

The PASS model for the assessment of cognitive functioning in South African schools: a first probe

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Diversity is an acknowledged characteristic of the South African society. Traditional standardised methods of assessment for cognitive functioning have been discouraged or abandoned, as they have been found to be discriminatory. Arguing for a systematic assessment process, a previous researcher has stated that standardised methods are the best ways of achieving understanding of the reasons for the breakdown in learning and ensuring effective intervention. An alternative model of intelligence and cognitive functioning developed in previous work is explored for possible application within the South African context. This model, referred to as the PASS model, refers to the cognitive processes of Planning, Attention, Simultaneous and Successive processing. The exploration of the PASS model is extended to the assessment tool used to quantify these four cognitive processes. The assessment tool is called the Cognitive Assessment System (CAS). The question posed in the study was whether results obtained with this PASS model of intelligence could provide insight into the cognitive functioning of South African children. To establish the validity of the CAS (the assessment tool), the scores were correlated with related achievement scores obtained. The sources for achievement were obtained from the normed standardised Woodcock Diagnostic Reading Battery (WDRB) as well as the pupil's school year marks for the previous year. The data obtained from the CAS, Woodcock Diagnostic Reading Battery (WDRB), and the scholastic marks obtained from school subjects for December 2000 were therefore examined for correlations. The findings of this first probe indicated that the PASS model of intelligence correlates with reading and scholastic achievement in the South African context. The consequence of these findings impacts on the strategies employed for assessment of and intervention with reference to children having difficulties in learning within the South African context. The need for additional research to explore the diagnostic value of the CAS in the wider community is one of the challenges emanating from this probe.

Intelligence and cognitive processing

The understanding of intelligence as a fixed, measurable and general ability, has dominated thinking in the past. In this regard Naglieri (1999b:3) argues that although the intelligence quotient (IQ) tests of Binet and Wechsler have enjoyed "widespread use in the last 100 years" they have limitations. Further concerns are expressed by Kaufman (2000:8), who stated that Binet and colleagues "conceptualised intelligence as one's ability to demonstrate memory, judgement, reasoning, and social comprehension" which are tasks that are "primarily verbal in nature, to measure aspects of global intelligence." Kaufman (2000:8) considers the fact that these intelligence tests "represent a technology that has not changed since Binet and Simon introduced their first scale in 1905" and the changes that have been made have been only "cosmetic changes" as another limitation of this view of intelligence. Gunderson and Siegel (2001:49) also maintain that over the years there have been many objections raised as to the fairness of the various IQ tests that have been developed. Nevertheless, "Stanford-Binet remained the acceptable norm through the 1940s and the 1950s."

In the 1960s, the Wechsler's scales became more widely used than the Binet. The reasoning provided by Kaufman (2000:9) for this change, was that it "was a practical, education-related, society-driven variable that facilitated the ascendance of the Wechsler approach." The strength of the Wechsler was that it provided the school psychologist with a profile that permitted the identification of learning difficulties and some understanding of cognitive strengths and weaknesses. This profile assisted the practitioners with decisions about programme intervention.

In the past a learning difficulty was conceptualised as existing when a learner's IQ score was discrepant with the lower achievement score. This view is often still prevalent. This was referred to as the "discrepancy definition" (Siegel, 1989:469; Kirby & Das, 1990:34). Such views led to assumptions regarding the correlation between IQ and Achievement. Various assumptions about IQ-Achievement testing are explored by Siegel (1989:469). These assumptions are whether "(1) IQ tests measure intelligence; (2) intelligence and achievement are independent, (3) IQ scores predict reading scores — therefore children with low IQ scores should be poor readers and children with

high IQ scores should be good readers; (4) individuals with reading disabilities of different IQ levels have different cognitive and information pro-processing skills."

Various researchers agree with Siegel's findings that IQ tests cannot be used to predict achievement, explain achievement difficulties or identify the specific cognitive processes that cause these breakdowns in functioning (Gunderson & Siegel, 2001; Siegel, 1989; Das, 1997; Naglieri & Readon, 1993; Kirby & Williams, 1998; Das, Mishra & Kirby, 1994a; Kops & Belmont, 1985; Kaufman, 1994). Das's (2000:29) explanation that a "child with an IQ of 80 is as likely to show up in a reading disability class or clinic as a child whose IQ is 120" supports this view. McCloskey and Athanasiou (2000:212) also agree, emphasising the assessment plight of "linguistically diverse children" and disadvantaged children whose academic success requires knowledge of school subjects. McCloskey and Athanasiou, (2000:212) and Stanovich (1989:487) are concerned that this practice "may lead to misuse of tests and questionable diagnoses." However Limbos and Geva (2001:136) warn of the dangers involved in delaying the identification of learning disabilities in learners who are learning English as a second language.

Research findings into higher order processes in the area of cognitive and neuropsychology research, however, did not cause any marked change in the applied world of Psychology. This was owing in part, to misconceptions and misunderstandings (Lucas, 2001:6). According to Das, Naglieri and Kirby (1994b:4) "psychologists who missed the cognitive revolution entirely may not even suspect the great chasm between their testing methods and a theoretical framework needed to drive practice." The theoretical framework proposed will, according to Das *et al.* (1994b:5), predict scholastic functioning using academic achievement measures. This process will provide insight into the learner's needs and the understanding of individual differences. Das *et al.* (1994b:4) go on to say that there needs to be a constant questioning as to the "fundamental assumptions made behind traditional intellectual assessment." The first such testing instrument, investigating cognitive processing and cited by Naglieri (1999a:7), was by Kaufman and Kaufman (1993) and was called the Kaufman Assessment Battery for Children.

The new wave of research which involved neuropsychology and

cognitive psychology, brought with it an awareness that intelligence could be viewed as a collection of cognitive processes (Das, Kirby & Jarman, 1979; Naglieri & Readon, 1993). Theoretical underpinning of test material also became an important area of focus with the practical applicability of results for intervention purposes (Kaufman, 2000:12). Another important influence, according to Kaufman (2000:12), has been that of technological advances such as the ability to factor analyse the various cognitive tests by making use of the Flanagan and McGrews cross-battery analysis. A test that fits the criterion mentioned in this paragraph, and is also able to predict scholastic achievement is, according to Kaufman (2000:11), the Cognitive Assessment System (CAS) developed by Naglieri and Das (1997b).

The CAS is rooted in the three functional units of Luria (1973). Das and Naglieri (1995:357) regarded these three functional units as "responsible for all cognitive activity" and claimed that they were linked to the anatomical areas of the brain. Acknowledging the limitations of previous intelligence tests, the goal of the Cognitive Assessment System is to move away from the traditional IQ, general ability approach, to a "theory-based, multidimensional view, with constructs built on contemporary research in human cognition" (Naglieri, 1999b: 7). Using the fields of neuropsychology and cognitive psychology, Das and colleagues have worked at developing a model of cognitive processing responsible for learning which is an alternative to the concept of a fixed general intelligence. The research of Luria and others into the area of intelligence has, over many years, caused a change in our understanding of intelligence. This change in the understanding of intelligence has resulted in a move away from behaviorist observable skills, to the measuring of hidden cognitive processes used in the production of the product (Kirby & Williams, 1998; Das & Kendrick, 1997; Das, Mishra & Kirby, 1994; Naglieri & Readon, 1993; Eysenck, 1993; Siegel, 1989; Kops & Belmont, 1985; Kirby & Das, 1990). This understanding of intelligence as being composed of different functional units that are the building blocks that provide the cognitive ability (Luria, 1973) suggests that success at the traditional type intelligence tests, favoured those learner's that had prior experience of that type of task.

Despite all these advances, the outcry over IQ assessment has not abated. Kaufman (2000:12) cited the call by Stanovich (1989) to rid the "clinical world of this pseudoscientific neurology that has plagued the field" and Siegel (1999) claims which "Scores on IQ tests are irrelevant and not useful and may even be discriminatory." This discriminatory factor and other assessment concerns were raised by Foxcroft (2000:2). Some of the concerns raised were the power of the tester over the test-taker in situations of selection and placement, and the argument by testers that they had no option but to use test "measures that were not necessarily appropriate for all South Africans" (Foxcroft, 2000:2). In an attempt to address this, Foxcroft (2000:8) suggests the possibility of "adapting the most commonly used 'foreign' measures for the South African context" and increasing the "capacity in test development." Damico (1998) cited by McCloskey and Athanasiou (2000:215) does, however, make the point that no tests are truly non-biased. An assessment strategy investigated in this study for the South African context involved cognitive processing, but more specifically the CAS as an assessment tool. Das *et al.* (1994a:240) provide empirical evidence showing that the functioning levels of various cognitive processes do identify and separate out various groups of learners. One example of this is that successive cognitive processing measures separated the dyslexic from non-dyslexic children more effectively than IQ scores.

Arguments for cognitive processing

Das *et al.* (1994b:xvii) argue for the need to establish a theoretical framework of intelligence before attempts are made at the assessment of cognitive functioning. The information gathered must then be applied in a practical sense to target specific areas of weakness and improve the learner's level of functioning.

Das *et al.* (1994b:12) propose an alternative view of intelligence.

They claim that the prediction of success and ability involves a set of cognitive processes (Naglieri & Das, 1997a:1). The application of this theoretical framework into practical testing strategies has been achieved by means of a test called the Cognitive Assessment System (CAS) which is individually administered. According to Naglieri and Das (1997a:1), the specific cognitive processes measured are Planning, Attention, Simultaneous and Successive (PASS) processing. This new view of intelligence and ability, maintains that these four areas of cognitive processing are what are needed "to alter the individual's base of knowledge" (Das *et al.*, 1994b: cited in CAS:2).

Roodin (1996:6) on reviewing the book by Das *et al.* (1994b), acknowledges the research involved in the development of the PASS theory, but also notes that for him, the model is a "somewhat static assumption of the rather complex understanding of contemporary neuroscience." However, the value for Roodin (1996:6) lies in not only its challenge of current concepts of intelligence but also for its practical applicability. According to Roodin (1996:341) the PASS provides a link between the theoretical structured understanding of cognitive processes and the educational intervention for remediation.

The purpose of cognitive assessment

Das *et al.* (1994b:6), state that assessment is not regarded as contentious if there is agreement on definition of what is being assessed and agreement as to the inferences that can be made from the data gathered. Intelligence testing has not however enjoyed agreement as to its construct or components (Das *et al.*, 1994b:6; Groth-Marnat, 1997).

Assessment involves observation and the making of inferences. The inferences made from the results obtained have in the past been for prediction of achievement. Das *et al.* (1994b:6) view cognitive assessment as "measuring a set of intellectual characteristics at a point in time to predict how individuals will perform on other measures or at other points in time or to predict the environmental conditions under which they will perform best." When clarifying predictive value, Das *et al.* (1994b:7) maintain that it is predictive if there is no intervention. Therefore, it is predictive of current functioning and therefore dissociated from the concept of a fixed intelligence. The boundaries identified, regarding prediction, relate to the context of the learner's world. If there is any change in the context, this will change the predictive value. Therefore, for Das *et al.* (1994b:8) what is more important than prediction, is an explanation and an understanding of the learners' functioning. With this theoretically based understanding, intervention strategies can be put into place to enhance functioning. This understanding is obtained by making use of the PASS model of cognitive functioning.

The PASS cognitive processing model

The PASS model involved integrating the work of Luria (1973) in neuropsychology and integrating research done in cognitive psychology. The importance of Luria's theory is highlighted by Crocker and Algina (1986), who claim that "psychological measurement, even though it is based on observable responses, ... (has) little meaning or usefulness unless it could be interpreted in light of the underlying theoretical construct." This theoretical framework proposes a structural basis for the understanding of cognitive processes whereby information is integrated for learning.

This PASS (Planning, Attention, Simultaneous and Successive) model of intelligence makes use of Luria's three functional units that are said to "work in concert, and necessary for any type of mental activity" (Naglieri & Readon, 1993:128).

The mode of input into the brain can be "visual, auditory, or kinaesthetic" (Das & Kendrick, 1997:194). This integration of information occurs in two possible ways and is called simultaneous or successive processing. These concepts will be clarified later, but for now successive processing refers to sensory information being provided sequentially. Simultaneous processing refers to information that is provided in its entirety. For further clarification, auditory input can only be presented serially, but with visual information this may be

presented successively or simultaneously (Das & Varnhagen, 1986).

In summary, the first functional unit is responsible for regulating cortical tone and maintenance of attention, the second unit receives processes and stores information using simultaneous and successive information coding and the third unit programmes, regulates and directs mental activity (Das *et al.*, 1994b:13). Knowledge base is another vital component of the functioning of the PASS processes and refers to the "sum total of a person's experiences ... formal and informal educational background, habits and predispositions" (Das & Naglieri, 1995:356). This knowledge is obtained informally, formally and may be practical or theoretical but involves the "cultural and social background of the individual" which includes language usage to support thinking (Das *et al.*, 1995:357). In the words of Das and Kendrick (1997:195), "the PASS processes float, as it were, on a sea of knowledge; without which it would sink." There is therefore an understanding that "prior knowledge sets the limits on how incoming information can be coded" (Das *et al.*, 1994b:54). The output phase provides an indication of what has occurred throughout this process and is, what is measured during an assessment process.

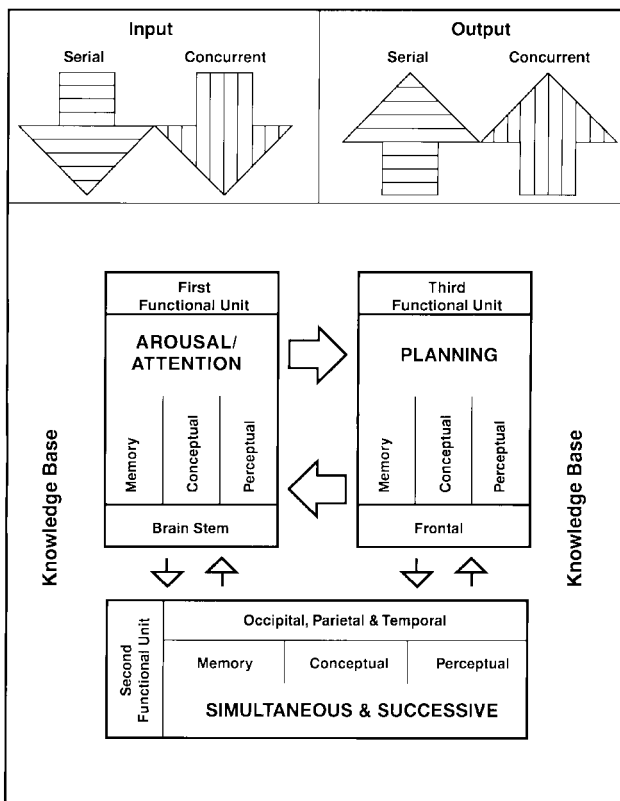


Figure 1 The PASS model of ability (Das *et al.*, 1994b:21)

Unit One: Attention and arousal

Unit one "maintains a proper state of arousal or cortical tone that allows for the focus of attention. Only when a proper waking condition is achieved can an individual receive and process information. Maintaining an appropriate level of arousal is especially important for effective activity since too much or too little interferes with proper information coding and planning. Appropriate levels of arousal also provide the opportunity for specific direction of attention. Insufficient performance of this first functional unit, therefore, leads to difficulty with information coding (simultaneous and successive processes) and planning, due to an under arousal or over arousal of the second and third functional units and difficulty in selective and organised responding" (Das *et al.*, 1994b:13).

The first functional unit can, according to Luria (1973:265), "be observed during organised selective behaviour ... but also by a whole group of symptoms which indicate a general increase in the level of preparedness or tone in the person." The identified symptoms include "changes in cardiac activity and respiration, constriction of the peripheral blood vessels, the appearance of a "psychgalvanic reflex, and the occurrence of desynchronisation phenomena (depression of the alho-rhythm), which are observed whenever attention is attracted by a stimulus or by some form of activity" (Luria, 1973:265). However, besides these signs, other signs revealing the specialized forms of activation of directed, selective attention identified by Das *et al.* (1994:42) are "changes in cortical evoked potentials.... (Various researchers found that) with the presentation of a special (visual, acoustic, tactile or nociceptive) stimulus evokes an electrical response (evoked potential) in the corresponding (occipital, temporal and central) regions of the cortex." An evoked potential is described by Das *et al.* (1994b:42) as "small changes in the EEG (electro-encephalogram) that arise shortly after a stimulus has been presented. A particularly important feature for our purpose here is that the structure of these changes varies substantially depending on the intensity of the stimulus and on the subject's activity. A change (increase in amplitude) of the evoked potential may arise as the direct response to a sensory stimulus in the first phase of the evoked potential (after a latent period of 30–50 ms), while changes induced by more complex activity, such as by the analysis of information, arise in the late stages of the evoked potentials." Evoked potential was increased if an instruction was provided. Therefore, Luria (1973:271) maintains that "any complex form of attention, involuntary or more especially voluntary, requires the provision of other conditions, namely the possibility of selective recognition of a particular stimulus and inhibition of responses to irrelevant stimuli of no importance in the current situation. This contribution to the organisation of attention is made by other brain structures located at a higher level: in the limbic cortex and in the frontal region."

Therefore, according to Das *et al.* (1994b:33), arousal is defined as a specific state of being active or alertness. Das *et al.* (1994b:35) state that a certain level of arousal is important for learning to occur but that, if it is too high, this would then cause "a narrowing of attention so that the individual does not take advantage of alternatives of responding, nor do they utilise the cues that might be presented before them."

Attention is defined as attending to something in particular. In clarifying this, Das *et al.* (1994b:33) see arousal as more sub-cortical and attention as being "controlled by the cortex particularly by the frontal lobe." A distinction is made between the various types of attention. The first is sustained attention which Parasuraman (1984) cited by Das *et al.* (1994b:36) describes as "the maintaining of attention to a single source of information for an unbroken period of time." The level of functioning in this area is affected by the length of the task and the frequency of signals. Selective attention may be at the receptive or expressive phase and is defined as either being focused or divided. Das *et al.* (1994b:37) define focused attention as being able to "attend to one source or kind of information and exclude the others, whereas in divided attention, the individual shares time between two or more sources or kinds of information or mental operations."

Tests for selective attention are the Stroop (Golden, 1978) for receptive and expressive attention, as well as Number Detection. Data driven selective tasks are those that require identifying characteristics and memory tasks are those that require matching letter names (Posner). However, the selective attention tasks have three main components, mentioned by Das *et al.* (1994b:38) and they are "selectivity, resistance to distraction and shifting strategies." Both the Stroop and the Posner tests are, according to Das *et al.* (1994b:48), "appropriate measures of selective attention, in that both are measures of discrimination, selectivity and the ability to handle more than one task at the same time. Selective attention, therefore, needs planning and the "failure of selectivity is seen in impulsive behaviour of hyperactive children" (Das *et al.*, 1994b:43).

Unit Two: Successive and simultaneous processing

Das *et al.* (1994b:15), citing Luria (1966), discuss the functions of Unit Two. In this Unit, the function reflects the manner in which the external stimuli, was received. The two variations are simultaneous processing defined as "integration of stimuli into synchronous and primarily spatial groups" and successive processing defined as "integration of stimuli into temporally organised serial order." Thus, Das *et al.* (1994b:16) note that the integration is not connected to the modality of the incoming stimuli but to the integration of the stimuli at the tertiary level of Unit Two.

Coding of information successively or simultaneously

The three aspects Das *et al.* (1994b:56) have identified as important for coding are the level of coding, the code content, and the type of coding. Level of coding refers to the complexity of the material presented and involves the level of abstraction and inferencing required. The lower levels of coding could occur "automatically, without any conscious effort, while the higher ones require more effort."

Code content divides the content into whether it is verbal or spatial in nature. This is, however, different from the type of content. Type of content refers to whether it involves simultaneous or successive processing (Das *et al.*, 1994b:59). According to Naglieri and Das, (1997a:4; 5), simultaneous processing is a "mental process by which the individual integrates separate stimuli into a single perceptual or conceptual whole." The two dimensions considered in simultaneous processing are "both non verbal-spatial as well as verbal-grammatical activities." The successive processing involves a "mental process by which the individual integrates stimuli into a specific serial order that forms a chain-like progression."

Das *et al.* (1994b:52) discuss where "incoming information is received and combined with prior knowledge in the knowledge base, transformed according to prior knowledge and to the operating plan, and stored for later usage. The stored knowledge adds to the individual's knowledge base." If incoming information is complex, then this process will require effort and limit the amount of effort expended on other aspects of the task. Part of this process requires storing of data for processing. This data may be held in short term memory (STM) or long-term memory (LTM). Das *et al.* (1994b:55) describe how with short term memory there is a limit to the amount of codes "that it can hold at any one time, estimating varying from four to seven." Thus, what works better is if each of the codes can hold as much as possible, through a process of chunking and increasing the working memory space. The working memory is where the processing can occur. Our knowledge base is formed by the LTM.

Unit Three: Planning

The third unit in the model is referred to as involving planning and being able to "provide the individual with the means to analyse cognitive activity, develop a method to solve a problem, evaluate the effectiveness of a solution and modify the approaches used ... to provide an efficient and/or systematic approach to solving a problem.... The generation, selection and execution of plans are the three main aspects of planning" (Das *et al.*, 1994b:17).

For Luria (1973:187) it is the part of the brain responsible for the "programming, regulation and verification of human activity." This, according to Anokhin, cited by Luria (1973:90), involves the "synthesis of external environmental information." Luria (1973:79) states that in response to incoming information, man "creates intentions, forms plans and programmes of his actions, inspects their performance, and regulates his behaviour so that it conforms to these plans and programmes; finally, he verifies his conscious activity comparing the effects of his actions with the original intentions and correcting any mistakes he has made."

The distinguishing feature of the prefrontal region of the brain, according to Luria (1973:84), is that it has a "very rich system of connections both with lower levels of the brain and with virtually all other parts of the cortex." These connections are two-way in character

and, as described by Luria (1973:89) are "a superstructure above all other parts of the cerebral cortex, so that they perform a far more universal function of general regulation of behaviour than that performed by the tertiary area of the second functional unit." Luria also describes how in the human species the tertiary formation of this area "occupies one-quarter of the total mass of the cerebral hemispheres."

The impact on behaviour, after injury to the frontal lobe, as manifested in fragmented and uncontrolled behaviour provides proof of the important role of the frontal lobes. Damage is seen in the disturbance of "impulse control, regulation of voluntary action and perception as in visual search ... adversely effecting memory and the adoption of strategies, to manipulate symbolic symbols" (Das *et al.*, 1994b:77). The frontal lobe has also been linked to the activation and modification of cortical tone necessary for continued mental activity. This finding was linked to frontal lobe functioning, as impairment only occurred if there had been damage to the frontal lobe area. This cortical tone is important for the "formation of plans and intentions that are stable enough to become dominant and to withstand any distracting or irrelevant stimulus" (Luria, 1973:198). According to Kirby and Williams (1998:68) planning for unfamiliar tasks is effortful. However, with time, this strategy becomes automatic requiring less effort stored in memory.

The processing required in the solving of a problem is diagrammatically well illustrated in Das *et al.* (1994b:18). For the problem solving processes the learner firstly needs to become aware that a plan is needed. Once this is achieved then a strategy is located from previous experience or a new one is developed. This process may require the gathering of additional information to devise a plan of action. Strategy level according to Kirby and Williams (1998:68) requires the use of a specific plan. Intervention at this level usually involves teaching specific strategies. The difficulty here is one of generalisation to other contexts. With regard to strategies, Kirby and Williams (1998:215) demonstrate an exercise to show poor planning. This involves the memorising of different words. An efficient strategy would be to categorise the words. Kirby and Williams (1998:215) maintain that if a learner with a learning problem is provided this strategy, their task performance does improve, indicating that the difficulty is related to the learner's automatic application of a planning strategy. They note that this difficulty is further compounded if the learner has previously experienced failure in that particular subject or if basic content knowledge is missing. This would contribute to what Kirby and Williams (1998:216) have referred to as "learned helplessness" and the use of strategies such as "guessing, or waiting for someone to supply the answer." The ideal, as seen with adult functioning, is the automatic use of strategies freeing up the working memory.

The attentional skills are of particular importance at this point, as the individual will need to select relevant from irrelevant information. The strategy of acquiring that information may be successive or simultaneous. Each time a plan of action is decided upon, there needs to be a process of evaluating and monitoring as to whether the strategy is working or not so that the task can be completed. In addition there is the level of selective attention. Selective attention skills enable the pupil to devote all his/her energies to the important components of the task. Kirby and Williams (1998:68) identify this as selective attention that is controlled by planning and not the automatic type associated with Unit One. Difficulties at this level are described as being "impulsive, lacking in self-control, inattentive, distracted and that these can originate from planning and or attention difficulties" (Kirby & Williams, 1998:69). Selective attention has, according to Kirby & Williams (1998:69), been found to improve with age and is therefore developmental in nature. However, there are negative consequences of school failure. A strategy suggested to improve this area is verbal self-control where the learner is encouraged to verbalise out loud thought/ meta-cognitive processes.

Das *et al.* (1994b:83) also discuss the concept of meta-cognition and its role in planning. In clarifying this concept, the opposite is clarified, as this is what is often the focus at schools. This involves the

focus on content acquisition, "skills and procedural knowledge," but not on the process or generalisation of that knowledge. A meta-cognitive level involves thinking about one's thinking. In the words of Kirby and Williams (1998:70), meta-cognition involves "the conscious awareness of ways of approaching tasks, of processing information and of monitoring success." In exploring the idea of intervention, Kirby & Williams, (1998:70) found that there is reason to believe that the deciding factor does appear to be the selective attention.

Kirby and Williams (1998:71) claim that learners with learning problems have been found to have difficulties with meta-cognition. The difficulty lies in knowing whether the poor meta-cognitive skills have caused the low achievement, or whether the poor meta-cognition is due to poor skills development. It is therefore proposed that activities that will promote meta-cognition should be part of an intervention programme. Kirby and Williams (1998:218) reiterate that, because all the processes are interrelated, a problem in planning is "unlikely to exist in isolation." Information that is processed is done by utilising either the successive or simultaneous skills. Consequently Kirby and Williams (1998:218) believe that a planning problem is also a processing problem. The types of planning problems identified by Kirby and Williams (1998:220) are:

- a passive or misguided plan;
- employment of the wrong plan;
- loss of place within a correct plan; and
- being unable to adapt and change a plan that is not working.

Interaction between the three functional units

Luria (1973:99) points out 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." When discussing perception, Luria (1973:100) states that all three functional units are necessary for perception. The first provides the necessary cortical tone, the second carries out the analysis and synthesis of incoming information, and the third provides for the necessary controlled searching movements which give perceptual activity its active character. This is also relevant for voluntary movement and action. Movement requires a constant flow of impulses, providing information on the state of the joints and muscles, the position of the segments of the moving system, and the spatial coordinates within which the movement takes place (Luria, 1973:101).

Kirby and Williams (1998:70) argue that the "entire cognitive system is involved in the production of intelligent actions and school achievement." By studying all the systems involved, a picture is gained of the learner experiencing learning problems. On reviewing literature, Das and Abbot (1995) state that each functional unit is distinct and that there is "support for the tasks specified to measure planning, attention, simultaneous and successive processing."

The cognitive assessment system (CAS)

The Cognitive Assessment System is based on the PASS model and first published in 1997. Das and Abbott (1995) cite research that shows the validity of the CAS tasks (Campbell-Wachs & Harris, 1986; Mishra, Lord & Sabers, 1989; Naglieri, 1989; Naglieri, 1993; Naglieri & Das, 1987; Naglieri & Reardon, 1993). Kranzler and Keith (1999: 30) do not however agree with their validity. Kranzler and Keith (1999) used the Confirmatory Factor Analysis (hereafter abbreviated as CFA) to look at the various CAS tests. Based on their results, they maintain that "they do not support the construct validity of the CAS." Some of their findings are that the "constructs measured by CAS are overlapping and related and that planning and attention are virtually indistinguishable."

Kranzler and Keith (1999:26) also believe that "planning and attention are indications of processing speed" and that "successive scale is a measure of short-term memory." They are of the opinion that McGrew's (1997) three stratum theories are "an excellent framework for understanding the constructs measured by new intelligence tests such as the CAS." In response to their article, Naglieri submitted a peer-reviewed manuscript which follows the Kranzler article (1999b:

21). Naglieri's (1999b:145) research article sets out to provide data that is "contrary to suggestions made by Kranzler and Keith (1999). Some issues covered are that of construct validity, that planning reflects strategy and not speed, and that the "CAS predicts achievement better than any test of ability." In addition, Naglieri (1999a:134) states that clinically, the CAS can provide a match between a cognitive weakness and achievement, awareness of discrepancies between cognitive processes and achievement and an explanation for the "academic problem."

The CAS has four scales matching each of the processing dimensions. Within each of these processing dimensions, there are three subtests scored for the standard battery and two if the basic battery is used. Naglieri (1999b) claims that this does not imply a hierarchical structure but provides improved score reliability.

Clinical application of CAS

Learner's with learning difficulties have in the past been identified on the basis of a discrepancy between their ability, as measured by traditional IQ tests, and their "(low) level of achievement." This, according to Naglieri (1999a:135), implies that the "IQ test was not sensitive to an intellectual problem that might be responsible for the academic failure." The Cognitive Assessment System (CAS) is according to Naglieri and Das (1997a:9), "intended to predict academic achievement in children" and "differentiate exceptional children (e.g. those with Learning Disabilities and Attention Deficits" (Naglieri, 1999b: 21).

The individual PASS Scales have relevance to success and failure in specific areas of academic performance (Kirby & Williams, 1998) and are analysed by identifying three aspects. The first is a discrepancy between the higher CAS score and the low achievement scores, a consistency between the low achievement score and a matching cognitive weakness, and finally, "a cognitive explanation for the academic problem" (Naglieri, 1999a:135). Naglieri and Readon (1993: 130) in their comparative study of PASS processes and reading achievement, found that children with reading difficulties presented with significantly lowered pseudo-words score which correlated significantly with their successive processing score.

Naglieri (1999), citing Naglieri and Das (1997), provides data to show that children with Attention-Deficit Hyperactivity Disorder (hereafter abbreviated as AD-HD) were found to have "difficulty with planning (self-regulation, inhibition of responses, control of behaviour) as measured by the CAS. Attention sub-test scores are also expected to be low for these children, but especially for those with the inattentive type of AD-HD." Other groups of children who were identified, are the gifted and low ability children (Grabmeier, 2000). A systematic, sequential process is recommended for this analysis and starts with the analysis of the Full Scale Score.

The relationship between the PASS model and achievement

For Naglieri (1999a:123) "one of the most important dimensions of validity for a test of cognitive ability is the relationship to achievement. Whether one views intelligence as a general ability construct or from a multi-dimensional perspective (PASS theory), the prediction of achievement offers an important way to evaluate the utility of the test's performance. If there is a strong relationship to achievement without content overlap, then whatever the test of ability measures can be said to include variables that are important for scholastic performance. Moreover, high correlations with achievement would also suggest explanatory power for exceptional children, something traditional IQ tests have had a difficulty doing." This is why Siegel (1989) states that "IQ is irrelevant to the definition of learning disabilities." Kirby and Williams (1998:70) utilise and link the PASS model of cognitive processing to areas of reading, spelling, arithmetic and mathematics.

Reading and other scholastic tasks involve many complex components, such as knowledge base, culture and various cognitive tasks. Kirby and Williams (1998:83) describe eight interactive levels in-

volved with reading. These involve the identification of various features that make up the letters, such as letter knowledge and matching particular letters with particular phonetic sounds. In addition, there are words which may be regular (phonetic) or irregular in nature (sight words) and stored in memory. Moreover, these are phrases, ideas (simple comprehension), main ideas and themes (underlying message). This bottom up process can also occur as a top down process causing the reader to "predict or expect" (Kirby & Williams, 1998:83). All these levels involve cognitive areas proposed in the PASS model. Furthermore, the automatic application at lower levels dictate the efficiency of functioning at higher levels.

Automatic functioning starts with what Kirby and Williams (1998:57) refer to as 'working memory.' Incoming information is screened at a pre-attentive level of information, is selected for processing and then held in working memory. The difficulty is that working memory is limited in the quantity of information that it can hold. This is, according to Kirby and Williams (1998:55), the "core of the information processing system" and involves the data that "we are actively thinking about." The quantity held in working memory can be extended if it can be chunked into meaningful wholes. At this stage, Kirby and Williams (1998:57) maintain that there are about twenty seconds of life for this data and that during that time, three different things can happen to this information. It can either be deleted, rehearsed to increase its life span, or recorded for storage in long term memory. This recoding involves creating meaning from the information so that working memory can hold more data.

Kirby and Williams (1998:71) diagrammatically represent their model of how learning problems are caused by cognitive difficulties in the "three functional units." The level one impact would be the attention and arousal level followed by planning. This would be followed by simultaneous and successive processing and, eventually academic achievement leading onto secondary implications. Each of these cognitive areas, according to Kirby and Williams (1998:71), impact on specific areas of academic achievement but the "higher the source of the problem the broader the problem."

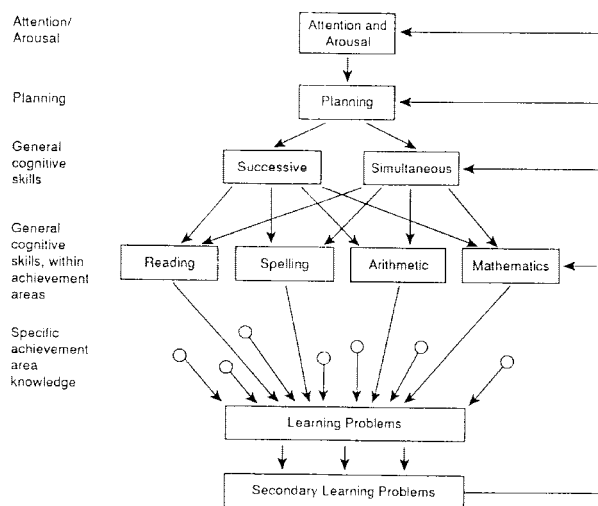


Figure 2 Impact of cognitive processes on learning (Kirby & Williams, 1991:71)

Naglieri and Readon (1993:131) and Kirby and Robinson (1987:243) therefore maintain that the practical implication is although "overall achievement may be effectively predicted by some combination of the PASS processes, it is also possible to link cognitive deficits with specific areas of reading achievement". One such example is that "phonological coding appears to be best predicted by successive processes" (Naglieri & Readon, 1993:131). Siegel (1999:307) identifies what she believes should be included in a reading assess-

ment process. These are pseudo-words for phonological awareness, word recognition and comprehension. According to Kirby and Williams (1998:85) two areas of focus on reading breakdown have been "the letters-to-sound-to words area (successive) and words-to chunks-to propositions area (simultaneous)."

Cognitive processing and reading skills

Being able to link and understand the impact of the various cognitive processing areas to reading achievement allows for improved intervention. Kirby and Robinson (1987:244) report various studies that have "associated superior performance on reading tasks with higher simultaneous and successive processing skills" (Ryckman 1981; Leong 1980; Kirby 1980; Das, Cummins, Kirby & Jarman, 1979; Randhawa & Hunt 1979; Das, Leon & Williams 1978; Kirby & Das 1977; Cummins & Das, 1977). Kirby and Robinson (1987:244) report on research also indicated that good readers use syntactic (simultaneous) cues to aid the extraction of meaning (Driver & Elkins, 1981; Fay, Trupin & Townes, 1981; Rousch & Cambourne, 1979; Watson & Clay, 1975; Kolers, 1972; Weber, 1970; Clay, 1968;). "Simultaneous processing has been more strongly related to comprehension and successive processing more strongly related to word decoding" (Kirby & Booth, 1996:443). However, successive processing has been found in children with learning difficulties (Kirby & Robinson, 1987:244, citing Krywaniuk & Das, 1976; Leong, 1980). For more detailed information linking specific cognitive processes to aspects of reading refer to Kirby and Williams (1998). The linking of the PASS scores and achievement in the Reid (2001) study involved correlating three sets of data sources, namely the CAS full scale score, the pupils 2001 year average score and the WDRB total reading score.

Statistical and administrative procedures

In a quantitative study by Reid (2001), scores derived from the CAS, WDRB and school results were all correlated. "A correlation is a measure of the relation between two or more variables. The coefficients can range from -1.00 to +1.00. The value of -1.00 represents a perfect negative correlation whilst a value of +1.00 represents a perfect positive correlation. A value of 0.00 represents a lack of correlation" (Statsoft.com 2001). For the purposes of the mentioned research, correlation refers to 'Pearson correlation' (hereafter called correlation), which assumes that the "two variables are measured on at least interval scales, and determines the extent to which values of the two variables are 'proportional' to each other" (Statsoft.com 2001).

The final stage of the Reid study (2001) involved the recording of the Full Scale score obtained for each learner. This was done to identify from the CAS manual (1997:209) the learners' predicted score in six areas, namely letter word recognition, word attack, passage comprehension, broad reading, basic reading and reading comprehension. These predicted scores were then correlated with the obtained scores achieved in the same areas to ascertain if a correlation existed between the obtained score and predicted score. According to Peers (1996:29) predictive validity is the "extent to which the test score predicts some subsequent criterion variable of interest." This is, according to Peers (1996:27), important since a "single mark or achievement score for a pupil acquires meaning only when it is interpreted together with other data such as achievement scores obtained by individuals on the same test or when compared with achievement norms."

The sample consisted of a randomly selected Grade 6 class (from three Grade 6 classes at the school) from a urban state school in a Northern suburb of Johannesburg. The participants, 32 Grade 6 learners, were all black and English Second Language learners.

Summary of findings and deductions

In a study by Reid (2001) it was established that a significant relationship ($p \leq 0.05$) existed between the three instruments, namely, the CAS, WDRB, and the learner's school marks for the year 2000 for black Grade 6 learners in a urban school in the Northern Suburb of Johannesburg (refer to Table 1).

The second major finding in Reid's study (2001) was that the Full Scale Score of the CAS is predictive of achievement as measured by the six sub-tests of the WDRB. Figure 3 shows the predictive correlation between the learners' full scale score and achieved comprehension score.

Table 1 Correlations between the three data areas of

- The WDRB reading aptitude
- The full scale score of the CAS
- The learner's YEAR AVERAGE for 2000

	CAS	Total reading
WDRB Total reading	.716**	
Learner YEAR MARK 2000	.603**	.701**

** Correlation is highly significant ($p \leq 0.01$) (2-tailed)

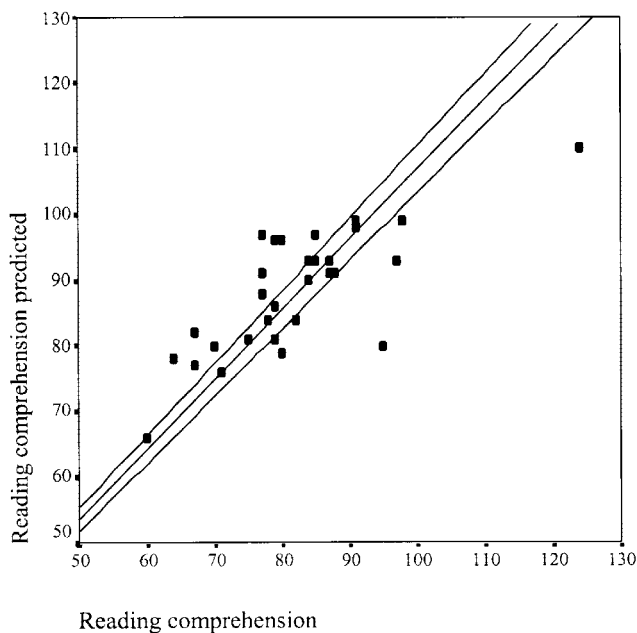


Figure 3 Predictive correlation: Learners' full scale score and achieved comprehension score (Reid, 2001:65)

Since the CAS Full Scale score is able to predict achievement for six cluster WDRB scores, it implies that the cognitive processes are directly linked to the success or failure of reading. This explanatory power should have diagnostic value and improve the understanding of the cognitive processes involved, which in turn should enhance the intervention strategies employed (Reid, 2001:69).

Conclusion

Assessment in the areas of cognition and achievement is a controversial topic, with strong opinions varying on what is in the best interests of the learner and society at large. This controversy is reflected in the South African arena where professionals are required to deal with referrals, and recommend interventions to suit diverse contexts. The current *modus operandi* is open to personal interpretation, is subjective in nature, is heavily dependent on the experience of the assessor, and is ultimately confusing communication between professionals, learners and parents. This study has attempted to explore the validity of the CAS as a fair diagnostic instrument in South African Schools. It was considered vital to explore the potential application of the CAS if we are to successfully address the educational needs within

the diversity of the South African context. The results seem to be promising enough to warrant further research on the CAS in the South African context.

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