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Cognitive Remediation based on Planning, Attention, Simultaneous and Successive Processing

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I. Introduction

Some 15% of children in the first 3 years of elementary schools in North America experience serious difficulties in reading. There are several reasons why children fail to acquire reading (Adams, 1990). These include socioeconomic disadvantage, general and specific cognitive dysfunctions, emotional and motivational problems, and importantly a failure of instruction for children with heterogeneous backgrounds. The situation is worsened because instructional approaches are confusing and fragmented. A review of the background of contemporary research on reading and current practices of instruction are provided in the first part of the paper. In the second part of the paper, an elaborate theory of Remediation inspired by the writings of Vygotsky and Luria together with a practical program of remediation of reading difficulties are presented. The Remediation program, PREP, is theory-driven, based as it is on the PASS (Planning, Arousal-Attention, Simultaneous and Successive) processing theory. The PASS theory and research essentially support Luria's functional organization of the brain. It is an attempt at formulating a comprehensive view of intelligence that comprises, as it must, (1) a theoretical understanding of major cognitive processes, (2) tests to measure these processes, and (3) a prescriptive or remedial component. The last component, remediation, is the major theme of this paper. In the third and final part of the paper a selected sample of children with reading difficulties are discussed. Included in this discussion are the spectacular changes in the children's cognitive PASS profiles after PREP treatment as well as their improvement in word reading. The paper is a tribute to Luria and reiterates the relevance of his ideas in neuropsychology.

I.I. Background and Summary of Current Directions in Reading

The following is essentially a summary of relevant passages from an authoritative paper by Rayner, Foorman, Perfetti, Pesetsky & Seidenberg (2001) with my comments.

A. Writing systems and the alphabetic principle

Reading: It is the process of gaining meaning from print (requires learning reader to learn how writing system works)

An alphabetic system is economical as it can map written units onto a small set of elements, which are phonemes.

Alphabetic principle: that is the central one for reading acquisition. It is defined as association of letters with phonemes.

Difficulties in learning to read alphabetic system arise due to:

- 1) The abstract nature of phonemes (especially consonants). For instance, pronunciation of a consonant can be highly dependent on the vowels that precede and follow it.
- 2) Alphabets do not represent each vowel with a unique symbol: English has more than twelve vowel sounds but only five vowels.

Children who learn to read must know how their language is represented in the writing system, but ability to read does not automatically lead to ability to write.

What is learned?

The writing system encodes spoken language

It must be taught or discovered by some children how this systematic encoding works

Luria remarked that when children discover this, they are filled with amazement; they realize that something as ephemeral as speech can be captured in writing!

B. Reading: Current practices in instruction

Whole-word: A natural unit, children recognize the 'whole word' as corresponding to speech. Phonemes are invisible.

Letter to phoneme mapping is unreliable in languages such as English

Phonics: Even though English has many irregular words (e.g. tough, though, tongue), phonics instruction starts with regular words, identifies the sound in each segment of the word

and builds upon the sounds that are identified. This helps 'producing' the word while reading from print. GPC (grapheme to Phoneme correspondence) can be generalized to read new words. Downside: 'Phonics drill' is dull and boring. Such exercises teach phonics without teaching the meaning of words.

Meaning Emphasis:

Reading is a psycholinguistic guessing game (Goodman). This is the whole-language approach. It is claimed that Phonics knowledge can develop naturally as children experience language, just as children learn patterns of oral language, so would they learn reading.

Downside: Reading is not a guessing game. Phonology plays an important part in learning to read. An unknown word cannot be read from its context (e.g. "he lost the deal" can be read in several ways including "he got the deal")

C. Reading Instruction

Prescriptive Reading for Letter-Sound Correspondence includes three major procedures: reviews of previously taught letter-sound, new letter-sounds are taught during which teacher reads and teaches vocabulary & comprehension, and finally, language arts comprising spelling, grammar, and writing.

Responsive teaching to help the child when help is needed rather than following a set curriculum. This method uses 'scaffolding' that may resemble Vygotsky's 'prompting' technique. Errors are pointed out and help is provided only in response to children's request.

In a large class, full of children who have different levels of reading skills and when children experience different problems in reading, this method is likely to fail. Smaller groups and teaching of phonology have been added to make Responsive Teaching more effective.

A Balanced Reading Instruction that combines Responsive teaching with elements of phonics instruction is preferred in American teachers in elementary schools.

Does this add to confusion and fragmentation?

Remediation is discussed next in the context of PASS (Planning, Arousal-Attention, Simultaneous and Successive) processes in the next two parts of the paper. At the beginning, of this presentation let us be reminded that remediation is not a substitute for reading instruction in the classroom. Rather remediation follows when a child does not benefit from regular classroom instruction.

III. PASS theory and Word Reading

A. PASS Theory

Luria (1966) described human cognitive processes within a framework of 3 functional units. The function of the first unit broadly located in the brain-stem and parts of frontal lobe includes the regulation of cortical arousal and attention; the second unit, structurally related to occipital-parietal-frontotemporal lobes, codes information using simultaneous and successive processes; and the third unit linked with the frontal lobe, provides for planning, self-monitoring, and structuring of cognitive activities. Luria's work on the functional organization of brain structures formed the basis of the PASS theory and was used as a blueprint for defining the four components of human intellectual competence.

The PASS theory provides a model to conceptualize human intellectual competence. A practical application of the model to the assessment of cognitive functioning, known as the Das-Naglieri Cognitive Assessment System (Naglieri & Das, 1997), will be discussed later. A logical extension of the theory was the development of the PASS Reading Enhancement Program (PREP), a remediation program for reading difficulties (Das, 1999)

The PASS diagram (see Figure 1) shows the basic division of input, processing and output (Das, Naglieri & Kirby, 1994). First, the input, which is information, received from external sources through our senses and internal sources comprising images, memories and thoughts. Input information can be presented serially, one after another or concurrently, such as when two different words are presented concurrently.

When the sensory information is sent for analyses, the central processes as well as knowledge base become active. There are 4 components that make up the central processing mechanisms. Together these represent the acronym PASS. All 4 processes must be active in the context of an individual's knowledge base. Knowledge can be of two kinds: tacit (spontaneous, experiential) and explicit (formal, instructed). Its base is essentially derived from long-term memory, whose impairment then degrades central processing. The last component of the PASS model is output, which is an action expressed in behavior. By changing the output demand, a change in performance may become evident

B. Successive processes and Reading

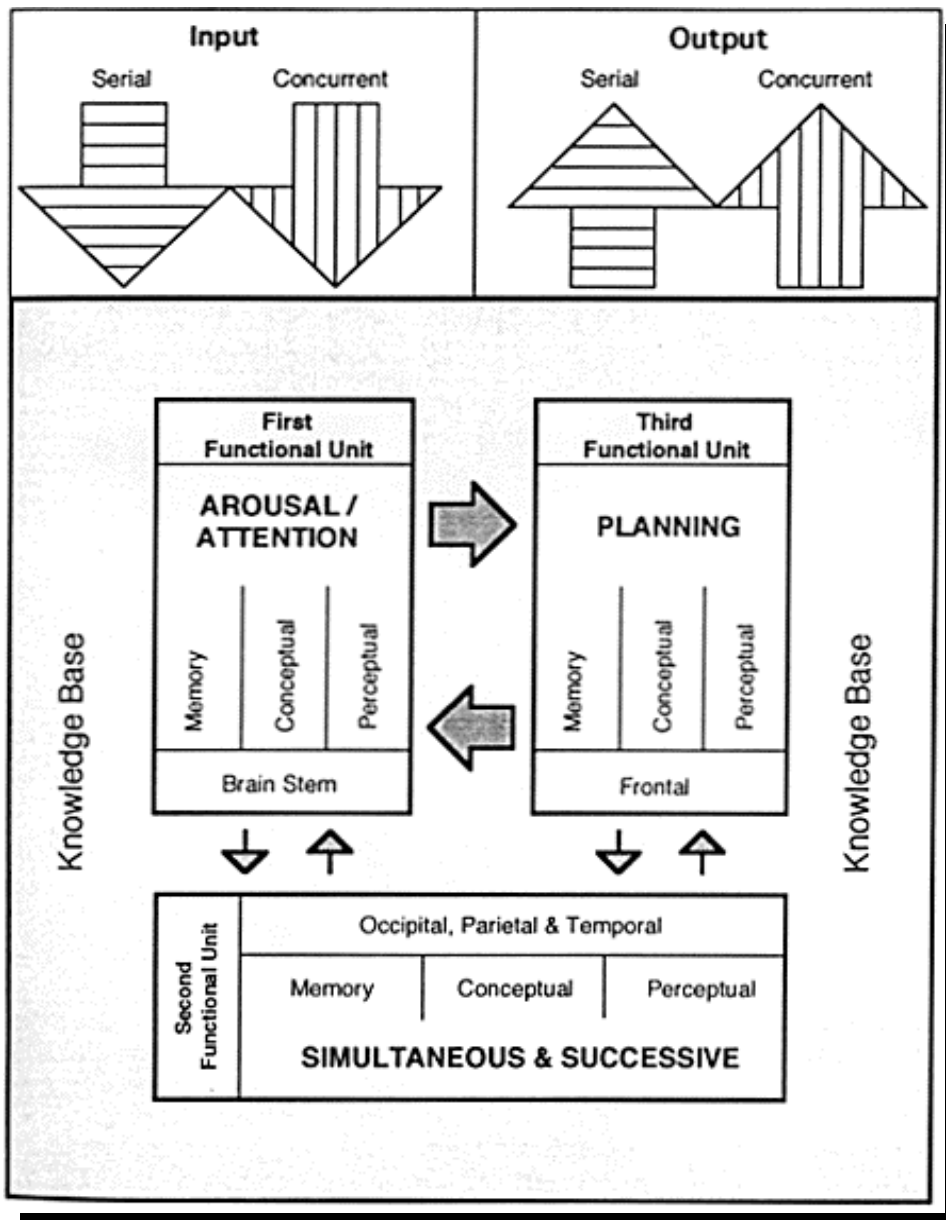
Theoretically, successive and simultaneous processing are both important for word reading. Dual-route theories of word recognition, for example, suggest that a word is recognized either through direct visual access, or through phonological coding of its sounds. The first should relate to mainly simultaneous processing via orthographic processing, and the second primarily to successive processing via phonological processing. Thus, the two processes should show correlations with word reading. Figure 2 shows a simplified presentation of these relationships.

The importance of phonological processing in word decoding has been established as discussed in the first part of the present paper. Therefore, successive processes are naturally expected to be more important at the level of word reading. However, after the initial stages of letter and visual word identification, simultaneous processing may play a secondary role in word reading due to the demand for blending and synthesis to enable the reading of the whole word. It should, be more strongly related to reading comprehension as confirmed in previous studies (Das, Naglieri & Kirby, 1994). Planning and attention are necessary in all levels of reading, although common decoding tasks are not likely to be affected by minor differences in these executive processes. Their importance increases as

a function of complexity of the reading task. (For further discussion, see Das, Parrila
Papadopoulos, 2000)

Figure Captions

Figure 1. Planning Attention Simultaneous Successive (PASS) Model. The diagram shows input and output and processing of information. Processing occurs within the constraints of the individual's knowledge base. Note that each of the four processes is broadly associated with one of the anatomical divisions of the brain. Furthermore, each process involves perception, memory and thinking.



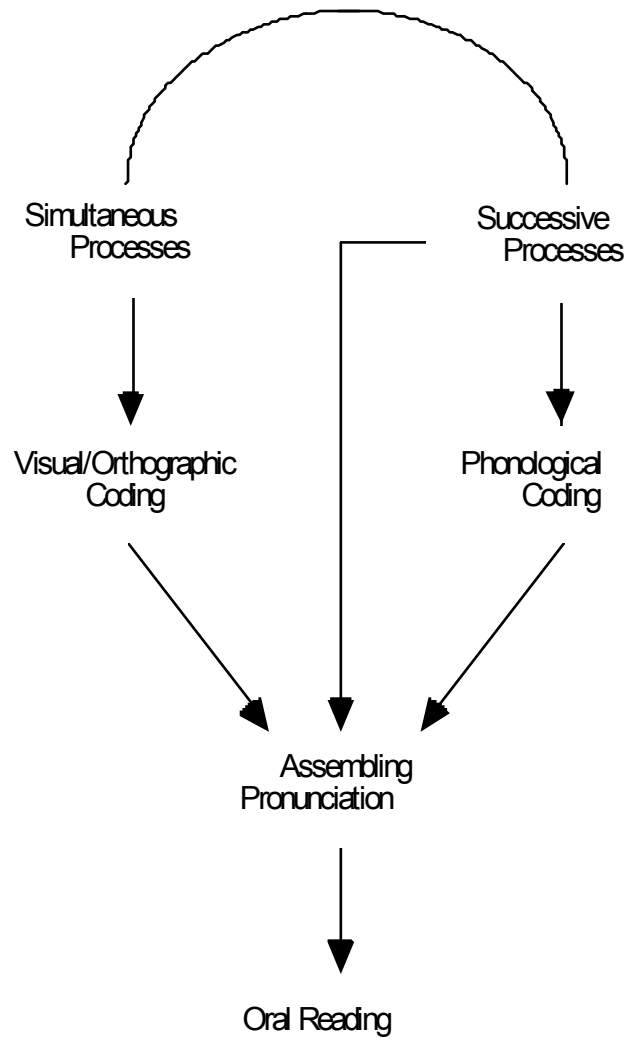


Figure 2. Processes underlying word recognition (adapted from Das, Naglieri, & Kirby, 1994).

In sum, studies on the relation between reading and PASS demonstrate that simultaneous processing and planning measures with no reading component are good predictors of reading comprehension, whereas successive measures are better predictors of word reading performance. The role of attention is less clear and several studies have found no differences in attention between good and poor readers. However, if the attention task used involves phonological stimuli, then it can be associated with reading problems. Reading is an interplay between knowledge base on the one hand (such as comprising letter recognition and phonological coding) and proximal and distal cognitive processes on the other. It is suggested that deficient reading can result from problems with any of the PASS components that make up the important distal processes. In the next part, PREP (PASS Reading Enhancement Program) is introduced. This is followed by examples of the successful application of PREP on four school students who were experiencing reading problems.

IV. An Essay on PREP

(A revised version of this was published as Das, 2000 (Dev.Dis Bulletin, vol 28,)

Remediation of word reading difficulties need not be atheoretical and eclectic. This paper presents an innovative remedial program structured around a theoretical core for enhancing reading ability. The roots of the program, its philosophical foundations and the design of both 'global' process training and 'bridging' activities are described in part one. In Part 2, essential elements of the program are presented. References are provided in support the efficacy of the program.

A. Theory for a cognitive program for reading enhancement

Many years ago a psychologist colleague told me a story about his child. The child was in kindergarten. I think it was his daughter who came back with a report card that said, "Improvement needed in paper cutting." Paper cutting improvement is not too far off from the early attempts at training the perceptual motor abilities of children. The then popular method of Frostig comes to one's mind. It was not only wrong but also wrong-headed, and led the movement towards remedial instruction backwards, so much so that reputable educational psychologists shied away from cognitive training for a long time.

However, like everything else in psychology and education, new ideas and innovative empirical research brought about a change in our attitudes towards cognitive remediation. Such remediation involves more than just correcting the mistakes a child is making in reading or writing. It also entails a theory, which explain the mistakes and which provide a solid rationale for the remediation undertaken. If a child makes errors in reading, writing or arithmetic, a teacher can certainly teach the child to correct the specific errors. But this is not remediation; it is instruction - an activity in which the teachers engage day in and day out. Remediation begins where normal instruction ends.

The first step is a theoretical one. Errors in reading, writing or arithmetic must be placed in a taxonomy. Without a proper taxonomy the behaviour would appear to be random and chaotic. Thus, if the child is unable to put the features of the letter "t" together in writing, it must be understood within a taxonomy. For example, a good taxonomy of how children code information would lead us to assess whether the child is unable to put the features together simultaneously, or whether he/she is having difficulty in sequencing the features. The results of this assessment would lead to remediation with a sound theoretical basis, which would lead to a more general improvement in the child's academic performance than ordinary instruction could provide.

Following the development of a proper taxonomy, we formulate certain hunches or hypotheses and try to gather evidence in support of or opposition to these hypotheses. Once the hypotheses have been proved or disproved we look back on the total results of our investigation

and formulate a general principle. The general principle is then tested empirically repeatedly. If it passes those tests then it becomes a reasonable law of behaviour or a theory.

Getting back to the child who failed to properly write the letter "t", we could hypothesize that perhaps the failure is not so much in distinguishing between the different features of the letter "t" but in the act of reproducing the features in sequence. Failure to process information sequentially, then, becomes our first hypothesis that is tested in other instances of the child's behaviour. Can the child, for example, quickly complete a series such as 2 plus signs followed by a minus sign followed by 2 plus signs followed by a minus sign, in a series that has 20 items? So can the child write +- +- continuously until 20 items have been written? Another example of the child's activity could be the repetition of a sentence that is syntactically correct but semantically meaningless. Can the child repeat the sentence "the blue greened the pink red"? If the child has difficulty in all of these different tasks that require sequencing or successive processing, then our hypothesis gains some status and the psychologist is alerted to the possibility that the child may have a successive processing deficit. A theory is needed. The theory of successive, as distinguished from simultaneous processing, then, becomes the over-arching context within which the child's inability to write the letter "t" can be viewed as an instance (Das, Kirby & Jarman, 1975; 1979).

Roots, Philosophies, Examples, and the Spirit of PREP

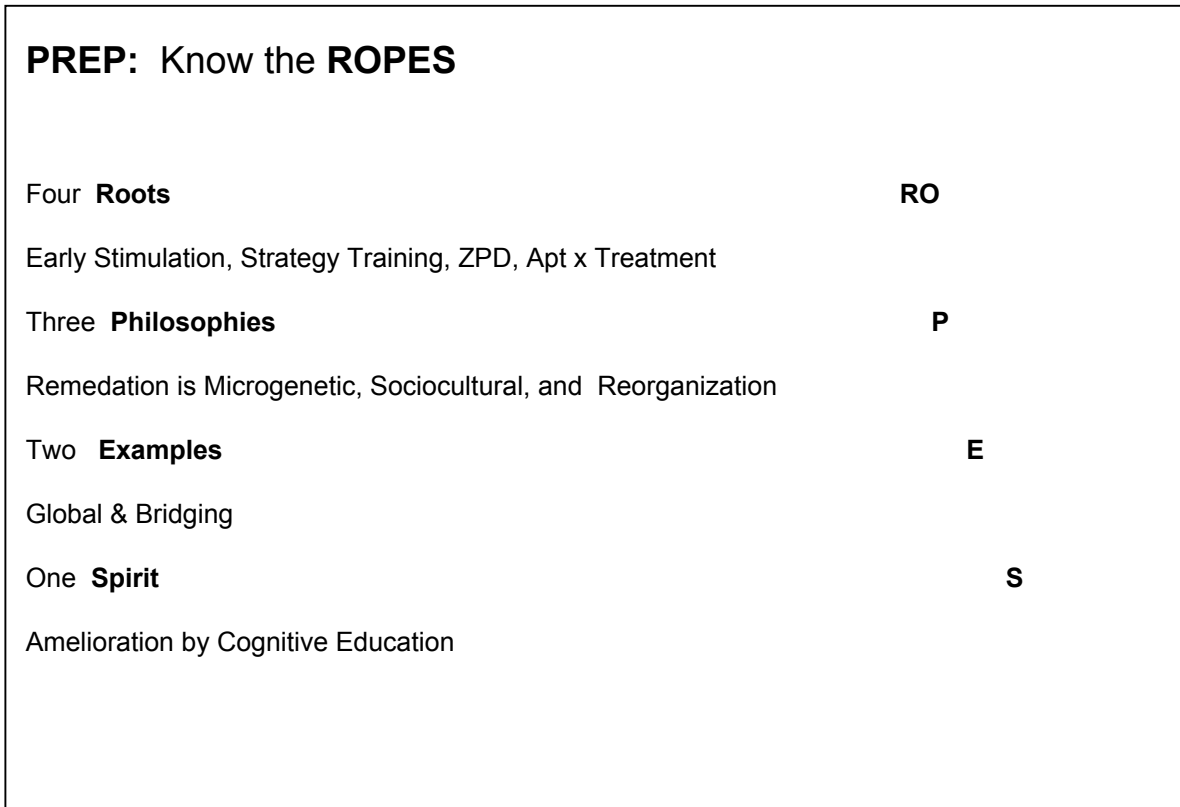
Do we then have theories, or in my own case, a theory, for PREP, PASS Reading Enhancement Program, as applied to reading? The answer I would like to give is yes. It is a theory that is open to scrutiny by examining the many articles and books in which PREP remediation is discussed (Das & Conway, 1992; Das, Naglieri & Kirby, 1994).

Know the Ropes of the Program:

Theoretical bases of the cognitive training program can be conceptualized by discussing its four roots, its three philosophies and the two examples of training shown in Figure 1. One could notice the amusing acronym, ROPES, shown in that Figure 1.

Figure 1:

A diagram explaining the theoretical foundations of PREP



The Four Roots:

1. *Early Intervention.* The second major influence on construction of the PREP remedial program was the pioneering work on early intervention. This research originated with Hebb and his associates who studied the effects of early sensory deprivation of rats on their problem

solving in a maze. As is well known, Hebb and his associates designed a stimulating environment for half of the rats and an extremely boring environment for the other half. They discovered that the first group was maze-bright and the second maze-dull. Not long after that, Hunt followed Hebb's lead and raised the question of an analogous effect in humans. He asked whether early deprivation would retard the intellectual growth of children. If the answer is yes, then can early cognitive stimulation of those children restore their intellectual development? Can they overcome their early disadvantaged environment? Haywood and his colleague Tapp reviewed the work on sensory deprivation and supported and elaborated the arguments of Mac V. Hunt, as these apply to humans (Haywood & Tapp, 1966). A renewed interest in early intervention has led to sophisticated research showing that neural plasticity unravels the neurological effects of early experience, both of a negative (abuse, toxicity) and positive kind (cognitive stimulation) (Nelson, 1999).

However, as would be apparent to any critique of work on sensory deprivation, seldom do we find large groups of human children who are as disadvantaged and deprived as the rats were. In any case, Zigler and others who pioneered the Head Start movement in early education were following the trail left by Hebb. It appeared to us, then, that Canadian Native children, for example, could be given early cognitive training in grade one, which should prevent the development of severe reading disability. More recently, we could trace the influence of Hebb's early intervention studies in the work of Feuerstein, Peter Bryant & L. Bradley (See Das & Conway, 1992).

2. *Strategy Training.* We turn to the four roots. The first is the model of memory. It is based on the research by groups of people who were attempting to improve the short-term memory performance of individuals with mental retardation. They were engaged in improving rehearsal and transfer from short term to long term memory. These were the two major components of control processes in memory, suggested by Atkinson & Shiffrin's (1986) model. The pioneers in this area of teaching strategies for better learning and memory were Belmont and Butterfield, students of Norman Ellis (Belmont & Butterfield, 1977). They showed, however, that there was

little transfer of the strategies learned by individuals with mental retardation in one situation to an entirely new situation. Nonetheless, we reasoned that strategy training is one of the primary roots for remediation. This may be true less for individuals with mental retardation than for non-retarded individuals. We subsequently came across the work of Brown and Campione, who were more successful in the transfer of learning by encouraging the development of general learning skills - with metacognition as one of its major components (Brown & Campione, 1981, 1986). The root of strategy training has been subsequently followed up by many other researchers - such as Scott Paris, but with only partial success (Paris, 1988).

This is not the place to enter into a critique of the major strategy training studies in the literature. These have been ably reviewed in a book by Ashman & Conway (1997). The root of strategy training has remained an attractive one, so much so that Ashman & Conway themselves have now developed techniques for what they term "process-based instruction", which can be applied by teachers.

3. *The Zone of Proximal Development.* The third root is a strong one - Vygotsky's idea that adult and child interactions can indeed bring about faster cognitive growth. What appeared not possible for a child to do in the past by any means, now was seen as achievable through the use of appropriate interaction with adults. The term "temporarily backward" is now used for some of these children who were regarded as irretrievably learning disabled. This influenced our thinking, and presented a challenge for us to reduce or remove such learning difficulties in Cree children by using the two major principles of Vygotsky - internalization and mediation. The now famous zone of proximal development (ZPD) was an influential concept for us in the early days (Krywaniuk & Das, 1976), when we were conceptualizing the predecessors of PREP (Vygotsky 1962, 1978).

4. *Aptitude by Treatment Interaction.* The fourth root involved acknowledging the efficacy of the aptitude by treatment interaction concept (Cronbach & Snow, 1977). Educators instinctively feel

that they should take advantage of the child's special aptitudes and design their instructional programs accordingly. But, although, aptitude - treatment interaction interventions (Das & Conway, 1992) were often not successful, their intuitive appeal has remained intact. In our applications, we learned to detect the cognitive process in which a child was weak, and then strengthen it. We reasoned that by exposing children to a set of tasks that could be attempted by using either simultaneous or successive processing, they would be able to use whichever strategy they were comfortable with, try it out, monitor their effectiveness, and be flexible enough to change to a strategy which made them successful. We also assumed that the children do not have to be aware of exactly what strategy they are using at any moment. Rather, they would automatically switch to their most effective strategy as they worked on the first tasks in the program.

The Three Philosophies.

There are three philosophies that guided our work.

1. *The Microgenetic Approach.* (Siegler & Crowley, 1991). This approach calls for a closer look at how change in behaviour occurs as individuals go through a learning experience. Remediation is a learning experience and it is important to know not only when changes in behaviour may occur, but also how the changes happen so that transfer of learning can be facilitated. The major assumption here is that, as individuals differ in their behaviour from time to time and even within the same training session, their strategies may shift and blend. The conditions that produce change in strategies and the variability in an individual's behaviour, of course, reside as much within the individual as in the task itself. A child going through a cognitive education program such as PREP has many strategies available and these strategies are in competition with each other.

So how do children choose one set of strategies rather than another? More importantly, how can we as cognitive educators direct their choice and observe the process of change? The philosophical emphasis here is in our orientation to look at minute changes in children's

behaviour as they go through learning. Incremental changes in learning are usually presented as the result of grouped data, grouped across several individuals or several trials of the same individual, not as microgenetic changes.

Thus the philosophical approach to observing behavioural change calls for not only a meticulous observation of how the change occurs in solving a problem as the child is learning and transferring, but also the possibility, as Kuhn suggests (Kuhn, 1995), of a second impetus for change. The impetus may come from a planning function, a regulative force that evaluates, monitors and selects the strategies that will be used. This is quite in line with the characteristic of cognitive planning that is largely a function of the pre-frontal cortex.

2. *Sociocultural*. The second philosophical orientation is a sociocultural one. How does cultural learning really take place? Apart from the influence of Vygotsky in thinking about cultural learning as a social product that has its origin in collaborative activity, cultural learning essentially is a symbolic activity (Das, 1973). At its center is language. I include both the traditional view of language as a tool for verbal mediation, as well as such symbols as mathematics, sign language and formalized gestures, as in dance and music. A major source of cultural learning is not so much the imitation of peers as the modeling of adult behaviour. An adult may, either by example or by words, influence a child's behaviour. The principle of modeling adult behaviour as the major mode of transmitting cultural learning is central to cognitive education. An example is reciprocal teaching or reciprocal learning (Brown, Bransford, Ferrera & Campione, 1983). In reciprocal learning, children may model each other's behaviour in a learning situation. The design of the reciprocal learning situation, however, is strictly a responsibility of the adult.

This philosophical orientation towards cultural learning comprises two other core ideas as well. These are inductive learning and the assumption that development and change in learning may occur without the awareness of the learner. The PREP training situation, therefore, comprises tasks that facilitate inductive learning through structured experience. In structuring this experience, we ensure that the learner has ownership of the strategies or concepts that are being

learnt, an idea taken from Brown & Campione (1981). Consequently, the gradual shaping of behaviour occurs almost without deliberate effort or awareness on the part of the learner.

3. *Substitution and Reorganization*. The third philosophical orientation is substitution and reorganization of functions when the usual route to solution is blocked, either by the absence of an appropriate strategy or by damage to the structure and functions of the brain. The idea originates from Luria's work on rehabilitation (Luria, 1963) and Stein's research on recovery of damaged functions due to brain injury (Stein, 1988). Luria observed, as many others have in recent times, that certain functions normally carried out by a particular region of the brain can be transferred to new areas. This is the principle of substitution. Even the restoration of speech can occur when the left hemisphere is damaged in a person whose speech area is located in the left side of the brain. Functions are also reorganized, sometimes radically, when remediation is successful. The philosophical orientation here is not to focus on what is absent, but on how functions that are intact can be substituted, for what is absent - by remedial training.

Where does that leave us in regard to the old question 'Should we teach to the strength or remove the weakness?' The answer, as always, is both. Teaching to strength takes advantage of our knowledge of the functions that are deficient, and allows the child to reorganize old strategies and substitute them for those that are deficient. This would facilitate the learning of appropriate approaches to problems such as reading disability.

Two examples of training -- Global process and Bridging to curriculum:

In designing the PREP program, comprising global and bridging components of training (discussed in Part II of this paper), our philosophical approach directed us not only to focus on the obvious difficulty that a child is demonstrating, but to go beyond it and search for its foundations. The foundations, or the sources, of difficulty were shown by research to be found in the basic cognitive processes of Planning, Attention, Simultaneous and Successive processes (PASS). Within our PASS model, global process training is concerned with enhancing processing

strategies, whereas the bridging component of training links the improved cognitive processes to specific tasks such as reading and comprehension.

In this context, Gal'perin's ideas about 3 types of learning situations that can be used for remediation (Gal'perin 1982) are appropriate. The first type is the trial and error learning, in which, the child is shown the end product and is asked to learn to produce it. The learning process does not include any clues or orientation.

The second type of learning situation provides orientation; its main feature is to allow the child to orient him or herself to the task and then execute the needed actions. Actions cannot be planned without goals and purpose; we know this from the work of Tolman (Hilgard & Bower, 1966) on rats! But it is difficult to instill purpose into the rat ahead of the rat's behaviour. Gal'perin makes a distinction between orientation to the task and mediation. Whereas orientation consists of letting the child know what is expected and generally helping him or her with how to do it, the nature of mediation is different. With mediation, the child is required to convert the action into a mental representation. The forming of a mental representation is facilitated, initially, by overt, and later by inner speech.

The third type of learning is a combination of type two learning with cognitive stimulation and cognitive motivational components. The purpose of type three training is to stimulate cognitive activity itself by strengthening and developing the child's cognitive interests. External rewards and punishments are avoided. Failure in the task in type three learning is perceived by the child as an opportunity for seeking a new solution, and for harnessing her/his curiosity. The knowledge acquired by the child in type three learning is more theoretical and somewhat removed from the direct application to an activity such as reading.

In the PREP program (Das, 1999) the global tasks provide exactly this type of cognitive stimulation. The purpose of the global tasks is to train the child to adopt a cognitive set. The global tasks allow the child to explore the type of strategies that would be best suited, not only to the demands of the task, but to her/his habitual ways of responding. Once the ability for a global task has been developed by a child, bridging tasks in the subject the child has been weak in - e.g.

reading - are worked on. Transfer from the global to the bridging tasks is facilitated because both types of tasks have the same form, and differ only in content. The child is motivated to do the bridging task because he/she is already very skilled and interested in the common structures and procedures it shares with the global task.

Our research with PREP had shown that a combination of both global and bridging tasks in the remediation program yields the best training results (Das, Mishra & Pool, 1995), whereas, the bridging task alone may not produce substantial improvement in reading although it is directly focused on reading. We have also found from research on PREP, that training may improve cognitive processing - as measured by PASS tasks - in addition to improving reading (Carlson & Das, 1997). Now that we know the ROPES, everything else about PREP falls into its place.

Part II. The Essentials of PREP: the PASS Reading Enhancement Program

The PASS Reading Enhancement Program (PREP) is founded on empirically derived principles from both child development and cognitive psychology (Das, Naglieri & Kirby, 1994). PREP aims at improving the information processing strategies (e.g., simultaneous and successive processing) that underlie reading, while at the same time avoiding the direct teaching of word reading skills. PREP is also founded on the premise that the transfer of learned principles is optimally facilitated through inductive rather than deductive inference (Das & Conway, 1992). Accordingly, the program is structured so that the tacitly acquired strategies that are implicit in PREP tasks are likely to be used in appropriate ways. Attention and Planning, the two other PASS components, are also emphasized in each task. Specifically, attention is required and used in performing each task, and planning is augmented by encouraging the children to engage in discussions, both during and following their performance.

An integral part of the structure of each task is to develop strategies such as rehearsal, categorization, monitoring of performance, prediction, revision of prediction, word sounding, and sound blending. Children naturally develop their ability to use these strategies through direct

experience with the tasks. Rather than being taught explicit strategies by the tutor, children are encouraged to become aware of their use of strategies through their verbalizing about it. The ability of students to use strategies, and to be aware of appropriate opportunities for their use, often develops over the course of remediation.

PREP consists of eight to ten tasks that vary considerably in content. Each task involves both a global training component and a curriculum-related bridging component. The global component includes structured non-reading tasks that require the application of simultaneous or successive processing strategies. These tasks also provide children with the opportunity to internalize strategies in a way that is personally meaningful. This facilitates transfer. The bridging component involves the same cognitive demands as its matched global component - simultaneous and successive processing - the acquisition of which has been closely linked to competency in reading and spelling (Das, Naglieri & Kirby, 1994).

The global tasks begin with content that is familiar and non-threatening so that strategy acquisition occurs in small steps. Complexity in trials is introduced gradually, and only after a review of easier content, so as to scaffold the development of competency in strategy use. The discussion of the strategies used by a student is intended to facilitate verbal mediation. This in turn will encourage a student to apply the strategies of the global and bridging components of PREP to academic tasks such as word decoding. The global and bridging components are further divided into three levels of difficulty. This allows the child to progress gradually in strategy development, and allows for starting at a higher level for those who already have some successful processing strategies in place.

A system of prompts is also integrated into each global and bridging component. The prompts create a scaffolding network that supports and guides the child to ensure that tasks are completed with a minimum amount of assistance and a maximum amount of success. A record of these prompts provides a monitoring system for teachers to determine when material is too difficult, or when a child is able to successfully progress to a more difficult level. A criterion of 80% correct responding is required before a child can proceed to the next level of difficulty. If this

criterion is not met, an alternate set of tasks at the same difficulty level is used to provide the additional training required.

In summary, PREP is a reading enhancement program that aims at improving the information processing strategies that underlie reading, while avoiding the direct teaching of word reading skills. One of the prime goals of remediation is the development of a relatively context-independent state, which extends the ways in which originally constrained declarative or procedural knowledge is used. Cognitive processes, rather than skills, are the target of intervention, and these are learned optimally through an inductive learning process. The efficacy of PREP has been addressed in previous investigations (Boden & Kirby, 1995; Carlson & Das, 1997; Das, Mishra & Pool, 1995), the results of which demonstrate that PREP training has been successful in improving word decoding skills in elementary school children.

V. Cognitive profiles of poor readers and gains following PREP

1. Profile of a generally poor reader with below average intelligence

Jack is a fourteen year old male Caucasian. He was referred for assessment and treatment for learning disability (LD). Jack struggles in his word reading and reading comprehension. Additionally, Jack was misdiagnosed with a seizure disorder and was given Lamictal unnecessarily. Jack's medical history is unremarkable. His condition at birth is described as good. It is reported that Jack has always had difficulty with his coordination, though he participates in wrestling at his school. His mother states that Jack learned to speak later than his siblings. His mother describes him as having difficulty in concentrating on academic subjects. Jack struggles with basic tasks related to reading. Despite extra help, Jack has failed to improve in reading, math, and comprehending other academic tasks.

Examination revealed a very cooperative but shy young man. Jack was pleasant throughout the testing. His statements were brief and his speech was laconic. He seemed interested in the tasks and eager to do well.

The Das-Naglieri Cognitive Assessment System (CAS) basic battery was administered. Jack earned a CAS Full Scale standard score of 73, which falls within the Below Average classification. His Full Scale standard score is ranked in the 4th percentile. Jack earned scores that ranged from Low Average (Attention and Simultaneous Scale) to Below Average (Successive Scale and Planning Scale).

Jack performed within the Below Average range on measures of planning processing and earned a score of 79, placing his score in the 8th percentile. He was unable to report the use of any strategies in completing the tasks. During the Matching Numbers task, Jack was observed scanning the row. Jack reported that he “looked at all the numbers” in order to complete the task.

Jack did not appear to develop or utilize strategies effectively during the Planning tasks. For instance, on the Planned Codes task, Jack completed both items by looking at the key and filling in the boxes left to right. When Jack was asked to report his use of strategies he replied, “I went that way” gesturing left to write and “Same way” on the second item.

Jack’s attentional processing was measured by subtests that required him to focus on specific features of test items while resisting the impulse to respond to distracters. Jack had many false detections on the expressive Attention Scale subtest. He earned a score of 85. This score ranks at the 16th percentile and falls within the Low Average range.

Jack earned a score of 78 on the Successive processing scale. This score falls in the Below Average range and ranks at the 7th percentile. Jack was required to retain information in a specific linear order.

Jack earned a score of 82 on the Simultaneous processing scale. This score falls in the Low Average range and ranks at the 12th percentile. The simultaneous tasks required Jack to integrate information in a meaningful holistic manner. His Verbal-Spatial Relations subtest yielded a scaled score of 5.

Jack was given a test of basic reading skills on the Woodcock Diagnostic Reading Battery. His scores are reported below:

<u>Test</u>	<u>AGE Eq</u>	<u>Percentile Rank</u>
Reading Skill	7-3	2
L-W Identity	7-11	1
Word Attack	6-3	1
<i>JACK is 14 years old</i>		

It was recommended that Jack be given a cognitive enhancement training intervention. Professor Prep, a remediation was administered twice weekly for a total of twenty-two sessions. Each session lasted for approximately 45 minutes.

Initially, most of the PREP tasks were somewhat difficult for Jack. PREP is designed to introduce tasks in an intentionally easy and non-threatening way. This helped Jack to maintain his focus and confidence as he developed his abilities. Tasks ranged from somewhat difficult for most of the early sessions, to sometimes frustrating, e.g., Shape Design bridging task. This was anticipated from the results of Jack's CAS battery, and PREP was modified to meet Jack's current level of functioning.

As our sessions progressed, Jack learned to reflect on his own thinking. As a clinician, I helped Jack to observe the complexity of his thought and the skillful approaches he invented while playing with PREP. Through his own creativity, Jack learned to explore many new ways of thinking and dealing with novel situations.

Jack had exceptional difficulty with Shape Design. This task required him to study a design that was presented for ten seconds and then reproduce it with colorful shapes of the same size. This was the global part of the task. The bridging component required Jack to read a phrase or story from a card that describes the arrangement of two to five animals. Jack then had to arrange plastic molded animals in order to recreate the scene.

Jack struggled with this task at the early levels. He had difficulty naming the objects and animals. He was encouraged to use his speech in order to identify what was in his awareness in order to make a meaningful scheme. This was difficult for him, but through time my records show an improvement in quantity of speech as well as quality of his creative descriptions. My records for session one state that Jack reported, "I imagined what it looked like" as the only strategy he utilized.

As our sessions progressed I began to notice qualitative changes in Jack's performance on the Shape Design task. By session six I noted that Jack's lips were moving as he concentrated on the shapes. His own reported strategies were, "I noticed the points on the triangles" and "There is a pattern there."

By session fourteen, Jack had made considerable progress on the Shape Design task. His enthusiasm was noted in my anecdotal records. He reported that on the bridging task "I used the main character, then the second, then the last" and "I imagined the picture in my head."

By the last session, Jack was flawless in his completion of the task, which by now had increased substantially in its cognitive demands. Jack's descriptions of the quality of his thinking had progressed from simple statements, e.g., "I imagined it" to rich portrayals of his thinking. During this session, I captured some of what he said. His words came easily and quickly. He reported that, "I just took the main character and went down the line to the next" and "I just sort of saw that the spider was going to be down below..." etc.

I have described the Shape Design task at the exclusion of the other tasks. Jack made remarkable progress in many areas. The Shape Design task was the only task that frustrated Jack, and at times I abandoned it early without his knowing it. As a clinician, it is important that Jack always feel challenged and successful at the same time.

Jack was post-tested some time after completing twenty-two sessions of PREP. His scores are compared below:

<u>Scale</u>	<u>First Score</u>	<u>Second Score</u>	p=.10
Planning	79	82	
Simult.	82	94	
Attn	85	91	
Succ.	78	89	Sig
FullScale	73	85	

His teachers note remarkable progress. They have decided to move Jack into a more challenging educational environment, per his request. Jack had, prior to this meeting, gone to the principal of the school to request a more challenging science book. Jack’s education team plans to graduate Jack with the same diploma given to his fellow students. Jack has set a goal to go into mainstream education for all subjects.

Jack reflected on his experience with PREP. He stated, “I can read words without having to stop and have the teacher tell me what it is” and “My memory has improved. I can remember more. It helps to break it down to chunks.”

2. Profile of a dyslexic:

Average intelligence, Specific deficit in Successive Processing

Evonna is a ten- year-old attending the fifth grade. Evonna’s mother brought her because of concern about Evonna’s difficulty in Math. Evonna has been through tutoring for reading and was reported to have improved. At the time of the first assessment Evonna was receiving math tutoring two times per week.

Evonna was administered the Cognitive Assessment System (CAS) basic battery. She earned a CAS Full-Scale standard score of 91, which falls within the Average classification. Her Full Scale standard score is ranked in the 27th percentile. There is a 90% probability that her true Full Scale standard score falls within the range of 84-100. Evonna

earned scores that ranged from High Average (Attention Scale) to Below Average (Simultaneous Scale).

Evonna performed within the Average range on measures Simultaneous Processing and earned a score of 91, placing his score in the 27th percentile. Her Planning score of 88 ranked her in the 21st percentile and low average range.

<u>Test</u>	<u>AgeEq</u>	<u>Percentile</u>
Reading Skill	9yr1mo	36
L-W Identity	9yr6mo	42
Word Attack	8yr-6mo	29

Evonna was given a test of basic reading skills on the Woodcock Diagnostic Reading Battery. Her scores are reported below:

It was recommended that the child be given Pass Reading Enhancement Program (PREP).

Evonna completed twenty-nine sessions of PREP given twice weekly. An emphasis was placed upon helping Evonna to develop cognitive planning skills and improve successive processing abilities. By session eight my records indicate that Evonna was making some qualitative shifts in her planning. She began to report the use of a variety of strategies and seemed more conscious of her activities. Her enthusiasm for the tasks inspired her to try new ways of completing the various tasks included in Professor Prep. A pre and post-test comparison is presented below:

<u>Scale</u>	<u>First Score</u>	<u>Second Score</u>	
Planning	88	112	Sig P<.10)
Sim.	91	94	NS
Att	118	130	Sig
Succ.	78	94	Sig
FullScale	91	110	Sig

She was post-tested eight months after her intake using CAS and subtests of the Woodcock Diagnostic Reading Battery. Her Reading scores are given below.

Reading Skill	95	104
L-W ID	97	105
Word Attack	92	101

Evonna reported remarkable changes. She stated that her memory improved and that math is much easier. Her recent report card was exceptional. She stated that “it is easier for me to read clocks” and often discussed current books she was reading. Her mother reported much improvement as well.

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