Planning, Attention, Simultaneous, Successive (PASS) 
Theory: A Revision of the Concept of Intelligence

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I. 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, Successive (PASS; Naglieri & Das, 1997a) theory is rooted in the work of A. R. Luria (1966, 1973, 1980) whose research on the functional aspects of brain structures formed the basis of the theory (Das, Naglieri, & Kirby, 1994). Das and Naglieri and their colleagues used Luria’s work as a blueprint for defining the important components of human intelligence (Das, Naglieri & Kirby, 1994). Their 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 could 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 (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). This means that 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 a 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 reading decoding strongly related to another. Effective functioning, for example, processing of visual information, also involves three hierarchical levels of the brain. Consistent with structural topography, these can be described in a simplified manner as the projection area where the modality characteristic of the information is intact. Above the projection area lies the association areas. As information reaches this area, it loses part of its modality tag.
Above this 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. This also illustrates that modality is most important at the level of initial reception and less at the level where information is integrated.

Three functional Units Described

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, 1973). This unit provides the brain with the appropriate level of arousal or cortical tone, and directive and selective attention (Luria, 1973). 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, depends 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" (Luria, 1973, 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 a person obtains from the external world. This unit involves Simultaneous processing and Successive processes. Simultaneous processing involves integrating stimuli into groups such that the interrelationships among the components is 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. While 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 syntagmatic 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” (Luria, 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, 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).

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 states “...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, we cannot, as phrenologists attempted, identify a “writing” spot in the brain but instead, must consider the concept of units of the brain that provide a function. Luria (1973) describes 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 (Varnhagen & Das, 1986).

Luria’s concept of dynamic functional units provides the foundation for Planning, Attention, Simultaneous and Successive processes. These basic psychological processes are firmly based on a biological correlate yet develop within a socio-cultural milieu. In other words, they are influenced in part by the cultural experiences of the child. 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 et al. (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). 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 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)

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 actually help to accelerate the utilization of planning and self-regulation and 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 selectively attend to objects that are relevant 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, and so on). Naglieri (2003) 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 the intervention section of this chapter and the CAS chapter.

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, 1973). 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, 1973). 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 plan 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 basis of the PASS theory is diagrammatically shown in Figure 1. Whereas rendering of a complex functional system in two-dimensional space has its limitation, the diagram provides 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 source 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 a 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, 1997, 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 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. It is, more specifically, associated with the prefrontal cortex and 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 achieve through the selection or development of plans or strategies needed to complete tasks for which a solution is needed and is critical to all activities where the child or adult has to determine how to solve a problem. This includes generation, evaluation, and execution of a plan as well as self-monitoring and impulse control. Thus, Planning allows for the solution of problems, control of attention, simultaneous, and successive processes, as well as 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 resist loss of attention to other stimuli. The longer attention is required the more the activity can be 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 parieto-occipital-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 process. 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 with 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 (like the number 9933811 organized into 99-33-8-11) but 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 and therefore it is 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 verbal achievement-like tests such as vocabulary. Additionally, 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. While the theory may have its roots in neuropsychology, “…its branches are spread over developmental and educational psychology” (Varnhagen & Das, 1986, p. 130). Thus 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).

**II. 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 Chapter x of this book. 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 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 the CAS chapter of this book.
III. 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 also provided in the CAS chapter in this text and in other resources (Naglieri, 1999; Naglieri, 2003; Naglieri & Das, 1997b).

1. Validity

The fundamental validity of the PASS theory is rooted in the neuropsychological work of A. R. Luria (1966, 1973, 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” (Luria, 1973). Using Luria’s three functional units as a backdrop, Das (1972), Das, Kirby, and Jarman (1975, 1979) and 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. Their work subsequently summarized in several books (e.g., Kirby, 1984, Kirby & Williams, 1991; Das, Naglieri, & Kirby, 1994; Naglieri, 1999; Naglieri & Das, 1997b) demonstrated that the PASS processes associated with Luria’s concept of the three functional units could be measured. Their 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 children’s performance on early versions of tests of these processes showed evidence of developmental differences by age for elementary and middle school aged children (Das, 1972; Das & Molloy, 1975; Garofalo, 1986; Jarman & Das, 1977; Kirby & Das, 1978; Kirby & Robinson, 1987;
Naglieri & Das 1988; Naglieri & Das, 1997b) and high school and college samples (Ashman, 1982; Das & Heemsbergen, 1983; Naglieri & Das, 1988).

Naglieri, Das and their colleagues have also demonstrated that the constructs represented in the PASS theory are strongly related to achievement. A full discussion of those results appear in the CAS chapter. 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 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 that 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.

2. Diagnosis

There are two important aims of diagnosis. First, to determine if variations in characteristics help distinguish one group of children from another, and second, to determine if these data help with prescriptive decisions. Prescription is discussed in the next section, the question of diagnosis will be 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) recently conducted such a study. A second way to examine diagnostic utility is by examination of specific populations (e.g. ADHD and LD). Both of these topics are summarized here, beginning with a discussion of PASS profiles in general then a look at two particular groups of special children.

PASS Profiles

Glutting, McDermott, Konold, Snelbaker, and Watkins (1998) suggested that research concerning profiles for specific children are 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” and “Cognitive” weaknesses.

Naglieri (1999) defined three types of disorders in one or more of the basic PASS processes as follows: A Relative Weakness (RW) is a significant weakness which is low 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 (CW) is found when a child has a significant intraindividual difference (using the ipsative method) and the lowest score also falls below some cut-off designed to indicate what is typical or average. The difference between a RW and CW, therefore, is that the CW 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 CW should be accompanied by an achievement test weakness comparable to the level of the PASS scale cognitive weakness. The children who have a cognitive and an academic weakness should be considered candidates for special educational services if other appropriate conditions are also met (especially that the child’s academic needs can not be met in the regular educational environment).

Naglieri (2000) found that the relative weaknesses method (the most common approach 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 had a relative weakness. Thus the concept of RW did not identify children who achieved differently from regular children. In 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 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 weaknesses partially support previous authors who have argued against the use of profile analysis for tests like the Wechsler (see Glutting et al. 1998, for a recent summary). The results for cognitive weaknesses
support the scale and PASS theory-driven approach that includes a dual criterion of a significant profile with below normal performance (Naglieri, 1999). The approach is also different from the subtest analysis approach because the method uses PASS theory-based scales included in the CAS rather than the traditional approach of analyzing a pattern of 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 could 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 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 services.

The example presented in Figure 2 illustrates how this theory could be used to identify a child as having a Specific Learning Disability (SLD). IDEA’97 defines 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 the need for 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 a learning disability 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 the CAS chapter) have also led researchers to begin an examination of the diagnostic potential of PASS profiles.

It is important to note that that diagnosis is based at the PASS theoretical level rather than the subtest level. Subtests are simply varying ways of measuring each
of the four processes and by themselves have less reliability than the composite score that represent 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 diagnosis 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 problems is different.

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 & Schwebach (2003) is exemplary. The part of the study that is relevant here concerns the comparison between a sample of ADHD children and the normative groups on two tests, CAS and WISC-III. The purpose was to examine the assumption that the PASS theory and its derivative CAS may be particularly sensitive to the cognitive difficulties of children with ADHD, whereas the general intelligence test WISC III is inadequate for diagnosis of ADHD. Specifically a low Planning mean score was expected for the ADHD sample. The results showed a large effect-size for Planning between the ADHD and the standardization samples. However, in regard to Attention scale, a small effect-size was observed. The differences between the two samples in Simultaneous and Successive scales were not significant at all. In regard to WISC III, the only difference that had a significant but small effect-size was found in Processing Speed when ADHD and the normative samples were compared.

Naglieri, Salter, and Edwards (in press) confirm the weakness of Planning, but not Attention, among ADHD in a recent report. Participants in the study were forty-eight children (38 males and 10 females) referred to an ADHD clinic. The contrast group consisted of forty-eight children (38 males and 10 females) in regular education. Their results indicate that the children in regular education settings
earned mean PASS scores that were all above average, ranging from 98.6 to 103.6. In contrast, the ADHD group earned mean scores close to the norm on the 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 score in planning for the ADHD found in this study is consistent with poor performance in planning reported in the previous study (Naglieri et al. 2003) as well as with previous research (Dehn, 2000; Paolitto, 1999) for children identified as ADHD 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 Barkely’s (1997) view that ADHD is a failure of self-control (e.g., Planning from PASS) 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).

Reading disability

The inability to engage in phonological coding has been suggested as the major cause of reading disability for children (Stanovich, 1988; Wagner, Torgeson & 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 et al. (1994), argues the phonological skills are causally related to normal acquisition of reading skills. Support for this claim can also be found in the relationship between pre-readers’ phonological scores and their reading development one to three years later (e.g., Bradley & Bryant, 1985). A recent 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, p. 9).

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 and reading deficit. For example, Successive processing can unite the various core correlates of word-decoding; its binding strength increases if the word is a pseudo-word and further if it is to be read aloud, requiring pronunciation. The correlates are speech-rate (fast repetition of 3 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 pseudo-
words. Whereas 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 discriminating between normal readers and 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 Processing tests in CAS) contributed nearly 72% to correct
classification. In other words, the discriminant function analysis showed that the two
tests, Speech rate and Word Memory, were better at classifying normal and poor
readers than a direct test of phonemic segmentation. Several studies on the
relationship between PASS and reading disability have since supported the
hypothesis that in predicting reading disability, such distal processes (e.g., PASS) 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, the ability for comprehension has been shown to be primarily related to
simultaneous processing (Das, Naglieri & Kirby, 1994; Naglieri & Das, 1997; Das,
Kar & Parrila, 1996) as well as to a relatively lesser extent, to 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 deficit, planning in ADHD, and finally, successive
and simultaneous processing in Reading Disabilities. As well, PASS theory has had
several applications in areas of contemporary concern in education relating to
diagnosis and placement, as Naglieri has discussed (1999). Because of limitations of
space in this chapter, we cannot present them here. However, in the chapter on
CAS, we include this discussion.

The research on PASS profiles has suggested that different homogenous groups
have distinctive weaknesses. Children with reading disabilities perform adequately
on all PASS constructs except successive processing. This is consistent with Das’
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 ADHD
combined type perform poorly in Planning (they lack cognitive control) but
adequately on the remaining PASS constructs (Dehn, 2000; Naglieri, Goldstein, & Iseman, 2003; Paolitto, 1999). Children with the Inattentive type of attention deficit have adequate PASS scores except on Attention (Naglieri & Pickering, 2003). Finally, Naglieri, Goldstein, Iseman and Schwebach (2003) found that children with anxiety disorders had a different PASS profile than those with ADHD. These findings suggest that the PASS theory and associated scores may have utility for differential diagnosis, and by extension, instructional planning. Moreover, these findings provide some support for the diagnostic validity of the PASS theory.

3. Prescription

Dillon (1986) argued that the extent to which a theory of cognitive processing would inform 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 J. P. Das (see Appendix 'Essentials of PREP'); the second is the Planning Facilitation Method described by Naglieri (see Appendix 'Essentials of Planning Facilitation'); the third is Kirby and Williams' 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 Home*. The first two methods are based on empirical studies and discussed at length by Das (2001), Das, Mishra & Pool, (1995), Das, Parrila & Papadopoulos (2000), 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). For a more complete discussion see the CAS chapter in this book.

4. 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 Teacher's rating of attention

A good example of the comparability of PASS is the relationship between the constructs and classroom performance. Earlier in this chapter we discussed the relationship between PASS and academic achievement scores. In this section we will 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. From PASS 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 teacher’s rating of children’s attentional behavior in the classroom and those children’s performances on the CAS tests of Expressive and Receptive Attention. An additional test, selective auditory attention, was also included in Das et al study; this test was taken from an earlier version of CAS (Naglieri & Das, 1988). All of these attention tasks had been shown to form a separate factor identified as attention, which is independent of the three other PASS processes (Das, Snyder & Mishra, 1992).

Teacher’s ratings of students’ attention status in class were determined using Das’ Attention Checklist (ACL). This is a checklist containing 12 items that rate the degree to which attentional behavior is shown by the 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 Conner’s 28 item rating scale. Das et. al. (1992) found that the ACL and Conner’s inattention/passivity items were strongly correlated ($r = .86$) but the correlation between the ACL and the Conner’s hyperactivity scale was substantially lower ($r = .54$). This is logical because the ACL is more a measure of Inattention than hyperactivity.

The correlations of ACL and the attention test 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 attention false detection score \( (r = .37) \); both were significant \( p < .01 \). All other correlations with the ACL were not significant. The relationship between the ACL and children’s performance on the CAS was further examined using factor analysis. Two factors were obtained: one had high loadings on the CAS Attention subtest scores and the omission scores (Receptive attention and a smaller loading on Expressive attention) and the omission scores of the selective attention tasks, whereas the other factor had high loadings on the ACL, the commission errors of selective attention task that reflect distractibility, as well as a high loading on the Expressive Attention task. Thus, it was clear that the ACL, which measures teacher’s 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 PASS is useful to explain why teacher’s ratings of attention in the classroom correlated with performance on the two CAS tasks that require selectivity and resistance to distraction.

5. 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 operationalized by the CAS (Naglieri & Das, 1997a). The instrument is a reliable measure of PASS constructs normed on a large representative sample of children 5 through 17 years of age. (See CAS chapter). In summary, we suggest that the test CAS is acceptable as a reliable and valid assessment of the PASS processes that 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).

6. 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 (a) have been operationalized into a practical method that can be efficiently administered; (b) can be assessed in a reliable manner; and (c) yield scores that are interpretable within the context of some relevant comparison system. As we have mentioned here and in other publications, PASS and its tests appear to have sufficient applications for diagnosis and treatment. It has value in detecting the cognitive difficulties experienced by children in several diagnostic groups (dyslexics, children with ADD/HD, traumatic brain injury, and mental retardation including Down syndrome) as well as in constructing programs for cognitive enhancement (Das, 2002; Naglieri, 2003).

### IV. Concluding Remarks

The concept of general intelligence has enjoyed wide spread use since it was originally described at the turn of the last century. Interestingly, 80 years ago Pintner (1923) noted that although researchers were concerned with the measurement of separate faculties, processes or abilities they "borrowed from everyday 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 includes verbal, nonverbal, and quantitative tests used 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 tests developers and define ability using a multidimensional approach. The most important difference between traditional IQ and PASS, therefore, lies in the use of cognitive processes rather than general ability. The multidimensional, as opposed to a unidimensional view of intelligence that the PASS theory provides is one of its distinguishing aspects (Das, 1992). It is a theory for which research has increasingly demonstrated utility (as summarized in this chapter and the CAS chapter) and practitioners have noted its consistency with 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, which is designed to meet the needs of psychologists practicing in the 21st century.
VII. References


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Appendix A

Essentials of PREP

Description of PREP

PREP was developed as a cognitive remedial program based on the PASS (planning, attention, simultaneous processing, and successive processing) model of cognitive functioning (Das, Naglieri, & Kirby, 1994). It aims at improving the information 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 Reading Difficulties and Dyslexia 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 or 3. In the present study, eight of the ten tasks (listed below in Remediation Programs) in the original program were selected and adapted for the Grade 1 level. Each of the 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 non-reading tasks. These tasks also facilitate transfer by providing the opportunity for children to internalize strategies in their own way (Das, Mishra, & Pool, 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, Mishra & Pool (1995) used PREP with a group of 51 Grade 3 and 4 students with reading disabilities who exhibited delays of at least 12 months on either the Word Identification or Word Attack subtest of the WRMT-R. Participants were first divided into two groups, PREP remediation and a no-intervention control group. The PREP group received 15 sessions of training, involving groups of two students, over a period of 2 ½ months. Children in the control group participated in regular classroom activities. After the intervention, both groups were tested again using the Word Identification and Word Attack subtests. The results indicated that while 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 eight-week period. Both the PREP and control groups (22 and 15 students, respectively) continued to participate in the regular Chapter 1 program. 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 x Time interaction effects. The second study essentially replicated these results with a larger sample of Grade 4 students also. 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-English) and monolingual (English) children.

The effectiveness of a modified 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 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 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 & Kirby (1999) is an extension of the above 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; 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 attempts to demonstrate the efficacy of PREP by showing the advantage of PREP over a meaning-based reading program received by the control group.

Fifty-eight Grade 1 children experiencing reading difficulties were divided into two matched remediation groups: PREP (PASS Reading Enhancement Program). Results showed a significant improvement of reading (Word identification and Word Attack) for the PREP group, the gain in reading was greater than it was for the
'meaning-based' training group. 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 a higher level of successive processing at the beginning of the program. In contrast, High-Gainers in the meaning-based program were characterized by higher level of planning.

Taken together, the above studies make a clear case for the effectiveness of PREP in remediating deficient reading skills during the elementary school years.
The concept 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 are based on similar research by Cormier, Carlson, and Das (1990) and Kari, Dash, Das, and Carlson (1992). These researchers utilized methods designed to stimulate children’s use of planning, which in turn had positive effects on problem solving on non-academic 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 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 10 minutes of math. During the Baseline phase discussion was irrelevant to the mathematics problems but in the intervention phase, 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.

Teachers made statements such as: “How did you do the math?” “What could you do to get more correct?” or “What will you do next time?” The teachers made not direct statements like, “That is correct,” or “Remember to use that same strategy.” Teachers did not provide feedback about the accuracy of previous math work completed and they did not give mathematics instruction. The role of the teacher was to facilitate self-reflection and encourage the children to complete the worksheets in a playful manner.
PASS Theory

Figure x
Pass Theory
Figure 2
Illustration of using the PASS theory within a Basic Psychological Processing Disorder Model.

Note: * = significant difference (P < .05) from Naglieri (1999)