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ABSTRACT

This monograph examines three approaches to intelligence that include cognitive processing components and relates each to assessment and interventions with students having reading disabilities. The first, Sternberg's Triarchic theory of intelligence (1985), includes three subtheories, contextual, experiential, and componential. The second, the Campione-Brown theory of intelligence (1978), utilizes an information processing model that proposes two hierarchical levels, the architectural system and the executive system. The third is the Planning, Attention, Simultaneous, Successive (PASS) theory of intelligence (1994). Empirical research on reading disabilities from the perspective of each theory is briefly reviewed, which shows the Triarchic theory to be a multifaceted approach to reading difficulties, the Campione-Brown theory's components (short-term and working memory, knowledge base, and control processes) to be especially relevant, and the PASS theory to be relevant at both the decoding and reading comprehension stages of reading. Evaluation of the theories' implications for assessment and intervention identifies promising assessment instruments and instructional systems based on each theory. (Contains approximately 90 references.) (DB)

Running head: READING DISABILITIES: THEORIES, ASSESSMENT, INTERVENTION

The Role of Intelligence in Reading Disabilities:

A Comparison of Three Theories

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Abstract

The role of intelligence and intelligence testing in reading disabilities has continued to be debated among researchers and practitioners. Siegel (1989) asserted that IQ is irrelevant to the definition of reading disabilities, while Naglieri and Reardon (1993) maintained that different measures of intelligence may be "more sensitive" to measuring intellectual differences in those with reading disabilities. In fact, traditional intelligence tests have failed to distinguish between children with reading disabilities and their non-disabled peers (Berk, 1983; Naglieri & Haddad, 1984; Mueller, Dennis, & Short, 1986). Yet, Sattler (1992) noted that cognitive processing approaches to intelligence have shown promise in the areas of test development, intervention strategies, and remediation programs with those with reading disabilities. This monograph will examine three approaches to intelligence which include cognitive processing components. An exploration of each theory and implications for assessment and intervention of those with reading disabilities in a school environment will be presented.

Monograph

Reading Disabilities: Views of Assessment and Intervention from Three Theories of Intelligence

The role of intelligence and intelligence testing in reading disabilities has continued to be debated among researchers and practitioners. Some argue that intelligence and reading disabilities have no relation, while others disagree and claim that new measures of intelligence are needed. Siegel (1989) asserted that IQ is irrelevant to the definition of reading disabilities, while Naglieri and Reardon (1993) maintained that different measures of intelligence may be "more sensitive" to measuring intellectual differences of those with reading disabilities. In fact, traditional intelligence tests have failed to distinguish between children with reading disabilities and their non-disabled peers (Berk, 1983; Naglieri & Haddad, 1984; Mueller, Dennis, & Short, 1986). Naglieri and Das (1990) argued that traditional tests have a too narrow view of intelligence and thus neglect many aspects of cognitive functioning. Sattler (1992) noted that cognitive processing approaches to intelligence have shown promise in the areas of test development, intervention strategies, and remediation programs with those with reading disabilities. The continuing debate raises many questions. Is intelligence related to reading disabilities? Do intelligence theories with cognitive processing components offer promise in differentiating between those with reading disabilities and those with no disabilities? What are the implications for assessment and intervention from different theories of intelligence? In what areas should future reading disability research be focused?

Plan of the Monograph

This monograph will examine three approaches to intelligence which include cognitive processing components, including the Triarchic theory of intelligence (Sternberg, 1985), the Campione-Brown theory of intelligence (Campione & Brown, 1978) and the Planning-Attention-Simultaneous-Successive theory of intelligence (Das & Naglieri, 1994). An exploration of each theory, including relevant research with reading disabilities, and implications for assessment and intervention in a school environment will be presented. Finally, recommendations for future research are proposed. While this monograph will specifically address reading disabilities, much of

the research on reading disabilities has involved heterogeneous samples (including a variety of learning problems or different types of reading problems such as decoding, comprehension, etc.) which complicates the interpretation of the findings. However, at this time, this is the research that is available.

Theories of Intelligence

Triarchic Theory of Intelligence

Sternberg's Triarchic theory of intelligence includes three subtheories: a Contextual subtheory, an Experiential subtheory, and a Componential subtheory (Sternberg, 1985). The Triarchic theory of intelligence is expanded from Sternberg's earlier intelligence theory which only included the Componential subtheory.

Contextual Subtheory

The Contextual subtheory shows how intelligent behavior is explained mainly by the sociocultural context in which it occurs. Sternberg (1985) maintains that contextually intelligent behavior involves (a) adapting to the present environment, (b) selecting an equal/better environment than the one the individual is in, and (c) shaping the environment so it is a better fit to the skills, interests, or values of the individual. Intelligent functioning includes the three behaviors of adaptation, selection, and shaping, although Sternberg acknowledges that contextual aspects are only part of a full theory of intelligence. The contextual subtheory relates to the outside world of the individual and looks at what and when behaviors are intelligent. This subtheory considers the individual and the settings he or she lives in, and explains how intelligent behaviors may vary from setting to setting (and person to person).

Experiential Subtheory

The Experiential subtheory maintains that for any situation not all behavior is equally intelligent. Sternberg asserts that an individual's intelligence is best demonstrated when he or she is (a) given a relatively (but not totally) novel task or situation or (b) is in the process of automatizing his/her performance on a given task or in a given situation (Sternberg, 1985). Novel tasks or situations are those that are outside the average person's experience, although they should not be

totally outside of that experience (for example, physics for an elementary student). Automatized tasks are those that are automatic (like driving for many) and thus require minimal effort mentally. The above two points are most relevant in understanding intelligence when an individual is involved in a task or situation. The experiential subtheory relates to the internal and external world of an individual and examines the relationship between intelligence shown in a task or situation and the amount of experience (novel or automatic) with that task or situation.

Componential Subtheory

The third subtheory, the Componential subtheory, delineates the elements that underlie intelligence. Intelligent behavior involves the functioning of metacomponents, performance components and knowledge-acquisition components. Metacomponents are the mental processes that control an individual's information processing, including the planning, monitoring and evaluating of that processing. Performance components carry out the plans produced by the metacomponents. The knowledge-acquisition components are responsible for encoding and combining new information, as well as comparing new knowledge to old information. These components include selective encoding, selective comparison, and selective combination (Spear-Swerling & Sternberg, 1996). Selective encoding occurs when an individual determines new information that is relevant from that which is not as relevant. For example, a psychologist needs to identify the family factors (out of many) that are relevant to a client's problem. Selective comparison is when one relates new information to information one has learned in the past, for example, a psychotherapist who decides to use a treatment on a client that has worked in the past (with a client with similar problems). Selective combination involves combining information into a unified whole from what may appear to be isolated pieces of information. Many of us have all the pieces of information needed to solve a problem but have not yet combined them effectively in a solution.

Overall, this subtheory explores the cognitive processes involved in adaptation to, selection of, and shaping of environments (Sternberg, 1988). The Componential subtheory looks at the

inside world of the individual and how intelligent behavior is created. In this subtheory, the mental processes involved in intelligence are seen to be the same across individuals and cultures.

The Triarchic theory was intended to be more broad than many theories of intelligence expanding to include the context, or "real world" in the description of intelligence. Similar to the Triarchic theory, the Campione-Brown theory of intelligence will examine the components of human information processing and also explore the role of knowledge base and metacognition in intelligence.

Campione-Brown Theory of Intelligence

The Campione-Brown theory of intelligence was developed by Joseph Campione and Ann Brown (1978) and then expanded by John Borkowski (1985). Their theory utilizes an information-processing model that proposes two hierarchical levels: the architectural system and the executive system.

The Architectural System

The Architectural system consists of the basic qualities needed for information processing (Campione & Brown, 1978). Borkowski (1985) identified the following structures in the system: Capacity or amount of space in short-term memory; durability or the rate which information is lost from memory; and efficiency, which includes selection and storage of information. The purpose of the Architectural system is to notice and react to sensory input (Borkowski, 1985). This system is biologically and genetically based. The second system, the Executive system, is more environmentally based and can be modified.

The Executive System

The Executive system "initiates and regulates retrieval of knowledge from long-term memory, modifies the knowledge base and mediates problem solving"(Borkowski, 1985, p. 111). The executive system is made of four components, which include knowledge base, schemes, control processes, and metacognition.

Knowledge plays a main role in intelligent behavior because it aids in interpreting and retaining new information, as well as reflecting (over an extended time) the individual's ability to

collect, retain and modify that information. Borkowski (1985, p. 112) states that "knowledge informs perceptions, provides a home for new memories amidst the storage of old ones, and informs cognitive routines and strategies in the face of complex problems." Thus, knowledge is an important part of intelligence.

The component of schemes (in the Campione-Brown theory) is borrowed from Piaget and is defined as similar actions or thoughts represented by a mental unit. For example, an infant might have a schema for grasping and use it for grabbing assorted objects in his or her environment (Ormrod, 1995). Control processes include rules and strategies that assist an individual in cognitive activities, including memorizing, understanding, and problem solving. (Campione & Brown, 1978). The component of metacognition refers to an individual's awareness of his or her own thought processes and thought strategies. The function of metacognition is "to inform and regulate cognitive routines and strategies" (Borkowski, 1985, p. 114).

Overall, the Campione-Brown theory examines both biological and environmental components of intelligence. The Planning, Attention, Simultaneous, and Successive (PASS) model of intelligence has similarities in that it also looks at the importance of noticing and reacting to input of the senses in the Attention unit, and metacognition in the Planning unit. However, the PASS model focuses more in depth on the way information is processed.

Planning, Attention, Simultaneous, Successive (PASS) Theory of Intelligence

The Planning, Attention, Simultaneous, Successive (PASS) model of intelligence is based on the work of Luria (1966, 1980), who proposed that human cognitive processing involves three units which work together and are needed for any type of mental processing. The first unit maintains a state of arousal or focus of attention which is needed for effective mental activity. The second functional unit is "responsible for receiving, processing and retaining" (Das, Naglieri & Kirby, 1994, p. 14) information that a person gets from the outside world and is composed of simultaneous and successive information processing. Simultaneous processing is used when all stimuli are interrelated, and successive processing is used when stimuli are put in a series where

the "elements form a chain-like progression" (Das, Naglieri & Kirby, 1994, p. 15). The third unit allows an individual to form plans, carry them out and evaluate whether they were effective.

Attention

Various definitions have been used to describe attention, but, in general, it implies that a person is alert. This alertness can be selective and can also be sustained for different periods of time. Arousal (also called alertness), selectivity, and maintenance of attention have been researched from both information processing and neuropsychology models (Das, Naglieri, & Kirby, 1994). Arousal is necessary for learning to occur, but excessive amounts of arousal (like test anxiety) can interfere with the learning process. Selective attention can be either focused or divided. In focused attention, "an individual is required to attend to one source or kind of information and exclude the others," while in divided attention "the individual shares time between two or more sources or kinds of information or mental operations" (Das, et al, 1994, p. 37). Sustained attention is focusing on a single piece of information for an unbroken period of time. In general, attention is related to problem solving and learning and is an important element of intelligent behavior.

Coding of Information: Simultaneous and Successive Processing

The function of the processing system is central to the PASS Model of information processing. While the attention and planning systems can either assist or interfere with processing, the processing system receives, combines and transforms information. Since the processing system also encodes and recodes information, it is also known as the "coding" system. Coding occurs when new or incoming information is "interpreted in terms of what we already know" (Das, et al, 1994, p. 52).The PASS model proposes that the two major types of coding are simultaneous coding or successive coding. Simultaneous processing involves the creation of a single code from an ordered set of information, while successive processing puts information in sequence (like the numbers in a phone number) even if it wasn't presented sequentially. The key features of simultaneous coding according to Das, et al. (1994) include the following:

1. The pieces of information possess some relationship with each other.

2. The relationship between information or how it is discovered must exist in long term memory.

3. The code is a holistic unit which takes up only one space in working memory.

4. The parts of the code (the information that was initially coded) does not have to retain a specific order after simultaneous coding.

5. Some information that was initially coded may be lost (e.g. you remember many people were listed, but not each one).

Das, et al (1994), describes the main features of successive coding as the following:

1. The only relationship perceived is the sequential one.

2. The successive code initially takes up as much space in working memory for as many units that the code has.

3. The sequential links within the code can be automated with practice or overlearning and thus take up less space in working memory.

4. The sequence or order of the items is crucial.

Overall, simultaneous and successive processing is central to information processing.

Planning

Planning has many definitions from both an information processing and neuropsychological perspective, but, in general, it is a set of decisions or strategies that one adopts and modifies to problem solve and reach a goal (Das, 1980). Naglieri (1997, p. 249) elaborates that "planning processes provide the individual with the means to determine and use efficient solutions to problems using attention, simultaneous, and successive processes and the individual's base of knowledge." In the planning process, an individual must recognize the need for a plan, as well as develop and initiate the plan. An essential part of planning is metacognition, the awareness of and knowledge about cognitive processes. This is where the individual examines the plan for its usefulness, modifies the plan, and creates another plan as needed. Planning is the process that appears to unite the information coding and attentional processes (Das, et al, 1994).

Naglieri (1997, p. 250) asserts that "PASS processes are dynamic in nature, respond to the cultural experiences of the individual, are subject to developmental changes and form an interrelated (correlated) interdependent system." As in the Triarchic theory above, sociocultural aspects are seen as influencing cognitive functioning. Naglieri and Sloutsky (1995) maintain that sociocultural systems provide a foundation for representing, processing and gaining new information.

All the theories above have some similarities, for example, a component of metacognitive functioning, although each theory, as shown, has its own unique aspects whether it is the role of context, information processing, or schemes in intelligence. Below, empirical research with those with reading disabilities will be examined from the perspective of each intelligence theory.

Relevant Research with Reading Disabilities

Triarchic Theory of Intelligence

Empirical research on reading disabilities specifically using the Triarchic theory of intelligence is limited although a few researchers (Kolligian & Sternberg, 1987; Spear-Swerling & Sternberg, 1996) outlined how this type of disability is seen from the Triarchic theory. Below the three subtheories (Componential, Experiential and Contextual) will be investigated in regards to reading disabilities.

Reading disabilities may occur in all parts of the Componential subtheory. Metacomponential functioning may be indirectly affected through deficits in working memory, since metacomponential information must be accessed by working memory before it is applied to a problem. Spear-Swerling and Sternberg (1996) state that as children become older, the planning strategies they use become more and more central to reading. In addition, inadequate communication between metacomponents and performance components may be involved in reading disabilities through a child's continued use of inefficient strategies. Performance components may also be involved, according to Kolligian and Sternberg (1987), when a child has an inability to use a reading process, such as orthographic processes, in reading. Knowledge-acquisition components are critical in reading disabilities since the use of selective encoding,

selective combination and selective comparison are involved in reading. Several researchers (Ceci, 1982; Bauer, 1982; Torgesen & Goldman, 1977) have found that those with reading disabilities were deficit in strategies of assimilating and organizing information (selective combination). It has also been hypothesized by Kolligian and Sternberg (1987) that reading disabled individuals have a limited ability to encode and combine information, and thus a limited knowledge base. Swanson (1982) also found less knowledge in relevant subject areas in reading disabled students and that this can influence a student's ability to process incoming information.

The Experiential subtheory looks at the experiential history of the child with reading disabilities, specifically assessing how they respond to novel and automatic tasks. Reading is a skill that begins as a novel task to beginning readers and progresses to becoming a more automatic task (Kolligian & Sternberg, 1987). Many studies have shown automatization failure in those with reading disabilities (Ackerman & Dykman, 1982; Spear & Sternberg, 1986; Sternberg, 1984). This means that they must allocate attention and effort to tasks others have learned to do automatically. Difficulties in coping with novelty may be due to inefficient knowledge-acquisition components, inadequate cognitive strategies, or limited knowledge base (Kolligian & Sternberg, 1987) . Another aspect of the Experiential subtheory includes examining the impact of school failure that many with reading disabilities have endured. Several studies (Harter, 1985; Renick, 1985) have found that those with reading disabilities view themselves as less competent than their peers.

Aspects of reading disabilities can also be explained by the Contextual subtheory. According to this subtheory, individuals attempt to adapt, shape or select environments that meet their needs. In many instances, the severity of an individual's reading disability may be determined by the extent he or she successfully adapts to, shapes, and selects his or her school environment. Unfortunately, older students with reading disabilities may "select" another environment by dropping out of school. Adaptation has been cited most often as impacting the severity of reading disabilities (Strawser & Weller, 1985; Weller, 1980; Weller, Strawser & Buchanan, 1985), which includes interpersonal, attentional, and/or organizational adaptations.

Overall, the Triarchic theory of intelligence is a multifaceted approach to interpreting reading difficulties, while the Campione-Brown theory also has several components which have been studied in regards to reading disabilities.

Campione-Brown Theory of Intelligence

Several components of the Campione-Brown theory of intelligence are especially relevant to reading disabilities: short-term and working memory, knowledge base, control processes and metacognition.

Short-term memory (STM) has been highly researched in the area of reading disabilities within the last 15 years (Swanson & Cooney, 1991). Many researchers argue that information that is temporarily retained in the STM is important to reading recognition (Bisiachhi, Cipolotti, & Denes, 1989; Ellis & Large, 1987; Jorm, 1983), while others even state that tasks that measure STM can be used to differentiate between those with and without reading disabilities, although the findings substantiating this have been mixed. In addition, correlations between STM and achievement have generally been low for both those with reading disabilities and those without (Swanson, 1994). In contrast, verbal working memory tasks have been found to correlate with achievement (Daneman & Carpenter, 1983; Kyllonen & Christal, 1990; Salthouse, 1990) and differentiate between reading disabled and nondisabled individuals (Siegel & Ryan, 1989; Swanson, 1992; Swanson, Cochran, & Ewars, 1989).

The Campione-Brown theory, like the Triarchic theory, also has a component based on knowledge. The research on knowledge-base, in regard to those with reading disabilities, that was mentioned for the Componential subtheory above is still applicable here.

The control processes, which help a child decide on relevant information, arrange information meaningfully, store information in the STM, and transfer information to the long term memory, have also been studied with those with reading disabilities. Many studies have shown that those with reading disabilities have inefficiencies or deficits in their processing (Rose, Cundick & Higbee, 1983; Lorsbach & Gray, 1985; Wong, 1982). It has been found that those with reading disabilities make little use of mnemonic aids, such as labeling, verbal rehearsal, clustering, and

chunking (Sattler, 1992). Several explanations have been formulated to explain reading disabled children's inefficient use of these strategies (Torgeson, 1980). These include verbal language processing difficulties, developmental delay, as well as being unprepared for the school environment.

Metacognition is also present in the reading disability literature, although psychology and education are still defining elements of metacognitive theory (Borkowski, Carr, Rellinger, & Pressley, 1990). Borkowski, Estrada, Milstead, and Hale (1989) asserted that self-regulation and the motivational beliefs associated with using learning strategies are the metacognitive concepts that are relevant to understanding reading disabilities. In addition, they maintained that teachers must understand these processes to be effective. Self-regulation skills form the basis for "adaptive, planful learning, thinking, reading, and problem solving across a number of academic domains" (Borkowski, 1992, p. 253). At the start of a task, the function of self-regulation is to analyze and select an approach to problem solving from alternatives. Later on, its function is to monitor learning and adjust and revise the strategy as needed (Borkowski, 1992). Cognitive acts also have motivational consequences that affect future self-regulatory actions. Students can learn to recognize the importance of using strategies and then begin to attribute their success to effort. These kinds of motivational factors were also seen as important to reading disabilities in the Triarchic theory of intelligence. Next, literature on the PASS theory of intelligence will be reviewed in regards to those with reading disabilities.

PASS Theory of Intelligence

Early research concerning the PASS model of intelligence and reading only assessed successive and simultaneous processing tasks in reading decoding and comprehension. Information coding has been found to be important in several studies (Cummins and Das, 1977; Kirby & Das, 1977; Leong, 1980; Rykman, 1981). Several studies have found that those with the highest scores on simultaneous and successive processing obtain the highest reading scores, while those low in those areas had the lowest scores (Kirby and Das,1977; Rykman, 1981; Leong, 1980). Cummins and Das (1977) found that successive processing is more important to students'

basic reading decoding skills, but simultaneous processing is more important for reading comprehension. They concluded that the requirements for reading change from basic decoding to more advanced levels of comprehension. More recently, Kirby and Robinson (1987) found that successive processing is particularly difficult for children with dyslexia, which was confirmed by Das, Mishra, & Kirby (1994) who also found that word decoding involved successive processing. Recent research has established the importance of both simultaneous and successive processing, as well as planning, in reading comprehension (Das, Mensink & Janzen, 1990; Naglieri & Das, 1988).

Those with reading disabilities have been studied in regards to both sustained and selective attention. Das (1988) found no differences in sustained attention between reading disabled and non-disabled individuals. Several studies have examined whether selective attention is a major cause of reading failure (Ross, 1976; Copeland & Reiner, 1984), although the results have been mixed (Samuels & Miller, 1985). Overall, Das, Naglieri and Kirby (1994) report that assessment of selective attention (more than sustained attention) has shown differentiation between youth with reading disabilities from the non-disabled. Furthermore, it has been found that those with reading disabilities take a longer time in matching upper to lowercase letters, so they are less efficient in selecting appropriate responses and encoding letters as the same or different (Das et al., 1994).

In general, research with reading disabled students has found that these students have difficulty in developing and using effective strategies and plans for remembering (Baker, 1982; Dillon, 1986; Kolligian, Jr. & Sternberg, 1987; Wong, 1988). Other research has specifically studied the planning aspect of the PASS model. Naglieri and Das (1987) found that planning was significantly related to students' reading achievement. They found reading scores for older students (6th and 10th grade) were most related to simultaneous processing and planning. Other researchers (Bardos, 1988; Das, Mishra & Kirby, 1994; Prewett, 1991; Flanagan, 1992) have found planning deficits in those with reading disabilities using the experimental edition of the Das-Naglieri: Cognitive Assessment System (an assessment instrument which will be described in more

detail in the next section). Naglieri & Reardon (1993) hypothesized that when more complex tasks are used to measure reading, more of the PASS processes become involved.

While each of the theories appears to have components that relate to reading difficulties, perhaps the most important aspect is whether these components can be measured reliably and the results then used to design effective intervention programs. Below, each theory will be explored in regards to assessment and intervention.

Implications for Assessment and Intervention

Triarchic Theory of Intelligence

Assessment

Assessment of intelligence using the Triarchic theory as a base has been developed by Sternberg (1990) and is currently available in a research version. The name of the instrument is the Sternberg Triarchic Abilities Test (STAT; Sternberg, in preparation) and measures abilities in academic and practical contexts, as well as the abilities to automatize information processing and cope with novelty. There are 12 item types which measure componential, coping-with-novelty, automatization and practical abilities in the verbal, quantitative, and figural domains. Designed to measure kindergarten through adulthood, scores are computed for each of the process and context domains. Items from the test have been tested in research and have also undergone a pilot testing. The results have been "favorable results across grade levels" (Sternberg, 1990, p. 219), showing reliability of items and subtest scores increasing with grade level.

Consistent with his theory, Sternberg himself realizes (1990) that intelligence must be tested within the boundaries of a culture and is affected by prior experience, although he believes intelligent behavior in any culture is based on the same components of intelligence (Sternberg, 1997). Overall, the test was developed to be more comprehensive than traditional intelligence tests and also to complement other forms of assessment (like portfolio assessments). Results from the STAT can also be linked to *Intelligence Applied* (Sternberg, 1986), a program for teaching intellectual skills based on the Triarchic theory.

Intervention

Sternberg's *Intelligence Applied* is a program for secondary and college-level students that leads students through information on the Triarchic theory and intelligence, as well as exercises to increase intellectual skills. This program is limited in its application because it is only for secondary students, and also requires a lengthy time commitment from teachers. Although Sternberg has used the program himself, little research was found that addressed the effectiveness of the program.

Other interventions have been based on the componential, experiential, and contextual subtheories of the Triarchic theory and are summarized by Sternberg (1997). The componential subtheory was applied to the teaching of vocabulary to adult learners, and results found that subjects given instruction based on the theory showed the most improvement. Both gifted and average children were studied in a program based on the experiential subtheory where insight skills (selective encoding, selective combination, and selective comparison) were taught. Children who underwent the program had significant improvement regardless of their IQ level.

Another program, *Practical Intelligence for the Schools* was based on the contextual subtheory and aimed to teach practical intellectual skills in the areas of writing, reading, test taking and homework. Sternberg reports that studies in several school districts have shown significant improvements on study-skills measures and performance-based measures for those who have undergone the program. These studies, although limited in number and subject type, are encouraging evidence that interventions based on the Triarchic theory of intelligence could be effectively implemented, yet more empirical research on the effectiveness of these programs needs to be completed.

Campione-Brown Theory of Intelligence

Assessment

There are no specific assessment instruments developed to measure intelligence from the perspective of Campione and Brown. However, Borkowski (1985) hypothesized how aspects of the model could be measured, and Campione and Brown have been proponents of dynamic assessment.

Borkowski (1985) believed measures of perceptual efficiency could include reaction time, span, inspection time, decoding speed, and backward masking tasks. Reaction time and span tasks would be used to measure encoding efficiency. Borkowski (1985) suggested the use of a word span test rather than digit span, in order to reduce the chance that a client used grouping strategies.

Borkowski (1985) also asserts that decoding speed could be measured by identifying name identity (whether a letter has the same name) or physical likeness in a pair of letters as fast as possible (for example Aa or AA). Decoding speed is then measured by subtracting the client's reaction time when classifying name identity from the reaction time to classify physical likeness. This technique has been used by Posner and Boies (1971) and Hunt (1978), and a similar task is included in the DN:CAS below. Backward masking or having a stimulus interfere (through noise or patterns) with the processing of the previously presented stimulus has been used to measure the speed of central processing. This task has been used successfully by Haber (1969) and Sperling (1963) to examine perceptual processes.

The components of the executive system (except for schemes), according to Borkowski (1985), can be measured directly. Knowledge can be measured using the information, vocabulary, and arithmetic subtests from the Wechsler scales. Control processes could be measured (as they have in the past) by the use of "clustering in free recall, interacting imagery in paired associate learning, and pause time pattern in a serial-probe task" (Borkowski, 1985, p. 118). In addition, metacognition can be assessed through the use of interviews (Kreutzer, Leonard, and Flavell, 1975; Paris, Wasik, & Turner, 1991), as well as the Metacomprehension Strategy Index (Schmitt, 1990) which measures awareness of reading strategies.

Brown and Campione (1986) have embraced dynamic assessment and criticized traditional standardized tests for only assessing competence levels and ignoring the learning process. They maintain that "dynamic assessment methods rely on expert guidance and supportive contexts to reveal the current state of a child's understanding"(p. 1065). This type of assessment sees the role of testing as that of prescription. Tests should provide knowledge about what a child doesn't know right now but is almost ready to learn. Campione (1989) contends that this approach provides more

insights into a child's learning potential and could bypass the "select and label" process of special education.

In this assessment approach, a learning environment is created in which a child's current level of functioning and potential for learning is evaluated. Although the term "dynamic assessment" is used to encompass several approaches, a common feature is an "emphasis on evaluating the psychological processes that are involved in learning and change" (Brown, Campione, Webber, & McGilly, 1992, p. 140). This change can be measured by looking at the product of assisted assessment (how much change has occurred) or the processes that have changed. An example of change in a process is the "comprehension monitoring" that students can learn to do while reading (described in more detail below under intervention). The teacher can then assess which processing skills are strengths and weaknesses. Brown et al. (1992) have focused on assessing a particular content area, while some researchers using dynamic assessment have looked at more broad cognitive functions.

To standardize the type of assistance given in the assessment, Brown et al. (1992) have looked at "transfer efficiency." They assess how much additional assistance was needed by a student to transfer what was learned to novel situations. In this model, a pretest is given on the knowledge of the domain being assessed. The students then work together with a tester/teacher who provides "hints" until the students can solve the problem. The role of the tester is to estimate the level of hint needed by a student and then to provide that assistance. Early hints are basic metacognitive suggestions, but the hints become more specific as the process continues. The assistance given the student is "taken as the estimate of his/her learning efficiency within that domain and that particular point in time" (Brown et al., 1992, p. 155). After the students achieve independent learning, they are given new problems to solve. At this time, the transfer of the learning is assessed. Brown et al. (1992) maintain that the measurement of the number of hints and transfer possesses adequate psychometric properties, including predictive and concurrent validity. Palincsar, Brown and Campione (1991) state that evidence for concurrent validity of

dynamic assessment is that those with higher academic ability required less assistance to learn rules and principles and transferred the use of the rules more quickly.

Intervention

Interventions based on the Campione-Brown model could include those in the areas of metacognition, attention, and storage and retrieval of information. The focus of much of the work of Campione and Brown has been in the area of metacognitive strategies.

Borkowski (1992) asserted that the metacognitive skill of self-regulation was important for those with learning disabilities. Use of self-regulation skills could be focused on through inservice training or consultation by a school psychologist. Manning and Payne (1996) describe a self-regulated learning activity called "comprehension monitoring." In reading tasks, the teacher works to activate the students' background knowledge, as well as have them make predictions about the content and set purposes for reading. Students also generate questions that they answer as they read. Another process which focuses on having students find meaning in text is Reciprocal Teaching (Brown & Campione, 1986). This teaching method involves a cooperative learning group where a teacher and students alternately lead a discussion on a text they are reading. The approaches they then use include questioning, clarifying, summarizing and predicting.

Students can also be taught more sophisticated metacognitive knowledge and strategies for learning which are highlighted by Ormrod (1995) below:

1. Students learn strategies best when they are taught within specific subjects and academic learning tasks.

2. Students can only use learning strategies when they have the knowledge base to which they can relate new information.

3. Students should learn a wide variety of strategies and where it is appropriate to apply them.

4. Effective strategies should be used with a variety of tasks over a long period of time.

5. Teachers can model effective strategies by "thinking aloud" about new information.

6. Students must believe that they can master challenging material through hard work and appropriate learning strategies.

Interventions based on the architectural system of the Campione-Brown theory should be designed to enhance the student's ability to attend to and respond to instruction. One area of consultation by school psychologists with teachers could be how to maintain student attention in the classroom. Ormrod (1995) lists the following suggestions, based on research, to be implemented to gain student attention:

1. Include a variety of topics and presentation styles.
2. Minimize distractions when students are doing seatwork.
3. Monitor students' physical clues as to whether they are attentive.
4. Ask questions to maintain students' attention.
5. Seat distractible students closer to the teacher.

Another area to address through consultation could include ways to facilitate student's storage and retrieval of information in the classroom. These strategies include making the learning meaningful for students by connecting reading assignments to relevant background knowledge (Beck, 1985). Presentation of information in an organized manner by the teacher, as well having the student utilize the information personally in a learning activity has been found to be beneficial (Brown & Campione, 1986). Students also retrieve information better that is stored in that context; thus, students should have opportunities to apply the information in a situation in which they will be using it (Ormrod, 1995).

PASS Theory of Intelligence

Assessment

Assessment of intelligence using the PASS theory of cognitive processing can be done by using the Das-Naglieri: Cognitive Assessment System (DN:CAS, 1997). This instrument was standardized using a random, stratified sample of 2,200 subjects between the ages of 5 and 17 years old from 68 sites nationwide. The subtests are briefly described below, although the tasks on some subtests vary for older and younger clients. Reliability information is not yet available, but

validity evidence is available in the literature for an experimental edition of the DN:CAS (which included some of the same tasks).

The planning subtests include Planned Codes, Matching Numbers and Planned Connections. Planned Codes provides a client with codes (XX, OO, XO, OX) which correspond to specific letters, and he or she then fills in the corresponding codes in the empty boxes. In Matching Numbers, the client identifies and underlines two numbers in a row that are the same. Planned Connections requires the client to connect sequential stimuli that appear on a page in an apparent random manner. For example, the easier items require a child to connect a series of numbers in order, while the more difficult items has him/her connect numbers and letters alternately (A to 1, B to 2, etc.) (Naglieri, 1997).

Subtests of attention include Number Detection, Receptive Attention, and Expressive Attention and are all measures of selective attention. Number Detection has subjects underline specific numbers that occur at the top of the page, while Receptive Attention has them underline pairs of pictures (younger) or letters (older) which are identical in appearance and then identify those with the same name. The Expressive Attention subtest varies by age, but for older subjects, (8-17) the client reads words, identifies colored shapes, and then must read the color of the word rather than pronouncing the word. For example, the word "blue" may be printed in red ink, and the client would say "red."

Measures of simultaneous processing in the DN:CAS include Verbal Spatial Relations, Nonverbal Matrices, and Figure Memory. Verbal Spatial Relations requires subjects to identify the picture that correctly answers the question read by the examiner, while in Nonverbal Matrices they examine an abstract pattern and solve the item by choosing the best option to complete the matrix. Figure Memory requires the client to examine a figure (i.e. a square) for 5 seconds and then identify the initial figure in a more complex design (Naglieri, 1997).

The successive processing subtests include Word Series, Sentence Repetition, Sentence Questions and Speech Rate. Word Series has the client repeat words in the same order as read by the examiner (from two to nine words). Sentence Repetition has subjects repeat each sentence

(which has color words in place of nouns and verbs) exactly as it was presented, and Sentence Questions has the client answer questions about the sentence. Speech Rate involves the repeated pronunciation of words in order. For example, the time would be recorded on how long it took the client to say three words in order ten times (Naglieri, 1997).

Overall, the assessment system yields a full scale score, four cognitive processing scales (both of these scales have a mean of 100 and a standard deviation of 15), and subtest scores (mean of 10 and a standard deviation of 3). The cognitive processing strengths and weaknesses of the student can then be addressed in an intervention based on the PASS model.

Intervention

An intervention program based on the PASS model, the PASS Remedial Program (PREP), began developing in 1976 and has been shown to be effective in improving reading (Das, Mishra, & Pool, 1995). Proposed as an alternative to direct training of strategies, the program is designed to encourage the development of processing strategies by internalizing the principles (Das et al., 1994). Although the PREP program has been modified as it developed, Das et al. (1995) used a current version to evaluate its effectiveness with children with decoding difficulties. The PREP program has two parts which include global process training (opportunities to internalize strategies) and bridges (training in strategies relevant to reading and spelling). The program, comprised of 10 tasks, is designed to improve successive and simultaneous processing deficits through rehearsal, prediction, revision of prediction, categorization, monitoring of performance, and sound blending (Das et al., 1995). Rather than direct instruction, children become aware of their cognitive processes through verbalizing and discussing their thinking during and following the tasks. The instructor also gives input on strategies that the child used but did not mention in the discussion.

In the Das et al. (1995) study, the students received remediation one to three times a week for a total of 15 sessions. Each session lasted 50-60 minutes. They found that the PREP group had significant improvement in both word identification and word attack skills, as well as an increase in performance by 9 months in a 6 month period. Other studies have also shown

promising results using the PREP approach to intervention (Brailsford, Snart, & Das, 1984; Krywaniuk & Das, 1976; Spencer, Snart, & Das, 1989).

Das et al. (1994) also propose that interventions should be interactive where the teacher asks the student about his or her learning process. Students should be able to relate instructional knowledge to their own knowledge and constantly relate the two while they are learning. Additionally, teachers should aim to train in global processes and then combine this training with content-specific curriculum teaching. The effective teaching strategies in maintaining student attention and encouraging metacognitive learning mentioned above for the Campione-Brown model would also be applicable to the Attention and Planning units of the PASS model.

Discussion

The theories of intelligence reviewed in this monograph offer structure for conceptualizing reading disabilities and show promise for assessment and intervention by school psychologists. These approaches offer a theoretical base to understand reading disabilities which acknowledges the complexity of intelligence, learning, and sociocultural influences. These theories break from the traditional views of a general factor of intelligence ("g") and intelligence assessment, in varying ways, to boldly define new paths to follow.

Best practices in assessment requires that tests with adequate standardization, a high degree of reliability and evidence of validity be used (Sattler, 1992), and at this time, it appears this only includes the DN:CAS (if reliability data is adequate). If the STAT becomes available, it may prove to be a useful assessment instrument, providing that it has satisfactory psychometric properties. Assessment of cognitive processing from the PASS model has been able to differentiate those with reading disabilities from the non-disabled, which has not been the case with traditional intelligence tests. Although, the dynamic assessment approach embraced by Brown and Campione is gaining acceptance, it appears that there is still much research to be done to evaluate its effectiveness.

There has been a call over the past decade to link assessment and intervention (Reschly, 1980; Shinn, 1989; NASP, 1994), instead of continuing to use assessment primarily to determine eligibility for special education services. Although the theories reviewed show promise in the area

of linking assessment to intervention, especially the Campione-Brown theory, there is still a lack of empirical research to substantiate the results with reading disabled students.

Overall, the traditional intelligence tests that are used in the schools have changed little since they were developed decades ago, and their developers have not embraced the increasing knowledge in the fields of intelligence and reading disabilities. Assessment instruments and intervention strategies based on the three theories reviewed in this monograph show promising evidence that this impasse may come to an end.

Future Research

Further research is needed on the three theories reviewed in this monograph, as well as in the area of reading disabilities. However, evaluation of past reading disability research in assessment and intervention has been difficult because of heterogeneous samples and vague sample descriptions (Durrant, 1994). These problems limit the generalizability of the findings, contribute to contradictory findings, and make interpretation of findings difficult. For assessment and intervention research to be as meaningful as possible, future researchers should follow the Council for Learning Disabilities (CLD) standards for description of subjects (Smith, et al., 1984). Moats & Lyon (1993) have proposed that a variety of specific disorders need to be defined for a valid classification system to be used in research.

Ultimately, it is important to know how to successfully help individuals once they have been identified as reading disabled. Building a foundation of effective interventions must be made a research priority. Specifically, research into early intervention programs which can identify and remediate reading problems before they become too severe is needed. Recent research (Iverson & Tunmer, 1993; Wasik & Slavin, 1993; Vellutino et al., 1996) has shown that most impaired readers can achieve grade-level reading if they receive early and intensive intervention.

If we are to understand and encourage success for those with reading disabilities, we must break from our ingrained traditions and thoroughly investigate new theories, assessment instruments and interventions. Effective methods of assessment and intervention, discovered

through research, must then be implemented in the schools and serve as the basis for professional practice by school psychologists.

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