of attention to the central dimension are required. Luria stated that optimal conditions of arousal are needed before the more complex forms of attention involving “selective recognition of a particular stimulus and inhibition of responses to irrelevant stimuli” (Luria, 1973, p. 271) can occur. This way of conceptualizing attention is analogous to such contemporary models as Mirsky and Duncan (2001, 2003) in which focus, shift, sustain, and stabilization of attention are necessary before complex learning can take place. Moreover, the second and third functional units can operate effectively only after individuals are sufficiently aroused and their attention is adequately focused.

The occipital, parietal, and temporal (particularly medial temporal portions) lobes posterior to the central sulcus of the brain are associated with the second functional unit. Information from the external world is received, processed, and retained within this unit. Thus, the major function of the second functional unit is sensory reception and integration (Semrud-Clikeman & Teeter Ellison, 2009). The areas of the second functional unit correspond to their sensory modality: temporal for auditory stimuli, parietal for tactile, and occipital for visual. This functional unit is hypothesized to be guided by three functional laws: (1) During development, the makeup of cortical zones does not remain the same; (2) the specificity of function of the cortical zones decreases with development; and (3) an increase in lateralization of function increases with development (Luria, 1980). This hierarchy is further subdivided into *zones*. The primary zones of these structural units employ modality-specific groups of neurons to receive impulses from the sensory organs, while the secondary zones of these structures surround the primary zones with associative neurons that enable incoming excitation to be conveyed to the tertiary zones. These tertiary zones are responsible for integrating and organizing the excitation arriving from the different sensory structures and converting the stimuli that are

received in a specific linear order into simultaneously processed groups (Luria, 1973). The secondary zones are involved in the input of data and integration of information. These zones process information sequentially and connect crossmodally with several stimuli impinging on the brain at a time. For example, reading is an integration of both visual and auditory material, and mathematics is the integration of visual material with the knowledge of numbers and quantity.

There are secondary zones for auditory, tactile, and visual information. The auditory secondary zone lies within the secondary regions within the temporal lobes and involves the analysis and synthesis of sounds and the sequential analysis of phonemes, pitch, tone, and rhythm. The secondary tactile zone is within the parietal lobe and is involved in the recognition of complex tactile stimuli and two-point discrimination, for example. The secondary visual zone borders the primary visual cortex of the occipital lobe. Visual discrimination of letters, shapes, and figures are related to it. Traditional intelligence tests are hypothesized to measure some aspects of the second functional unit (Semrud-Clikeman & Teeter Ellison, 2009). Because the second functional unit can be considered as the center for analysis, coding, and storage of information, damage to the structures forming the second functional unit can result in difficulty with academic areas such as basic reading, writing, and math skills.

Tertiary zones process and integrate information from all sensory areas. This integration of information from various modalities occurs through simultaneous processing. For example, some math involves the integration of both visual materials and knowledge of number quantity. Math reasoning, in the form of word problems, may additionally involve the integration of grammatical skills, analysis of auditory information, and the comprehension of auditory or written material. Damage to these zones has been related to lower measured intelligence and difficulties across several basic academic areas.

Simultaneous processing and successive processes are subserved by the second functional unit. Simultaneous processing is a mental activity by which a person integrates stimuli into interrelated groups or a whole. For example, to follow multistep directions, the relationships among the different parts of what is said must be correctly understood. Reading unfamiliar words that are initially difficult to decode and then are later quickly and effortlessly recognized as a whole word is another example of a task initially demanding successive processing, followed by the efficient simultaneous processes of reading the word as a whole unit. Children presenting with difficulties performing on tasks that require learning new information by associating it with other information may have deficits in simultaneous processing. Difficulty in integrating visual information may be a primary deficit in children with nonverbal learning disabilities. These children have been found to do more poorly on measures that demand simultaneous processing such as visual-motor integration and visual-perceptual skill

tests compared to children with attention-deficit hyperactivity disorder (ADHD) and normally developing children (Wilkinson & Sernund-Clikeman, 2008).

Simultaneous processing involves working with interrelated stimuli, whereas successive processing is a mental activity by which a person processes stimuli in a specific serial order to form a chain-like progression. Successive processing involves both the recognition of stimuli in sequence and the formation of sounds and movements in order. For example, successive processing is involved in the decoding of unfamiliar words, production of syntactic aspects of language, and speech articulation. Following a sequence such as the order of operations in a math problem is another example of successive processing. This is almost the inverse of simultaneous processing, which involves integration of separate elements into groups. Most real life situations will require both of these processes to become activated to some degree.

The prefrontal areas of the frontal lobes of the brain are associated with the third functional unit (Luria, 1980). The prefrontal cortex is well connected with every distinct functional unit of the brain (Goldberg, 2009). This unit is mostly responsible for output planning and is involved with most behaviors we typically consider as executive functions and, more recently, as executive function capacities (McCloskey, Perkins, & Van Diver, 2009). The third functional unit is also further differentiated into three zones, with the primary zone in the motor strip of the frontal lobe being concerned with motor output. The secondary zone is responsible for the sequencing of motor activity and speech production, whereas the tertiary zone is primarily involved with behaviors typically described as executive functions. Damage to any of several areas of the frontal regions has been related to difficulties with impulse control, learning from one's mistakes, delay of gratification, and attention. Because the third functional unit has rich connections with other parts of the brain, both cortical and subcortical, there can be forward and backward influences to and from other regions such as the thalamic, hypothalamic, and limbic areas. Additionally, a growing body of evidence points to a network of connected regions in the adjacent frontal and parietal lobes, which have been implicated in higher-order processing such as attention, decision making, and intelligence (Kolb & Wishaw, 2009).

Luria stated that "the frontal lobes synthesize the information about the outside world ... and are the means whereby the behavior of the organism is regulated in conformity with the effect produced by its actions" (Luria, 1980, p. 263). The frontal lobes provide for the programming, regulation, and evaluation of behavior and enable the child to ask questions, develop strategies, and self-monitor (Luria, 1973). Other responsibilities of the third functional unit include the regulation of voluntary activity, conscious impulse control, and various linguistic skills such as spontaneous conversation. The third functional unit provides for the most complex aspects of human behavior, including personality and consciousness (Das,

1980). A reciprocal relationship exists between the first and third functional units. The higher cortical systems both regulate and work in collaboration with the first functional unit while also receiving and processing information from the external world and determining an individual's dynamic activity (Luria, 1973). It is influenced by the regulatory effects of the cortex, and it also influences the tone of the cortex. The ascending and descending systems of the reticular formation enable this relationship by transmitting impulses from lower parts of the brain to the cortex and vice versa (Luria, 1973). Thus, damage to the prefrontal area can alter this reciprocal relationship so that the brain may not be sufficiently aroused for complex behaviors requiring sustained attention. Goldberg (2009) describes a breakdown in any portion of the complex looplike interactions between the prefrontal, ventral brain stem and posterior cortex as producing symptoms of attention deficit.

The connection between units also links the psychological processes that are routed in each of the functional units. For the PASS theory, this means that psychological processes of attention and planning are necessarily strongly related because planning often has conscious control of attention. In other words, one's limited attentional resources are dictated by the plan for one's behavior. However, attention and the other PASS processes are influenced by many variables other than planning. One of these influences is the environment. Novel encounters within daily life demand that we act in one way or the other. Several PASS processes can be involved as we make judgments about similarities and differences between past situations and the present demands while hypothesizing possible outcomes of our actions as we act on the environment.

FUNCTIONAL UNITS: INTERACTIONS AND INFLUENCES

Luria's organization of the brain into functional units was not an attempt to map out the precise locations where specific areas of higher cognition took place. In fact, Luria believed no part of the brain works by itself. Thus, no cognitive task solely requires simultaneous, successive planning or attention processing or any other process, but rather, it is a matter of emphasis. He stated, "... perception and memorizing, gnosis and praxis, speech and thinking, writing, reading and arithmetic, cannot be regarded as isolated or even indivisible 'faculties' ..." (Luria, 1973, p. 29). That is, an attempt to identify a fixed cortical locale for any complex behavior is a mistaken endeavor. Instead, the brain should be conceptualized as a functioning whole composed of units that provide purpose.

Activities such as reading and writing can be evaluated and seen as constellations of activities related to specific working zones of the brain that support them (Luria, 1979). This means that since the brain operates as an integrated functional system, even a minor disruption in an

area can cause disorganization in the entire functional system (Varnhagen & Das, 1986). Thus, many behaviors may be impacted by a disruption caused by a lesion, damage, or underdeveloped structures. For example, lesions or damage to the prefrontal cortex, with its complex connections with other areas of the brain including several subcortical areas, may result in affective dissociations, impaired executive functions, poor judgment and processing, or intellectual deficits.

Luria believed that a child's cultural experience is a significant influence on the functional units and also a necessary foundation that aids the development of human cognition (Luria, 1979). The organization of the brain into functional units also accounts for the interaction of cultural influences and biological factors within higher cognition. Luria (1979) notes "... the child learns to organize his memory and to bring it under voluntary control through the use of the mental tools of his culture" (p. 83). Kolb, Gibb, and Robinson (2003) also wrote that although "the brain was once seen as a rather static organ, it is now clear that the organization of brain circuitry is constantly changing as a function of experience" (p. 1). Various brain systems are highly modifiable by experience and dependent on experience only during particularly sensitive time periods, and other systems remain capable of changing by experience throughout life (Neville, 2006; Neville & Stevens, 2008). Similarly, Vygotsky (1976) described this interplay when he described speech as a self-regulatory function. Self-talk functions, such as self-guidance and self-regulation, allows children to think about their mental activities and behaviors while selecting different courses of action. These functions are the foundation for higher cognitive processes (e.g., controlled attention, deliberate memorization and recall, categorization, planning, problem solving, abstract reasoning, and self-reflection). Stuss and Benson (1990) described this interplay as follows:

The adult regulates the child's behavior by command, inhibiting irrelevant responses. His child learns to speak, the spoken instruction shared between the child and adult are taken over by the child, who uses externally stated and often detailed instructions to guide his or her own behavior. By the age of 4 to 4 ½, a trend towards internal and contract speech (inner speech) gradually appears. The child begins to regulate and subordinate his behavior according to his speech. Speech, in addition to serving communication thought, becomes a major self-regulatory force, creating systems of connections for organizing active behavior inhibiting actions irrelevant to the task at hand (p. 34).

Culture influences the development of higher cognitive functioning through a variety of different channels. Luria (1979) emphasized the importance of the frontal lobes in language, organization and direction of behavior, and speech as a cultural tool that furthers the development of the anterior brain region and self-regulation. Cultural experiences accelerate the use of planning and self-regulation and other cognitive processes. Luria (1979) suggested that abstraction and generalizations

are themselves products of the cultural environment. Children learn, for example, to selectively pay attention to items that are pertinent through conversations and playful interactions with adults. Even simultaneous and successive processes are influenced by cultural experiences (e.g., learning dances, poems, game rules). Naglieri (2003) summarized research that showed that the influence of social interaction on children's use of plans and strategies resulted in improvements in performance on academic tasks. Luria's concept of functional units and their relationship to the larger sociocultural context provides the foundation for the PASS theory.

FROM THE THREE FUNCTIONAL UNITS TO THE PASS THEORY

The four processes in the PASS theory represent a fusion of cognitive and neuropsychological constructs including executive functioning (planning); selective, sustained and shifting attention (attention); visual-spatial tasks (simultaneous); and serial features of language and memory (Successive; Naglieri & Das, 2005). These four processes are more fully described in the sections that follow.

As one of the prominent capacities that differentiate humans from other primates, planning is associated with the prefrontal cortex. The prefrontal cortex "plays a central role in forming goals and objectives and then in devising plans of action required to attain these goals. The cognitive processes required to implement plans, coordinate these activities, and apply them in a correct order are subserved by the prefrontal cortex. Finally, the prefrontal cortex is responsible for evaluating our actions as success or failure relative to our intentions" (Goldberg, 2009 p. 23).

Planning helps one to achieve goals through the development of strategies necessary to accomplish tasks for which a solution is required. Therefore, planning is an essential ability to all activities that demand the child or adult to figure out how to solve a problem. This includes self-monitoring, impulse control, and making, assessment, and implementation of a plan. Thus, planning allows for the generation of solutions, discriminating use of knowledge and skills, and control of attention, simultaneous, and successive processes (Das, Kar, & Parrila, 1996).

The essential dimension of the construct of planning as defined by Naglieri and Das (1997b) is very similar to the description of executive function provided by others (see Naglieri & Goldstein, 2006). For example, O'Shanick and O'Shanick (1994) describe executive functions as including the abilities to formulate and set goals, assess strengths and weaknesses, plan and/or direct activities, initiate and/or inhibit behavior, monitor current activities, and evaluate results. Executive functions include abilities to formulate a goal, plan, carry out goal-directed behaviors effectively, and monitor and self-correct

spontaneously and reliably (Lezak, Howieson, & Loring, 2004). McCloskey et al. (2009) identify two key dimensions that unify several diverse definitions of executive functions. To some degree, all definitions address components that direct and cue other processes, and all address functions that link activation to the frontal lobe regions. These skills are essential for fulfilling most daily responsibilities and maintaining appropriate social behavior. A variety of assessment tools that have been proposed to assess executive functions often yield conflicting data given the very broad definition of these functions (e.g., for a review of this issue in the assessment of ADHD, see Barkley, 1997). Planning in the PASS theory offers a more finite description that may be characterized as executive function.

Attention is a cognitive process that is closely connected to the orienting response. Brain structures within Luria's first functional unit, the reticular formation, allow one to focus selective attention toward a stimulus over a period of time without the loss of attention to other competing stimuli. The longer the attention needed, the more the activity necessitates vigilance. Intentions and goals mandated by the planning process control attention, whereas knowledge and skills play an integral part in the process as well. The attention work of Schneider, Dumais, and Shiffrin (1984) and the attention selectivity work of Posner and Boies (1971), which relates to deliberate discrimination between stimuli, are similar to the way that the attention process was conceptualized. Planning processes regulate a variety of other processes, including attention.

Simultaneous processing is a necessity for sorting information into groups or a coherent whole. The ability to recognize patterns as interrelated elements is made possible by the parieto-occipital-temporal brain regions. Because of the substantial spatial characteristics of most simultaneous tasks, there is a visual-spatial dimension to activities that demand this type of process. Conceptually, the examination of simultaneous processing is achieved using tasks that could be described as involving visual-spatial reasoning, found in progressive matrices tests like those developed by Penrose and Raven (1936). Simultaneous processing is not, however, limited to non-verbal content, as demonstrated by the important role it plays in the grammatical components of language and comprehension of word relationships, prepositions, and inflections (Naglieri, 1999). This is most apparent in the inclusion of the Verbal-Spatial Relationship subtest in the CAS (Naglieri & Das, 1997a). Typically, however, matrices tests have been included in the so-called nonverbal scales of intelligence tests such as *Wechsler Nonverbal Scale of Ability* (Wechsler & Naglieri, 2006), the perceptual reasoning portion of *Wechsler Intelligence Scale for Children—Fourth Edition* (WISC-IV; Wechsler, 2003), *Stanford-Binet—Fifth Edition* (Roid, 2003), *Naglieri Nonverbal Ability Test* (Naglieri, 1997), and *Kaufman Assessment Battery for Children—Second Edition* (K-ABC2; Kaufman & Kaufman, 2004), and a Simultaneous Processing Test (Naglieri & Das, 1997).

Successive processing is relevant when working with stimuli arranged in a defined serial order such as remembering or completing information in compliance with a specific order. Successive processing is typically an integral element involved with the serial organization of sounds, such as learning sounds in sequence and early reading. Furthermore, successive processing has been conceptually and experimentally related to the concept of phonological analysis (Das et al., 1994). When serial information is grouped into a pattern, however (like the number 553669 organized into 55-3-66-9), then successful repetition of the string may be a function of planning (i.e., using the strategy of chunking) and simultaneous processing abilities (organizing the numbers into related groups). This method is often used by older children and can be an effective strategy for those who are weak in successive processing (see Naglieri & Pickering, 2003). Clinically, we have observed that young children with poor successive processing often have difficulty following directions or comprehending what is being said to them when sentences are too lengthy. Teachers and parents often misinterpret this weakness as a failure to comprehend or as a problem of attention. The concept of successive processing is also related to the concept of sequential processing included in the *K-ABC2* (Kaufman & Kaufman, 2004) and tests that require recall of serial information such as Digit Span Forward on the *WISC-IV* (Wechsler, 2003).

Traditionally, intelligence is measured through verbal, nonverbal, and quantitative tests, yet the PASS theory offers an alternative approach to intelligence. This theory broadens the idea of what abilities should be measured and also emphasizes the significance of basic neurocognitive processes. Additionally, the functional units of the brain that encompass the PASS processes are considered the building blocks of ability conceptualized within a neurocognitive processing framework. While the theory may have its roots in neuropsychology, "... its branches are spread over developmental and educational psychology" (Varnhagen & Das, 1986, p. 130). Thus, with its connections to developmental and cognitive processing, the PASS theory offers an advantage in explanatory power over the notion of general intelligence (Naglieri & Das, 2002).

CAS: APPLICATION OF THE PASS THEORY

The PASS theory was operationalized by the CAS (Naglieri & Das, 1997a). This instrument is thoroughly described in the CAS interpretive handbook and other sources (Naglieri & Das, 1997b) and by (Naglieri 1999; Naglieri & Conway, 2009). Naglieri and Das (1997a) generated tests to measure the PASS theory following a systematic and empirically based test development program designed to obtain efficient measures of the processes for individual administration. The PASS theory was used as the foundation of the CAS, and so the *content of the test*

was determined by the theory and not influenced by previous views of ability. The CAS was standardized on a sample of 2,200 children aged 5–17 years who were representative of the U.S. population on a number of important demographic variables. The sample is a nationally representative, stratified sample based on gender, race, ethnicity, region, community setting, classroom placement, and parental education (see Naglieri & Das, 1997b, for more details).

ADMINISTRATION AND SCORING

There are two versions of the CAS. The Standard Battery contains all 12 subtests, whereas the Basic Battery is made up of only eight of the subtests. If the Basic Battery is administered, the first two subtests in each of the four PASS Scales are given. The subtests included in the Basic Battery are clearly noted in several ways on the Record Form and in the Administration and Scoring Manual. Regardless of which version is administered, both yield PASS Scale and Full Scale standard scores with a mean of 100 and *SD* of 15.

One of the unique administration features of the CAS is the opportunity to provide help. The instructions for administration of the CAS have been written to ensure that the child will understand the demands of every subtest. Several methods have been used to ensure that the child understands what is being requested. This includes sample and demonstration items and opportunities for the examiner to clarify the requirements of the task. If the child does not seem ready or appears in any way confused or uncertain after the first sample item is given, the examiner is instructed to "provide a brief explanation if necessary." This gives the examiner the freedom to explain what the child must do in any terms considered necessary so as to ensure that the child understands the task, including gestures, verbal statement, or communication in any language. The intent is to give full decision making in clarifying the demands of the subtest and to allow the examiner to be certain that the child understands what to do. This instruction, however, is not intended to teach the child how to do the test, but rather to tell the child what is required. There are two methods for scoring the CAS. First, the CAS Rapid Score (Naglieri, 2003) software can be used to convert all raw scores to standard scores, make comparisons among the PASS scores, compare PASS and Full Scale scores to achievement, and obtain a written description of the results. Alternatively, the CAS can be manually scored.

Interpretation

The goal of interpreting a child's CAS is to integrate PASS theory with all other information so that a comprehensive view of the child is achieved and a thorough plan for treatment, if appropriate, can be developed, implemented, and evaluated. The interpretative methods discussed

below should be applied flexibly and within the context of all available information about the child. A five-step interpretation procedure will be discussed.

Step 1—The CAS Full Scale and PASS Scale Standard Scores

The first step is to describe the PASS and Full Scale standard scores using categories that can be found in Appendix C in the Administration and Scoring Manual (Naglieri & Das, 1997a). These categories qualitatively summarize the child's scores. Further description of the scores includes the confidence intervals and percentile ranks that are provided in the sum of scaled score to raw score conversion tables. Estimated true-score-based confidence intervals are provided in the PASS and Full Scale standard score conversion tables (Appendix B of the Administration and Scoring Manual), making calculation unnecessary (Naglieri & Das, 1997b). The Full Scale score should be considered a good general description of a child's cognitive ability when the four PASS Scale scores are similar. However, when there is significant variability among the PASS Scale standard scores, emphasis on the Full Scale may obscure important relative strengths and weaknesses. When this happens, then the Full Scale score should be de-emphasized.

Step 2—Compare the Four PASS Standard Scores

One of the main purposes of the CAS is to examine the variability across PASS ability scores to determine if the child has cognitive strengths or weaknesses. There are two factors to consider; first, the statistical significance of the profile of scores, and second, the percentages of children in the standardization sample with such differences. The statistical significance of the variation in PASS scores, that is the profile, is evaluated using an intraindividual or ipsative (Kaufman, 1994) method. Examining the child's PASS profile for significant variability helps determine if the differences in scores are reliable and issues of eligibility and diagnosis as well as instructional planning.

PASS cognitive processing strengths (scores that are significantly greater than the child's mean score) or weaknesses (scores that are significantly lower than the child's mean score) are found if a score is significantly high or low relative to the child's own level of performance. Because the PASS scores are compared to the individual child's average (and not the normative mean of 100), this tells us about relative strengths or weaknesses. The steps needed to determine if a child's PASS profile is significant are listed below, and the values needed at different levels of significance and the values for the Standard and Basic Batteries are provided in the manual.

1. Calculate the average of the four PASS standard scores.
2. Subtract the mean from each of the PASS standard scores to obtain the intraindividual difference scores.

3. Compare the intraindividual difference scores (ignore the sign) to the values needed for significance. Differences equal to or greater than the tabled values are significantly from the child's average PASS Scale standard score.
4. Label any significant score that is above the mean as a strength and those below the mean as a weakness.
5. Any variation from the mean that is not significant should be considered chance fluctuation.

When a significant weakness in the PASS Scale profile is found, it is also important to consider the level of performance in relation to the standardization sample. For example, if a child has a significant intraindividual difference score that also falls below a score of 90 (in the low average range or lower), then it should be labeled a cognitive weakness. In contrast, a child could have a significant weakness that still falls in the average range (90–110). This score should be viewed as relative weakness because it is low in relation to the child's mean but still in the average range of normative expectations. In this case, the finding is important for different reasons (it could explain uneven high performance for a child who typically functions very well), but it is not the same as a cognitive weakness. A cognitive weakness is a more serious finding because it represents poor performance relative to peers as well as in comparison to the child's own level.

Step 3—Compare Subtest Scores Within Each Scale

Variation in CAS subtests, set at a mean of 10 and *SD* of 3, can be examined using the same method used for studying the PASS profile. The subtest scaled scores are compared to the child's mean subtest score and the presence of significant differences determined. These variations should also be interpreted within the context of the theory, consideration of strategy use, and other relevant variables. Although this analysis has the advantage of allowing for close examination of the child's performance, it has the disadvantage of involving scores with lower reliability than the PASS Scales.

Step 4—Compare the PASS and Full Scale With Achievement Standard Scores

The CAS scores can be used to help determine if a child's achievement is below expectations and to assist when interventions are being planned and when eligibility for special education services is being considered. The exploration of these differences is intended to fit within a theoretical framework designed to discover if the child has a PASS cognitive weakness and an associated academic weakness.

The CAS allows practitioners to detect if there may be a cognitive explanation for an academic problem. When a child's Full Scale or separate PASS Scale standard scores are significantly higher than achievement, then the

discrepancy is found. However, because a child's weakness in a specific area of achievement (e.g., reading decoding) could be related to a specific weakness in a PASS area (e.g., successive processing), the *consistency* between these two scores (successive and reading decoding) and a *discrepancy* between other CAS Scales with achievement scores can be found. The consistency between successive processing and reading decoding is indicated by a non-significant difference between these scores. Finding evidence of this type contributes to the interpretation that successive processing and reading decoding underlie the child's academic problems as suggested by Naglieri (2000) and Naglieri & Conway (2009), and such a suggestion has intervention implications.

Step 5—Comparison of CAS Scores Over Time

It is sometimes important to administer a test of cognitive functioning on two occasions to monitor recovery or deterioration associated with neurological conditions or to evaluate cognitive functioning that may have changed over the course of medical treatment. This may be especially important when evaluating the recovery of children who have experienced traumatic brain injury (TBI). The statistical significance of the differences between first and second Full Scale and PASS standard scores can be made using a method described by Atkinson (1991). This involves the comparison of the first test score with a range of scores that represents the variability expected by both regression to the mean and test reliability. The method can be applied when sufficient time has elapsed, for example, 6–12 months, so that minimal practice effects are anticipated.

PSYCHOMETRIC PROPERTIES

Support for the PASS theory and its operationalization in the CAS is well documented through empirical research (see Das, Kirby, & Jarman, 1979; Das et al., 1994; Naglieri, 1999, 2003, 2005; Naglieri & Conway, 2009; Naglieri & Das, 1997b, 2005). The CAS Full Scale has a high internal reliability ranging from 0.95 to 0.97 for the different age groups. The average reliability coefficients for the scales are 0.88 (planning), 0.88 (attention), 0.93 (simultaneous processing), and 0.93 (successive processing). Additional evidence is provided in the sections that follow (see Naglieri & Das, 1997b for more details).

VALIDITY

Using Luria's neuropsychological framework of three functional units, Das (1972), Das, Kirby, & Jarman (1979), and Das et al. (1994, 1975), began the task of figuring out methods for measuring the PASS processes. These efforts included extensive analysis of the methods used

by Luria, related procedures used within neuropsychology, experimental research in cognitive and educational psychology, and related areas. Their work was summarized in several books by Das et al. (1994), Kirby (1984), Kirby and Williams (1991), Naglieri (1999), and Naglieri and Das (1997b), which provide considerable evidence that the PASS processes associated with Luria's concept of the three functional units could be measured and that, once measured, these processes have considerable reliability and validity. Their work also demonstrated that there was significant potential for the application of the theoretical conceptualization of basic psychological processes. The remainder of this section will provide a summary of relevant validity research on the PASS theory as operationalized by the CAS.

RELATIONSHIP TO ACHIEVEMENT

One of the purposes of an ability test is to determine a child's level of cognitive functioning that can then be used to anticipate performance in a number of contexts, such as school. Some have noted that the relationship between a test of ability and achievement is perhaps one of the most important aspects of validity (Brody, 1992; Cohen, Swerdlik, & Smith, 1992; Naglieri & Bornstein, 2003). For many years, researchers have studied the relationship between ability and achievement. Well-known IQ tests often include measures of vocabulary, general information, and arithmetic, as do tests of achievement. It is no surprise then that the relationship between ability and intelligence has been found to be about 0.55–0.60 (Brody, 1992; Naglieri, 1999). It has been argued, however, that a portion of the correlation between traditional IQ tests and academic achievement tests is due to the similarity in content that exists between these two types of tests (Naglieri & Bornstein, 2003; Naglieri & Rojahn, 2004). Given that the CAS does not include test items that are typically part of traditional IQ tests such as vocabulary and arithmetic, how well does it correlate with achievement?

Naglieri and Rojahn (2004) studied the relationship between the PASS processing scores of the CAS with the *Woodcock–Johnson—Revised Tests of Achievement: Standard and Supplemental Batteries* (Woodcock & Johnson, 1989), with a sample of 1,559 students aged 5–17 years. The correlation between the CAS Full Scale with the Woodcock–Johnson—Revised (WJ-R) Tests of Achievement was 0.71 for the Standard (all 12 subtests) and 0.70 for the Basic Battery score (eight subtests). These findings provide evidence for the construct validity of the CAS and more importantly suggest that basic psychological processes are strongly related to academic performance as measured by this standardized test of achievement.

Naglieri, Goldstein, DeLauder, and Schwebach (2006) compared the WISC-III (Wechsler, 1991) to the CAS and the *Woodcock–Johnson III Tests of Achievement* (WJ-III-ACH;

Woodcock, McGrew, & Mather, 2001) with a sample of children aged 6–16 years who were referred for evaluation due to learning problems. The correlation of the WJ-III-ACH scores with the WISC-III Full Scale IQ scores was 0.63 and 0.83 with the CAS Full Scale. However, the CAS Full Scale score correlations were significantly higher (Naglieri et al., 2006).

The findings provide evidence for the construct validity of the CAS and suggest that basic psychological processes are strongly correlated with academic performance and are especially important because the measures of the PASS processes do not include achievement-like subtests (e.g., vocabulary and arithmetic). This provides considerable advantage and is especially important for children who come from disadvantaged environments and those who have had a history of academic failure.

Importantly, Naglieri and Rojahn (2004) also found that prediction of achievement was slightly higher for the four PASS Scales than the CAS Full Scale. These findings suggested that the four PASS Scales individually and collectively correlate higher with achievement than the four scales aggregated into the one Full Scale score. Additionally, the predictive power of the combination of the four PASS Scales was weakened when any one of the PASS Scales was excluded in the prediction equation (Naglieri & Rojahn, 2004). This suggests that each of the PASS Scales has additive value in predicting Achievement and further supports the notion of interrelated neurocognitive processes within the Luria's framework of functional units.

RELATIONSHIP TO BEHAVIOR

Limited research has been conducted specifically examining the relationship of PASS processes to behavior. Clinically, the connection between PASS processes and a child's behavior is often observed. For example, successive processing involving the ability to follow information in a linear organization or chain-like progression will exert a significant impact on a child's behavior. Planning processing involving the ability to focus one's thinking, attend and screen out distractions which is essential for children to play effectively with others on the playground, interact with adults, as well as a variety of real life tasks.

Several researchers have examined the relationship between the behavioral difficulties seen in children with ADHD and PASS profile scores. For example, Paolitto (1999) studied matched samples of ADHD and normal children. Children with ADHD earned significantly lower scores on the planning scale. Similarly, Dehn (2000) and Naglieri, Goldstein, Iseman, and Schwebach (2003) found that groups of children who met diagnostic criteria for ADHD earned significantly lower mean scores on the planning scale of the CAS. These results support the view that ADHD involves problems with behavioral inhibition and self-control, which is associated with

poor executive control (Planning; Naglieri & Goldstein, 2006). These findings suggest that the PASS processing theory has utility for differential diagnosis, intervention, and response to intervention for behavioral problems (Naglieri, 2003, 2005).

The CAS has been utilized with individuals who suffer from TBI. Because of the fact that cognitive impairments and deficits are very common in individuals with TBI, the CAS is a measure that can be used to assess the cognitive processes of this population. According to Luria (1973), when one suffers severe brain damage, it is likely that he or she will also experience impairments in such processes as organization and planning (as cited in Gutentag, Naglieri, & Yeates, 1998). One of the main reasons as to why an assessment tool such as the CAS would be particularly useful for the TBI population is because typical intelligence tests only yield results that reflect one's general intelligence; they do not provide measurement of basic psychological processes. For example, deficits in attention and planning that interfere with the academic performance of children with TBI must be measured. Gutentag et al. (1998) studied that children with TBI showed deficits on the CAS compared to a matched control group drawn from the CAS normative population. Neurocognitive deficits were most pronounced in the attention and planning domains and less severe in the simultaneous and successive domains (Gutentag et al., 1998, p. 265).

The CAS has been increasingly used in other clinical neuropsychology studies. In Spain, Perez-Alvarez, Timoneda-Gallart, and Baus-Rosell (2006) used the CAS in a study assessing the effects of Topiramato (a pharmacological treatment for epilepsy) on cognitive processes and behavior. The 35 patients ranging in age from 5 to 15 years were assessed with the CAS at baseline and again at 6 and 12 months. The parents were given behavior rating scales at each interval as well. At baseline, 6 months, and 12 months, patients had lower successive scores. At 12 months, planning scores had increased significantly, whereas there was a concomitant improvement on behavior as measured by rating scales. McCrea (2009) studied three patients with unilaterally focalized stroke lesions longitudinally on the CAS subtests at 1 month and 6 months. Patient 1 with a left temporal pole lesion had a severe syntactic comprehension deficit on Sentence Questions. Patient 2 had a rare right anterior cerebral artery aneurysm culminating in an orbitofrontal syndrome and impairments on expressive attention, word series, and a praxis-based figure ground reversal phenomenon on figure memory. Patient 3 suffered a right frontoparietal lesion with resulting representational as well as elements of motor neglect and impairments on matching numbers, number detection, and receptive attention. Each patient's lesions were all entirely consistent with the nature of cognitive neuropsychological symptoms suggesting that the CAS subtests are unique and also sensitive and specific to focalized cortical lesions.

FAIRNESS

The characteristics of the U.S. population continue to change with every census, and the need for fair assessment of children has become progressively more important. As discussed earlier, it is common for traditional IQ tests to have items that measure content that is dependent on exposure to the dominant culture, language, and formal education. This content can create an unfair disadvantage for many children, such as those living in non-English-speaking homes and impoverished environments. Reducing the amount of knowledge needed to correctly answer the questions on intelligence tests is a useful way to ensure appropriate and fair assessment of diverse populations. Some researchers have suggested that conceptualizing intelligence as a set of psychological processes, such as the PASS theory as operationalized by the CAS, has utility for assessment of children from culturally and linguistically diverse populations because verbal and quantitative skills are not included (Naglieri, Rojahn, & Matto, 2007; Naglieri, Rojahn, Matto, & Aquilino, 2005).

On traditional measures of ability, researchers have found up to a 15-point mean difference between Blacks and Whites. Results for PASS processing tests have shown only small differences between these groups. For example, Naglieri et al. (2005) compared CAS scores of a sample composed of 298 Black children and 1,691 White children. Controlling for key demographic variables, regression analyses showed an estimated CAS Full Scale mean score difference of 4.8, which is smaller than that found with traditional tests of ability. Another finding was that correlations between the CAS scores and WJ-R Tests of Achievement were very similar for Blacks (0.70) and Whites (0.64; Naglieri et al., 2005). Naglieri et al. (2006) examined CAS scores for 244 Hispanic and 1,956 non-Hispanic children. They found that the two groups differed by 6.1 points when the samples were unmatched samples, 5.1 with samples matched on basic demographic variables, and 4.8 points when demographics differences were statistically controlled. These findings further demonstrate the utility of PASS theory as one way to fairly assess diverse populations.

When evaluating the cognitive ability of English language learners (ELL), psychologists currently have three practice options (Ortiz, 2009). These methods are (1) modifications and adaptations of the standardized administration and scoring of the test, (2) the selection and use of specific tests or battery of tests that are of a nonverbal nature, and (3) the use of a more traditional native language-based test (e.g., *WISC-IV* Spanish). Each method has its limitations and advantages. The first method modifying or adapting the tests in terms of administration or scoring violates standardization directly, resulting in error and in less reliability and validity of scores attained. The second method, and perhaps the most commonly practiced (Ortiz, 2009) method, involves the use of a nonverbal battery or the administration of select subtests that make up the performance IQ (Figueroa, 1990), or, more

recently, the Perceptual Reasoning Index. This method, although it reduces the impact of language on test results, would not be helpful in cases in which the student's dysfunction is actually language based (such as reading or written language). The third option, the use of a native language test, may seem to be the ideal option with ELL students. However, these tests fail to control for the level of language proficiency (Harris & Llorente, 2005).

In the case of ELL Hispanic children, Naglieri, Otero, De-Lauder, and Matto (2007) compared the English and Spanish versions of the CAS for bilingual Hispanic children. The children in this study earned very similar CAS Full Scale scores, and deficits in successive processing were found on both versions of the test. Importantly, 90% of children who had a neurocognitive weakness on one version of the CAS also had the *same* neurocognitive weakness on the other version of the CAS. These results suggest that the PASS scores from both the English and Spanish version of the CAS could be used as part of a comprehensive evaluation.

DIAGNOSTIC UTILITY OF PASS

Two major goals of diagnosis are to discern variations in characteristics that help distinguish one group of children from another and, subsequently, to determine if this identification can help with intervention decisions. With these goals in mind, one way to examine the diagnostic utility of the PASS cognitive profiles is through the analysis of the frequency of the PASS cognitive weaknesses found in children in regular and special educational settings. A second way to explore the diagnostic utility is by examining specific populations (e.g., ADHD and learning disability [LD]). Research that has examined the PASS cognitive profiles using these two methods are summarized below.

Naglieri (1999) defined three types of disorders that can be identified in one or more of the basic PASS processes. Using the ipsative methodology originally proposed by Davis (1959) and modified by Silverstein (1982, 1993), we define relative weakness as a significant weakness which is low in relation to the child's mean PASS score. In contrast, a disorder in one or more of the basic psychological processes (termed a cognitive weakness) is found when a child has a significant intraindividual difference (using the ipsative method), *and* the lowest score also falls below some cutoff designed to indicate what is typical or average. Therefore, in comparison to a relative weakness, a cognitive weakness method uses a dual criterion based on having a low score relative to the child's mean and a low score relative to the norm group. Naglieri (1999) further suggested that a diagnosis is most appropriate when a cognitive weakness and an academic weakness are uncovered. Children who have a cognitive weakness and an academic weakness should be considered candidates for special educational services if other appropriate conditions are also met (e.g., the child has

had opportunity to learn when appropriate instruction was provided; Naglieri, 1999).

Naglieri (2000) found that children with a cognitive weakness earned lower scores on achievement, and the more pronounced the cognitive weakness, the lower the achievement scores were. Additionally, children with a PASS cognitive weakness were more likely to have been previously identified and placed in special education. Finally, the presence of a cognitive weakness was significantly related to achievement, whereas the presence of a relative weakness was not. Naglieri's (2000) findings support the view that the PASS theory could be used to identify children with cognitive and related academic difficulties for the purpose of eligibility determination and instructional planning. Naglieri (2003) and Naglieri and Pickering (2003) provide theoretical and practical guidelines about how a child's PASS cognitive weakness and accompanying academic weakness might meet criteria for special educational programming.

The PASS theory offers a way to define and measure a disorder in basic psychological processes that can be integrated with both academic performance and all other relevant information to help make a diagnosis. Although the PASS constructs play an important role in the identification process, the determination of an LD or any other disorder cannot be made solely on the basis these constructs. Still, the connections between the PASS and academic instruction have also led researchers to begin an examination of the diagnostic potential of PASS profiles.

DIAGNOSTIC UTILITY IN SPECIFIC POPULATIONS

The profiles of the PASS scores obtained from populations of children with ADHD, mental retardation, and reading disabilities have been examined in several studies (Naglieri, 1999). The finding among the various studies has been that differences between the groups have emerged in predictable and discriminating ways. That is, children with mental retardation earned low and similar PASS scores (Naglieri & Das, 1997b), whereas those with evidence of reading decoding failure obtained average scores on PASS except for low successive scores (Naglieri, 1999). In contrast, children diagnosed with ADHD earned average scores except in planning (Dehn, 2000; Naglieri, Salter, & Edwards, 2004; Naglieri et al., 2003; Paolitto, 1999). A brief summary of the PASS research examining children with ADHD and those with evidence of reading disabilities is provided below.

There is now a consistent line of research that suggests that ADHD (combined type) can be viewed as a failure of self-control or planning as defined by the PASS theory. Some researchers have described a planning cognitive deficit as a distinguishing mark of ADHD (Naglieri & Goldstein, 2006). This interpretation of ADHD is consistent with Barkley (1997, 1998) who has suggested that ADHD is a failure of control related to frontal functioning intimately involved in regulating and self-monitoring

performance, which fits directly with the planning part of the PASS theory. Additionally, there is mounting evidence that suggests that adults and children with ADHD also have planning (e.g., executive functioning) deficits (Ellison, 2005). This is relevant because, as noted earlier, the planning process and executive functioning share many of the same qualities.

Children with ADHD have earned PASS profiles that are both predictably similar to each other and distinctly different from other populations. Naglieri et al. (2003) reported that children with ADHD had a different PASS profile than those with anxiety disorders. Additionally, Van Luit, Kroesbergen, and Naglieri (2005) found that Dutch children with ADHD earned their lowest score on measures of planning. These findings are in contrast to profiles reported for children with reading disabilities that were low on successive processing and those with anxiety disorders that showed no PASS weakness.

It has been suggested that a major cause of reading disability for children is the inability to engage in phonological coding (Stanovich, 1988; Wagner, Torgeson, & Rashotte, 1994). Reading research generally supports the idea that phonological skills play an important role in early reading. Wagner et al. (1994) argue that phonological skills are causally related to normal acquisition of reading skills. A review by Share and Stanovich (1995) concluded that there is strong evidence that poor readers, as a group, are impaired in a very wide range of basic tasks in the phonological domain (1995).

The various studies involving special populations lead to the conclusions that children with LD and ADHD have different PASS profiles. The findings for children with reading decoding problems and ADHD have important implications for differential diagnosis, intervention, and predicting children's response to instruction (Naglieri, 2003, 2005).

TREATMENT VALIDITY

There are several resources for applying the PASS theory to academic remediation and instruction. The PASS Remedial Program (PREP, 1999) developed by J. P. Das is an option, as is the Planning Strategy Instruction, also known as the Planning Facilitation Method, described by Naglieri and Pickering (2003). Other resources include Kirby and Williams' (1991) book *Learning Problems: A Cognitive Approach* and Naglieri and Pickering's (2003) book *Helping Children Learn: Instructional Handouts for Use in School and at Home*. Since the two books utilize the concepts of both PREP and Planning Strategy Instruction, only PREP and Planning Strategy Instruction will be discussed in further detail.

PREP

Based on the PASS theory of cognitive functioning (Das et al., 1994), PREP was developed as a cognitive remedial

program and is supported by a line of research beginning with Brailsford, Snart, and Das (1984), Kaufman and Kaufman (1979), and Krywaniuk and Das (1976). These researchers demonstrated that students could be trained to use successive and simultaneous processes more efficiently, which resulted in an improvement in their performance on that process and some transfer to specific reading tasks (Ashman & Conway, 1997, p. 169). PREP aims to improve information processing strategies—specifically, simultaneous and successive processing—that underlie reading while avoiding the direct teaching of word-reading skills such as phoneme segmentation or blending. The tasks in the program teach children to focus their attention on the sequential nature of many tasks, including reading. This helps the children better utilize successive processing, which is a very important cognitive process needed in reading decoding.

Support for PREP has been established by studies that examine the effectiveness of the instructional method for children with reading decoding problems. Carlson and Das (1997) and Das, Mishra, and Pool (1995) studied reading-disabled children who were divided into a PREP and control groups. There were 15 PREP sessions given to small groups of four children. Word Attack and Word Identification tests were administered pre- and posttreatment. In both studies, PREP groups outperformed the control groups. Similarly, Boden and Kirby (1995) studied a group of learning-disabled children who were randomly assigned to a PREP training or a control group that received regular instruction. As in previous studies, the results showed significant differences between the two groups in reading decoding of real and pseudowords. Similarly, Das, Parrila, and Papadopoulos (2000) found that children who were taught using PREP improved significantly more in pseudoword reading than did a control group and Parrila, Das, Kendrick, Papadopoulos, and Kirby (1999) showed a significant improvement of reading (Word identification and Word Attack) for the PREP group. Specific relevance to the children's CAS profiles was also demonstrated by the fact that those children with a higher level of successive processing at the beginning of the program benefited the most from the PREP instruction but those with the most improvement in the meaning-based program were characterized by higher level of planning (Parrila et al., 1999).

All of these experimental studies of the PREP instruction “suggest that process training can assist in specific aspects of beginning reading” (Ashman & Conway, 1997, p. 171). Taken together, the above studies make a clear case for the effectiveness of PREP in remediating deficient reading skills during the elementary school years. Additionally, they illustrate the connection between the PASS theory and intervention.

Planning Strategy Instruction

The connection between planning and intervention has been well illustrated by research that has examined

the relationship between strategy instruction and CAS planning scores. Studies have involved both math and reading achievement scores. These intervention studies focused on the concept that children can be encouraged to be more planful when they complete academic tasks and that the facilitation of plans positively impacts academic performance. The initial concept for Planning Strategy Instruction was based on the work of Cormier, Carlson, and Das (1990) and Kar, Dash, Das, and Carlson (1992). These authors taught children to discover the value of strategy use without being specifically instructed to do so. The children were encouraged to examine the demands of the task in a strategic and organized manner. They demonstrated that students differentially benefited from the technique that facilitated planning. Children who performed poorly on measures of planning demonstrated significantly greater gains than those with higher planning scores. These initial results indicated that a relationship between PASS and instruction might be possible.

Naglieri and Gottling (1995, 1997) showed Planning Strategy Instruction to improve children's performance in math calculation. All children in these studies attended a special school for those with learning disabilities. In the investigations, students completed mathematics worksheets in sessions over an 82-month period. The method designed to indirectly teach planning was applied in individual one on one tutoring sessions (Naglieri & Gottling, 1995) or in the classroom by the teacher (Naglieri & Gottling, 1997) about two to three times per week in half hour blocks of time. Students were encouraged to recognize the need to plan and use strategies when completing mathematic problems during the intervention periods. The teachers provided probes that facilitated discussion and encouraged the children to consider various ways to be more successful. More details about the method are provided by Naglieri and Gottling (1995, 1997) and Naglieri and Pickering (2003).

The relationship between Planning Strategy Instruction and the PASS profiles for children with learning disabilities and mild mental impairments was studied by Naglieri and Johnson (2000). The purpose of this study was to determine if children with cognitive weaknesses in each of the four PASS processes and children with no cognitive weaknesses showed different rates of improvement in math when given the same group Planning Strategy Instruction. The findings from this study showed that children with a cognitive weakness in planning improved considerably over baseline rates, whereas those with no cognitive weakness improved only marginally. Similarly, children with cognitive weaknesses in simultaneous, successive, and attention showed substantially lower rates of improvement. The importance of this study was that the five groups of children responded very differently to the same intervention. Thus, the PASS processing scores were predictive of the children's response to this math intervention (Naglieri & Johnson, 2000).

Another study that examines the effects of Planning Strategy Instruction is reported by Haddad et al. (2003). This study assessed whether an instruction designed to facilitate planning would have differential benefit on reading comprehension and whether improvement was related to the PASS processing scores of each child. The researchers used a sample of general education children sorted into three groups based on each of the PASS scale profile from the CAS. Even though the groups did not differ by CAS Full Scale scores or pretest reading comprehension scores, children with a planning weakness benefited substantially (effect size of 1.52) from the instruction designed to facilitate planning. In contrast, children with no PASS weakness or a successive weakness did not benefit as much (effect sizes of 0.52 and 0.06, respectively).

Iseman and Naglieri (in press) examined Planning Strategy Instruction in children with learning disabilities and ADHD. Students in the experimental group engaged in Planning Strategy Instruction designed to encourage effective strategies in mathematics. A comparison group received additional math instruction by the regular teacher. Following the intervention, an analysis examined students with and without a cognitive weakness in planning on the CAS. Students with a planning cognitive weakness in the experimental group improved considerably on math worksheets. In contrast, students without a planning cognitive weakness in the comparison group did not improve. Students with ADHD with a cognitive weakness in planning in the experimental group improved considerably on the worksheets. In contrast, students with ADHD without a cognitive weakness in planning in the comparison group did not improve. Thus, individuals with cognitive weaknesses in planning, with and without ADHD, benefited more from Planning Strategy Instruction than normal instruction (Iseman & Naglieri, in press).

The results of these Planning Strategy Instruction studies using academic tasks suggest that changing the way aptitude is conceptualized (e.g., as the PASS rather than traditional IQ) and measured (using the CAS) increases the probability that an aptitude-by-treatment interaction (ATI) is detected. Past ATI research suffered from inadequate conceptualizations of aptitudes based on the general intelligence model. That approach is very different from the basic psychological processing view represented by the PASS theory and measured by the CAS. The summary of studies provided here are particularly different from previous ATI research that found students with low general ability to improve little to instruction and those with high general ability to improve a lot to instruction. In contrast, children with a weakness in one of the PASS processes (planning) benefited *more* from instruction compared to children who had no weakness or a weakness in a different PASS process. The results of these studies also suggest that the PASS profiles can help predict which children will respond to the academic instruction and which children will not.

CONCLUSIONS

There is a growing need for neuropsychological measures to evaluate and explain function, to facilitate prognosis, and most importantly to guide intervention. Luria's PASS theory offers a blueprint for defining the basic neuropsychological processes underlying human performance and behavior. Appreciation and application of this model as a framework for neuropsychological assessment provides pediatric neuropsychologists with the essential mindset necessary to not just understand children's learning and behavior but to guide and develop effective intervention. The PASS theory as operationalized by the CAS provides a well-developed nationally standardized tool for assessment of the four basic psychological processes described by Luria. The considerable amount of validity evidence summarized here and in other sources strongly supports the utility of this theory and the CAS.

REFERENCES

- Ashman, A. F., & Conway, R. N. F. (1997). *An introduction to cognitive education: Theory and applications*. London: Routledge.
- Atkinson, L. (1991). Three standard errors of measurement and the Wechsler Memory Scale-Revised. *Psychological Assessment*, 3, 136-138.
- Memory Scale-Revised. *Psychological Assessment*, 3, 136-138.
- Barkley, R. A. (1997). *ADHD and the nature of self-control*. New York: Guilford.
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121, 65-94.
- Barkley, R. A. (1998). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (2nd ed.). New York: The Guilford Press.
- Boden, C., & Kirby, J. R. (1995). Successive processing, phonological coding and the remediation of reading. *Journal of Cognitive Education*, 4, 19-31.
- Bradley, L., & Bryant, P. (1985). *Rhyme and reason in reading and spelling*. Ann Arbor, MI: The University of Michigan Press.
- Brailsford, A., Snart, F., & Das, J. P. (1984). Strategy training and reading comprehension. *Journal of Learning Disabilities*, 17(5), 287-290.
- Brody, N. (1992). *Intelligence*. San Diego, CA: Academic Press.
- Carlson, J., & Das, J. P. (1997). A process approach to remediating word decoding deficiencies in Chapter 1 children. *Learning Disabilities Quarterly*, 20, 93-102.
- Cohen, R. J., Swerdlik, M. E., & Smith, D. K. (1992). *Psychological testing and assessment*. Mountain View, CA: Mayfield Publishing.
- Cormier, P., Carlson, J. S., & Das, J. P. (1990). Planning ability and cognitive performance: The compensatory effects of a dynamic assessment approach. *Learning and Individual Differences*, 2, 437-449.
- Das, J. P. (1972). Patterns of cognitive ability in nonretarded and retarded children. *American Journal of Mental Deficiency*, 77, 6-12.
- Das, J. P. (1980). Planning: Theoretical considerations and empirical evidence. *Psychological Research (W. Germany)*, 41, 141-151.
- Das, J. P. (1999). *PASS reading enhancement program*. Deal, NJ: Sarka Educational Resources.
- Das, J. P. (2001). *Reading difficulties and dyslexia*. Deal, NJ: Sarka.
- Das, J. P., & Abbott, J. (1995). PASS: An alternative approach to intelligence. *Psychology and Developing Societies*, 7(2), 155-184.
- Das, J. P., Kar, B. C., & Parrila, R. K. (1996). *Cognitive planning: The psychological basis of intelligent behavior*. Thousand Oaks, CA: Sage Publications.

- Das, J. P., Kirby, J. R., & Jarman, R. F. (1975). Simultaneous and successive syntheses: An alternative model for cognitive abilities. *Psychological Bulletin*, 82, 87–103.
- Das, J. P., Kirby, J. R., & Jarman, R. F. (1979). *Simultaneous and successive cognitive processes*. New York: Academic Press.
- Das, J. P., Mishra, R. K., & Kirby, J. R. (1994). Cognitive patterns of dyslexics: Comparison between groups with high and average non-verbal intelligence. *Journal of Learning Disabilities*, 27(4), 235–242.
- Das, J. P., Mishra, R. K., & Pool, J. E. (1995). An experiment on cognitive remediation or word-reading difficulty. *Journal of Learning Disabilities*, 28, 66–79.
- Das, J. P., Naglieri, J. A., & Kirby, J. R. (1994). *Assessment of cognitive processes*. Needham Heights, MA: Allyn & Bacon.
- Das, J. P., Parrila, R. K., & Papadopoulos, T. C. (2000). Cognitive education and reading disability. In A. Kozulin & Y. Rand (Eds.), *Experience of mediated learning* (pp.276–291). Amsterdam: Pergamon.
- Davis, F. B. (1959). Interpretation of differences among averages and individual test scores. *Journal of Educational Psychology*, 50, 162–170.
- Dehn, M. J. (2000, April). *Cognitive assessment system performance of ADHD children*. Paper presented at the annual NASP Convention, New Orleans, LA.
- Ellison, P. A. T. (2005). School neuropsychology of attention-deficit/hyperactivity disorder. In R. C. D'Amato, E. Fletcher-Janzen, & C. R. Reynolds (Eds.), *Handbook of school neuropsychology* (pp. 460–486). Hoboken, NJ: John Wiley & Sons, Inc.
- Figueroa, R. A. (1990). Assessment of linguistic minority group children. In C. R. Reynolds & R. W. Kamphaus (Eds.), *Handbook of psychological and educational assessment of children: Volume 1 intelligence and achievement* (pp. 135–152). New York: Guilford.
- Gutentag, S. S., Naglieri, J. A., & Yeates, K. O. (1998). Performance of children with traumatic brain injury on the cognitive assessment system. *Assessment*, 5, 263–272.
- Goldberg, E. (2009). *The new executive brain: Frontal lobes and the civilized mind*. New York: Oxford University Press.
- Haddad F. A., Garcia Y. E., Naglieri, J. A., Grimditch, M., McAndrews, A., & Eubanks, J. (2003). Planning facilitation and reading comprehension: Instructional relevance of the PASS theory. *Journal of Psychoeducational Assessment*, 21, 282–289.
- Harris, J. G., & Llorente, A. M. (2005). Cultural considerations in the use of the Wechsler intelligence scale for children-Fourth edition. In A. Prifitera, D. H. Saklofske, & L. G. Weiss (Eds.), *WISC-IV clinical use and interpretation: Scientist-practitioner perspectives* (pp. 382–416). San Diego, CA: Academic Press.
- Hayes, S. C., Gifford, E. B., & Ruckstuhl, L. E. (1996). Relational frame theory and executive function: A behavioral approach. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory and executive function* (pp. 279–306). Baltimore, MD: Brookes.
- Iseman, J. S., & Naglieri, J. A. (in press). A cognitive instructional approach to improving math calculation for children with ADHD: A randomized controlled study. *Journal of Learning Disabilities*.
- Kar, B. C., Dash, U. N., Das, J. P., & Carlson, J. S. (1992). Two experiments on the dynamic assessment of planning. *Learning and Individual Differences*, 5, 13–29.
- Kaufman, A. S. (1994). *Intelligent testing with the WISC-III*. New York: Wiley.
- Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman assessment battery for children* (2nd ed.). Circle Pines, MN: American Guidance Service.
- Kaufman, D., & Kaufman, P. (1979). Strategy training and remedial techniques. *Journal of Learning Disabilities*, 12, 63–66.
- Kirby, J. R. (1984). *Cognitive strategies and educational performance*. New York: Academic press.
- Kirby, J. R., & Williams, N. H. (1991). *Learning problems: A cognitive approach*. Toronto, ON: Kagan and Woo.
- Kolb, B., Gibb, R., & Robinson, T. E. (2003). Brain plasticity and behavior. *Current Directions in Psychological Science*, 12, 1–4.
- Kolb, B., & Whishaw, I. Q. (2009). *Fundamentals of human neuropsychology* (6th ed.). New York: Worth Publishers.
- Korkman, M. (1999). Applying Luria's diagnostic principals in the neuropsychological assessment of children. *Neuropsychology Review*, 9, 89–105.
- Koziol, L. F., & Budding, D. (2009). *Subcortical Structures and Cognition: Implications for Neuropsychological Assessment*. New York: Springer
- Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological assessment* (4th ed.). New York: Oxford University Press.
- Krywaniuk, L. W., & Das, J. P. (1976). Cognitive strategies in native children: Analysis and intervention. *Alberta Journal of Educational Research*, 22, 271–280.
- Lewandowski, L., & Scott, D. (2008). Introduction to neuropathology and brain-behavior relationships. In R. C. D'Amato & L. C. Hartlage (Eds.), *Essentials of neuropsychological assessment: Treatment planning for rehabilitation* (2nd ed.). New York: Springer Publishing Company.
- Luria, A. R. (1966). *Human brain and psychological processes*. New York: Harper and Row.
- Luria, A. R. (1973). *The working brain*. New York: Basic Books.
- Luria, A. R. (1979). *The making of mind: A personal account of Soviet psychology*. Cambridge, MA: Harvard University Press.
- Luria, A. R. (1980). *Higher cortical functions in man* (2nd ed.). New York: Basic Books.
- Luria, A. R. (1982). *Language and cognition*. New York: Wiley.
- McCloskey, G., Perkins, L. A., & Van Diver, B. (2009). Assessment and intervention for executive function difficulties. New York: Routledge.
- Mccrea, S. M. (2009). A cognitive neuropsychological examination of the Das-Naglieri cognitive assessment system subtests: A report of three stroke cases studied longitudinally during recovery. *International Journal of Neuroscience*, 119, 4, 553–559.
- Mirsky, A. F. (1996). Disorders of Attention. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention memory and executive function* (pp. 71–98). Baltimore, MD: Paul Brookes.
- Mirsky, A. F., Duncan, C. C. (2003). Attention battery for children: A systematic approach to assessment. In G. Goldstein & S. R. Beers (Eds.), *Comprehensive handbook of psychological assessment, Volume 1, Intellectual and neuropsychological assessment*. New York: Wiley.
- Mirsky, A. F., & Duncan, C. C. (2001). A nosology of disorders of attention. *Annals of New York Academy of Science*, 931, 17–32.
- Naglieri, J. A. (1997). *Naglieri nonverbal ability test*. San Antonio, TX: The Psychological Corporation.
- Naglieri, J. A. (1999). *Essentials of CAS assessment*. New York: Wiley.
- Naglieri, J. A. (2000). Can profile analysis of ability test scores work? An illustration using the PASS theory and CAS with an unselected cohort. *School Psychology Quarterly*, 15, 419–433.
- Naglieri, J. A. (2003). Current advances in assessment and intervention for children with learning disabilities. In T. E. Scruggs & M. A. Mastropieri (Eds.), *Advances in learning and behavioral disabilities Volume 16: Identification and assessment* (pp. 163–190). New York: JAI.
- Naglieri, J. A. (2005). The cognitive assessment system. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment* (2nd ed., pp. 441–460). New York: Guilford.
- Naglieri, J. A., & Bornstein, B. T. (2003). Intelligence and achievement: Just how correlated are they? *Journal of Psychoeducational Assessment*, 21, 244–260.
- Naglieri, J. A., & Conway, C. (2009). The cognitive assessment system. In J. A. Naglieri & S. Goldstein (2009). *A practitioner's guide to assessment of intelligence and achievement* (pp. 3–10). New York: Wiley.
- Naglieri, J. A., & Das, J. P. (1997a). *Cognitive assessment system*. Itasca, IL: Riverside Publishing Company.
- Naglieri, J. A., & Das, J. P. (1997b). *Cognitive assessment system interpretive handbook*. Chicago, IL: Riverside Publishing Company.
- Naglieri, J. A., & Das, J. P. (2002). Practical implications of general intelligence and PASS cognitive processes. In R. J. Sternberg & E. L. Grigorenko (Eds.), *The general factor of intelligence: How general is it?* (pp.855–884). New York: Erlbaum.
- Naglieri, J. A., & Das, J. P. (2005). Planning, Attention, Simultaneous, Successive(PASS)theory: A revision of the concept of intelligence.

- In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment* (2nd ed., pp. 136–182). New York: Guilford.
- Naglieri, J. A., & Goldstein, S. (2009). *Assessing intelligence & achievement: A practitioners guide*. New York: Wiley.
- Naglieri, J. A., & Goldstein, S. (2006). The role of intellectual processes in the DSM-V diagnosis of ADHD. *Journal of Attention Disorders*, 10, 3–8.
- Naglieri, J. A., Goldstein, S., Delauder, B. Y., & Schwebach, A. (2006). WISC-III and CAS: Which correlates higher with achievement for a clinical sample? *School Psychology Quarterly*, 21, 62–76.
- Naglieri, J. A., Goldstein, S., Iseman, J. S., & Schwebach, A. (2003). Performance of children with attention deficit hyperactivity disorder and anxiety/depression on the WISC-III and Cognitive Assessment System (CAS). *Journal of Psychoeducational Assessment*, 21, 32–42.
- Naglieri, J. A., & Gottling, S. H. (1995). A cognitive education approach to math instruction for the learning disabled: An individual study. *Psychological Reports*, 76, 1343–1354.
- Naglieri, J. A., & Gottling, S. H. (1997). Mathematics instruction and PASS cognitive processes: An intervention study. *Journal of Learning Disabilities*, 30, 513–520.
- Naglieri, J. A., & Johnson, D. (2000). Effectiveness of a cognitive strategy intervention to improve math calculation based on the PASS theory. *Journal of Learning Disabilities*, 33, 591–597.
- Naglieri, J. A., Otero, T., DeLauder, B., & Matto, H. (2007). Bilingual Hispanic Children's performance on the English and Spanish Versions of the Cognitive Assessment System. *School Psychology Quarterly*, 22, 432–448.
- Naglieri, J. A., & Pickering, E. (2003). *Helping children learn: Instructional handouts for use in school and at home*. Baltimore, MD: Brookes.
- Naglieri, J. A., & Rojahn, J. R. (2004). Validity of the PASS Theory and CAS: Correlations with achievement. *Journal of Educational Psychology*, 96, 174–181.
- Naglieri, J. A., & Pickering, E. (2010). *Helping children to learn: Instructional handouts for use in school and at home* (2nd ed.). Baltimore, MD: Brookes.
- Naglieri, J. A., Rojahn, J., & Matto, H. (2007). Hispanic and non-Hispanic children's performance on PASS cognitive processes and achievement. *Intelligence*, 35, 568–579.
- Naglieri, J. A., Rojahn, J. R., Matto, H. C., & Aquilino, S. A. (2005). Black white differences in intelligence: A study of the PASS theory and cognitive assessment system. *Journal of Psychoeducational Assessment*, 23, 146–160.
- Naglieri, J. A., Salter, C. J., & Edwards, G. (2004). Assessment of ADHD and reading disabilities using the PASS theory and cognitive assessment system. *Journal of Psychoeducational Assessment*, 22, 93–105.
- Neville, H., & Stevens, C. (2008). Experience shapes human brain development and function: A framework for planning interventions for children at-risk for school failure (Summary). Annual meeting of the American Association for the Advancement of Science, Boston.
- Neville, H. (2006). Different profiles of plasticity within human cognition. In Y. Munakata & M. Johnson (Eds.), *Processes of change in brain and cognitive development*. New York: Oxford University Press.
- Ortiz, S. O. (2009) Bilingual-multicultural assessment with the WISC-IV. In E. O. Lichtenberger, & A. S. Kaufman (Eds.), *Essentials of the WISC-IV* (pp. 295–309). New York: Wiley.
- O'Shanick, G. J., & O'Shanick, A. M. (1994). Personality and intellectual changes. In J. M. Silver, S. C. Yudofsky, & R. E. Hales (Eds.), *Neuropsychiatry of traumatic brain injury* (pp. 163–188). Washington, DC: American Psychiatric Press.
- Paolitto, A. W. (1999). Clinical validation of the cognitive assessment system with children with ADHD. *ADHD Report*, 7, 1–5.
- Parrila, R. K., Das, J. P., Kendrick, M., Papadopoulos, T., & Kirby, J. (1999). Efficacy of a cognitive reading remediation program for at-risk children in Grade 1. *Developmental Disabilities Bulletin*, 27, 1–31.
- Penrose, L. S., & Raven, J. C. (1936). A new series of perceptual tests: Preliminary communication. *British Journal of Medical Psychology*, 16, 97–104.
- Perez-Alvarez, P., Timoneda-Gallart, C., & Baus-Rosell, J. (2006). Topiramato y epilepsia a la luz del Das-Naglieri Cognitive Assessment System. *Revista Neurologia*, 42, 1, 3–7.
- Posner, M. I., & Boies, S. J. (1971). Components of attention. *Psychological Review*, 78, 391–408.
- Reynolds, C. R., & French, C. L. (2005). The brain as a dynamic organ of information processing and learning. In R. C. D'Amato, E. Fletcher-Janzen, & C. R. Reynolds (Eds.), *Handbook of school neuropsychology* (pp. 86–119). Hoboken, NJ: John Wiley & Sons, Inc.
- Roid, G. (2003). *Stanford-Binet* (5th ed.). Itasca, IL: Riverside.
- Schneider, W., Dumais, S. T., & Shiffrin, R. M. (1984). Automatic and controlled processing and attention. In R. Parasuraman & D. R. Davies (Eds.), *Varieties of attention* (pp. 1–28). New York: Academic Press.
- Semrud-Clikeman, M., & Teeter Ellison, P. A. (2009). *Child Neuropsychology: Assessment and intervention of neurodevelopmental disorders* (2nd ed.). New Jersey: Springer.
- Silverstein, A. B. (1982). Pattern analysis as simultaneous statistical inference. *Journal of Consulting and Clinical Psychology*, 50, 234–240.
- Silverstein, A. B. (1993). Type I, Type II, and other types of errors in pattern analysis. *Psychological Assessment*, 5, 72–74.
- Share, D. L., & Stanovich, K. E. (1995). Cognitive processes in early reading development: Accommodating individual differences into a model of acquisition. *Issues in Education*, 1, 1–57.
- Stanovich, K. E. (1988). Explaining the differences between dyslexic and the garden-variety poor reader: The phonological-core variable-difference model. *Journal of Learning Disabilities*, 21, 590–604.
- Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary*. New York: Oxford University Press.
- Stuss, D. T., & Benson, D. F. (1990). The frontal lobes and language. In E. Goldberg (Ed.), *Contemporary psychology and the legacy of Luria*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Van Luit, J. E. H., Kroesbergen, E. H., & Naglieri, J. A. (2005). Utility of the PASS Theory and cognitive assessment system for Dutch children with and without ADHD. *Journal of Learning Disabilities*, 38, 434–439.
- Varnhagen, C. K., & Das, J. P. (1986). Neuropsychological functioning and cognitive processing. In J. E. Obzrut & G. W. Hynd (Eds.), *Child neuropsychology, Vol. 1: Theory and research* (pp. 117–140). New York: Academic Press.
- Vygotsky, L. S. (1976). *Mind in society: Development of higher psychological processes*. London: Harvard University Press.
- Wagner, R. K., Torgeson, J. K., & Rashotte, C. A. (1994). Development of reading-related phonological processing abilities: New evidence of bi-directional causality from a latent variable longitudinal study. *Developmental Psychology*, 30, 73–87.
- Wilkinson, A., & Sermund-Clikeman, M. (2008, February). *Motor speed in children and adolescents with nonverbal learning disabilities*. Paper presented at the International Neuropsychological Society, Waikola, Hawaii.
- Witsken, D., Stoeckel, A., & D'Amato, R. C. (2008). Promoting educational change: Using a neuropsychological approach to develop a Response-to-Intervention program. *Psychology in the Schools*.
- Wechsler, D. (1991). *Wechsler intelligence scale for children* (3rd ed.). San Antonio, TX: The Psychological Corporation.
- Wechsler, D. (2003). *Wechsler intelligence scale for children* (4th ed.). San Antonio, TX: The Psychological Corporation.
- Wechsler, D., & Naglieri, J. A. (2006). *Wechsler nonverbal scale of ability*. San Antonio, TX: Harcourt Assessment.
- Woodcock, R. W. (1987). *Woodcock reading mastery tests-Revised*. Circle Pines, MN: American Guidance Service.
- Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson revised tests of achievement: Standard and supplemental batteries*. Itasca, IL: Riverside Publishing.
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III tests of achievement*. Itasca, IL: Riverside Publishing.

