

Best Practices in Interventions for School Psychologists: A Cognitive Approach to Problem Solving

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OVERVIEW

The purpose of this chapter is to illustrate how interventions can be linked to cognitive assessment within a problem-solving context. The chapter focuses on cognitive assessment methods as a means of understanding the nature of the problem and what might be done to solve the problem (instructions that are rooted in cognitively based educational principles). The approach combines a way of thinking about intelligence as specific cognitive processes and a way of teaching that places emphasis on the cognitive activities involved in academic tasks, sometimes referred to as cognitive education. In order to place this new approach to intervention within a larger context, the chapter begins with a brief look at the current state of the art of using results from traditional IQ tests. Next, cognitive education will be defined and illustrated and the steps needed to go from cognitive assessment to cognitively based interventions will be discussed. An illustration of using a cognitive approach to assessment and intervention will be provided along with instructional handouts that school psychologists could give to a teacher or parent. This illustration is intended to show how the connections between cognitive assessment and cognitively based educational methods may be achieved and how it may be conducted within a problem-solving context.

BACKGROUND

The concept of using results from an intelligence test to guide educational recommendations and interventions is intuitively appealing, yet traditional IQ tests have been criticized for providing limited information for intervention design (Reschly & Grimes, 1995). This limitation has been recognized for some time. For example, Kaufman and Kaufman took a historically important step about 20 years ago when they suggested that tests of intelligence like their Kaufman Assessment Battery for Children (K-ABC; Kaufman & Kaufman, 1983) could be used for instructional decision making. While the K-ABC made many important contributions to the assessment of intelligence, the suggestion that their measure of ability could be used to guide intervention is one of the ways in which that test distinguished itself. More recently, Ashman and Conway (1997) have suggested that tests like the K-ABC or the more recent Cognitive Assessment System (CAS; Naglieri & Das, 1997a) could be combined with cognitively based educational approaches to aid in the development of interventions to provide more effective instructional environments for children.

Peverly (1994) noted the value of a cognitive approach in a review of the potential impact of cognitive psychology on school psychology. He wrote that instructional "programs that include the knowl-

verbal tests provide an efficient solution to the problem of assessing general intelligence for persons from diverse cultural and linguistic populations and are still used today, as illustrated by the recent publications of nonverbal individual (Universal Nonverbal Intelligence Test by Bracken and McCallum (1998)) and group (Naglieri Nonverbal Ability Test by Naglieri (1997)) tests. Thus the organization of tests into Verbal and Performance Scales on the Wechsler tests can be considered a dichotomy of convenience rather than a representation of two different types of intelligence. Many have published important works to help us interpret these verbal and nonverbal tests in a variety of ways, each designed to go beyond the overall IQ scores.

There have been many attempts to find theoretical explanations for the Wechsler subtests. Kaufman (1994a, 1994b) and Kaufman and Lichtenberger (2000) provided outstanding texts for interpretation of the various Wechsler scales so that practitioners may extract meaning from the many scores the test yields by using a mixture of psychometric analysis, knowledge of the research, and clinical judgment. Others have provided similar texts to better understand the results of the Wechsler, and other tests of general intelligence (e.g., Sattler's 1988 text), and there have been many published papers on how to interpret the subtests. Among the most recent attempts to provide school psychologists with still another way to interpret the Wechsler is the cross-battery approach (McGrew & Flanagan, 1998), which applies a Gf-Gc model. This reinterpretation in particular has a basic limitation noted by Kaufman (2000) when referring to Horn's Fluid/Crystallized approach and the related Carroll model:

There is no empirical evidence that these approaches yield profiles for exceptional children, are directly relevant to diagnosis, or have relevance to eligibility decisions, intervention or instructional planning—all of which are pertinent for school psychologists (p. 27).

It is becoming more apparent that while there are many possible ways to interpret the Wechsler scales, these methods have not resulted in improvements in diagnosis or interventions for children with academic problems (Naglieri, 1999; Reschly & Grimes, 1995). It is reasonable, therefore, to suggest that the quest for

obtaining meaning from the various Wechsler scores does little to help practitioners move from assessment to intervention. This is not as much a criticism of the general intelligence approach as recognition that this way of conceptualizing ability is better used as an overall estimate of ability rather than as a tool for differential diagnosis and treatment planning.

The view that Wechsler's scales are not based on firm theoretical concepts of verbal and nonverbal intelligence but rather on the vague concept of general intelligence (e.g., a global aggregate or all-round ability and knowledge concept) with subtests that contain verbal and nonverbal content helps us see why this approach does not lend itself to being useful within the ATI context. In order to have an interaction between a child's underlying ability and some instructional method, there needs to be a clear conceptualization of what the underlying ability is. There also must be a good understanding of the underlying component of the instructional method using the same theoretical basis. That is, in order to show an interaction between an aptitude and performance in the classroom, the same underlying cognitive component should be involved in both. This will be illustrated later in this chapter by using methods that come from the cognitive education literature. It is, however, important to understand the basic elements of a cognitive approach to education.

Cognitive Education

One important purpose of education is to provide children with the knowledge and skills they need in order to be productive members of a society. Considerable emphasis has been placed on teaching children facts like who discovered America, how to solve a math word problem, what sounds each letter and letter combinations make, what the components of a proper sentence are, and so forth. Knowledge and skill acquisition has been and continues to be essential to success. It is becoming apparent, however, that in addition to teaching students knowledge and skills that seem important today, teachers also need to help children learn how to effectively manage situations that they will face well after schooling is completed. Modern instruction should help children acquire knowledge and skills, but, more importantly, "to plan and control, to think and inquire, to evaluate and reflect" (Scheid, 1993, p. 3). This means that knowl-

nection between a child's cognitive processing competence and academic performance can be understood (Pevery, 1994). This demands a strong theoretical perspective and assumes that the school psychologist has a working knowledge of the cognitive processes. This is important because the cognitive demands of the academic tasks need to be determined and these demands related to a theory of cognitive processing. One approach to defining cognitive processes is the PASS (Planning, Attention, Simultaneous, Successive) theory, which is measured using the CAS (Naglieri & Das, 1997a). This theory is well supported by a considerable amount of research summarized in the *Cognitive Assessment System Interpretive Handbook* (Naglieri & Das, 1997b) and in *Essentials of CAS Assessment* (Naglieri, 1999). The CAS provides the most extensively validated way to measure the four processes defined as follows:

1. Planning is a mental activity that provides cognitive control, use of processes, acquisition of knowledge and skills, intentionality, and self-regulation.
2. Attention is a mental activity that provides focused, selective cognitive activity over time and resistance to distraction.
3. Simultaneous is a mental activity by which the child integrates stimuli into inter-related groups.
4. Successive is a mental activity by which the person integrates stimuli in a specific serial order to form a chain-like progression.

The four processes measured by the CAS have been found to have a greater correlation with achievement than do traditional IQ tests; yield profiles of PASS scores that are sensitive to the cognitive problems experienced by children with, for example, Attention Deficit/Hyperactivity Disorder and reading disabilities (Naglieri, 1999); yield the smallest differences between white and African-American children (Wasserman & Becker, 2000); and relate to intervention (Naglieri & Gottling, 1995, 1997; Naglieri & Johnson, 2000). Additionally, extensive research evidence that supports the validity of the separate PASS scales is provided. For example, Naglieri and Das

(1997b) reported that the standardization sample children who used strategies to solve the planning tests earned good scores on those subtests while the children who did not use strategies earned low scores. Importantly, strategy use (Planning) has also been related to interventions that improve performance in mathematics calculation (Naglieri & Gottling, 1995, 1997; Naglieri & Johnson, 2000). The relationship between PASS and academic improvement found in these research papers in combination with research on differential diagnosis provides ample support for the use of CAS for building interventions, especially when a child has a cognitive weakness (which will be described in greater detail later in this chapter) in one of the PASS scales.

Evidence That Cognitive Interventions Can Work

Perhaps the research most relevant to using cognitive processing information to improve educational outcomes is the planning facilitation research most recently illustrated by Naglieri and Johnson (2000). This research, which is based on the work of Cormier, Carlson, and Das (1990) and Kar, Dash, Das, and Carlson (1992), utilized a method that stimulated children's use of planning, which had positive effects on performance. The method was based on the view that planning processes should be facilitated rather than directly taught so that children discover the value of strategy use without being specifically told to do so.

The studies reported by Cormier et al. (1990) and Kar et al. (1992) demonstrated that students differentially benefited from a technique intended to facilitate planning. They found that participants who initially performed poorly on measures of planning earned significantly higher scores than those with good scores in planning. The method encouraged a planful and organized examination of the demands of the task, and this helped those children that needed to do this the most (those with low planning scores). These studies were the basis for three experiments by Naglieri and Gottling (1995, 1997) and Naglieri & Johnson (2000) that focused on improving math calculation performance.

The two research studies by Naglieri and Gottling (1995, 1997) demonstrated that an intervention that facilitated planning led to improved performance on multiplication problems for those with low scores in

is related to academic difficulty. When a child's academic skill deficit has an associated cognitive processing deficit, then an intervention that takes into consideration the connection between these two dimensions is needed. If, however, a child has an academic skills deficit without a cognitive deficit, nor an emotional or behavioral or some other child-based problem, then the best intervention may be to provide additional instruction of the academic skill, make alterations to the environment, ensure that the child is exerting effort to learn, and so forth.

When a child has an academic problem and is weak in some area of cognitive processing and the cognitive demands of the academic tasks have been carefully examined, one option is to consider interventions that help the child use a different process when doing the academic work. For example, suppose that a child has difficulty learning basic math addition facts such as $9 \times 6 = 54$, and the teacher's instructional method is to make the child recite the phrase "nine times six equals fifty-four" or write the statement many times until the facts are remembered (become automatic). This task demands recall of information in a specific order, which demands considerable Sequential (from K-ABC) or Successive (from CAS) processing. If a child is poor in this type of processing, recall of the string of words could be very difficult. Thus, the problem may be that the processing demand of the task as presented by the teacher has a heavy reliance on Successive processing and the child has a cognitive weakness (Naglieri, 1999) in that area. Instruction that takes into account the underlying processing demand of the academic task needs to be selected or prepared. That is, it may be helpful to use a different instructional approach that has a different cognitive processing demand (this will be expanded in the description of step 2). At this point in the procedure, the child's knowledge and skills as well as cognitive competencies have been examined.

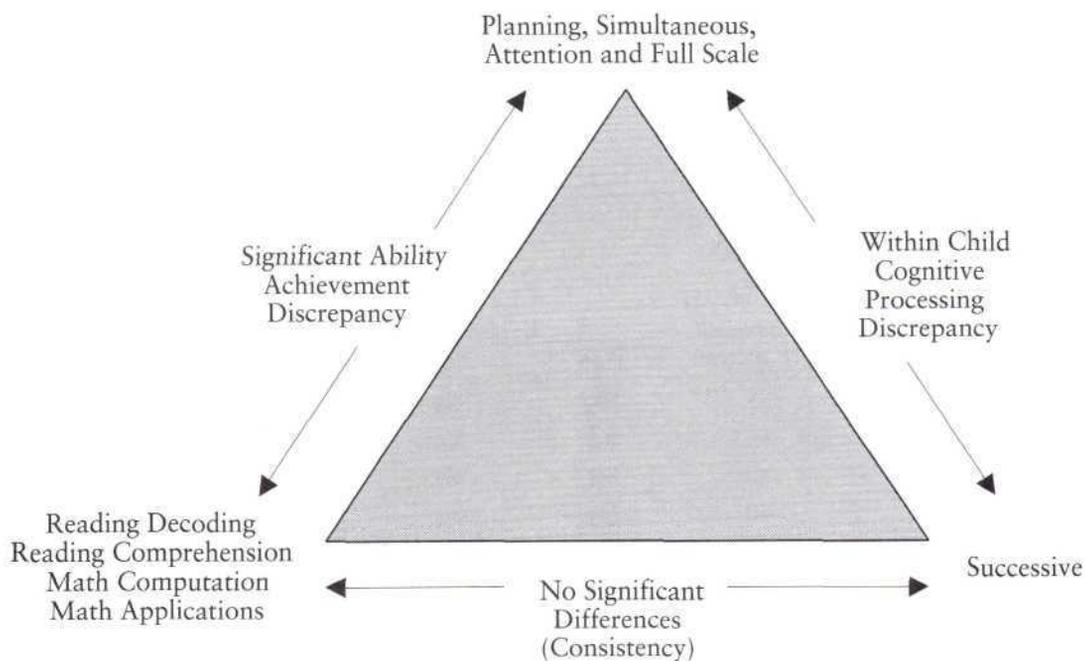
STEP 2

Preparation of the best teaching method is the second step in the instructional cycle described by Naglieri and Ashman (1999). This phase includes selection of the content, examination of the various methods available to help the child acquire the content, selection of the best materials, and consideration of the processing demands vis-à-vis the academic demands of the activity. Continuing from the example given

previously, the teacher and school psychologist might collaboratively determine that the child needs to be taught basic math facts using a method that does not put so much emphasis on successive processing. One way to do that is to teach the child to use strategies for obtaining the correct answer (i.e., use more planning processing and less successive). When a strategy or plan is used in this way, the correct answer is arrived at by thinking about the problem (being strategic or planful) rather than by rote memory (which demands much successive processing). This alteration in the methods used changes the cognitive demands of the task considerably.

There are many strategies or plans that can be used to change the processing demands of a task like memorization of facts. When the teacher switches instructional methods in this manner the use of strategies (plans) for remembering basic math facts can have very positive results (Pressley & Woloshyn, 1995). Geary (1994) also stressed the importance of teaching children strategies for remembering math facts, and Goldstein and Mather (1998) provided a comprehensive list of strategies for remembering math facts. For example, in order to learn the 9 times tables the child may use a system of obtaining the answer as follows: For the problem presented above ($9 \times 6 = 54$) the strategy works like this. Take 1 away from the multiplier (6), then add a number to that one which equals 9. For example, to calculate 9×6 , you would say: $6 - 1 = 5$, so 5 goes in the 10s place, and $5 + 4 = 9$, so 4 goes in the 1s place making the answer 54.

Another example, using more basic math might involve the "doubles plus one rule." This rule teaches children that if they know the sum of two same numbers ($7 + 7 = 14$), then a problem like $7 + 8$ is one more than $7 + 7$. This strategy for obtaining the answer shifts the cognitive demand from one that demands recall of the specific series of words—"7 plus 8 equals 15" (which demands much successive processing)—to a planning rich activity where the child thinks to arrive at the answer. The child might say " $7 + 8$, I know $7 + 7$ is 14, 8 is 1 more than 7, so the answer has to be 1 more than 14 which is 15." Shifting the cognitive processing demand of a task is an excellent intervention because not only does it help the child perform a task in a way that does not rely on his or her cognitive weakness but it gives the child a chance to be successful using strategies or plans as suggested by Geary (1994) and Pressley (1998).

Figure 1. Relationships among CAS and K-TEA scores

has been used in intelligence testing (see Kaufman, 1994a, 1994b; Naglieri, 1993; Sattler, 1988) for some time. In contrast, there are two requirements for a child to have a “cognitive weakness.” The first is that a relative weakness is present, and the second is that the low cognitive processing score should be below normal limits (e.g., a standard score of 85, representing one standard deviation below the mean). Additionally, some area of academic skills deficit similar in level to the cognitive weakness should be present to indicate that some intervention is necessary. This distinction is important because Naglieri (2000) found that children with a cognitive weakness were more likely to have significant academic problems and have been previously placed in special education settings while children with a relative weakness were less likely to have experienced academic problems.

Illustration of the Cognitive Education Approach to Intervention

STEP 1: ASSESSMENT

The examination of a child’s academic problems is, as described above, multifaceted and may or may not involve decisions about eligibility. When initial

attempts to solve educational problems did not meet with success or the severity of the problem warrants an in depth examination of the entire situation, it will be important to determine if a child has a cognitive weakness. In this illustration it is assumed that the academic problem detected by a teacher was not solved by initial pre-referral intervention efforts and the child was administered a test of cognitive processing (CAS) and achievement (K-TEA) as well as other relevant assessment methods not summarized here. The data presented in Table 1 are illustrative rather than actual.

The data provided in Table 1 are first analyzed by computing the child’s PASS standard score mean and comparing each of the four PASS scores to that mean (see Naglieri, 1999, for more details). This allows the school psychologist to determine if a cognitive weakness is present. In this illustration the child’s Successive Scale standard score is significantly lower than the mean of 94.25 and below a cut-score of 85 used to designate below normal functioning. This means that the child has difficulty with tasks that require the use of information in a specific series, the memory of serial information, and comprehension of information based on linearity (see Naglieri, 1999, for more information about interpretation of this process).

the importance of attending to the sounds of events in order and helps the child apply good successive processing to reading. Other interventions that do not require the teacher to use a pre-packaged program include strategies for reading decoding and reading comprehension that the regular or special education teacher could apply.

A child with a successive processing weakness but adequate planning could be taught to utilize strategies to decode words as an alternative to sounding out the letters and the sounds that go with them. This is illustrated in Appendix 1, which is a handout developed by Naglieri and Pickering (2000). This intervention is a strategy (a plan) that can be used by children who have trouble decoding words, perhaps due to a successive processing weakness. Another appropriate intervention would be to utilize strategies to improve reading comprehension (Appendix 2). This method is designed to teach children the strategies used by good readers to obtain information from text. This includes teaching children how to integrate their prior knowledge with what is read, how to look for cues that help define the meaning of the text, and how to approach reading comprehension questions. In both these illustrations, the successive processing weakness is being addressed by teaching the child to approach the task with strategies, or plans, which engage planning processing. Thus, the processing demands of the task initially might have been very successive but with these interventions there is a shift toward a more strategic (planful) way of approaching the material. The same approach would be used to help the child be more successful in math calculation.

Two math calculation interventions are suggested. First, one strategy that helps a child with successive processing weakness learn facts without rote memory of a linear statement like $8 + 7 = 15$. The child who is taught to memorize these facts by repeatedly saying or writing the string of numbers and signs uses successive processing to commit the statement into memory. In contrast, the "Using Plans to Learn Math Facts" handout (Appendix 3) encourages teachers to help children use strategies for obtaining the correct answer. This intervention helps the teacher instruct the child to arrive at the answer using a strategy that changes the dominant cognitive process from successive (memory of the sequence of facts) to planning (obtaining the information via a strategy that is based on what was previously known). There are several

strategies for math facts that are presented by Naglieri and Pickering (2000).

STEPS 3 AND 4: IMPLEMENTATION AND EVALUATION
Once the teacher and school psychologist have developed a plan, the methods are implemented. During this time the teacher should follow the concepts developed in the intervention plan in a flexible way and modify the method as the situation demands. Although frequent monitoring of progress is an important component of this step, evaluation of the effectiveness of the intervention (step 4) should occur after the treatment has been completed. Naglieri (1999) recommends that the effectiveness of the overall program of interventions should be made in comparison to initial results from standardized achievement tests. In this example, a K-TEA Reading Decoding score of 89 is needed to demonstrate reliable improvement over the initial standard score of 79. Refer to that source for more information and values needed for significance to demonstrate significant improvement over time.

PROBLEM-SOLVING MODEL

The use of a cognitive processing approach to evaluate a child's competence described here fits within a problem-solving model. For example, Deno's (this volume) description of the IDEAL problem-solving model includes five components: identify the problem, define the problem, explore alternative solutions to the problem, apply a solution, and look at the effects of that application. Clearly, the steps described earlier in this chapter fit these problem-solving components. For example, the first two components are a part of step 1 (Assessment) where the nature of the problem is identified (cognitive and academic difficulties) and if so then define the problem within the PASS theory. In the illustration provided above, the child was found to have a cognitive weakness in Successive processing and similarly poor performance in Successive processing. Thus the problem has been identified and carefully defined. Step 2 (Preparation) is accomplished in the third component of the problem-solving model – exploring solutions. Continuing with the illustration, at this point possible interventions such as PREP or those provided by Naglieri and Pickering (2000) are considered and a plan for intervention is prepared. Step 3 (Instruction) is the same

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Appendix 1. Example of a teacher handout for reading decoding**IMPROVING READING DECODING USING THE
READING BY ANALOGY STRATEGY**

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Background

Fluent reading requires good reading decoding, which involves making sense out of printed letters and words including understanding letters, what they represent, how they work together, and how they relate to sounds. Decoding involves several cognitive processes but particularly successive processing. Knowing what order letters, letter sounds, and words must be in to make sense requires successive processing. Understanding how letters and word parts relate to one another requires simultaneous processing. Using strategies for decoding involves planning. Attention is needed for recognition of details such as letter orders (ie or ei), punctuation, focus on the story line, etc.

Decoding is important for basic reading as well as for fluent and successful comprehension. Good readers are able to decode words quickly and easily and therefore can devote more attention to comprehending what is read. A strategy like comparing known words to new words with similar spelling patterns may be helpful for the student having trouble decoding a word or text for the first time. The strategy, Reading by Analogy, may be helpful for a student having difficulty decoding new words and who may be poor in successive or planning on the CAS.

Reading by Analogy Strategy

Words that sound the same often are spelled similarly. This can be used to help a child who knows how to pronounce a word such as “tank” to make a reasonable guess at “rank.” The same student might also have a good chance at pronouncing “bank,” “Frank,” and “thank” if he or she were to use the Reading by Analogy strategy. In Reading by Analogy students are taught to compare words they do not know to similar words they do know.

One way to present the Reading by Analogy strategy is to explicitly teach it and then introduce new target words along with five to six new words that can be related to words the students already know. In this method, students are encouraged to learn the new words by analogy and are asked why and how the strategy helps them. Each word is presented on a sheet of paper and the students are instructed to write two or three other words that share the same spelling pattern. After this stage, the students are asked to read passages containing the new words and are encouraged to use analogies to decode them. The teacher should model the use of analogies while reading and provide feedback for the student independently using the strategy.

Once the strategy is taught, modeled, and the students have practiced it, they may be simply encouraged to use the strategy whenever they encounter new words. It may be helpful for the teacher to post a list of words the students know by sight that they may refer to when they encounter a new

Appendix 2. Example of a teacher handout for reading comprehension

IMPROVING READING COMPREHENSION WITH STRATEGIES

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Background

Expert readers use a variety of strategies to understand what they read. They combine their background knowledge with context cues to create meaning, monitor their ongoing comprehension solving comprehension problems as they read, and they evaluate what they have read (e.g., Is the content believable? Does it make sense?) (Pressley & Woloshyn, 1995). This thoughtful approach to reading takes planning, which is why teachers should instruct children to be planful when they read. Good comprehension instruction should incorporate not only decoding (see Reading Decoding Strategy handout) and understanding of what is read but also the systematic planful approach to comprehending what is read.

When students encounter difficult text the consistent use of multiple comprehension strategies is essential for good comprehension (Pressley & Woloshyn, 1995). Students who are taught to be planful in reading are more successful. Teachers should make the strategies and mental processes for good comprehension explicit in their instruction by thinking aloud to the students when they teach and model strategy use. The key is teaching students a variety of strategies and encouraging them to use all of them when appropriate (which includes teaching *when* a strategy is appropriate). This will be very important for all children but especially those who are poor in planning (see Naglieri & Gottling, 1995; Naglieri, 1999).

Strategies

The following strategies can be easily taught and may be very helpful for the reader who is struggling with comprehension, especially those with poor planning scores on the CAS:

- *React* to text, by relating ideas in text to prior knowledge. This can be achieved by encouraging students to activate background knowledge related to text.
- *Predict* upcoming content by relating prior knowledge to ideas already encountered in text. This includes teaching students to check whether the predictions they made were consistent with text content.
- *Construct images* representing the ideas in text.
- *Slow down*, reading more carefully, and check back in text when unsure.
- *Generating questions* in reaction to text, perhaps by using specific question-asking methods, with the answers then pursued by reading groups.
- *Summarization*, including construction of notes capturing the important ideas in a text (see Summarization Strategy for Improving Comprehension).

Appendix 3. Example of a teacher handout for learning math facts

USING PLANS TO LEARN MATH FACTS

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Background Information

There are many ways to learn math facts: Some involve rote memory while others rely more on an understanding of how math works. Students are often encouraged to memorize math facts so they can be produced automatically. Sometimes they are encouraged to say or write the basic facts in order to learn them (for example, the fact $7 + 8 = 15$). Writing or saying this sequence of numbers puts the task into a linear order with at least five steps as shown in the figure. Whenever a child has to learn something that is arranged in a specific linear order, the task demands considerable successive processing (using the PASS theory as a guide). If a child is poor in successive processing, then memorization of the statement $7 + 8 = 15$ can be very difficult.

7	+	8	=	15
1	2	3	4	5

Memorization, however, is not the only way children can learn math facts. In order to reduce the heavy reliance on successive processing, children can be taught to use strategies (plans) for getting the correct answer. When a child uses a strategy to remember a math fact, the answer is obtained by thinking (using the plan or method) rather than by relying on remembering the string of numbers and signs (successive processing). For example, if a child is taught the "Doubles Plus One" rule, then the answer can be obtained by using this strategy as follows: " $7 + 8$... well, $7 + 7$ is 14, so $7 + 8$ has to be one more than 14, so the answer is 15." Alternatively, the child may reason: " $7 + 8$ is the same as $7 + 7 + 1$ so the answer is $14 + 1$, which is 15." This strategy changes the cognitive processing demands of the task from one that relies on successive processing to one that involves planning. Children who are poor in successive processing and who have problems memorizing math facts should be taught to use strategies like the illustrations that follow.

Strategies for Multiplication and Division

Multiplication by:

0s – 0 x any number is always 0 ($0 \times 9 = 0$).

1s – 1 x any number is always that number ($1 \times 7 = 7$).

2s – 2 x a number will end in a zero or an even number (0, 2, 4, 6, or 8).

5s – 5 x any number, the answer must end in 0 or 5.

- 5 x any number involves counting by fives, as when telling time from a standard clock.
- 5 x an even number is half that number with a 0 added ($4 \times 5 = 20$, $5 \times 8 = 40$).

6s – 6 x any number is half that number in front of the 6, so $6 \times 8 = 48$. Half of $8 = 4$ (which goes in the tens place with the 8 in the 1s place) and remember the answer must be even.

9s – 9 x any number can be solved by a plan: take one away from the multiplier and then add a number to make 9, those two numbers are the answer. For example, for 9×8 , take 1 from $8 = 7$, $7 - 9 = 2$, those two numbers (7 and 2 or 72) make the answer.

- 9 x any number is that number times 10 minus the number (9×7 is $10 \times 7 = 70$ then $70 - 7 = 63$). Of course the 10s rules are best to have mastered before this one.