Planning, Attention, Simultaneous, Successive (PASS) Theory

A Revision of the Concept of Intelligence

JACK A. NAGLIERI
J. P. DAS

ORIGINS OF THE THEORY

> Authors of psychometric approaches to measurement of intelligence have become increasingly theory conscious, realizing the importance of explicitly stating the basis for derivation of the procedures. Without a theory, it is very difficult to evaluate the relevance and information value of the procedure.
>
> —LIDZ (1991, p. 60)

The Planning, Attention, Simultaneous, and Successive (PASS; Naglieri & Das, 1997a) theory is rooted in the work of A. R. Luria (1966, 1973a, 1973b, 1980) on the functional aspects of brain structures. We used Luria's work as a blueprint for defining the important components of human intelligence (Das, Naglieri, & Kirby, 1994). Our efforts represent the first time that a specific researched neuropsychological theory was used to reconceptualize the concept of human intelligence.

Luria theorized that human cognitive functions can be conceptualized within a framework of three separate but related "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. Luria (1973b) stated that "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). The four processes form a "working constellation" (Luria, 1966, p. 70) of cognitive activity. A child may therefore perform the same task with different contributions of the PASS processes, along with the application of the child's knowledge and skills.

Although effective functioning is accomplished through the integration of all processes as demanded by the particular task, not every process is equally involved in every task. For example, tasks like math calculation may be heavily weighted or dominated by a single process, while tasks such as reading decoding may be strongly related to another process. Effective functioning—for example, processing of visual information—also involve three hierarchical levels of the brain. Consistent with structural topography, these can be described in a simplified manner. First, there is the *projection area*, where the modality characteristic of the information is intact. Above the projection area is the *association area*, where infor-

mation loses part of its modality tag. Above the association area is the *tertiary area* or *overlapping zone*, where information is amodal. This enables information to be integrated from various senses and processed at a higher level. Thus modality is most important at the level of initial reception, and less important at the level where information is integrated.

Description of the Three Functional Units

The function of the first unit provides regulation of cortical arousal and attention; the second codes information using simultaneous and successive processes; and the third provides for strategy development, strategy use, self-monitoring, and control of cognitive activities.

According to Luria, the first of these three functional units of the brain, the attention–arousal system, is located primarily in the brainstem, the diencephalon, and the medial regions of the cortex (Luria, 1973b). This unit provides the brain with the appropriate level of arousal or cortical tone, as well as directive and selective attention (Luria, 1973b). When a multidimensional stimulus array is presented to a person who is then required to pay attention to only one dimension, the inhibition of responding to other (often more salient) stimuli, and the allocation of attention to the central dimension, depend on the resources of the first functional unit. 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" (1973b, p. 271), can occur. Moreover, only when individuals are sufficiently aroused and their attention is adequately focused can they utilize processes in the second and third functional units.

The second functional unit is associated with the occipital, parietal, and temporal lobes posterior to the central sulcus of the brain. This unit is responsible for receiving, processing, and retaining information the person obtains from the external world. This unit involves simultaneous processing and successive processes. Simultaneous processing involves integrating stimuli into groups so that the interrelationships among the components are understood. For example, in order to produce a diagram correctly when given the instruction "Draw a triangle above a square that is to the left of a circle under a cross," the relationships among the different shapes must be correctly comprehended. Whereas simultaneous processing involves working with stimuli that are interrelated, successive processing involves information that is linearly organized and integrated into a chain-like progression. 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. In contrast, simultaneous processing involves integration of separate elements into groups.

The third functional unit is associated with the prefrontal areas of the frontal lobes of the brain (Luria, 1980). 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" (1980, p. 263). This unit provides for the programming, regulation, and verification of behavior, and is responsible for behaviors such as asking questions, solving problems, and self-monitoring (Luria, 1973b). 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).

Functional Units: Influences and Issues

Luria's organization of the brain into functional units accounts for cultural influences on higher cognition as well as biological factors. He stated that "perception and memorizing, gnosis and praxis, speech and thinking, writing, reading and arithmetic, cannot be regarded as isolated or even indivisible 'faculties' " (Luria, 1973b, p. 29). That is, we cannot, as phrenologists attempted to do, identify a "writing" spot in the brain; instead, we must consider the concept of units of the brain that provide a function. Luria (1973b) described the advantage of this approach:

> It is accordingly our fundamental task not to "localize" higher human psychological processes in limited areas of the cortex, but to ascertain by careful analysis which groups of concertedly working zones of the brain are responsible for the performance of complex mental activity; when contributions made by each of these zones to the complex functional system; and how the relationship between these concertedly working parts of the brain in the performance of complex mental activity changes in the various stages of its development. (p. 34)

Activities such as reading and writing can be analyzed and linked as constellations of activities to specific working zones of the brain that support them (Luria, 1979, p. 141). Because the brain operates as an integrated functional system, however, even a small disturbance in an area can cause disorganization in the entire functional system (Das & Varnhagen, 1986).

Luria's concept of dynamic functional units provides the foundation for PASS processes. These basic psychological processes are firmly based on biological correlates, yet develop within a sociocultural milieu. In other words, they are influenced in part by the cultural experiences of the child. Luria (1979) noted that "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). More recently, Kolb, Gibb, and Robinson (2003) have also noted 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). Similarly, Stuss and Benson (1990) recognize this interplay and especially the use of speech as a regulatory function when they state:

> 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 4½, 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)

Luria stressed the role of the frontal lobes in language, organization, and direction of behavior and speech as a cultural tool that furthers the development of the frontal lobes and self-regulation. Cultural experiences thus actually help to accelerate the utilization of planning and self-regulation, as well as the other cognitive processes.

Luria (1979) also points out that abstraction and generalizations are themselves products of the cultural environment. Children learn, for example, to attend selectively to relevant objects through playful experiences and conversations with adults. Even simultaneous and successive processes are influenced by cultural experiences (e.g., learning songs, poems, rules of games, etc.). Naglieri (2003) has summarized the influence of social interaction on children's use of plans and strategies, and the resulting changes in performance on classroom tasks. This will be further discussed in a later section of this chapter, and by Naglieri in Chapter 20 of this volume.

The relationship between the third and first functional units is particularly strong. The first functional unit works in cooperation with, and is regulated by, higher systems of the cerebral cortex, which receive and process information from the external world and determine an individual's dynamic activity (Luria, 1973b). In other words, this unit has a reciprocal relationship with the cortex. It influences the tone of the cortex and is itself influenced by the regulatory effects of the cortex. This is possible through the ascending and descending systems of the reticular formation, which transmit impulses from lower parts of the brain to the cortex and vice versa (Luria, 1973b). For the PASS theory, this means that attention and planning are necessarily strongly related, because attention is often under the conscious control of planning. That is, our planning of behavior dictates the allocation of our limited attentional resources.

Three Functional Units and PASS Theory

Luria's concept of the three functional units used as the basis of the PASS theory is

diagrammatically shown in Figure 7.1. Although rendering a complex functional system in two-dimensional space has its limitations, the diagram illustrates some of the important characteristics of the PASS theory. First, an important component of the theory is the role of a person's fund of information. Knowledge base is a part of each of the processes, because past experiences, learning, emotions, and motivations provide the background as well as the sources for the information to be processed. This information is received from external sources through their sense organs. When that sensory information is sent to the brain for analysis, central processes become active. However, internal cognitive information in the form of images, memory, and thoughts becomes part of the input as well. Thus the four processes operate within the context of an individual's knowledge base and cannot operate outside the context of knowledge. "Cognitive processes rely on (and influence) the base of knowledge, which may be temporary (as in immediate memory) or more long term (that is, knowledge that is well learned)" (Naglieri & Das, 1997c, p. 145). Cognitive processing also influences knowledge acquisition, and learning can influence cognitive processing. Both are also influenced by membership in particular social and cultural milieus (Das & Abbott, 1995, p. 158). The importance of knowledge is therefore integral to the PASS theory. A person may read English very well and have good PASS processes, but may falter when required to read Japanese text—due to a deficient knowledge of Japanese, rather than a processing deficit.

Planning is a frontal lobe function. More specifically, it is associated with the pre-

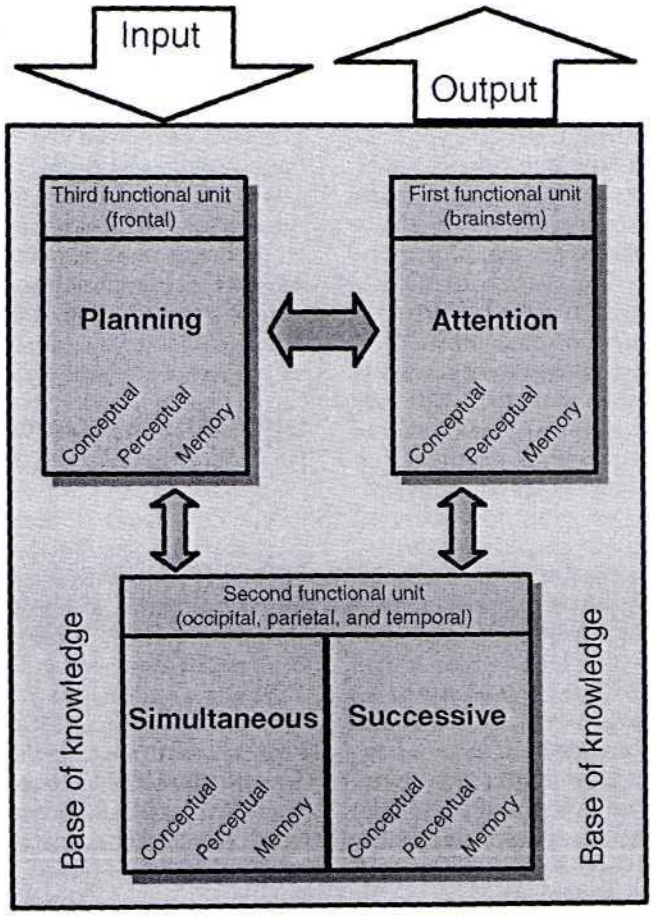

FIGURE 7.1. PASS theory.

frontal cortex and is one of the main abilities that distinguishes humans from other primates. The prefrontal cortex

> plays a central role in forming goals and objectives and then in devising plans of action required to attain these goals. It selects the cognitive skills required to implement the plans, coordinates these skills, and applies them in a correct order. Finally, the prefrontal cortex is responsible for evaluating our actions as success or failure relative to our intentions. (Goldberg, 2001, p. 24)

Planning therefore helps us select or develop the plans or strategies needed to complete tasks for which a solution is needed, and is critical to all activities where a child or adult has to determine how to solve a problem. It includes generation, evaluation, and execution of a plan, as well as self-monitoring and impulse control. Thus planning allows for the solution of problems; the control of attention, simultaneous, and successive processes; and selective utilization of knowledge and skills (Das, Kar, & Parrila, 1996).

Attention is a mental process that is closely related to the orienting response. The base of the brain allows the organism to direct focused selective attention toward a stimulus over time and to resist loss of attention to other stimuli. The longer attention is required, the more the activity is one that demands vigilance. Attention is controlled by intentions and goals, and involves knowledge and skills as well as the other PASS processes.

Simultaneous processing is essential for organization of information into groups or a coherent whole. The parietal, occipital, and temporal brain regions provide a critical "ability" to see patterns as interrelated elements. Because of the strong spatial characteristics of most simultaneous tasks, there is a strong visual–spatial dimension to activities that demand this type of processing. Simultaneous processing, however, is not limited to nonverbal content, as illustrated by the important role it plays in the grammatical components of language and comprehension of word relationships, prepositions, and inflections.

Successive processing is involved in the use of stimuli arranged in a specific serial order. Whenever information must be remembered or completed in a specific order, successive processing will be involved. Importantly, however, the information must not be able to be organized into a pattern (e.g., the number 9933811 organized into 99-33-8-11); instead, each element can only be related to those that precede it. Successive processing is usually involved with the serial organization of sounds and movements in order. It is therefore integral to, for example, working with sounds in sequence and early reading.

The PASS theory is an alternative to approaches to intelligence that have traditionally included verbal, nonverbal, and quantitative tests. Not only does this theory expand the view of what "abilities" should be measured, but it also puts emphasis on basic psychological processes and precludes the use of verbal achievement-like tests such as vocabulary. In addition, the PASS theory is an alternative to the anachronistic notion of a general intelligence. Instead, the functions of the brain are considered the building blocks of ability conceptualized within a cognitive processing framework. Although the theory may have its roots in neuropsychology, "its branches are spread over developmental and educational psychology" (Das & Varnhagen, 1986, p. 130). Thus the PASS theory of cognitive processing, with its links to developmental and neuropsychology, provides an advantage in explanatory power over the notion of general intelligence (Naglieri & Das, 2002).

OPERATIONALIZATION AND APPLICATION OF THE THEORY

The PASS theory is operationalized by the Cognitive Assessment System (CAS; Naglieri & Das, 1997a). This instrument is amply described in the CAS Interpretive Handbook (Naglieri & Das, 1997b) and by Naglieri in Chapter 20 of this book. We (Naglieri & 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 that could be individually administered. The PASS theory was used as the foundation of the CAS, so the content of the test was determined by the theory and not influenced by previous views of ability. This is further elaborated in Chapter 20 of this book.

EMPIRICAL SUPPORT FOR THE THEORY

Dillon (1986) suggested six criteria (validity, diagnosis, prescription, comparability, replicability/standardizability, and psychodiagnostic utility) for evaluation of a theory of cognitive processing. Naglieri (1989) evaluated the PASS model on these criteria, using the information available at that time; in this chapter, we use the same criteria to evaluate the current status of the PASS theory as operationalized by the CAS. This section includes summaries of research due to space limitations, but additional information is provided in Chapter 20 of this text and in other resources (Naglieri, 1999, 2003; Naglieri & Das, 1997b).

Validity

The fundamental validity of the PASS theory is rooted in the neuropsychological work of Luria (1966, 1973a, 1973b, 1980, 1982), who associated areas of the brain with basic psychological processes as described earlier in this chapter. Luria's research was based on an extensive combination of his and other researchers' understanding of brain functions, amply documented in his book *The Working Brain* (1973b). Using Luria's three functional units as a backdrop, Das and colleagues (Das, 1972; Das, Kirby, & Jarman, 1975, 1979; Das, Naglieri, & Kirby, 1994) initiated the task of finding ways to measure 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. This work, subsequently summarized in several books (e.g., Das, Naglieri, & Kirby, 1994; Kirby, 1984; Kirby & Williams, 1991; Naglieri, 1999; Naglieri & Das, 1997b), demonstrated that the PASS processes associated with Luria's concept of the three functional units could be measured. This work also illustrated that the theoretical conceptualization of basic psychological processes had considerable potential for application.

Initial studies of the validity of the PASS theory included basic and essential elements for a test of children's cognitive competence, such as developmental changes. Researchers found that performance on early versions of tests of these processes showed evidence of developmental differences by age for children of elementary and middle school ages (Das, 1972; Das & Molloy, 1975; Garofalo, 1986; Jarman & Das, 1977; Kirby & Das, 1978; Kirby & Robinson, 1987; Naglieri & Das, 1988, 1997b) and for high school and college samples (Ashman, 1982; Das & Heemsbergen, 1983; Naglieri & Das, 1988).

We and our colleagues have also demonstrated that the constructs represented in the PASS theory are strongly related to achievement. A full discussion of those results is provided by Naglieri in Chapter 20 of this book. The results demonstrate that the PASS constructs are strongly related to achievement, and the evidence thus far suggests that the theory is more strongly related to achievement than are other measures of ability. Importantly, despite the fact that the measures of PASS processes do not include achievement-like subtests (e.g., vocabulary and arithmetic), the evidence demonstrates the utility of the PASS theory as operationalized by the CAS for predication of academic performance. Because one purpose of the CAS is to anticipate levels of academic performance on the basis of levels of cognitive functioning, these results provide critical support for the theory.

Diagnosis

There are two important aims of diagnosis: first, to determine whether variations in characteristics help distinguish one group of children from another; and second, to determine whether these data help with prescriptive decisions. Prescription is discussed in the next section; the question of diagnosis is addressed here. One way to examine the utility of PASS cognitive profiles is by analysis of the frequency of PASS cognitive weaknesses for children in regular and special educational settings. Naglieri (2000) has conducted such a study. A second way to examine diagnostic utility is by examination of specific populations (e.g., children with attention-deficit/hyperactivity disorder [ADHD] or learning disabilities). Both of these topics are summarized here; we begin with a discussion of PASS profiles in general, and then take a look at two particular groups of special children.

PASS Profiles

Glutting, McDermott, Konold, Snelbaker, and Watkins (1998) have suggested that research concerning profiles for specific children is typically confounded, because the "use of subtest profiles for both the initial formation of diagnostic groups and the subsequent search for profiles that might inherently define or distinguish those groups" (p. 601) results in methodological problems. They further suggested that researchers should "begin with unselected cohorts (i.e., representative samples, a proportion of which may be receiving special education), identify children with and without unusual subtest profiles, and subsequently compare their performance on external criteria" (p. 601). Naglieri (2000) followed this research methodology, using the PASS theory and his (Naglieri, 1999) concepts of *relative weakness* and *cognitive weakness.*

Naglieri (1999) described how to find disorders in one or more of the basic PASS processes as follows. A *relative weakness* is a significant weakness in relation to the child's mean PASS score determined using the ipsative methodology originally proposed by Davis (1956) and modified by Silverstein (1982, 1993). A problem with the approach is that a child may have a significant weakness that falls within the average range if the majority of scores are above average. In contrast, a *cognitive weakness* is found when a child has a significant intraindividual difference on the PASS scale scores of the CAS (according to the ipsative method), and the lowest score *also* falls below some cutoff designed to indicate what is typical or average. The difference between a relative weakness and a cognitive weakness, therefore, is that the determination of a cognitive weakness is based on dual criteria (a low score relative to the child's mean and a low score relative to the norm group). Naglieri further suggested that a cognitive weakness should be accompanied by an achievement test weakness comparable to the level of the PASS scale cognitive weakness. Children who have both a cognitive and an achievement test weakness should be considered candidates for special educational services if other appropriate conditions are also met (especially that the children's academic needs cannot be met in the regular educational environment).

Naglieri (2000) found that the relative-weakness method (the approach more commonly used in school psychology) identified children who earned average scores on the CAS as well as on achievement, and that approximately equal percentages of children from regular and special education classes had a relative weakness. Thus the concept of relative weakness did not identify children who achieved differently from children in regular education. By contrast, children with a cognitive weakness earned lower scores on achievement, and the more pronounced the cognitive weakness, the lower the achievement scores. Third, children with a PASS scale 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.

The findings for relative weakness partially support previous authors' arguments against the use of profile analysis for tests like the Wechsler (see Glutting et al., 1998, for a summary). The results for cognitive weakness support the PASS-theory-driven approach that includes the dual criteria of a significant profile with below-normal performance (Naglieri, 1999). The approach is also different from the subtest analysis approach, because the method uses the PASS theory-based-scales included in the CAS, rather than the traditional approach of analyzing a pattern of specific subtests. Finally, the approach is different because the focus is on cognitive, rather than relative, weaknesses (Naglieri, 1999).

Naglieri's (2000) findings support the view that PASS theory can be used to identify children with cognitive and related academic difficulties for the purpose of eligibility determination and, by extension, instructional planning. Naglieri (2003) and Naglieri and Pickering (2003) provide theoretical and practical guidelines about how a child's PASS-based cognitive weakness and accompanying academic weakness might meet criteria for special educational programming. If a child has a cognitive weakness on one of the four PASS constructs and comparable scores in reading and spelling, along with other appropriate data, the child may qualify for specific learning disability (SLD) services.

The example presented in Figure 7.2 illustrates how this theory could be used to iden-

tify a child as having an SLD. The 1997 amendments to the Individuals with Disabilities Education Act define an SLD as "a disorder in one or more of the basic psychological processes [PASS processes are clearly consistent with this language] involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, read, write, spell, or to do mathematical calculations" (p. 27). In the hypothetical case described here, there is a disorder in successive processing that is involved in the child's academic failure in reading and spelling. Assuming that the difficulty with successive processing has made attempts to teach the child ineffective, some type of special educational program may be appropriate.

The PASS theory provides a workable framework for determination of a disorder in basic psychological processes that can be integrated with academic performance and all other relevant information to help make a diagnosis. Of course, the determination of an SLD or any other disorder is not made solely on the basis of PASS constructs, but these play an important role in the identification process. The connections between PASS and academic instruction (discussed elsewhere in this chapter and in Chapter 20) have also led researchers to begin an examination of the diagnostic potential of PASS profiles.

It is important to note that emphasis is placed at the PASS theoretical level rather than the specific subtest level. Subtests are simply varying ways of measuring each of the four processes, and by themselves have less reliability than the composite scale score that represents each of the PASS processes. It is also important to recognize that profile analysis of the PASS constructs should not be made in isolation or without vital information about a child's academic performance. The procedure described here illustrates that PASS profile analysis must include achievement variation, which allows differential di-

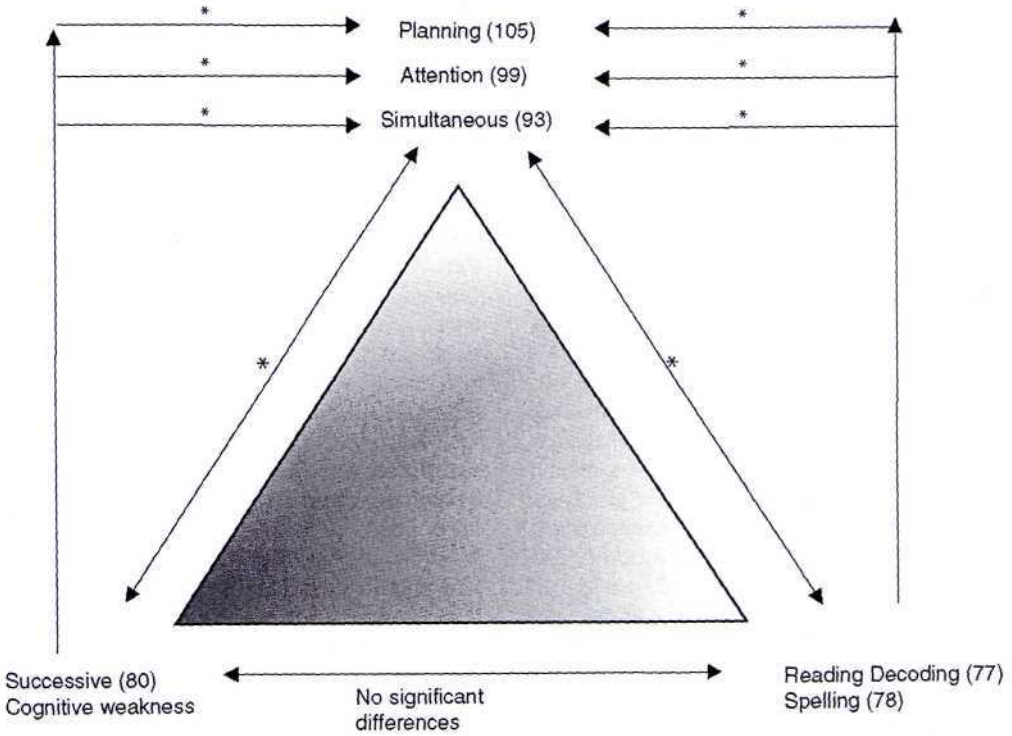

FIGURE 7.2. Illustration of using the PASS theory (and scores on the CAS scales derived from this theory) to identify a child as having a basic psychological processing disorder model.

agnosis based upon a configuration of variables across tests rather than simply within one test. Thus a child with a written language disorder could have a cognitive weakness in planning, with similarly poor performance on tests that measure skills in writing a story (Johnson, Bardos, & Tayedi, 2003). In contrast, a child with an attention deficit may have a cognitive weakness in planning, along with behavioral disorganization, impulsivity, and general loss of regulation. Planning weaknesses may be seen in both children, but the larger context of their problems is different.

Children with ADHD

In contrast to an attention deficit, a planning deficit is hypothesized to be the distinguishing mark of ADHD within the constraints of PASS theory. A recent study by Naglieri, Goldstein, Iseman, and Schwebach (2003) is exemplary. The part of the study that is relevant here concerns the comparison between children with ADHD and the normative groups on two tests, the CAS and the Wechsler Intelligence Scale for Children—Third Edition (WISC-III). The purpose was to examine the assumption that the PASS theory and its derivative test, the CAS, may be particularly sensitive to the cognitive difficulties of children with ADHD, whereas a general intelligence test (the WISC-III) is inadequate for diagnosis of ADHD. Specifically, a low CAS Planning mean score was expected for the sample with ADHD. The results showed a large effect size for Planning between the children with ADHD and the standardization sample. However, in regard to the CAS Attention scale, a small effect size was observed. The differences between the two samples on the CAS Simultaneous and Successive scales were not significant. In regard to the WISC-III, the only difference that had a significant but small effect size was found when children with ADHD were compared to the normative samples on the Processing Speed Index.

Naglieri, Salter, and Edwards (2004) confirm the weakness of planning, but not attention, among children with ADHD in a recent report. Participants in the study were 48 children (38 males and 10 females) referred to an ADHD clinic. The contrast group consisted of 48 children (38 males and 10 females) in regular education. The results indicated that the children in regular education settings earned mean PASS scale scores on the CAS that were all above average, ranging from 98.6 to 103.6. In contrast, the experimental group earned mean scores close to the norm on the CAS Attention, Simultaneous, and Successive scales (ranging from 97.4 to 104.0), but a significantly lower mean score on the Planning scale (90.3).

The low mean Planning score for the children with ADHD in this study is consistent with the poor Planning performance reported in the previous study (Naglieri et al., 2003), as well as with previous research (Dehn, 2000; Paolitto, 1999) for children identified as having ADHD of the hyperactive–impulsive or combined types (Barkley, 1997). The consistency across these various studies suggests that some of these children have difficulty with planning rather than attentional processing as measured by the CAS. This finding is consistent with Barkley's (1997) view that ADHD is a failure of self-control (e.g., planning in the PASS theory) rather than a failure of attention. The PASS profiles of these groups have been different from those with reading failure and anxiety disorders (Naglieri et al., 2003).

Children with Reading Disability

The inability to engage in phonological coding has been suggested as the major cause of reading disability for children (Stanovich, 1988; Wagner, Torgesen, & Rashotte, 1994). Reading researchers generally agree that phonological skills play an important role in early reading. One of the most frequently cited articles in the field, by Torgesen, Wagner, and Rashotte (1994), argues that phonological skills are causally related to normal acquisition of reading skills. Support for this claim can also be found in the relationship between prereaders' phonological scores and their reading development 1–3 years later (e.g., Bradley & Bryant, 1985). 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.

We have suggested (Das, Naglieri, & Kirby, 1994) that underlying a phonological skills deficit is a specific cognitive processing deficit that is involved in word-reading deficits. For example, successive processing can unite the various core correlates of word de-

coding; its binding strength increases if the word is a pseudoword, and further if it is to be read aloud, requiring pronunciation. The correlates are speech rate (fast repetition of three simple words), naming time (for naming simple short and familiar words arranged in rows, naming rows of single letters, or digits and color strips), and short-term memory for short lists of simple and short words. Of these tasks, speech rate correlates best with decoding pseudowords. Although the correlation with naming time is the next best one, it has, however, a slight edge over speech rate in decoding short familiar words (Das, Mishra, & Kirby, 1994). Thus in a discriminant-function analysis of normal readers versus children with dyslexia, it was shown that a test of strictly phonemic coding, such as phonemic separation, led to approximately 63% of correct classification, whereas two tests that involve articulation and very little phonemic coding (Speech Rate and Word Series, both Successive subtests in the CAS) contributed nearly 72% to correct classification. In other words, the discriminant-function analysis showed that the two subtests, Speech Rate and Word Series, were better at distinguishing normal readers from children with dyslexia than a direct test of phonemic segmentation was. Several studies on the relationship between PASS and reading disability have since supported the hypothesis that in predicting reading disability, distal processes (such as the PASS processes) are as important as proximal ones (such as phonological awareness and other tests of phonological coding) (Das, Parrila, & Papadopoulos, 2000).

Word reading and comprehension are two relatively separate skills. If some aspects of word-reading or decoding disability can be predicted by successive processing, disability in comprehension has been shown to be primarily related to deficits in simultaneous processing (Das, Kar, & Parrila, 1996; Das, Naglieri, & Kirby, 1994; Naglieri & Das, 1997c), as well as (to a relatively lesser extent) in successive processing and planning.

In concluding this section on the uses of PASS theory, we have presented some samples of empirical studies on all four processes that help in understanding the role of attention in attention deficits, planning in ADHD, and finally successive and simultaneous processing in reading disabilities. Moreover, PASS theory has had several applications in areas of contemporary concern in education relating to diagnosis and placement, as Naglieri (1999) has discussed. Because of space limitations in this chapter, we cannot present them here. However, Chapter 20 of this book includes this discussion.

The research on PASS profiles has suggested that different homogeneous groups have distinctive weaknesses. Children with reading disabilities perform adequately on all PASS constructs except successive processing. This is consistent with Das's view (see Das, 2001; Das, Naglieri, & Kirby, 1994) that reading failure is the results of a deficit in sequencing of information (successive processing). Those with the combined type of ADHD perform poorly in planning (they lack cognitive control), but adequately on the remaining PASS constructs (Dehn, 2000; Naglieri et al., 2003; Paolitto, 1999). Children with the inattentive type of ADHD have adequate PASS scores except on attention (Naglieri & Pickering, 2003). Finally, Naglieri and colleagues (2003) found that children with anxiety disorders had a different PASS profile from those with ADHD. These findings suggest that the PASS theory and associated scores may have utility for differential diagnosis and, by extension, for instructional planning. Moreover, these findings provide some support for the diagnostic validity of the PASS theory.

Prescription

Dillon (1986) argued that the extent to which a theory of cognitive processing informs the user about interventions is an important dimension of validity. The PASS theory appears to have an advantage in this regard.

There are at least four main resources for applying the PASS theory to academic remediation and instruction, which we discuss briefly. The first is the PASS Remedial Program (PREP), developed by Das; the second is the Planning Facilitation Method, described by Naglieri; the third is Kirby and Williams's 1991 book *Learning Problems: A Cognitive Approach*; and the fourth is Naglieri and Pickering's (2003) book *Helping Children Learn: Intervention Handouts for Use in School and at Home*. The first two methods are based on empirical studies and discussed at length by Das

(2001), Das, Mishra, and Pool (1995), Das and colleagues (2000), and Naglieri (2003). The two books contain several reasonable approaches to academic interventions. The instructional methods use structured and directed instructions (PREP) as well as minimally structured instructions (Planning Facilitation). The books vary from very applied (Naglieri & Pickering, 2003) to more general (Kirby & Williams, 1991). In this chapter, the concepts behind the first two methods are more fully described in the sections that follow.

Description of the PREP

The PREP was developed as a cognitively based remedial program based on the PASS theory of cognitive functioning (Das, Naglieri, & Kirby, 1994). It aims at improving the processing strategies—specifically, simultaneous and successive processing—that underlie reading, while at the same time avoiding the direct teaching of word-reading skills such as phoneme segmentation or blending. PREP is also founded on the premise that the transfer of principles is best facilitated through inductive, rather than deductive, inference (see Das, 2001, for details). The program is accordingly structured so that tacitly acquired strategies are likely to be used in appropriate ways.

PREP was originally designed to be used with students in grades 2 and 3. Each of the 10 tasks involves both a global training component and a curriculum-related bridging component. The global components, which require the application of simultaneous or successive strategies, include structured nonreading tasks. These tasks also facilitate transfer by providing the opportunity for children to internalize strategies in their own way (Das et al., 1995). The bridging components involve the same cognitive demands as their matched global components—that is, simultaneous and successive processing. These cognitive processes have been closely linked to reading and spelling (Das, Naglieri, & Kirby, 1994).

Das and colleagues (1995) studied 51 grade 3 and grade 4 students with reading disabilities who exhibited delays of at least 12 months on either the Word Identification or Word Attack subtest of the Woodcock Reading Mastery Tests—Revised (WRMT-R). Participants were first divided into two groups: a PREP remediation group and a no-intervention control group. The PREP group received 15 sessions of training, involving groups of two students apiece, over a period of 2½ months. Children in the control group participated in regular classroom activities. After the intervention, both groups were tested again with the WRMT-R Word Identification and Word Attack subtests. The results indicated that although both groups gained during the intervention period, the PREP group gained significantly more on both Word Identification and Word Attack.

Carlson and Das (1997) report on two studies using a small-group version of the PREP for underachieving grade 4 students in Chapter 1 programs. In the first study, the experimental group received 15 hours of "add-on" training with PREP over an 8-week period. Both the PREP and control groups (22 and 15 students, respectively) continued to participate in the regular Chapter 1 program. The Word Attack and Word Identification subtests of the WRMT-R were administered at the beginning and the end of the study. The results showed significant improvement following training in PREP, as well as significant group × time interaction effects. The second study essentially replicated these results with a larger sample of grade 4 students. Since then, several other replication studies completed in the same school district have essentially reproduced the original results with children from grades 3, 4, 5, and 6, and with both bilingual (Spanish- and English-speaking) and monolingual (English-speaking only) children.

The effectiveness of a modified version of PREP (for an older group) was studied by Boden and Kirby (1995). A group of fifth- and sixth-grade students who were identified a year earlier as poor readers were randomly assigned to either a control or an experimental group. The control group received regular classroom instruction, and the experimental group received PREP in groups of four students for approximately 14 hours. As in previous studies, the results showed differences between the control and PREP groups on the WRMT-R Word Identification and Word Attack subtests after treatment. In relation to the previous year's reading scores, the PREP group performed significantly better than the control group.

Finally, the study by Parrila, Das, Kendrick, Papadopoulos, and Kirby (1999) was an ex-

tension of the above-described experiments, but with three important changes: (1) The control condition was a competing program given to a carefully matched group of children; (2) the participants were beginning readers in grade 1, and therefore younger than the grade 3 to grade 6 participants in the previous studies (8 of the 10 original PREP tasks were selected and modified for the grade 1 level); and (3) the training was shorter in duration than in most of the previous studies. The more stringent control condition was seen as an important test of the efficacy of PREP. The study attempted to demonstrate the efficacy of PREP by showing the advantage of PREP over the meaning-based reading program received by the control group.

Fifty-eight grade 1 children experiencing reading difficulties were divided into two matched remediation groups, one receiving the modified version of PREP and the other receiving the meaning-based program. Results showed a significant improvement of reading (WRMT-R Word Identification and Word Attack) for the PREP group, the gain in reading was greater than it was for the meaning-based training group. The relevance of the children's CAS profile was demonstrated as follows: Further results indicated that the high gainers in the PREP group were those with higher CAS Successive scores at the beginning of the program. In contrast, the high gainers in the meaning-based program were characterized by higher CAS Planning scores.

Taken together, the studies described here make a clear case for the effectiveness of PREP in remediating deficient reading skills during the elementary school years. These findings are further examined in Chapter 20 of this book.

Essentials of Planning Facilitation

The effectiveness of teaching children to be more strategic when completing in-class math calculation problems is well illustrated by research that has examined the relationship between strategy instruction and CAS Planning scores. Four studies have focused on planning and math calculation (Hald, 1999; Naglieri & Gottling, 1995, 1997; Naglieri & Johnson, 2000). The methods used by these researchers were based on similar research by Cormier, Carlson, and Das (1990) and Kar, Dash, Das, and Carlson (1992). The researchers utilized methods designed to stimulate children's use of planning, which in turn had positive effects on problem solving on nonacademic as well as academic tasks. The method was based on the assumption that planning processes should be facilitated rather than directly taught, so that the children would discover the value of strategy use without being specifically told to do so.

The Planning Facilitation Method has been applied with individuals (Naglieri & Gottling, 1995) and groups of children (Naglieri & Gottling, 1997; Naglieri & Johnson, 2000). Students completed mathematics worksheets that were developed according to the math curriculum in a series of baseline and intervention sessions over a 2-month period. During baseline and intervention phases, three-part sessions consisted of 10 minutes of math, followed by 10 minutes of discussion, followed by a further 10 minutes of math. During the baseline phase, discussion was irrelevant to the mathematics problems; in the intervention phase, however, a group discussion designed to encourage self-reflection was facilitated, so that the children would understand the need to plan and use efficient strategies.

The teachers provided questions or observations that facilitated discussion and encouraged the children to consider various ways to be more successful. Such questions included "How did you do the math?", "What could you do to get more correct?", or "What will you do next time?" The teachers made no direct statements such as "That is correct," or "Remember to use that same strategy." Teachers also did not provide feedback about the accuracy of previous math work completed, and they did not give mathematics instruction. The role of the teachers was to facilitate self-reflection and encourage the children to complete the worksheets in a planful manner. The positive effects of this intervention have been consistent across the research studies, as presented in Chapter 20 of this book.

Comparability

The extent to which cognitive processing constructs have relevance to some target task is an important criterion of validity for a theory, and one that is relevant to evaluation of

the PASS theory. One example of the comparability of PASS and classroom performance can be found in the examination of the relationships between the attention portion of the theory and in-class behaviors of children.

Attention Tests and Teachers' Ratings of Attention

A good example of the comparability of PASS is the relationship between the constructs and classroom performance. Earlier in this chapter, we have discussed the relationship between PASS and academic achievement scores. In this section we look at one particular issue: the relationship between attention measures and ratings of attention in the classroom. This is an environment where a child must selectively attend to some stimuli and ignores others. The selectivity aspect relates to intentional discrimination between stimuli. Ignoring irrelevant stimuli implies that the child is resisting distraction. In terms of the PASS theory, this means that attention involves at least three essential dimensions, which are selection, shifting, and resistance to distraction. One way to examine the comparability of the PASS theory to classroom attention is therefore to look at the relationships between measures of attention and attending in the classroom.

Das, Snyder, and Mishra (1992) examined the relationship between teachers' rating of children's attentional behavior in the classroom and those children's performances on the CAS subtests of Expressive Attention and Receptive Attention. An additional test, Selective Auditory Attention, was included in this study; this test was taken from an earlier version of the CAS (Naglieri & Das, 1988). All three of these tasks had been shown to form a separate factor identified as Attention, which is independent of the three other PASS processes (Das et al., 1992).

Teachers' ratings of students' attention status in class were made with Das's Attention Checklist (ACL). This is a checklist containing 12 items that rate the degree to which attentional behavior is shown by a child. All the items on this checklist load on one factor that accounts for more than 70% of the variance, and the ACL has high reliability (alpha of .94; Das & Melnyk, 1989). In addition to the CAS and ACL, the children were given the Conners 28-item rating scale. Das and colleagues (1992) found that the ACL and Conners Inattention/Passivity items were strongly correlated ($r = .86$), but that the correlation between the ACL and the Conners Hyperactivity scale was substantially lower ($r = .54$). This is logical, because the ACL is more a measure of inattention than of hyperactivity.

The correlations of ACL and the Attention subtest scores suggested that classroom behaviors and performance on measures of cognitive processing were related. The ACL correlated significantly ($p < .01$) with Expressive Attention ($r = .46$) and the Selective Auditory Attention false-detection score ($r = .37$). All other correlations with the ACL were not significant. The relationship between the ACL and children's performance on the CAS was further examined via factor analysis. Two factors were obtained: One had high loadings on the CAS Attention subtest scores (Receptive Attention and a smaller loading on Expressive Attention) and the omission score on the Selective Auditory Attention task, whereas the other factor had high loadings on the ACL, the commission errors on the Selective Auditory Attention task (which reflects distractibility), and the Expressive Attention task. Thus it was clear that the ACL, which measures teachers' ratings of attention in the classroom, was associated with performance on objective tasks that require resistance to distraction. Their common link is most probably failure of inhibition of attention to distractors. This was further supported in subsequent studies (Das, 2002). Therefore we suggest that attention as defined by the PASS theory is useful to explain why teachers' ratings of attention in the classroom correlated with performance on the two CAS tasks that require selectivity and resistance to distraction.

Replicability/Standardizability

The value of any theory of cognitive processing is ultimately related to the extent to which it can be uniformly applied across examiners and organized into a formal and standardized method to assure replication across practitioners. The availability of norms and interpretive guidelines provided the basis for accurate, consistent, and reliable interpretation of PASS scores as opera-

tionalized by the CAS (Naglieri & Das, 1997a). The CAS instrument is a reliable measure of PASS constructs normed on a large representative sample of children 5 through 17 years of age (see Naglieri, Chapter 20, this volume). In summary, we suggest that the CAS is acceptable as a reliable and valid assessment of the PASS processes, and that it can be used in a variety of settings for a number of different purposes, as shown in several books and the CAS interpretive handbook (Naglieri & Das, 1997b).

Psychodiagnostic Utility

Dillon's (1986) *psychodiagnostic utility* criterion deals with the ease with which a particular theory of cognitive processing can be used in practice. This criterion is linked to Messick's (1989) idea of *consequential validity* and emphasizes the transition from theory to practice, the extent to which the theory can be effectively applied. The best theory of intelligence, ability, or cognitive processing will ultimately have little impact on the lives of children unless the constructs (1) have been operationalized into a practical method that can be efficiently administered; (2) can be assessed in a reliable manner; and (3) yield scores that are interpretable within the context of some relevant comparison system. As we have mentioned here and in other publications, the PASS theory and the CAS appear to have sufficient applications for diagnosis and treatment. They have value in detecting the cognitive difficulties experienced by children in several diagnostic groups (children with dyslexia, ADHD/traumatic brain injury, and mental retardation [including Down syndrome]), as well as in constructing programs for cognitive enhancement (Das, 2002; Naglieri, 2003).

CONCLUDING REMARKS

The concept of general intelligence has enjoyed widespread use since it was originally described at the turn of the last century. Interestingly, Pintner (1923) noted over 80 years ago that although researchers were concerned with the measurement of separate faculties, processes, or abilities, they "borrowed from every-day life a vague term implying all-round ability and knowledge" and are still "attempting to define it more sharply and endow it with a stricter scientific connotation" (p. 53). Thus the concept of intelligence that has included the use of verbal, nonverbal, and quantitative tests to define and measure intelligence for about 100 years has been and remains just that—a concept in need of more clarity.

In some ways, PASS theory is an attempt to revive the intentions of early intelligence test developers by taking a multidimensional approach to the definition of ability. The most important difference between traditional IQ and PASS theory, therefore, lies in the use of cognitive processes rather than general ability. The multidimensional, rather than unidimensional, view of intelligence that the PASS theory provides is one of its distinguishing aspects (Das & Naglieri, 1992). It is a theory for which research has increasingly demonstrated utility (as summarized in this chapter and in Chapter 20), and practitioners have noted its consistency with the more modern demands placed on such tests. We suggest that PASS is a modern alternative to *g* and IQ, based on neuropsychology and cognitive psychology, and that it is well suited to meet the needs of psychologists practicing in the 21st century.

ACKNOWLEDGMENT

Preparation of this chapter was supported in part by Grant No. R215K010121 from the U.S. Department of Education.

REFERENCES

Ashman, A. F. (1982). Strategic behavior and linguistic functions of institutionalized moderately retarded persons. *International Journal of Rehabilitation Research, 5*, 203–214.

Barkley, R. A. (1997). *ADHD and the nature of self-control.* New York: Guilford Press.

Boden, C., & Kirby, J. R. (1995). Successive processing, phonological coding, and the remediation of reading. *Journal of Cognitive Education, 4*, 19–32.

Bradley, L., & Bryant, P. (1985). *Rhyme and reason in reading and spelling.* Ann Arbor MI: University of Michigan 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.

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 Educational Resources.

Das, J. P. (2002). A better look at intelligence. *Current Directions in Psychology, 11*, 28–32.

Das, J. P., & Abbott, J. (1995). PASS: An alternative approach to intelligence. *Psychology and Developing Societies, 7*(2), 155–184.

Das, J. P., & Heemsbergen, D. (1983). Planning as a factor in the assessment of cognitive processes. *Journal of Psychoeducational Assessment, 1*, 1–16.

Das. J. P., Kar, B. C., & Parrila, R. K. (1996). *Cognitive planning: The psychological basis of intelligent behavior*. Thousand Oaks, CA: Sage.

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., & Melnyk, L. (1989). Attention checklist: A rating scale for mildly mentally handicapped adolescents. *Psychological Reports, 64*, 1267–1274.

Das, J. P., Mishra, R. K., & Kirby, J. R. (1994). Cognitive patterns of dyslexics: Comparison between groups with high and average nonverbal intelligence. *Journal of Learning Disabilities, 27*, 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., & Molloy, G. N. (1975). Varieties of Simultaneous and Successive processing in children. *Journal of Educational Psychology, 67*, 213–220.

Das, J. P., & Naglieri, J. A. (1992). Assessment of attention, simultaneous–successive coding and planning. In H. C. Haywood & D. Tzuriel (Eds.), *Interactive Assessment* (pp. 207–232). New York: Springer-Verlag.

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 Press.

Das, J. P., Snyder, T. J., & Mishra, R. K. (1992). Assessment of attention: Teachers' rating scales and measures of selective attention. *Journal of Psychoeducational Assessment, 10*, 37–46.

Das, J. P., & Varnhagen, C. K. (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.

Davis, F. B. (1959). Interpretation of differences among averages and individual test scores. *Journal of Educational Psychology, 50*, 162–170.

Dehn, M. J. (2000). *Cognitive Assessment System performance of ADHD children*. Paper presented at the annual convention of the National Association of School Psychologists, New Orleans, LA.

Dillon, R. F. (1986). Information processing and testing. *Educational Psychologist, 21*, 161–174.

Garofalo, J. (1986). Simultaneous synthesis, regulation and arithmetical performance. *Journal of Psychoeducational Assessment, 4*, 229–238.

Glutting, J. J., McDermott, P. A., Konold, T. R., Snelbaker, A. J., & Watkins, M. L. (1998). More ups and downs of subtest analysis: Criterion validity of the DAS with an unselected cohort. *School Psychology Review, 27*, 599–612.

Goldberg, E. (2001). *The executive brain: Frontal lobes and the civilized mind*. New York: Oxford University Press.

Hald, M. E. (1999). *A PASS cognitive processes intervention study in mathematics*. Unpublished doctoral dissertation, University of Northern Colorado.

Jarman, R. F., & Das, J. P. (1977). Simultaneous and successive synthesis and intelligence. *Intelligence, 1*, 151–169.

Johnson, J. A., Bardos, A. N., & Tayebi, K. A. (2003). Discriminant validity of the Cognitive Assessment System for students with written expression disabilities. *Journal of Psychoeducational Assessment, 21*, 180–195.

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.

Kirby, J. R. (1984). *Cognitive strategies and educational performance*. New York: Academic Press.

Kirby, J. R., & Das, J. P. (1978). Information processing and human abilities. *Journal of Educational Psychology, 70*, 58–66.

Kirby, J, R., & Robinson, G. L. (1987) Simultaneous and successive processing in reading disabled children. *Journal of Learning Disabilities, 20*, 243–252.

Kirby, J. R., & Williams, N. H. (1991). *Learning problems: A cognitive approach*. Toronto: Kagan & Woo.

Kolb, B., Gibb, R., & Robinson, T. E. (2003). Brain plasticity and behavior. *Current Directions in Psychological Science, 12*, 1–4.

Lidz, C. S. (1991). *Practitioner's guide to dynamic assessment*. New York: Guilford Press.

Luria, A. R. (1966). *Human brain and psychological processes*. New York: Harper & Row.

Luria, A. R. (1973a). The origin and cerebral organization of man's conscious action. In S. G. Sapir & A. C.

Nitzburg (Eds.), *Children with learning problems* (pp. 109–130). New York: Brunner/Mazel.

Luria, A. R. (1973b). *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.

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational measurement* (pp. 13–103). New York: American Council of Education/MacMillan.

Naglieri, J. A. (1989). A cognitive processing theory for the measurement of intelligence. *Educational Psychologist, 24,* 185–206.

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: Vol. 16. Identification and assessment* (pp. 163–190). Greenwich, CT: JAI Press.

Naglieri, J. A., & Das, J. P. (1988). Planning–arousal–simultaneous–successive (PASS): A model for assessment. *Journal of School Psychology, 26,* 35–48.

Naglieri, J. A., & Das, J. P. (1997a). *Das–Naglieri: Cognitive Assessment System.* Itasca, IL: Riverside.

Naglieri, J. A., & Das, J. P. (1997b). *Das–Naglieri Cognitive Assessment System: Interpretive handbook.* Itasca, IL: Riverside.

Naglieri, J. A., & Das, J. P. (1997c). Intelligence revised. In R. Dillon (Ed.), *Handbook on testing* (pp. 136–163). Westport, CT: Greenwood Press.

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., 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., & Pickering, E. (2003). *Helping children learn: Instructional handouts for use in school and at home.* Baltimore: Brookes.

Naglieri, J. A., Salter, C. J., & Edwards, G. (2004). Assessment of children with ADHD and reading disabilities using the PASS theory and Cognitive Assessment System. *Journal of Psychoeducational Assessment, 22,* 93–105.

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.

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.

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.

Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological–core variable–difference model. *Journal of Learning Disabilities, 21,* 590–604, 612.

Stuss, D. T., & Benson, D. F. (1990). The frontal lobes and language. In E. Goldberg (Ed.), *Contemporary psychology and the legacy of Luria* (pp. 29–50). Hillsdale, NJ: Erlbaum.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1994). Longitudinal studies of phonological processing and reading. *Journal of Learning Disabilities, 27,* 276–286.

Wagner, R. K., Torgesen, 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.