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A COGNITIVE FRAMEWORK FOR DERIVING AND INTERPRETING LEARNING STYLE DIFFERENCES AMONG A GROUP OF INTERMEDIATE GRADE NATIVE AND NON NATIVE PUPILS

by

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ABSTRACT

This study investigates a framework for deriving and interpreting cognitive performance differences between 32 Native and 32 non Native intermediate grade Merrit B.C. pupils. Seven processing factors were identified and operationalized by twenty-two measures. Bottom-up attentional processing was defined as incidental attention to dominant or culturally relevant stimulus characteristics (e.g. attention to color). Top-down visual attentional processing was defined as goal-directed attention to stimuli characteristics activated by the identification of response characteristics and under the control of concrete/active planning associated with visual-motor modelling or feedback. Top-down verbal attentional processing was defined as goal-directed attention to stimuli characteristics activated by the identification of response characteristics and under the control of verbal/logical planning associated with verbal instructions or feedback. Simultaneous processing was defined as recoding of separate stimulus characteristics into meaningful wholes in which all the elements are mutually surveyable and meaning is associated with the whole rather than the separate parts. Successive processing was defined as recoding of separate stimulus characteristics into temporal, sequence-dependent forms with meaning accessed by the order. Concrete/active processing

was defined as generation, selection and monitoring of goal-directed behavior associated with visual/motor feedback. Verbal/logical processing was defined as generation, selection and monitoring of goal-directed behavior associated with verbal feedback.

A cognitive process task analysis was used to generate a target matrix for the 22 tasks used in the study. Separate orthogonal procrustes solutions were used to generate error matrices for both Native and non Native groups. An examination of the mean error rates for both groups suggests the preliminary efficacy of the framework. An extensive review of the literature provides the necessary precision in language for deriving instructional implications from the framework. Native and non Native learning strengths and weaknesses, based on these seven processing factors, are discussed and related to changes in instructional tasks demands designed to optimize strengths. A Native learning style is identified with the pattern of modelling mediation characteristic of the "observational" learning environment.

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All language is of a successive nature; it is not an effective tool for reasoning the eternal, the intemporal.

--Jorge Borges

There are two kinds of people, those who believe there are two kinds of people, and those who don't.

--Tom Robbins

CHAPTER ONE: INTRODUCTION

Differences in cognitive performance between Native[1] children and their non-Native counterparts have a long history dating from the first attempts to "educate" Native children. For over three decades, non-Native researchers and educators designed and carried out research which demonstrated that Native children, when presented with tests of mental abilities valued in the majority non-Native culture, could not handle the task demands as well as their non-Native counterparts. Consistent evidence from studies of Native performance on the Wechsler scales has been viewed by educators from a deficiency perspective (McShane and Plas, 1984).

This has led many educators to design educational programs that stress skill development in the areas directly assessed by the Wechsler scales. For example, a verbal deficiency interpretation has led to a remediation approach which emphasizes language and vocabulary development. This style of interpretation ignores the assumption of most "academic intelligence" theorists who believe that these tests measure both aptitudes for learning and knowledge or products of this learning (e.g., Sternberg, 1982).

Brown and French (1974) point out that other than being

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[1]Native is used as the generic term for all North American indigeneous people.

able to predict fairly accurately the school failure of learning disabled children, there is little else that our IQ tests offer. This "deficiency" orientation has undoubtly biased both our research as well as our attitudes and treatment of Native children. In contrast to the overwhelming evidence concerning what the Native child cannot do or is deficient in, we know very little about what the Native child can do, under what learning conditions he or she can work best, and on what tasks this occurs. The latter concerns, it will be noted, are of course of much greater concern from an educational perspective.

More recently, research concerned with the examination of information processing skills exercised in the context of Native culture has highlighted some cognitive proficiencies of Native peoples. This research has outlined a complex array of culture-relevant learning strategies (e.g.,Berry, 1971; Black, 1973; Brokenleg and Bryde, 1983; Cazden and John, 1971; Darnell, 1979; Dumont, 1972; Erickson, 1978; Greenbaum & Greenbaum, 1983; Kaulbach, 1984; Kleinfeld, 1970; Koenig, 1981; Krywaniuk 1974; Kuske, 1969; Lombardi, 1969; MacArthur, 1978; More, 1984a; Schubert and Cropley, 1972; Taylor and Skanes, 1975; Weitz, 1971).

These studies, taken as a whole, have been interpreted as demonstrating that Native children possess relative stren-

gths in visual/spatial processing and relative weaknesses in verbal processing abilities. As educators and researchers began to interpret the tremendous range of tasks used to assess cognitive performance differences between Native and non-Native children, they began to question the ecological validity (culture-specific relevance) of these differences.

The first attempts to directly investigate the ecological validity of Native strengths in visual processing and weaknesses in verbal processing were conducted under the rubric of "cognitive style" research (e.g., Berry, 1966; 1971; Kleinfeld, 1970; MacArthur,1968; Weitz, 1971). This line of research provided detailed descriptions of the "historical" learning environment of Native peoples and the ecological demands associated with that environment. The difficulty with this approach is that while demonstrating the ecological validity of Native children's strengths in visual processing, these studies failed to investigate whether the same ecological demands could be identified in the aspirations of present-day Native groups.

More (1984a) reports the results of over 200 interviews of Native parents, teachers and others concerned with setting the goals and priorities for Native children's education, concluding, "The responses make it very clear that basic academics, particularily reading and writing, are the highest

priority for educational goals" (More, 1984a, p 39).

If Native children differ from their non-Native counterparts in terms of relative strengths in visual/spatial processing and relative weaknesses in verbal processing, then these visual/spatial strengths may aid in the development of instructional strategies which promote the use of these strengths on academic tasks. To ignore the instructional implications of these strengths is to deny the importance placed on academic achievement by Native parents and educators or the ecological validity of these strengths.

The major difficulty associated with previous research on cognitive differences between Native children and their non-Native counterparts is that the specific differences identified lack the clinical utility necessary for deriving instructional implications. Instead of defining the academic underachievement of Native children in terms of cognitive skill deficits, it may be more appropriate to define Native underachievement in terms of interactive patterns of academic/cognitive strengths and weaknesses.

A fully interactive analysis of academic/cognitive strengths and weaknesses of Native children would be much easier to interpret--and to derive instructional implications from--if the tests were based on a single integrated theory of reading, language, and cognition (Doehring, Trites, Patel,

and Fiedorowicz, 1981). In order to facilitate a more ecologically valid and clinically useful framework for the interpretation of cognitive performance difference between Native and non-Native children, a number of theoretical distinctions need to be drawn.

There are "quantitative and qualitative differences between Native and non-Native children on a variety of cognitive and academic measures" leading to many interpretations which can be broadly classified as being derived from either single-syndrome competency or from deficiency explanations of Native performance. A deficiency or competency of a uniquely human cognitive function can have three aspects: structure, process, and knowledge base (Hunt, 1980). Differences in cognitive abilities within an individual and between groups (e.g., Native and non-Native children) may be accounted for by the interaction between differences in these three aspects of a cognitive function.

The structural aspects of a cognitive function have been linked to the concept of functional units of the brain through the neurophysiological observations of A. R. Luria (1966a; 1966b; 1970; 1973). Observations of the cognitive/academic performance of patients sustaining relatively discrete injury to specific areas of the brain revealed three functional units of the brain differing in terms of the

demands placed on attention, coding and planning by the various tasks (Luria, 1966a; 1966b). Implicit in the definition of the structural aspects of a cognitive function is the notion that structure is interdependent upon the tasks used to assess that structure. It follows, that deficits in structure are difficult to separate from experiential defictis associated with the specific task characteristics used to measure them.

For example, the identification of the brain structures associated with attention are linked to tasks demands which emphasize attention over coding or planning functions. An attentional function has been linked to performance deficits, on tasks requiring scanning and focusing of stimuli characteristics. The response characteristics of these tasks emphasize rapid visual discrimination. Attentional deficits have been evidenced by individuals who have sustained injury to relatively discrete brain structures, as well as by the learning disabled (see Ross, 1976 for a review of this point of view).

That structural differences can lead to performances differences is inherent in the manner in which the structures have been defined. This does not imply, however that these structural differences represent only neurophysiological deficits. Rather, these differences may be accounted for in part by differences in an individul's familiarity with

the tasks used to measure these structures. The latter view is consistent with the perspective of this paper.

Differences in cognitive performance may also reflect differences in the processes utilized in solving the task. The manner in which an individual attacks a particular cognitive task reflects what Kirby (1984) terms "cognitive control strategies," involved the selection of which stimuli characteristics to attend to, which code type and organization to utilize in storing and retrieving the information, and which type of feedback is to be utilizeded in evaluating performance.

According to Das (1984a) selection of cognitive control strategies may vary depending on the task demands and/or the subject's competency with that strategy. At least two factors contribute to competency with a particular control strategy. First, competency may reflect the neurophysiological integrity of the underlying brain structures. This implies that the processing aspects of a cognitive function are interrelated to and interdependent upon the structural aspects of that function.

Second, competency may reflect the learning history of the individual both with the processes themselves, as well as with the task demands thought to be associated with those processes. This implies that the processing aspects

of a particular cognitive function interact with the occurrence, frequency, and patterning of tasks characteristics and mediated models of that process provided in an one's-learning history.

The greater the frequency of a partcular form of mediation being consistently patterned with a specific set of task characteristics, the greater the likelihood of that mediated strategy being employed when those task characteristics are presented. When more than one cognitive process has been patterned with a given set of task characteristics then selection of a control process usually reflects the habitual mode of processing (Luria, 1984a). This implies that differences in processing between Native and non-Native children's cognitive-task performance may reflect experiential differences associated with the mediation provided by their unique learning environment.

At least two learning environments can be identified for any individual on the basis of the style of mediation provided. Mediation in the form of feedback has been characterized as largely concrete/active and/or verbal/logical (Luria, 1970), and reflects the distinction drawn between the "observational" and "formal academic" learning environments of Native and non-Native children drawn by Greenbaum and Greenbaum (1983).

The mediation provided by or resulting from a learning environment develops into a characteristic or habitual mode of functioning which has been variously termed as; a "global proccessing system" (e.g., Sternberg, 1980), a "cognitive style" (e.g., Werner, 1979), or a "learning style" (e.g., Kaulbach, 1984; More, 1984a). A "learning style" in this paper refers to the selection of cognitive control strategies related to and dependent upon the mediation provided in the two learning environments. Differences in cognitive task performance, evidenced by Native and non-Native children as well as other groups, may reflect differences in the type of mediation provided by the "observational" and "formal academic" learning environments. According to Greenbaum and Greenbaum non-Natives recieve relatively more exposure to the task characteristics and mediational characteristic of the formal academic learning environment than their Native counterparts.

Finally, differences in cognitive performance may be accounted for by differences in the knowledge bases one has acquired in one's learning history. A deficit in a particular knowledge base (e.g., vocabulary) affects both the activation of the structural aspects of a cognitive function and the selection of control processing. For example, the lack of verbal labelling of task characteristics may not prevent

efficient performance of tasks associated with the "observational" learning environment. The absence of verbal labelling may, however limit activation or selection of the most efficient control strategy when that "observational" task is transferred to the "formal academic" learning environment, since, verbal labelling is a task demand characteristic of the "formal academic" learning environment.

A distinction which has been drawn by O'Conner and Blowers (1980) between cognitive functions associated with stimuli processing and response processing, implies that while the stimuli presentation of a task or knowledge of those characteristics may activate a certain set of structures and their dependent control strategies, knowledge of the response characteristics may activate an entirely different set. Specification of the knowledge base aspects of a cognitive function must reflect dimensions that are broad enough to describe both stimuli and response characteristics. Similarily, specification of the control processes must be broad enough to provide a framework for exploring the interaction be the structural and knowledge base aspects of a cognitive function. In other words, the knowledge base aspects of this framework must be operationalized in terms of task characteristics designed to provide distinctions between stimuli and response demands, as well as between

the depth of processing or structural demands (i.e., attention, coding, and planning).

Defining the control processes involves the identification of strategies which are associated with all three functional systems of the brain (i.e., Attention, Coding and Planning), as well as with stimuli and response characteristics of tasks occurring in both the "observational" and "formal academic" learning environments. For these reasons, each cognitive control strategy identified in this study will first be defined in information processing terms by specifying the depth of processing associated with each structural aspect (i.e., attentional, coding, and planning processes). Second, each processes will then be identified with stimuli and response task characteristics selected from typical "observational" and "formal academic" learning tasks. Third, the definition of the cognitive control processes will be further specified by the operationalization of these processes on twenty-two cognitive tasks-- detailed in the Methodology chapter. Finally in the Discussion chapter, the control processes will be identified with the empirical task demands and instructional implications will be drawn.

Lupart and Mulcahy (1984) identified three cognitive control strategies associated with attentional performance on reading tasks. The first of the strategies identified

involves unintentional focusing and scanning of stimuli characteristics and is termed "Bottom-up attentional control." Note that, the important distinction in this case involves incidental attention to stimuli characteristics. Bottom-up attentional tasks are associated with "incidental" learning which is characteristic of the modelling provided in the "observational" learning environment. For example, learning correct social eye contact behavior is an incidental learning task common to an observational learning environment in which the dominant (i.e., biologically essential or culturally relevant) stimuli characteristic of eye contact activates attention to the eyes of the mediator or person serving as the model, and thereby facilitates incidental learning of appropriate eye-contact etiquette during modelling (e.g., Greenbaum & Greenbaum, 1983; Kleinfeld, 1970; and Phillips, 1976).

Formal academic learning tasks associated with bottom-up attention should be identifiable in terms of incidental attention to dominant stimuli characteristics relevant to this environment. For example, reading requires that limited attentional resources are devoted to a number of different stimuli characteristics. The process of becoming a proficient reader requires that progressively larger and larger portions of the stimuli characteristics become "automatized" (La Berge

and Samuels (1974). The process of "automatically" recognizing letters, words and sentences is characterized by these stimuli becoming progressively more dominant and therefore is associated with incidental or bottom-up attention.

The second cognitive control strategy identified by Lupart & Mulcahy (1984) involves the intentional scanning and focusing of stimuli characteristics associated with a given set of visual response characteristics and is termed "Top-down Visual attentional control." Note that distinctions may be drawn between intentional and incidental attention as well as between stimuli and response characteristics. Furthermore, the response characteristics are visual rather than verbal.

For example, nonverbal modelling of task performance relies on the learner matching his or her pattern of visual-motor performance to that of the mediator or task model. In this case, the model is considered a response characteristic of the task, while the learner's performance is considered a stimuli characteristics of the task. The fact that the response characteristics involve the provision for visual-motor feedback implies that visual top-down attention interacts with or is part of concrete/active planning. In this manner, visual top-down attentional control represents the attentional component of concrete/active planning.

Formal academic tasks which require visual top-down attentional control or intentional focusing and scanning of visual response characteristics is more characteristic of primary grade tasks than intermediate and secondary grade level tasks. This is emphasized by item content of standardized reading tests. For example, the response characteristics of a standardized primary level reading comprehension subtest usually provide a picture response format, while the intermediate and secondary levels of the same subtest provide a verbal response format. Therefore, performance differences on reading comprehension subtests may reflect performance differences associated with response characteristics in addition to performance differences associated with stimuli characteristics.

The third attentional control strategy identified by Lupart & Mulcahy (1984) involves the intentional scanning and focusing of stimuli characteristics associated with identification of verbal response characteristics and is termed "Verbal Top-down attentional control." The distinction between the two top-down attentional control strategies involves differences in the nature of the response characteristics which serve as the focus of intentional attention (i.e., visual/verbal). The association between identification of the response characteristics and the planning structures

of a cognitive function implies that the distinction between the two top-down attentional control strategies is based on the form of planning associated with the response characteristics. That is, visual feedback is associated with concrete/-active planning, while verbal feedback is associated with verbal/logical planning. The distinction between top-down attentional control and bottom-up attentional control involves a distinction between intentional versus incidental attention during task performance.

The observational learning environment provides frequent visual-motor modellling of response characteristics; however, there is relatively less exposure to verbal labelling of response characteristics in the observational environment than within the formal academic learning environment. For example, drawing of various geometric shapes is a frequent activity within the observational learning environment. This drawing is guided by visual-motor modelling and visual feedback.

In contrast, the same task requiring the drawing of geometric shapes within the formal academic learning environment usually patterns visual-motor modelling with verbal labelling. As the child's competency in drawing the figures increases the visual modelling is withdrawn and the task comes under the control of verbal instructions (e.g., "Draw

a circle").

On the basis of behavioral observations of patient's with localized cortical lesions, Luria (1966a; 1966b) proposed two modes of organizing and processing information, "simultaneous" and "successive" and delineated their cortical structures. Simultaneous processing, according to Luria, involves the synthesis of separate elements into quasi-spatial groups with all parts of the synthesis being surveyable. This type of synthesis is required in the formation of gestalts as well as the determination of verbal and nonverbal relationships between two or more objects. This synthesis is carried out as a recoding function, and as such involves the Coding level structures. Detailed specification of tasks associated with simultaneous processing within the observational and formal academic learning environments will be discussed in the Review of the Literature chapter of this paper.

Successive processing is characterized by the integration of discrete elements into groups based on temporal ordering. The entire synthesis is not accessible at any one time; instead, individual elements can be accessed only by the preceding element. Each element maintains an intrinsic independence to all other elements within the series, and acquires meaning only in terms of the entire sequence. This type of synthesis is carried out within the coding level functional

unit. Detailed specification of tasks associated with successive processing within the observational and formal academic learning environments will be discussed in the Review of the Literature chapter of this paper.

Factor analytic studies have shown that simultaneous and successive control processes appear to be viable individual difference variables (Das, Kirby and Jarman, 1979). It follows, therefore, that disparities in cognitive behavior may be the result of differing information processing modes (i.e., the two types of synthesis, simultaneous and successive), can be viewed as components in the processing of information and thus their appropriate use in task performance could be a determinant, in part, of individual cognitive performance and achievement.

The distinction drawn between the attentional and coding level control processes reflects the function of the structual aspects of a cognitive activity. In other words, the differences between attentional and coding control processes reflects the distinction between attention and coding. Attention involves the scanning and focusing of stimuli characteristics while coding involves the organization of these characteristics for storage and retrieval.

In discussing the two top-down attentional control processes reference was made to the involvement of planning

in providing the appropriate response characteristics in the form of visual and/or verbal feedback. Similarily, coding control processes may be associated with either the stimuli characteristics of a task or with the response characteristics of a task. In the former case, the stimuli characteristics activate coding control processes independent of response characteristics and the synthesis is said to be carried out without the involvement of the planning structures. In the latter case, the response characteristics activate the coding control processes as part of an overall goal-directed strategy and the planning structures are implicated.

Luria (1970) identified two forms of processing associated with the planning functional unit: concrete/active and verbal/logical. In this manner, the planning function can be characterized as the generation, selection, and monitoring of goal-directed attention and coding processes. The distinction between the two forms of planning control processes reflects differences in the nature of the response characteristics utilized in goal-directed attentional and coding processing. Note however, that the identification of response charateristics of a task is always intentional or a "top-down" attentional activity, while the identification of stimuli characteristics may or may not be intentional or "top-down" attentional activity. This implies that, stimuli character-

istics of a task must be utilized to operationalize the distinction between "top-down" and "bottom-up" attentional processing, while response characteristics must be utilized to operationalize the verbal/visual distinction in top-down attentional processing.

Top-down processes always involve intentional or goal-directed scanning and focusing of stimuli characteristics, while bottom-up attentional control processing is characterized by the scanning and focusing of dominant stimuli characteristics. Interestingly, a dominant stimuli characteristic is considered to acquire saliency through the process of discriminant stimuli learning, which may involve pairing response characteristics with stimuli characteristics in a goal-directed manner. This pairing is initially associated with interpersonal mediation, which is internalized in the form of the newly acquired dominant stimuli or as a bottom-up attentional process.

The observational learning environment is characterized by the provision of visual-motor models, while the formal academic learning environment is characterized by verbal/logical feedbackor instructions. A modelling mediational style is internalized by the learner into concrete/active planning according to Vygotsky's (1978) General Law of Cultural Development. To paraphrase Vygotsky, interpersonal

mediation becomes intrapersonal mediation. Similarly, verbal/logical interpersonal mediation becomes the basis of verbal/logical planning.

This line of reasoning and set of examples drawn from both learning environments provides the basis for the following definitions of the seven cognitive control processes:

a. BOTTOM-UP ATTENTIONAL CONTROL- 'incidental' attention to dominant (i.e., discriminant) stimuli characteristics.

b. TOP-DOWN VISUAL ATTENTIONAL CONTROL- 'intentional' or goal-directed attention to stimuli characteristics activated by the identification of response characteristics and under the control of concrete/active planning associated with visual-motor modelling or feedback.

c. TOP-DOWN VERBAL ATTENTIONAL CONTROL- 'intentional' or goal- directed attention to stimuli characteristics activated by the identification of response characteristics and under the control of verbal/logical planning associated with verbal instructions or feedback.

d. SIMULTANEOUS CODING CONTROL- recoding or synthesis of separate stimuli elements into meaningful wholes in which all the elements are mutually surveyable and meaning is only accessible from the whole.

e. SUCCESSIVE CODING CONTROL- recoding or synthesis of separate stimuli elements into temporal, sequence-dependent forms which are surveyable only one at a time and meaning is only accessible from the order.

f. CONCRETE/ACTIVE PLANNING CONTROL- generation, selection and monitoring of goal-directed attentional and coding processes associated with visual-motor feedback.

g. VERBAL/LOGICAL PLANNING CONTROL- generation, selection, and monitoring of goal-directed attentional and coding processes associated with verbal feedback.

Based on these definitions and a review of the relevant literature a study was designed to address the following

theoretical questions:

QUESTION 1

Can the seven control factors be operationally defined in such a way as to be identifiable in the cognitive performances of both Native and non-Native children across a wide range of cognitive tasks?

RATIONALE:

It would be incorrect to deny that there are quantitative differences in performance between Native and non-Native children on tasks used to operationally define control processes. It would be equally wrong and perhaps more pernicious to deny qualitative differences in control strategies. Kirby (1984) asks: "Can methods of instruction be designed that promote academic achievement (perhaps as defined by the particular culture) but [that] protect the cultural identity of the learners? If this is to be done, a greater understanding of the nature of strategies and their relation to performance is required" [p 9].

QUESTION 2

Do quantitative and qualitative performance differences on the seven control factor tasks provide sufficient detail for deriving instructional implications for cognitive process training within the formal education system?

RATIONALE:

It is assumed that the precision provided in both the theoretical and operational definitions of the cognitive control strategies will allow an instructional cognitive process task analysis to be conducted on various academic tasks. Due to the exploratory nature of this study a formal aptitude-treatment interaction study is considered premature. Rather, the emphasis is on providing precise descriptions of the task demands which activate various cognitive processes and on determining which control processes increase the likelihood of efficient performance on the various cognitive tasks. In this manner one should be able to specify which Native cognitive processes are used most frequently and which cognitive processes are in need of remediation.

QUESTION 3

Do quantitative and qualitative performance differences on the seven control factors provide sufficient detail for deriving instructional implications for academic lesson planning?

RATIONALE:

It is assumed that the precision provided in both the theoretical and operational definitions of the cognitive control strategies will allow an instructional cognitive process analysis to be conducted on various academic tasks.

The emphasis is on identifying cognitive control strengths which can then be activated by manipulations of the task demands as identified in Question 2. Question 3 implies that Native children attack reading tasks differently than their non-Native counterparts because of the type of task demands required in the "formal academic" and "observational" learning environments activate different control strategies--an implication consistent with cognitive style and information processing research on reading (e.g., Cummins and Das, 1977; Davey, 1983).

In summary, one of the more promising recent attempts to improve the delivery of educational programs in school has been to match the methods of instruction to the cultural cognitive strengths or preferences of the Native child (e.g., Klesner, 1982). The assumption behind matching teaching style to cognitive strengths is that a certain control strategy will function more effectively than another for the purposes of information processing if that certain control strategy has recieved a rich reinforcement schedule within the "observational" learning environment.

It is argued that instruction keyed to a child's cognitve strengths will considerably enhance and facilitate his or her ability to learn. Conversely, those taught without any

regard for "learning" style may experience great difficulty and even face school failure if they lack the strategies to efficiently process and retain information presented in a particular fashion (Kaulbach, 1984). This has led some researchers to view the mismatch between learning style and instructional style as a prime cause of school failure among Native children (Havinghurst, 1970; Kleinfeld, 1970).

Attempts to match instructional style to "learning" style do not assume that one instructional method is better than another; nor is it assumed that students with certain characteristics are better learners than others. Rather, the two factors (i.e., teaching method and learner characteristics) may interact in ways that have instructional implications (Berliner and Cahen, 1973; Cronbach and Snow, 1977).

The identification of a Native child's learning style for instructional purposes is maximally useful only when certain conditions are met (Laboratory of Comparative Human Cognition, 1982). The first requirement is that all, or at least a majority, of a child's educationally relevant cognitive abilities and methods of higher order information processing skills must be assessed in a quantifiable, replicable, and valid manner. The second requirement is that variations in cognitive performance must be systematically related to levels of achievement. And finally, the cognitive

abilities and higher order information processing skills assessed must facilitate the process of selecting instructional task demands. Only if these requirements are met can the promise of a learning style/instructional style matching approach be fulfilled.

This paper is an attempt to meet these requirements by providing a theoretical framework for interpreting the cognitive performance differences between Native and non-Native children from which instructional implications can be clearly and precisely derived. A detailed specification of seven control strategies derived from a single integrated theory of reading, language, and cognition, may then be used to help identify how Native and non-Native children process information and to assist in the process of specifying the instructional task demands which match this processing style.

Kane (1984) has summarized this learning/instructional style matching approach in the following manner:

> "Ideally, educators must first recognize how they deal with information and communicate with others and then become flexible enough to incorporate contrasting strategies in their modus operandi. By doing so, educators will successfully reach more learners. Lastly, educators must help learners to recognize how they process information and problem-solve and assist them in developing alternative cognitive styles of thinking and learning" [p91].

CHAPTER TWO: REVIEW OF THE LITERATURE

The First Canadians:

The first Canadians were Natives as their title proclaims. Having mastered the complex skills needed to cope with harsh environmental conditions, and having survived even harsher treatment meted out in the process of subsequent European colonization, today's Native peoples face an unparalleled challenge to their cultural survival. To meet this challenge, Native children have acquired a series of problem-solving strategies from various learning environments and use these strategies with varying degrees of success in coping with daily tasks.

British Columbian Native people may be living in modern urban apartment buildings, in houses located in metropolitan suburbs, in small country towns, or in northern islands and coastal communities set among the rainforests of the B.C. coast. Alternatively, they may be living, sometimes under deplorable conditions, on reserves throughout B.C. Whatever their present situation, the cultural heritage of Native people is unique, extensive, and diverse.

Deficiency Theories of Native Cogniton:

The earliest recorded assessments by Europeans of Natives and their way of life were couched in harsh derogatory terms. Disparaging commentaries by early Spanish and English navigators began a fairly consistent pattern of negative value judgements by the new arrivals (Patterson, 1972).

Chapter Two Review of the Literature

The advent of further exploration and colonization brought in its wake anthropologists, historians, as well as, traders, soldiers, and administrators; however, increased contact and more detailed observations produced little if any amelioration of earlier reactions to Natives. Their comparative lack of material possesions, instead of being viewed as the purposeful and successful product of efficient adaptation by a hunting and gathering society, was interpreted as a sign of cultural impoverishment, with its consequent association of intellectual inferiority. Occasionally, and with direct benefit to white society, observational concessions were made to Native cognitive competence, usually referring to displays of visual skills apparent in hunting or trapping. Where such seemingly positive comments did occur, these were nevertheless interpreted as evidence of the close association between Natives and lower animal forms, since animals rely more heavily than human beings on such keenly developed senses as sight and smell for everyday survival. In contrast, whites were seen to possess a superior "intellectual" sense.

This assumption was supported, at the time, by findings which revealed that Native children achieved less well than non-Native children on tests measuring intelligence or innate ability. It wasn't until researchers began to critically examine the content and bias of these tests that the fal-

lacious assumption was seriously challanged. Researchers suggested that all of these tests emphasized verbal reasoning, and therefore, openly discriminated against Native children, many of whom do not speak English as their first language (Jamieson and Sanford, 1928). Other researchers discredited the assumption of intellectual deficiency by pointing to evidence that indicated that Native children scored exceedingly well on intelligence tests which require visual-motor skills such as the Goodenough Draw-A-Man Test (e.g., Goodenough, 1926; Telford, 1932; Eells, et al., 1951).

The Wechsler Scale Performance of Native Children:

The difficulties Native children experienced on verbal intelligence tests and the mastery they displayed on visual-motor tests of intelligence were reflected on the Wechsler scales by a Verbal/Performance scale discrepancy (e.g., Cundlick, 1970; Havighurst and Janke, 1944; McAvery, 1976; Peck, 1973; Peters, 1973; Sacks, 1974; St. John and Bauman, 1976; Thurber, 1976; Turner and Penfold, 1952).

Research on Wechsler subtest performance has revealed patterns seemingly unique to Native children (Mc Shane and Plas, 1984). A partial list of these findings include; an 8 to 19 point discrepancy favoring the Performance scales; Bannatyne (1971) factor scores indicating Spatial scores superior to Conceptual and Acquired Knowledge scores (e.g., Mc Shane and Plas, 1982; Zarske, Moore, and Peterson, 1981);

and the absence of a third "distractibility" factor usually present in white samples (Reschly, 1978; Zarske, Moore, and Peterson, 1981).

These findings, taken as a whole, have been interpreted as indicating a verbal deficiency among Native children not entirely accounted for by English as a second language. For example, Mc Shane and Plas (1984) suggest the following factors may underly the evidenced verbal deficiency of Native children: physiological factors such as higher prevalence rates of "otitis media", or middle ear disease, among Native groups (e.g., Mc Shane, 1982; Mc Shane and Plas, 1982); neurological factors such as a linguistic predisposition for right hemisphere specialization (e.g., Hynd and Scott, 1980; Thompson and Bogen, 1976; Mc Keever, 1981); and finally, and more germaine to this paper, socio-ethnic factors such as reliance on nonverbal communication techniques among Native families (e.g., Boggs, 1965; Greenbaum and Greenbaum, 1983; Guilmet, 1981; Hickerson, 1970; 1971; Kleinfeld, 1970; Phillips, 1976). While there appears to be no disagreement over the verbal deficiency interpretation, there appears to be continued confusion as to what factors may underly this deficiency (e.g., Brandt, 1984).

Competency Theories of Native Cognition:

One positive note coming from studies using the Wechsler scales on Native children is the finding of average to above

average visual-motor skills. Not only does this finding help shatter the ethnocentric assumption that Native children lack learning aptitudes, but it also further supports the notion that Native children may represent a unique group of students whose learning potential may be not be accurately assessed by verbally dominated tests of intelligence like the Wechsler scales. In support of this contention are the results of studies of Native cognitive performance utilizing so called nonverbal intelligence tests like the Goodenough Draw-A-Man test (e.g., Eells, et al., 1951; Goodenough, 1926; Telford, 1932). These studies demonstrate average to above average nonverbal intelligence among the diverse Native groups assessed. Given these results, the verbal deficiency interpretation of Native children's performance on Wechsler tests was viewed as a by-product of an over reliance on nonverbal modes of communication and problem-solving among Native children. In this manner, the verbal deficiency evidenced by Native children was thought to be a product of a learning environment that selectively reinforced the development of visual/motor problem-solving strategies over verbal strategies. The factors influencing the development of a visual competency among Native children and the nature and extent of this competency, have been the focus of recent studies of Native children's performance.

Perhaps the most comprehensive and most detailed studies

of the factors influencing the development of visual problem-solving strategies has been the work of John Berry and the late Herman Witkin from within a cognitve style framework (see Werner, 1979 for a recent review). Briefly, the cognitive style/psychological differentiation framework links the nature of the task demands within a learning environment to the nature of the socialization provided by a culture. Through the combination of techniques of socialization associated with ecological and other demands, specific strategies are welded into "charateristic self-consistent modes of functioning found pervasively throughout an individual's cognition, that is, perceptual and intellectual activities" (Witkin, 1966). From this perspective the factors influencing the development of a Native competency in visual strategies is related to the method of socialization (instruction), as well as the task demands which originally activated these strategies.

More (1984b) and Kaulback (1984) review cognitive style studies conducted among Canadian Natives. The evidence is inconclusive regarding the field independence of Native groups as a whole, however, some sub-samples appear to be relatively more field independent than field dependent. One explanation of the sometimes conflicting evidence regarding field independence among Canadian Natives may lie in the nature of the socialization process associated with the sub samples.

For example, more traditional Native groups were more field independent than transitional, urban Native groups (Weitz, 1971). This finding interpreted from a cognitve style/psychological differentation perspective, suggests that the more traditional Native groups differ significantly from transitional Native groups in the style of socialization provided. This interpretation is consistent with recent observational studies of interaction patterns and learning activities in traditional Native homes (see Greenbaum and Greenbaum, 1983 for a recent review of these studies). The "observational" learning environment associated with more traditional Native homes provides frequent opportunities to practice and reinforce skills associated with a field independent cognitive style. The defining strategy associated with a field independent cognitive style is the selection and generation of an organizational framework for a disorganized set of observations (Witkin, 1966). This framework is initially activated by a series of "mediated" strategies provided by the processes of socialization.

For example, in learning to make a traditional blanket each step in the process is first modelled by a competent expert before the child is allowed to begin. The division of the overall process into a series of steps represents the imposition of an organizational structure on what would be considered a disorganized set of observations. Within

the observational learning environment this organizational structure is activated by a visual control strategy, whereas within the formal classroom, the structure is usually considered to be activated by verbal strategy. The process of activating an organizational structure reflects Vygotsky's (1978, p 57) General Law of Cultural Development, whereby the form of social control provided for a task by a social mediator becomes the form of control strategy employed by the individual on similar tasks.

> "Any function in children's cultural development appears twice, or on two planes. First, between people as an inter-psychological category and then within the individual child as an intra-psychological category. This is equally true with regard to voluntary attention, logical memory, the formation of concepts and the development of volition"
> (Vygotsky, 1978, p 57).

One implication that can be drawn from Vygotsky's law is that visual control strategies appear twice in a Native child's development. First, they appear as "observational" learning (Kaulbach, 1984) or "observe-and-do" learning (More, 1984b), and then, they appear as intrapsychological visual control or global processing strategies. The same would be true for auditory/linguistic functions. First, they appear as "verbally-mediated" learning strategies, and then as verbally regulated individual problem-solving strategies.

Given the "observational" learning environment in more traditional Native homes, one would anticipate that facility

with verbally regulated problem-solving strategies would be less developed among the more traditional Native groups. Schubert and Cropley (1972) found that rural Nothern Saskatchewan Native children demonstrated less proficiency on a verbal regulation of behavior task then did urban and non--native children. This finding may be interpreted as implying that the "verbal deficiency" evidenced by most Native children on the Wechsler tests represents at least two distinct classes of deficiencies.

First, there is a class of deficiencies associated with the "performance characteristics" of specific functions (Sternberg, 1980). For example, Mc Shane and Plas's (1984) explanations of the "verbal deficiency" Wechsler data include physiological and neurological factors that result in deficiencies in performance characteristics. In this sense, the deficiency is considered to be structural in nature.

Flavell and other metacognitive researchers have identified a second class of deficiencies called "production deficiencies" (Flavell, Beach and Chinsky, 1966). A production deficiency occurs when a person fails to spontaneously employ a strategy on a task even though he has demonstrated he can successfully employ that strategy (Flavell et al., 1966). The cognitive style/psychological differentiation theory of Witkin and his colleagues and the cultural development theory of Vygotsky both provide interpretation frameworks that stress the factors related to the development of a

"verbal production deficiency". In a similar manner, there must be at least two classes of competencies.

The first class represents competencies in the performance characteristics of strategic behavior. For example, the visual strengths evidenced by Native children can be interpreted as representing a structurally more developed visual processing system. Alternatively, these strengths can be representative of the spontaneous production of control strategies. This distinction has been drawn by Kirby (1984) in reference to a study of Native children's performance on information processing tasks:

> "...For instance, Krywaniuk (1974) showed that Canadian native Indian children performed less well on measures of successive processing than did white children. A remedial program improved their scores on successive processing tests, as well as on measures theoretically related to successive processing (i.e.reading). Had the native children previously had low successive processing ability, and had the remedial program increased that ability, or had they had normal ability but not known how or when to use it? In the former case, the problem and solution concerned only processing (performance characteristics); in the second, planning or (control) strategies are clearly implicated" [p 7].

The question of whether verbal deficiencies in Native children's performances are related to either a processing deficiency or a planning deficiency has only recently received the attention it deserves.

Davidson and Klich (1984) have pointed out the difficulty

of investigating the lack of transfer of strategies which develop within the indigeneous context to their application within the formal educational context:

> "One issue that has been neglected by the research on context and transfer is whether the lack of transfer is a result either of the greatly different demands of indigeneous and formal educational contexts and the subsequent inability of culturally different children to make the transition, or of the inability of those children to distinguish between the different contexts and to adjust their strategies accordingly" [p. 147-148].

In their terms, the underachievement evidenced by Native children may reflect a verbal deficiency activated by the highly verbal nature of formal education tasks, or alternatively, it may reflect the inability of Native children to recognize verbal task demands, and to therefore verbally regulate their behavior.

Utilizing Hunt's (1980) description of the three aspects of any cognitive function, the transfer of any cognitive function can be seen as having three separate but interelated aspects; structure, processing and knowledge base. For example, the failure to transfer a verbal function may have a structural aspect which can be related to neurological and physiological factors (e.g., Bogen et al., 1972), or, a processing aspect which can be related to the activation of control strategies by inter-pychological functions becoming intra-pschological functions, and finally, an aspect associ-

ated with domain specific knowledge (see Campione et al., 1982 and Das, 1984 for fuller discussions of these aspects). A Native child's deficiency and/or competency may be associated with any or all of these aspects.

In order to facilitate the interpretation of Native children's difficulties in transferring cognitive functions from the "observational" learning environment to the formal educational environment, an interactive framework which has explanatory power over differences in structure, processing and domain specific knowledge is essential. In other words, this framework must account for differences in cognition, language, and reading by providing an integrated model of the interaction between the structural, processing, and knowledge base units of a cognitive function (Doehring et al., 1981). One model which holds a great deal of promise for explaining such interrelated aspects of cognitive functions has been called the Luria/Das model (Kaufman and Kaufman, 1984).

The Structures:

Luria (1966a; 1966b; 1969; 1970; 1973) has identified and investigated three units of the brain. The units are functional systems; the location for which was determined through deficits in performance following injury to these large areas of the brain. Reading, language, and cognition depend upon the participation of all three functional units:

Block I--a unit for regulating attention; Block II--a unit for coding and processing information; and Block III--a unit for programming, regulating, and evaluating mental activities (Das et al., 1977; 1979). Das (1984) has suggested that these functional systems may represent the structural aspects of a cognitive function.

The Structures: Block I--Attention

The attentional system of the Luria model is situated in the upper and lower brain stem, the reticular formation, and the hippocampus structures of the brain. Marked damage to this functional unit will produce changes in the arousal level of the cortex (Luria, 1973). According to Das, et al., 1979):

> "An appropriate level of arousal is required for any task, any deviations from this optimal level in either direction decreases performance (the Yerkes-Dodson Law). Inappropriate arousal (whether it be habitual or situational specific) interferes with attentional processes, affects processing which occurs in Block II, and can produce deterioration in the planning functions of Block III" [p 43].

Not only does a deficiency of arousal or attention interact to produce deficiencies in other structures, but also a deficiency in attentional structures may result in limited development of their associated processing and knowledge base aspects.

The Structures: Block II--Coding

The second functional unit is located in the neocortex and includes the occipital, temporal and parietal lobes (Luria, 1973). It is organized hierarchially according to primary, secondary, and tertiary zones. Block II is regulated by the principle of diminishing modality specificity (i.e., primary zones are more closely linked to modality deficits than tertiary zones). The coding block is also regulated by a principle of increasing functional lateralization (i.e., tertiary zones are more associated with hemispheric specialization than primary zones). Marked damage to this unit will produce significant changes in mnemonic performance charaterized by the extent of the injury to the three zones (Das et al., 1979). Coding level deficits have been linked to academic achievement by several researchers (Das et al., 1979; Cummins and Das, 1977; Kaufman, 1978; Krywanuik, 1974; Leong, 1974).

The Structures: Block III - Planning

The third functional unit of the Luria model is located in the frontal lobes, or more specifically, anterior to the precentral gyrus. It may be organized into a global processing system as charaterized by Sternberg (1982). Luria (1973) describes the function of the prefrontal lobes in the following manner:

> "It is these portions of the brain belonging to the third zone of the cortex that play a decisive role in formulation of intentions and programs and in the regulation and verification of the most complex forms of human behavior" [p 84].

The prefrontal region is involved in both the reception and integration of information from Block I attention and Block II coding, and for organizing and regulating the activities of these blocks. The frontal lobes, through their association with the reticular formation, regulate conscious attention and execute programmed actions combining all three aspects of cognitive functioning including process and knowledge base activation (see Sternberg, 1982, for a more detailed discussion). A link between planning-task performance and academic test performance has been established by Das and his fellow researchers (e.g., Snart, O'Grady, and Das, 1982; Snart and Swann, 1982).

The Processes: Block I--Attention

Three distinct but interrelated attentional control processes have been identified in a recent cognitive theory of reading processes (Lupart and Mulcahy, 1984). First, there are the "bottom-up attentional" processes which are activated by dominant stimulus charateristics. For example, color and shape are considered dominant characteristics which should activate certain attentional processes. The extensive use of color and shape prompts provided in the formal classroom should attest to the importance placed on these stimulus

characteristics for eliciting attention. In fact, the entire range of word attack reading approaches are based on the hope that grapheme (shape) characteristics will activate a child's attention.

Second, the group of attentional processes reviewed by Lupart and Mulcahy (1984) are activated by visual control strategies. In support of visual control of attention, Day (1975) reviewed literature identifying six developmental trends associated with a child's increasing ability to control his visual scanning behavior. With increasing age and subsequent familarity children:

1. demonstrate more systematic, task-appropriate strategies for acquiring visual information,
2. show an increasing ability to maintain optimal performance across variation in the content and arrangement of stimuli,
3. exhibit visual scanning that becomes more exhaustive and more efficient,
4. show an increasing focus on the portions of visual stimuli that are most informative for the specific task,
5. show an increase in the speed of completion of visual search and comparison tasks,
6. show an increase in the size of the useful "field of view" (Lupart & Mulcahy, 1984, pp. 228-229).

Although the list is not specific to reading and academic tasks, it should be clear that these trends reflect what La Berge and Samuels (1974) termed the "automatization" of the decoding process, which is significantly related to successful reading and therefore to successful school achievement.

The third group of attentional processes discussed by

Lupart and Mulcahy (1984) are activated by verbal control strategies. In support of verbally controlled attentional strategies, Lupart and Mulcahy (1984) proposed a top-down or cognitive view of attention in which, both visual and verbal control of attenion occur. They subsequently reviewed recent studies supporting this view, concluding:

> "In summary, the preceding review of the literature in the area of reading suggests that the proficient reader is one who can flexibly apply his or her attention to the visual information on the page, to the interpretation of the author's meaning, to the reader's own reflective or background knowledge, or to an overriding macro-goal that can be self-regulated or other imposed. Where the attention gets allocated is both self- and situationally- determined. The decision for attentional allocation is dictated by the reader's self-defined, self-regulated or interpretive view of the task purpose" (Lupart & Mulcahy, 1984, pp.233-234).

The emphasis on self-regulated attentional allocation is consistent with recent research on the mentally-retarded, suggesting: self-regulatory control may be implicated as the deficient process among inefficient learners like the retarded. These self regulatory processes have been referred to as metacognitive (Brown,1978; Campione & Brown, 1977; Flavell & Wellman, 1977) or executive control (Belmont & Butterfield, 1977; Brown, 1974) processes.

That self-regulatory processes may involve either visual and/or verbal mediators is implied by the General Law of Cultural Development. If the form of cultural mediation

provided in the traditional Native child's "observational" learning environment is largely visual in nature then this visually-mediated interpsychological process must appear as a visual self-regulation process. Similarily, if the form of mediation provided in the more urban, transitional Native child's learning environment is largely verbal, then the performance of less traditional Native and non-Natives on a verbal regulation of behavior task should be superior to Native groups who are exposed largely to an "observational" learning environment. This is consistent with the results of Schubert and Cropley's (1972) investigation.

The form of visual mediation provided by an observational learning environment can be thought of in terms of the developmental visual scanning trends described by Day (1975). Similarily, the form of verbal mediation provided in a classroom can be thought of in terms of the developmental trends associated with the comprehension, and monitoring of communication (Flavell et al., 1981). Day's description of visual scanning strategies can be adapted to describe verbal mediation trends in a manner consistent with the research reviewed by Flavell et al. (1981). In other words, with increasing age and subsequent familiarity children:

1. demonstrate more systematic, task appropriate strategies for acquiring "verbal" information,
2. show an increasing ability to maintain optimal performance across variation in the content and arrangement of "verbal" stimuli (e.g., reading),

3. exhibit "active listening" that becomes more exhaustive and more efficient,
4. show an increasing focus on the portions of "communications" that are most informative for the task,
5. show an increase in their "rate of comprehension" and "vocabulary",
6. show an increase in the exent of their auditory/temporal processing.

These developmental processes are assumed to represent the processes associated with verbal control of attention and at the same time to provide a framework from which to draw instructional implications.

The Processes: Block II--Coding

On the basis of behavioral observations of patients with cortical lesions, Luria (1966a; 1966b) proposed two modes of information integration--simultaneous and successive syntheses. Simultaneous process according to Luria (1966b) involves the synthesis of separate features into quasi-spatial groups with all the synthesis being surveyable at the same time. Successive synthesis is characterized by the integration of discrete features into groups based on temporal ordering. The entire synthesis is not accessible at one time; instead, individual features can be accessed only by the preceding feature. Each feature maintains an intrinsic independence to all features within the series, and acquires meaning only in terms of the entire series.

The simultaneous/successive coding processes have received considerable research leading Das and his colleagues

to enumerate the strength of this model (Das, et al., 1979). Specifically, the model: (a) provides for a unified holistic framework for interpreting a wide range of individual difference variables associated with performance on cognitive measures; (b) rests upon a well-developed theoretical base in clinical neuropsychological research; (c) presents a process rather than a product explanation for deficit performance; (d) provides factor analytic evidence identifying independent simultaneous and successive processing factors associated with performance on a wide variety of cognitive tasks--across various demographic and cultural sub-samples; and, (e) provides empirical evidence indicating that simultaneous-successive syntheses are necessary for- and significantly related to- academic acheivement (see e.g., the recent review of the simultaneous-successive syntheses studies by Das, 1984a).

Das (1984a) attempted to summarize the current postulates of the theory of simultaneous and successive processing and at the same time, he specified the nature of the relationship between coding level processes and the planning level processes:

1. simultaneous-successive and planning processes occur at all three levels of cognition: perceptual, mnestic, and conceptual,
2. simultaneous and successive processes are not hierarchical,
3. however, either simultaneous or successive processing may appear earlier than the other and have a distinct pattern of development that is not shared by the other,

4. the same task (test) may be approached either simultaneously or successively (and within each mode of encoding, there may be variation in strategies for solution). This would be determined by the interaction of the subject's (a) competence in one mode of encoding; (b) habitual mode of encoding when he or she is competent in both modes of encoding; and (c), task demands that can be modified by instructions,

5. simultaneous like successive processing operates on verbal as well as nonverbal information,

6. simultaneous and successive processes operate on information presented through any sensory receptor,

7. planning subsumes (a) generation and selection of plans and strategies; (b) decision making; and (c), execution of decisions and plans,

8. planning and coding are interdependent (Das, 1984, pp. 21-26).

Not only do these postulates further specify the nature of simultaneous/successive syntheses; but also, they begin to address the question of how deficits and strengths in particular aspects of cognitive functions might interact. From this interpretation perspective, not only do planning processes affect coding processes but coding processes affect planning processes. The same recursive relationship is assumed to exist between attentional and coding and planning processes. To paraphrase Das (1984), planning depends on both the nature of the attentional processing, as well as the coded information provided by simultaneous and successive processing. On the other hand, the generation and selection of attentional and coding strategies, or the decison to choose one process over another, and the execution of decisions and plans are all functions of planning level processes.

The Processes: Block III--Planning

The nature of planning processes can be theoretically inferred from the nature of the interpsychological mediation provided by a particular learning environment. For example, the type of planning processes that would develop in an "observational" learning environment would be associated with the generation, selection, and execution of largely visual-motor strategies or plans in which the decision making process is based on concrete (visual) and/or active (motor) feedback. In contrast, in a "verbally mediated" learning environment the planning processes should be characterized by the generation, selection, and execution of largely verbal strategies or plans in which the decision making process is based on verbal feedback and/or logical consistency. Luria (1973) termed these processes concrete/active and verbal/logical after identifying deficits in the performance of brain trauma patients.

Das and his colleagues (Das et al., 1979) suggest that:

> "...cognitive styles may be related to the planning function, or to the sequence of cognitive operations that are selected by the individual in response to a problem situation" [p 140].

This implies that all planning processes interact not only with all other processing occurring within different structures but as well with the knowledge bases associated with these structures. Before turning to a discussion of the knowledge bases associated with each of the structures it

is important to note that each knowledge base is considered both an independent aspect of a cognitive function as well as an interdependent aspect of a cognitive function. Put simply, this means that one type of knowledge base is independent from another but interdependent on the processing generated, selected, or used in the execution of a task.

The Luria/Das cognitive functions have been described in terms of both structure and processing. Luria's (1973) description of the the functional systems of the brain suggests that these systems have both depth as well as spread. Processing activity within a functional system is spread over a wide area and is consistent with the notion that processing is not hemispherically specialized. It is assumed that the other processes described are equally non hemispherically specialized. If processing is not hemispherically specialized, then, how can we explain the overwhelming evidence concerning hemispheric specialization for various cognitive functions (e.g, Allen, 1983; Bradshaw and Nettleton, 1981).

Das, Kirby and Jarman (1979) suggest that:

> "There is a crucial difference between the the laterality model and Luria's, however; the former is at least to a large extent "code content" specific, while the latter is not. By code content we mean not the stimulus content (verbal, spatial, etc.), but the characteristics of the code (verbal etc)" [p 149].

The Luria/Das model states that all processes can be applied

to codes of any type.

The nature of code content and how it affects processing within the Luria/Das functional systems is related to the hierarchical arrangement of cortical zones (Luria, 1973) and the notion of depth of processing (Craik and Lockhart, 1972):

> "Considering depth, any kind of coding, such as visual information, passes through three hierarchical levels of the brain consistent with its topography. These can be described in a rather simplistic manner as the projection area where the modality characteristics of the information is intact. Above the projection area lies the projection-cum-association area. As information reaches this area it loses part of its modality tag. Above this area is the tertiary area or zone of overlapping where information is typically amodal. This enables information to be integrated from different sensory organs without any restriction due to modality (Das, 1984b, p 19).

The hemispheric specialization of language and other cognitive functions are explained in terms of the increasing functional lateralization of information as it moves from the primary zones of the cortex through to the tertiary zones; to quote:

> "The last point is that progressive lateralization of functions occurs as one progresses from the primary cortical areas through the secondary to the tertiary area. Luria has observed that higher functions such as speech illustrate the degree of lateralization of functions. The functions of the secondary and tertiary zones of the left hemisphere start to differ radically from those of the right hemisphere in right handed people.... For instance Luria mentions that if lesions

> are in the primary zones, the left/right difference is not seen. However, when these are in the secondary or tertiary zones, the differences in function is quite apparent (Das, Kirby, Jarman, 1979, p 40).

Hemispheric specialization is most pronounced on tasks requiring an association between the stimuli and some familiar "second signal", as on a task requiring labeling of a feature or features. The link between code content and depth of processing will be discussed more fully in the sections which specify the knowledge bases associated with the structural aspects of the Luria/Das model.

The Knowledge Bases: Block I--Attention

The attentional knowledge bases can be characterized by the nature of the features identified when scanning for perceptual features. The first set of attention level knowledge bases are characterized by visual-spatial configurations of global information that are largely controlled by the Gestalt principles of perceptual organization and in which only the overall outline is verbally labeled or visually framed. In contrast, there are a set of attention level knowledge bases characterized by temporal arrangement of detailed information in which each feature is verbally labeled or visually framed. The evidence regarding knowledge bases associated with attentional structures and processes is based largely on conjecture. Nonetheless, it seems reasonable to argue that neuropsychological research which is coming

to rely more and more on a holistic/analytic distinction as underlying hemispheric specialization, supports the contention that initial perceptions or attentional knowledge bases can be characterized by holistic, visual-spatial labels or frames, as well as by analytic/temporal labels and frames (e.g., Allen, 1983; Bradshaw and Nettleton, 1981).

The Knowledge Bases: Block II--Coding

The holistic and analytic features provided by attentional processes are associated with familiar labels or visual patterns within the Coding level (Das, Kirby, and Jarman, 1979). It is the nature of this association which forms the definition of the coding level knowledge bases. Paivio has suggested that these associations:

> "...are represented and processed in functionally independent, though inter- connected, cognitve systems.... One system, the imagery system, is presumably specialized for encoding, storing, organizing, trans- forming, and retrieving information concerning concrete objects and events. In brief, it represents our knowledge of the world in a form that is highly ... analogous to perceptual knowledge.... The other (verbal) system is specialized for dealing with information involving discrete linguistic units and structures. Independence implies, among other things, that the two systems can be independently accessed by relevant stimuli; the imagery system is activated more directly by perceptual objects or pictures than linguistic stimuli; and conversely in the case of the verbal system. Interconnectedness simply means that nonverbal information can be transformed into verbal information, or vice versa." (Paivio, 1975, p 635).

Reese (1977) reviews evidence supportive of a unique organizational function for the imagery system as compared to the verbal system. This function appears to influence associative memory by affectng the strength or memorability of associations. It can also increase stimulus differentiation (Reese, 1977). While the imagery and verbal systems described by Paivio (1975), and Reese (1977), describe the nature of factors influencing the organization and memorability of associations, the descriptions of these systems in the literature do little to specify the nature of the content of an association. This latter concern is more germaine to our discussion of coding level knowledge bases.

Paivio's (1975) conceptualization of the verbal and imagery systems implies that a stimulus feature may be coded either largely in terms of perceptual knowledge (e.g., color, shape, configurations, etc.) or in terms of lingustic knowledge (e.g., labels). The interconnectedeness of the dual code theory implies that perceptual knowledge, or knowledge supplied to the coding level by attention level functions, can be coded into linguistic knowledge. Reid (1974) provides a more detailed account of this encoding process by specifying the nature of two basic classes of imagery and verbal associations which can be generated independently by either the imagery and/or the verbal code systems:

> "Constraints in the use of language reflect to different kinds of relationships-paradigmatic and syntagmatic.... Paradigmatic relations are conceived of in terms of the shared conceptual features that characterize the members of a given paradigmatic set. Units in a set closely relate to one another and share a large number of such features, whereas fewer features are shared by those members not so closely related. Syntagmatic relations, on the other hand, do not consist of features but the relationships that hold between the features of the various participants in the image. Rather than sharing features, syntagmatically related participants each have features that interlock in various ways with the features of the other participants. (Reid, 1974, p 331).

This implies that an association can be charaterized as belonging to either a paradigmatic and/or a syntagmatic class. In the case of a paradigmatic association the feature(s) arriving from the attentional functions are related to previously acquired "paradigmatic sets" or clusters of "shared conceptual features". For example, the separate features of an object or picture of a football can be related to the class of "balls" known as "footballs". It is important to note, that both analytic and holistic features can be paradigmatically associated.

In the case of syntagmatic associations, the feature(s) arriving from the attentional functions are related to previously aquired "syntagmatic relatons" or by the order of their arrival as discrete features. For example, the separate features of an object or picture of a football can be related

to either a feature labelling process (e.g., brown, oblong, used for kicking etc.), or by relating these discrete features as they arrive into descriptive definitions of the object (e.g. a brown, oblong ball used for kicking).

Jarman (1980) reviews evidence on syntagmatic-paradigmatic associations from three different research areas: (1) developmental studies and experimental studies of word retrieval; (2) clinical research on aphasia; and (3), differences in simultaneous and successive synthesis. Developmental and experimental studies, taken as a whole, suggest that both paradigmatic and syntagmatic associations can be identified as individual difference variables among widely divergent populations and, furthermore, demonstrate a fairly consistent shift from syntagmatic free association to paradigmatic free association soon after entry into school (Entwistel,1966; Entwistel, Forsythe, and Muus, 1964; Ervin, 1961; Palermo, 1971; Palermo & Jenkins, 1963).

From clinical investigations of disrupted language functioning among aphasics, associated dysfunctions have been characterized as representative of syntagmatic or paradigmatic knowledge deficits and the processes which are associated with these deficits are successive and simultaneous syntheses, respectively (e.g., Jakobson, 1956, 1964, 1966, 1977; Luria, 1964, 1970, 1972, 1973; and Pribram, 1971). Not only do these studies link paradigmatic/syntagmatic associations

to hemispheric specialized structures or the secondary and tertiary zones of the cortex, but, in addition, they link these associations to simultaneous and successive processing (see also Cummins and Das, 1978). In summary, the knowledge bases associated with coding level processing have been characterized as syntagmatic/paradigmatic associations which are coded either verbally or by imagery.

The Knowledge Bases: Block III-- Planning

The knowledge bases associated with the planning level are the same knowledge bases, already identified, at the attention and coding levels. That is, the planning level knowledge bases have been defined in terms of how they are activated rather than by identifying uniquely different bases.

Sternberg and Powell (1982) describe a theory of planning or intelligence which identifies two levels of planning. First, a "global" mode in which the generation, selection, and execution of cognitive functions is "hierarchical and consciously controlled" and, secondly, a local mode which is "non hierarchical and automatic":

> "Thus in processing information from old domains or domains in which one has acquired considerable expertise, the individual relies primarily upon automatic, local processing. A central executive initially activates a system consisting of locally applicable processes and a locally applicable knowledge base. Multiple local systems can operate inparallel. Performance

> in this system is both automatic and of almost unlimited capacity; attention is not focussed upon the task at hand. Only knowledge that has been transferred to the local knowledge base is available for access by the storage and retrieval components utilized in a given task. An important detail to note is that the local system is activated by metacomponents from the global processing system" (Sternberg and Powell, 1982, p 990).

This description of the operation of a local processing system may be considered an adequate description of how each of the attentional and coding control strategies operate. For example, if a child has not previously acquired a label/frame for a particular analytic or holistic feature, attention will be directed only to the salient charateristics of the stimuli. That is, only bottom-up attentional processing will be activated. In this manner, each attentional and coding control process can operate independently of all others. Similarly, each of these local control processes can operate in parallel with any or all of the others. Planning has been described as the generation, selection, and execution of strategies or cognitive functions. The nature of this process has been described further by Sternberg and Powell in their description of the "global processing" system:

> "In contrast, in domains in which one has little expertise, processing is largely focused in the global processing and knowledge system. As expertise develops, greater and greater proportions of processing are transferred to (i.e., packed into) a given local processing system. The advantage of the local system is that acti-

> vation is of the system as a whole, rather than of individual components within the system, and thus it requires much less attention than does the global system" (Sternberg & Powell, 1982, p 990).

This implies that the selection of a control strategy is based on familiarity. Activation of a local control system by familiar task demands includes a restriction on the knowledge bases available. In other words, a local control process, when activated as part of a local system, does not have access to other local knowledge bases but is limited to the habitual or preferred association or feature identification. In contrast, activation of the global system by unfamiliar task demands allows unlimited access to various combinations of control processes and knowledge bases.

Any given knowledge base can be transferred into any given control process. In the case of local control process activation, selection of the knowledge base is considered habitual. When global activation of control processes occurs, selection of a knowledge base is considered intentional or goal-directed in keeping with a the goal-directed nature of the planning process.

Summary of The Luria/Das Cognitive Functions:

Seven cognitve functions have been identified in terms of three aspects: processes, structures, and knowledge bases. Each aspect of a cognitive function is considered independent from- but interconnected with- the other aspects. The sel-

ection of a particular aspect of a cognitive function can be either habitual or intentional. Quantitative and qualitative performance differences have been demonstrated, on a wide variety of tasks and research designs, and across a diverse population. This suggests these cognitive functions possess explanatory power over a wide variety of individual difference variables including academic acheivement.

The Emic Validity of the Luria/Das Model:

There are several points which suggest that the factors identified in this paper underlie the cognitive task performance of Native children, both within the "observational", as well as, within the formal academic learning environ ments. First, it is reasonable to expect that a model based on neuropsychological theory and empirical investigations will apply equally across cultures since the same structural aspects are present in all human learning environments (Luria, 1966a). Second, considerable investigation of the model across diverse populations and on a variety of tasks suggests that these aspects can be identified even on indigeneous tasks, such as the card playing strategies demonstrated by Australian aborigines (Klich and Davidson, 1984). Third, research carried out on Native children's cognitive styles can be theoretically linked to one of the seven cognitive strategies and its associated knowledge base. For example, the analytic-holistic knowledge bases can be theoretically

linked to the knowledge required on field articulation tasks and to visual control of attention (see Kane, 1983).

And finally, there is a small, but growing body of literature identifying these cognitive functions among Native populations. For example, simultaneous and successive syntheses have been investigated in Canadian (e.g.,Krywaniuk, 1974: More, 1984a) and American (Brokenleg and Bryde, 1984) Native children. These studies used different batteries of marker tests to identify these processes by factor analyses. Krywaniuk's study utilized the simultaneous- successive battery designed by Das et al. (1979). Despite the fact that the American researchers utilized the Kaufman Assessment Battery For Children - K-ABC (Kaufman and Kaufman, 1983) to operationalize simultaneous-succesive syntheses, all researchers identified a simultaneous factors on which the majority of simultaneous marker tasks were highly loaded. The same held true for the identification of a successive processing factor. Evidence regarding quantitative and qualitative performance differences between Native and non-native groups on the tasks used to operationalize simultaneous and successive processing factors is less conclusive.

Krywaniuk (1974) compared low achieving grade 3 Cree children attending a reserve school to high and low achieving white children attending an urban school. Mean WISC Performance IQ's for low achieving white and Native children were

not significantly different (i.e., mean 98.96, s.d. 11.78 versus mean 93.39, s.d. 12.41, respectively). In terms of Verbal IQ the Cree children were significantly lower than the low achieving white (i.e., means of 73.05 versus 93.88, respectively). This verbal-performance discrepancy is consistent with most studies reviewed in this paper.

Krywaniuk then administered a battery of tests to measure simultaneous/successive processing (Das, et al., 1979) to all groups. Results of separate principal component factor analyses on the performance of the Cree and low achieving whites indicate different factor loadings for the two groups on a variety of the tests, suggesting that Native children may approach the same task in a manner distinguishable from the manner of low achieving white children. For example, on the Raven's Progressive Matrices Test, low achieving whites appeared to use simultaneous processing consistent with prior simultaneous-factor loadings for the Raven performance's obtained in validation studies of the battery. In contrast, the Cree children appear to use successive processing as demonstrated by its high loading on the factor with the majority of successive marker tests. There was no significant quantitative performance difference between the two groups, despite qualitative performance differences on this task.

A second important finding of Krywaniuk's study is that the Cree children demonstrated significantly lower performance

on all marker tests of successive processing. In fact, the only test with a high loading on the successive factor that the Natives performed well on was the Raven. This result led Das and his colleagues to speculate as to the nature of a successive processing deficiency among Natives:

> "How does one account for the similarity of performance in simultaneous processing but difference in successive processing between white and native children? Further, how does one interpret the differences in factor loadings? One may argue that since the white and native children had comparable Performance IQ's, and since WISC-P is akin to simultaneous, they are not expected to differ on usual simultaneous tests. However, the simultaneous tasks did not behave in the usual manner in terms of the factor lodings for the native data. Similarly one may argue that since one group was higher than the other on WISC-R Verbal IQ, these differences would be expected. Again a simple inference such as this will be in error: Color Naming and Cross Modal coding are not verbal in the sense of serial recall of words. Perhaps, we should understand that native children have not learnt to use successive processing effectively" (Das, Kirby, and Jarman, 1979, p 130).

Recent studies using the K-ABC with Native children support the interpretation of a successive processing deficiency among more traditional Natives groups like those assessed by Krywaniuk (1974). Kaufman and Kaufman (1983) report two reliability and validity studies carried out among North American Native children. Brokenleg and Bryde administered the K-ABC to 20 male and 20 female Sioux children who were well integrated into white society, attended regular public

schools, and spoke English well. In contrast, Naglieri et al.'s study included 14 male and 19 female Navajo children who lived on a reservation, in an isolated community, and spoke primarily Navajo. The Navajo sample appears to match both the Cree children tested by Krywaniuk, as well as the more traditional groups described by Kleinfeld (1970) and Greenbaum and Greenbaum (1983).

Before interpreting the results of these studies it is important to note the WISC-R Verbal-Performance discrepancy typically found in Native children's performance was not evidenced in ths Sioux sample (i.e., mean VIQ 91.4, s.d. 14.68 versus PIQ mean 103.6, s.d. 11.8). In contrast, the Navajo evidenced the typical WISC-R Verbal-Performance discrepancy (i.e., VIQ mean 74.9, s.d. 13.5 versus PIQ mean 102.8, s.d. 11.8).

The K-ABC defines intelligence in terms of an individual's style of solving problems and processing information. The K-ABC Mental Processing scales are based on the simultaneous-successive processes outlined in the Luria/Das model and have been validated against the original battery (Kaufman & Kaufman, 1983). The Mental Processing scales were designed to minimize the role of language and verbal skills. In addition to the Simultaneous and Successive Mental Processing scales, the K-ABC provides Achievement and Nonverbal scales, as well as a Mental Processing Composite score (i.e., simultan-

eous + successive processing scores).

The Sioux and the Navajo groups earned virtually identical mean standard scores on the Simultaneous Processing scale (i.e., mean 101.3, s.d. 10.7 versus mean 99.8, s.d. 10.2, respectively). This finding implies that traditional and transitional Native groups do not differ significantly from each other on tests designed to measure simultaneous processing nor, for that matter, from the standardization sample. In contrast, the Sioux children obtained a significantly higher Sequential scale standard score than the Navajo (i.e., mean 99.6, s.d. 12.4 versus mean 87.7, s.d. 11.3, respectively). Interestingly, the Achievement scale standard scores of the Sioux and Navajo demonstrated the same discrepancy favoring the Sioux (i.e., mean 93.3, s.d. 12.8 versus mean 81.7, s.d. 11.2).

These results, as well as Krywaniuk's (1974) findings, suggest more traditional Native groups, such as the Navajo, can be differentiated from transitional Siuox and non-native groups on the basis of performance on marker tasks for successive-sequential processing. Furthermore, the relative performance deficit evidenced on the sequential tasks by traditional Native groups is reflected in a comparable deficit in Achievement subtest performance. There is no evidence to indicate whether this performance deficit on successive marker tasks is of the "production deficiency" type. Navajo

children did as well as both the Siuox and the standardization sample on Hand Movements, which is one of the three Sequential scale subtests. This implies that the sequential processing deficit evidenced by Navajo children is most pronounced on the largely verbal subtests of the sequential scale. A "production deficiency" in sequential/successive processing would be implicated if the Navajo children's relatively poorer performance on the largely verbal Number Recall and Word Order subtests were a function of not spontaneously employing the successive processing strengths, which they had previously demonstrated on the Hand Movement task, to the execution of the more verbal sequential processing subtests. The low verbal requirements of the K-ABC suggest that vocabulary alone cannot account for the lower performance of Navajo speaking children on sequential subtests.

An alternative explanation for the discrepancy between the Navajo's relative strength on Hand Movements and relative weaknesses on Number Recall and Word Order implies that the processing used on the Hand Movements subtest was not sequential in nature, rather, Navajo children may have transferred a concrete/active planning strategy, developed in the "observational" learning environment to the coding of the various hand movements. This concrete/active planning strategy may have involved the activation of a simultaneous processing function.

Since the sequential processing deficit evidenced by the Navajo was associated with a deficit on the Achievement scale, determining the nature of the deficit is a neccessary, but not a sufficient, pre-condition for drawing instructional implications. For example, a verbal knowledge base deficit associated with sequential processing implies the need for vocabulary and language development type programs. A deficit in sequential processing implies that instruction should focus on cognitive process training ala Krywaniuk (1974). A "production deficit" implies the need for "executive control training" as described by Borkowski and Cavanaugh (1978, p 54). This pattern of interpretation reflects interventions aimed at the knowledge base, processing, and planning aspects of the sequential cognitive function. Consistent with the independent but interrelated description of the model, all three deficits, presumably interact with each other necessitating all three instructional approaches.

The interpretation of the sequential-successive processing performance of the Navajo, to date, has been conducted from within a deficiency perspective. Alternatively, the relative weaknesses demonstrated by the Navajo on the Sequential Processing scale of the K-ABC, may reflect the use of Navajo children's relative competencies in concrete/active planning and simultaneous processing. In this case, the performance deficit is interpreted as a function of the in-

efficiency of simultaneous processing and concrete/active planning to meet the task demands. Here, the instructional implications are to modify the task demands in such a way as to improve the efficiency of concrete/active planning and simultaneous processing. Notice that the competency interpretation leads to an instructional style/ "learning" style matching program. In order to determine whether a competency based interpretation of Native performance and its subsequent instructional style/learning style matching is appropriate for specific academic tasks, a clearer understanding of the "etic" validity of the various Luria/Das cognitive factors is needed. In other words, before instructional style/learning style matching can occur, a clearer specification of the role of cognitive functions on academic tasks is needed.

The "Etic" Validity of the Luria/Das Model:

There are several factors which suggest that the Luria/Das cognitive factors outlined in this report underlie, and significantly account for, the academic performance of both Native and non-native children. First, the neuropsychological model implies that the structural aspects of the model are "etic" or "trans-cultural" constructs. Secondly, various aspects of the model have been isolated in reading disability subtype studies. For example, a sequential reading disability subtype has recently been identified (Doehring et. al., 1981,

p 195). Thirdly, whenever a performance deficit in one of the aspects of the model has been identified in a population, there has usually been an indication of lowered achievement, as demonstrated in the studies of sequential processing among more "traditional" Native groups (i.e., Krywaniuk, 1974). And finally, there is a considerable body of evidence directly linking various aspects of the model to the reading achievement of diverse non-native populations. A selected review of these studies is provided with an emphasis on the identification of related reading deficits and instuctional implications.

The relationship between the attentional functions and reading achievement has been theoretically derived from studies of attentional processes during reading (see Lupart and Mulcahy, 1984). Bottom-up attentional functions are theoretically linked to the recognition of such dominant stimuli characteristics as color, shape, and outline (Lupart and Mulcahy, 1984). Performance on a color naming task which requires the recognition of dominant color characteristics has been successfully used to discriminate between various reading disability subtypes (e.g., Doehring et. al., 1981: Satz and Morris, 1980). This finding implies that the ability to recognize various dominant stimuli may be implicated in the processes of reading. In general, the reading disability subtype described was characterized by an oral reading

deficit.

Top-down visual attentional functions have been theoretically identified with tasks requiring "analytic" and "holistic" feature identification (e.g., cognitive style tasks). Davey (1983) reviews a number of studies investigating the relationship between a field-independent cognitive style and reading achievement, implying a field-independent style interacts differentiallly with academic task performance depending on the nature of the task demands and degree of field independence demonstrated.

> "For example, types of reading comprehension which appear to relate positively to field independence include: paragraph meaning, location of main ideas, and tasks requiring a reorganization of material.... In addition strong supports exists for the superiority of field independence in spelling, word recognition skills and grammar..." (Davey, 1983, p 683)

Top down verbal attentional functions have been identified with the control of feature identification by a verbal mediation process based upon syntagmatic/paradigmatic associations. In this case, the associations serve to focus attention. Cummins and Mulcahy (1982) provide limited evidence that the "nominative" and "predicative" aspects of paradigmatic-syntagmatic associations are related to story recall. They found that the rate at which a child recalled nominative units of a story loaded on simultaneous processing factor and reflected the efficiency of simultaneous processing

for organization of the nominative aspects. They reasoned that predicative aspects of language would be related to successive processing since these aspects are necessary for understanding syntactically complex material. The accuracy of recall on syntactically complex material loaded on a successive processing factor. It appears that paradigmatic mediation of attention is highly efficient for rapid story recall, while syntagmatic mediation of attention is required in order to understand the story.

Several studies have related simultaneous-successive processing to reading achievement (e.g., Cummins & Das, 1977; 1979; Das, Manos and Kanungo, 1975; Kirby & Das, 1977) using traditional factor analytic approaches. The relationship between simultaneous and successive processes and reading in these studies has been described in the following manner:

> "Among children who are likely to experience difficulty in reading, competence in successive processing is strongly related to reading achievement. However, among normal readers at more advanced levels of reading skills, simultaneous processing is equally, if not more, important" (Cummins & Das, 1977, p 254).

This implies that simultaneous and successive processing interact with reading task demands in a manner consistent with the attentional functions of the model. Of more clinical significance are recent investigations of cognitive process training which indicate that improvements in successive process can be transferred to academic tasks.

Two studies have shown that non academic tasks and special instructional procedures can be used to improve successive processing (Kaufman and Kaufman, 1979; Krywaniuk, 1974). Importantly, the instruction given in these studies also seemed to transfer to academic areas, as evidenced by improved performance in word reading and mathematics. Brailsford (1981) included procedures for increasing simultaneous processing in a training program containing the original successive training tasks. An experimental group outperformed the control group on all successive tests and one of the simultaneous tests: but more importantly, they demonstrated significant gains on a reading level measure. Not only does research on simultaneous and successive process training hold promise for specifying the nature of processing deficits and suggested techniques for remediating them which can be generalized to academic tasks, additionally, it holds promise for designing changes in task demands in order to elicit processing strengths.

The importance of a distinction between global and local processing systems is apparent when studying the acquistion of decoding and comprehension skills in reading. La Berge and Samuels (1976) suggested that for fluent readers the decoding process was automatic or under the control of a local processing system. Sternberg (1981), suggests that the advantage of using a local system is that attention is

not focused on the task, at hand, thereby allowing attention to be devoted to more semantic and syntatic processes. Reading deficits evidenced in various studies have been interpreted as related to a successive processing deficit. This deficit may be entirely within the coding level and therefore be associated with an inefficient local processing system which lacks the neccessary knowledge base for rapid decoding.

A second explanation of the link between successive processing deficits and reading deficits is the finding that reading disabled children, as a group, approach reading tasks as largely decoding tasks, while proficient readers view reading as a communication process (Barclay & Hagen, 1982; Meyers and Paris, 1978; Olshavsky, 1977). The difficulty with understanding the purpose of reading prevents reading disabled chidren from using their "average" intelligence to solve the task.

Similarily, it can be argued that an instructional emphasis on phonetic decoding aspects of reading may prevent a Native child from using his own strengths in simultaneous processing. Phonetic task demands have been related to successive processing (Cummins and Das, 1977). Most adult and peer modelling of reading problem-solving behaviors emphasize successive processing strategies in some form of the "sound-it-out" strategy. It may be that children who approach reading as a decoding task do so because they have not been

exposed to a satisfactory problem-solving model for reading that emphasizes their strengths rather than weaknesses.

A planning deficit may be more characteristic of how we are taught rather than how well we learn. Thus, before we learn how to teach we must first know more about how others learn.

CHAPTER THREE: METHODOLOGY

THE OPERATIONALIZATION OF THE LURIA/DAS MODEL:

Luria (1976) reviews evidence indicating that during mnemonic activity at least three separate phases of activity can be identified and linked to brain structures:

> "...Hippocampal structures are responsible for elementary comparison of actual stimuli with traces of previous experience. The gnostic and speech areas of the cortex are concerned with the analysis and coding of incoming information and establishing the essential conditions for organization of the material to be memorized. The anterior (frontal) areas of the cortex perform completely different roles in this system, since they provide for maintenance of the plan, the programming of behavior, and the performance of active, selective, mnestic activity" (Luria, 1976, p 15).

Selection of the various tasks used to operationalize the Luria/Das model are based on this description, as well as those provided throughout the review of the literature. For example, tasks designed to assess attentional functions were selected on the basis of requiring "elementary comparison(s) of actual stimuli with traces of previous experience". Coding tasks were selected which required "the analysis and coding of incoming information and establishment of the essential conditions for the organization of the material". And finally, planning tasks were selected which required "active, selective, mental activity".

Chapter Three Methodology

In order to operationalize a bottom-up attentional function, a task that required elementary comparisons of highly salient stimuli charateristics needed to be idenified. Additionally, these characteristics have been further defined in terms of analytic and holistic features. Three tasks were selected which seemed to meet these requirement: (1) the K-ABC Spatial Memory subtest (Kaufman & Kaufman, 1983); (2) the Test of Concept Utilization's (TCU) (Crager & Spriggs, 1977), "Color Reality Match score" and (3), the TCU Shape Reality Match score. The K-ABC Spatial Memory subtest, which requires comparison of holistic features (i.e., grid location) and also efficient performance, is considered to be related to a field-independent cognitive style. "Spatial Memory" demands good concentration for success, and performance can easily be disrupted by poor attention span, distractibility, anxiety, and possibly a field-dependent cognitive style" (Kaufman and Kaufman, 1983, p 49).

The TCU's Color Reality Match score is based on the number of times, out of ten trials, a subject will correctly identify a similarity in color between pictures of everyday objects, when those objects have been deliberately paired in terms of color (Crager & Spriggs, 1977, p 4). The fact that the selection of color pairings has often involved two colors and only parts of the objects implies that both ana-

lytic and holistic features have been presented. This task requires elementary comparison of both analytic and holistic features. The use of 'everyday objects' is assumed to improve the generalizability of the feature concepts being assessed. For example, knowing which two colored squares are alike is a greatly different task from using color to determine the similarity between objects when they vary on so many other dimensions. In the former case, one is assessing a perceptual matching task, while in the latter a conceptual matching task. That is, the TCU Color Reality Match score reflects conceptual feature identification and in most cases these features are characteristic of analytic knowledge bases.

The TCU Shape Reality Match score is based on the number of times, out of ten trials, a subject will correctly identify a similarity in shape between pictures of two everyday objects. The shape comparisons reflect mainly overall feature shape or outline matching. The task requires analytic knowledge of the outlines of everyday objects. All three bottom-up attentional marker tasks are assumed to present task demands requiring visual attention to highly salient stimuli characteristics (i.e., location, color, and outline, respectively).

Top-down visual attentional functions are characterized by visually mediated comparisons of elementary stimuli.

The operational definition of these tasks has been limited to comparisons involving holistic features, so that, links between a holistic knowledge base and a field independent/ dependent cognitive style can be explored (e.g., Cohen, 1969). Error and number attempted scores from the Hidden Patterns Test--CF2 (HPT) were selected to represent top-down visual attentional control functions.

Elementary comparisons of visual holistic features have been defined in terms of two performance factors: perceptual speed and flexibilty of closure (Ekstrom, et al., 1976). Both require the subject to make a match, but "disembedding" is required on the flexibility of closure portion of the task while locational information is required for increasing perceptual speed. In addition, both factors have been associated with a field independent cognitive style (Ekstrom, 1973). The flexibility of closure function is operationalized by the error score of the HPT, while the perceptual speed function is measured by the number- attempted score.

Top-down verbal attentional functions are characterized by verbally mediated comparisons of elementary stimuli. The operational definition of these tasks has been limited to comparisons of analytic features, in order to investigate the relationship between analytic feature identification and an implusive/reflective cognitive style (e.g., Zelniker

and Jeffrey, 1976). Error and number-attempted scores from the Identical Pictures (IPT) test were used to operationalize top-down verbal attentional functions (Ekstrom et al., 1976) in a manner consistent with the operational definition of top-down visual attentional functions. In others words, the major operational distinction between the top-down visual and verbal functions is characterized by the unit of attentional-feature identification. In the case of visual functions that unit is considered a holistic feature, while in the case of verbal attentional function that unit is considered an analytic feature.

Elementary comparisons of visual analytic features have been defined in terms of two performance characteristics: perceptual speed (or the IPT number-attempted score and visual discrimination score) or the number of items correct on the IPT (Ekstrom et al., 1976). In addition, both factors have been related to cognitive style: "It is possible that this factor [perceptual speed] is related to the automatization of cognitive style" (Ekstrom et al., 1976, p 123).

Note that the HPT contains a perceptual speed factor. Since this factor is related to automatization of a cognitive style, high number-attempted score on the HPT is assumed to reflect the degree of automatization of a field independent-dependent cognitive style, while a high number-attempted

score on the IPT is assumed to reflect the degree of automatization of an impulsive/reflective cognitive style. In these cases, the error scores represent the breadth of the knowledge base associated with holistic and analytic features. In this manner top-down attentional functions can be characterized in terms of the degree of facility with which a person demonstrates a particular cognitive style characteristic.

According to Zelniker and Jeffrey (1976), the differential performance of implusives and reflectives on detail matching and global matching of identical picture items reflects the difference in degree of perceptual analysis demonstrated by these groups. Impulsives adopt a whole-scanning strategy effective on global items while reflectives adopt a part-scanning strategy effective on detail items. In an attempt to broaden this distinction to include conceptual as well as perceptual analysis, these authors administered a concept-attainment task to groups of implusives and reflectives.

Zelniker and Jeffrey (1976, pp 36 - 37), in reporting the results of this study, link a detail feature-identification strategy to the examination of only a single dimension of a concept at one time:

> "...the difference between the two cognitive style groups was expressed in a tendency to focus on or to examine a single dimension or

> component at a time versus several dimensions of the stimuli simultaneously. Quality and speed of performance were not differentially related to the two scanning strategies; there were no significant differences between impulsive and reflective subjects in number of problems solved, number of cards to solution, nor in response latency per card to solution of concept-attainment problems.... The effectiveness of the whole-scanning strategy may be particularily marked in solving multidimensional problems where it is likely to enable solution with fewer cards than the part-scanning strategy"

The TCU requires comparison of pictures of two everyday objects in order to answer one of the questions: "How are they alike?", or, "How do they go together?" The selection of TCU Color and Shape reality match scores for operationalizing the bottom-up attentional functions was based on the assumption that these features of a stimuli would be dominant, and therefore, would control attentional functions during the comparison process. This implies attention on the TCU is initially directed towards dominant stimuli characteristics. Subsequently, and only following the failure to identify a match on dominant features, would one expect to see attention come under the control of a visual or verbal attentional function. This sequence of attention from bottom-up to top-down control is in keeping with Sternberg and Powell's (1982) view of the interaction between local processing and global processing systems. This also suggests that the TCU is a concept-attainment task requiring compar-

isons of elementary features one-at-a-time in sequence. For example, the two objects are compared first in terms of dominant stimuli characteristics (e.g., location, color, and shape), then failing a match, these objects are compared on a series of other dimensions which have important implications for verbal functions. The task demands favor the generation of visual and verbal mediators one at a time until a match is found. This implies the TCU measures both a perceptual matching aspect or bottom-up attentional function and a conceptual matching aspect or top-down verbal attentional function.

The TCU Homogenous Function Reality Match score will be used to operationalize the syntagmatic (i.e., predicative) knowledge base associated with top-down verbal attentional functions. The homogeneous function score is based on the number of times out of ten trials that a subject correctly identifies a pair of objects as serving a similar purpose when those objects have been selected to reflect a homogeneous function (e.g., typewriter and pencil). Notice that the task requires the identification of noun-verb or syntagmatic relationship: that is to say, a typewriter and a pencil are both used for writing.

The TCU Abstract Function Reality Match score will be used to operationalize the paradigmatic (i.e., nominative)

knowledge base associated with top-down verbal attentional functions. The abstract function score is based on the number of times, out of ten trials, that a subject correctly identifies a pair of objects as belonging to the same abstract class when those objects have been selected to reflect abstract class membership (e.g., tree and pig). Notice that the task requires the identification of a noun-noun or paradigmatic relationship, that is, a tree and a pig are both living entities. Non-verbal attentional functions can then be described in terms of the subjects facility with an analytic cognitive style, and his breadth of syntagmatic/ paradigmatic knowledge.

The K-ABC Simultaneous and Sequential Mental Processing scales were selected to operationalize the coding functions of the Luria/Das model since these provide a direct link to the measurement of these processes among Native children (as discussed in the review (Kaufman & Kaufman, 1983)). A cognitive process analysis of the various subtests suggests that besides measuring simultaneous and successive coding functions, these tests may very well be measuring a concrete/ active planning function. Further specification of both the process and knowledge base aspects of each of the subtests is required.

The Simultaneous scale is composed of five subtests;

Gestalt Closure, Triangles, Matrix Analogies, Spatial Memory, and Photo Series. Although all of these subtests loaded on the simultaneous factor during the standardization of the K-ABC, there is sufficient theoretical justification to suggest that these subtests may measure aspects of coding well beyond simultaneous processing. For example, Gestalt Closure requires the child to identify an object from an incomplete line drawing. Kaufman et al. (1983) suggest that Gestalt Closure is a reasonably "pure" measure of simultaneous processing at all age levels assessed by the K-ABC. The Gestalt Closure raw score will be used to operationally define simultaneous processing of holistic feature knowledge.

The Triangles subtest requires a child to assemble several identical rubber triangles (blue on one side, and yellow on the other) to match a picture of an abstract design. "Performance is enhanced for those who can employ a systematic strategy for analyzing the model design into its component parts, and for those who are flexible in their approach to problem-solving (Kaufman & Kaufman, 1983, p 44). The Triangles raw score will be used to operationalize both concrete-active planning, as well as simultaneous processing.

The Matrix Analogies subtest requires the child to select a picture or design that best completes a two-by-two visual analogy. According to Kaufman & Kaufman (1983), "... Matrix

Analogies was includsed in the K-ABC because it was found to be a superb measure of simultaneous processing for school-age children (p 47)." The Matrix Analogies raw score will be used to operationally define simultaneous processing of paradigmatically related features.

The Spatial Memory subtest requires the child to recall the locations of pictures arranged randomly on a grid. Location has been identified with bottom-up stimuli characteristics and represents one aspect of analytic feature identification. The Spatial Memory raw score will be used to operationally define bottom-up attention and simultaneous processes.

The Photo Series subtest, which loads on the simultaneous factor in the standardization studies of the K-ABC, was not used to operationalize simultaneous processing. The justification and description of this subtest will be discussed with regard to the concrete-active planning functions.

Das (1984b) has suggested that simultaneous processing underlies verbal as well as non-verbal organization of material for retrieval. Jarman (1980) provides evidence indicating that the nature of a word association may interact with the selection of either simultaneous or successive syntheses. The selection of a paired associate for recall is considered to interact with the selection of processing strategy.

One form of association defined by Moran (1966) is "iconic" or a syntagmatic word pair that ascribes a quality to a referent (e.g., red-blood, big-city, old-gentleman, etc.). It is assumed that if the quality is ascribed to the referent is a dominant stimuli characteristic, then the association will be coded in the form of a "unitized" image by simultaneous or parallel processing (Paivio, 1974; 1975; Reese, 1977). The number of correctly recalled "iconic" paired-associates will be used to operationally define simultaneous processing of syntagmatic verbal knowledge.

The Sequential scale is composed of three subtests: Hand Movements, Numbers Recall and Word Order. Hand Movements requires the child to repeat a series of fist, palm, and side-hand movements demonstrated by the examiner which increase in length and complexity of pattern. "Hand Movements, a visual-motor task, assesses the unique skill of motoric reproduction of a sequence (Kaufman and Kaufman, 1983, p 40)." Number Recall requires serial repetition of an increasing longer string of digits. Number Recall is considered the "best measure of Sequential Processing across all age ranges assessed by the K-ABC" (Kaufman, et al., 1982). Word Order requires the reproduction of an increasingly longer word series. In order to prevent the use of "rehearsal", or repeating the word series to aid retention, a color naming

task was inserted between the presentation of stimulus words and recall. The use of a nonverbal, that is touching the pictures in the correct order according to an auditory sequence, suggests that a separation between sequential processing and verbal knowledge is maximized, particularily in light of the fact that all vocabulary is taught.

The Hand Movements raw score will be used to operationalize sequential processing of verbally-mediated motor activity. For example, Kaufman and Kaufman (1983) point out, "While concentrating, it is beneficial to develop some type of mediating strategy (e.g., verbally labelling each of the three hand positions or finding a method for organizing the stimuli into a pattern) to aid performance (p 40). The Number Recall raw score will be used to operationally define sequential processing of auditory knowledge in the form of perceptual or 'first' signal system information. The Word Order raw score will be used to operationally define sequential processing of nonverbally-mediated knowledge. The lack of verbal mediation is ensured by the use of an interference task between presentation and recall.

In addition to the K-ABC sequential subtests, the number-attempted score on the Identical Pictures Test will be used to operationalize sequential processing. Since the Identical Picture Test has been associated with verbal top-

down attentional control through the successive scanning of analytic features, the use of sequential processing is implicated in the scanning process of the task.

One final task used to operationalize sequential processing is the TCU Relational Function Reality Match score. This score is based upon the number of times, out of ten trials, a subject correctly identifies a pair of objects as being related to each other in some "active" fashion when those objects were selected to reflect such an "active" relationship (e.g.,apple-tree). The identification of this "active" relationship requires the use of predicative structures (e.g., an apple grows on a tree). The TCU Relational Function Reality Match score will be used to operationally define sequential processing of paradigmatic verbal knowledge.

Concrete/active planning has been defined in terms of "the generation, selection, and monitoring of goal-directed attentional and coding processes activated by familiar visual-motor feedback". Two subtests from the K-ABC present task demands consistent with this definition: Photo Series and Triangles. The Photo Series subtest requires the child to organize a randomly placed array of photographs illustrating a familiar event and then order them in their proper time sequence. "Photo Series requires reasoning and planning ability, the latter skill akin to the Luria-based thinking

process that Das and his colleagues have investigated in conjunction with successive and simultaneous processing" (Ashman & Das, 1980; Das & Jarman, 1981; Kaufman & Kaufman, 1983, p 50). The Photo Series raw score will be used to operationally define concrete/active planning of both attentional and coding processes, since access to the previously ordered pictures is restricted by having the child hold the pictures in a pile as the task is completed. Triangles, which requires flexibility of problem-solving strategies, is considered to operationally define concrete/active planning of attentional processes, since the model is always present and does not require memorization or coding.

The TCU Color Reality Match score operationalizes one aspect of bottom-up attentional functions; but, it also serves as an operational definition of concrete/active planning of attentional feature identification. The aspect of concrete/active planning associated with the Color Reality Match score is the monitoring of bottom-up attentional feature identification in order to solve a concept learning task. The child, when presented with pictures of two objects which vary on several dimensions must not only identify and match key features, but also must monitor this automatic or local processing in order to select which of the several features identified provide a concept match between the two objects.

Color is assumed to represent the most dominiant stimuli characteristic on the TCU, and therefore, color is most likely to be processed automatically with the visual/ verbal mediation serving as a label for the response portion of bottom-up attention. In this manner, the TCU Color score is representative of concrete/active planning of mediators for the products of bottom-up attention.

Verbal/Logical planning has been defined in terms of "the generation, selection, and monitoring of goal-directed attentional and coding processes activated by familiar verbal feedback" (Luria, 1966a; 1966b). The operational definition of this control process emphasizes the use of verbal mediators to code the relationships between paired associates on a recall task. Moran (1973) suggested four such mediators between paired associates. First, are Iconic mediators for syntagmatic (adjective-noun) word pairs that ascribe qualities to the referents (e.g., redblood). The relationship between the quality and the referent is mediated by a label which "unitizes" these two words and thereby facilitates retrieval (Reese, 1977). Generation of this mediator is considered to be a product of simultaneous processing and not verbal/ logical planning.

Second, are Enactive mediators for syntagmatic (noun-verb) pairs that describe actions upon the referent (butter-

melt). The relationship between the action and the referent is mediated by a "predicative", verbal/logical label which serves to increase "depth of processing" and thereby facilitates retrieval (Craik and Lockhart, 1972). Generation of this mediator is considered to be a product of verbal/logical monitoring of the successive processing of verbal and/or imagery coded material.

Third, are Functional mediators for paradigmatic (noun-noun) pairs that describe a co-function for the pair (e.g., table-chair). The relationship between the two nouns is mediated by a functional categorization in the form of a verbal/logical label which serves to increase the "depth of processing" and thereby facilitates retrieval (Craik & Lockhart, 1972). Generation of this type of mediator is considered to be a product of verbal/logical monitoring of conceptual learning.

Fourth, are Logical mediators for paradigmatic (noun-noun) pairs that link the two nouns in a categorical sense (e.g., ocean-sea). The relationship between the two nouns may be characterized by: a) semantic equivalence (car-automobile); b) super-ordinates (cat-animal); or, c) contrasts (circle- square). The use of any of these categorical characteristics does not require a verbal label or mediator but does require conceptual knowledge of the category. The search

for conceptual categories is considered to increase the "depth of processing" and thereby facilitates retrieval (Craik & Lockhart, 1972). Generation of this type of mediator is considered to be a product of verbal/logical monitoring of conceptual learning.

Based on these four types of mediators (i.e., iconic, enactive, functional and logical) a paired associate task was designed which presented each type of mediated pair sixteen times. Eight of these presentations utilized concrete nouns and the other eight used abstract nouns. This procedure yielded 64 paired associates in a 2 (abstract-concrete) by 4 (iconic, enactive, functional and logical) nested design. A latin-square procedure was used to control for order effects of presentation (see Appendix I for a sample task). The number of correctly recalled associates is considered to reflect the efficiency with which a child can use the various forms of mediators as aides during recall. Enactive, Functional, and Logical recall scores are considered to be operational definitions of the verbal/ logical planning processes.

Table One presents 22 measures which have been selected to operationally define the various processing dimensions associated with the review of the literature. Rationales for selection of the tasks have been specified and where necessary a task has been assigned to two processing factors.

TABLE 1: SUMMARY OF THEORETICAL COGNITIVE PROCESS ANALYSIS OF THE TWENTY-TWO MEASURES

TASKS	SOURCE	PROCESSING FACTORS: BOTTOM UP ATTENTION	TOP DOWN VISUAL	TOP DOWN VERBAL	SIMULTANEOUS CODING	SUCCESSIVE VIVID	CONCRETE CODING	VERBAL/LOGICAL FEATURE	KNOWLEDGE BASES: HOLISTIC FEATURE	ANALYTIC FEATURE	VISUAL AUDITORY	AUDITORY SIMULTANEOUS	SIMULTANEOUS SUCCESSIVE	SUCCESSIVE SIMULTANEOUS	VERBAL MEDIATORS	NON VERBAL MEDIATORS	CONCRETE VERBAL	VERBAL FEEDBACK
HIDDEN PATTERNS ATTEMPTED	EKSTROM ET AL., 1976	-	*	-	*	-	-	-	-	*	*	-	*	-	-	*	*	-
HIDDEN PATTERNS ERRORS	EKSTROM ET AL., 1976	-	*	-	-	-	-	-	-	*	*	-	*	-	-	*	*	-
IDENTICAL PICTURES ATTEMPTED	EKSTROM ET AL., 1976	-	-	*	-	*	-	-	-	*	*	-	*	-	*	-	*	-
IDENTICAL PICTURES ERRORS	EKSTROM ET AL., 1976	-	-	*	-	-	-	-	-	*	*	-	*	-	*	-	*	-
K-ABC HAND MOVEMENTS	KAUFMAN & KAUFMAN, 1983A	-	-	-	-	*	-	-	-	*	*	-	-	*	*	*	*	-
K-ABC GESTALT CLOSURE	KAUFMAN & KAUFMAN, 1983A	-	-	-	*	-	-	-	*	-	*	-	*	-	*	-	*	-
K-ABC NUMBER RECALL	KAUFMAN & KAUFMAN, 1983A	-	-	-	-	*	-	-	-	*	-	*	-	*	-	*	-	*
K-ABC TRIANGLES	KAUFMAN & KAUFMAN, 1983A	-	-	-	*	-	*	-	-	*	*	-	*	-	-	*	*	-
K-ABC WORD ORDER	KAUFMAN & KAUFMAN, 1983A	-	-	-	-	*	-	-	-	*	-	*	-	*	*	-	*	-
K-ABC MATRIX ANALOGIES	KAUFMAN & KAUFMAN, 1983A	-	-	-	*	-	-	-	-	*	*	-	-	*	-	*	-	*
K-ABC SPATIAL MEMORY	KAUFMAN & KAUFMAN, 1983A	*	-	-	*	-	-	-	*	-	*	-	*	-	-	*	*	-
K-ABC PHOTO SERIES	KAUFMAN & KAUFMAN, 1983A	-	-	-	-	-	*	-	-	*	*	-	*	-	-	*	*	-
ICONIC PAIRED ASSOCIATES	APPENDIX I	-	-	-	*	-	-	-	-	*	-	*	-	*	*	-	*	-
ENACTIVE PAIRED ASSOCIATES	APPENDIX I	-	-	-	-	-	-	*	-	*	-	*	-	*	*	-	-	*
FUNCTIONAL PAIRED ASSOCIATES	APPENDIX I	-	-	-	-	-	-	*	*	-	-	*	-	*	*	-	-	*
LOGICAL PAIRED ASSOCIATES	APPENDIX I	-	-	-	-	-	-	*	-	*	-	*	-	*	*	-	-	*
TCU UNILATERAL CONCEPTS	CRAGER & SPRIGGS, 1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TCU COLOR REALITY MATCH	CRAGER & SPRIGGS, 1977	*	-	-	-	-	*	-	*	-	*	-	*	-	-	*	*	-
TCU SHAPE REALITY MATCH	CRAGER & SPRIGGS, 1977	*	-	-	-	-	-	-	*	-	*	-	*	-	-	*	*	-
TCU HOMOGENEOUS FUNCTION REALITY MATCH	CRAGER & SPRIGGS, 1977	-	-	*	-	-	-	-	*	-	*	-	*	-	*	-	-	*
TCU ABSTRACT FUNCTION REALITY MATCH	CRAGER & SPRIGGS, 1977	-	-	*	-	-	-	-	*	-	*	-	*	-	*	-	-	*
TCU RELATIONAL FUNCTION REALITY MATCH	CRAGER & SPRIGGS, 1977	-	-	-	-	*	-	-	-	*	*	-	*	-	*	-	-	*

* indicates presence of characteristic

SUBJECTS:

Age, degree of ethnicity, and sex were selection criteria for the Native sample. A mean age of approximately ten years (mean = 126 months; s.d. = 8.9) was selected to reflect the period in a child's growth when the learning environment to which the child is exposed undergoes numerous and fundamental changes. For example, the "cross-over" phenomenon associated with increasing declines in achievement begins to be demonstratable at about this age. Increasing demands upon verbal skills are characteristic of the begining-intermediate grades. As well, reading comprehension begins to be a measure of a skill; in addition, it begins to be a measure of the limit of the acquistion of information from the formal academic learning environment.

The degree of ethnicity, or membership in a particular Native group, reflects the socio-cultural learning environment within the band according to Vygotsky's General Law of Cultural Development. The issue of ethnicity or membership in a particular Native group was decided by the particular Native group and not by the author. Such an approach ensures the ecological validity of the Native sample. The thirty-two Native children identified by the Nicola Valley Indian Authority for inclusion in this study can be characterized as primarily English-speaking, rural-reserve children.

The majority of the measures selected to operationalize the processing factors have not demonstrated sex-consistent performance differences in the standardization samples (e.g., Crager & Spriggs, 1977; Kaufman & Kaufman, 1983). However, differences between male and female Native children's performance on the Wechsler scales have been reported in a number of studies reviewed by McShane & Plas (1984), suggesting that sex differences are more frequently evidenced among Native than non-Native children. For this reason, the Native sample was balanced for sex by inclusion of sixteen male and sixteen female children.

The non-Native sample was drawn from the same classrooms as the Native sample but no attempt was made to control for age, degree of ethnicity, or sex within the non-Native sample. It is assumed that this limits the generalizability of the non-Native sample findings. As it turned out, the entire non-Native population of these classrooms (mean age = 119 months; s.d. = 7.0 months) was included in the study. The younger mean age of the non-Native sample reflects the more frequent retention of Native children in the primary grades relative to their non-Native counterparts.

The non-Native sample included a number of East Indian, Chinese, and various other ethnic groups, as well as many "white" ethnic groups. There were more female students

(twenty-one) than male students (eleven) in these classrooms. All children included in the study had attended at least four years of provincial schooling. Many of the Native children, however, attended bandoperated preschools and kindergarten, and some Native children had attended special primary adjustment classes. No child included in the study was considered a full-time special education pupil according to the district definition.

DATA COLLECTION PROCEDURES:

Data collection was carried out over a six week period. Testing was carried out in two sessions each of 1 hour and 20 minutes in duration. The first session was an individual standardized administration of the K-ABC by the author or a fellow graduate student trained in the procedures. The paired-associate task (see Appendix I) was administered immediately following administration of the K-ABC. The second session was a group administration of the TCU, the HPT and the IPT tests to all of the students tested in the first session. An average delay of four weeks occurred between the first and second sessions.

The administration of the TCU requires the examiner to individually present each item and to record the subjects oral statement verbatim. This procedure was changed to

facilitate group administration of the TCU by having the children write their answers while two qualified teachers were available for assistance with grammar. There was no TCU response which was entirely unscorable due to either handwriting or spelling difficulties. This implies that the children, as a group, possessed the skills necessary for the written format.

Raw scores for each of the standardized measures were calculated for each student according to the procedures outlined in their respective scoring guides (i.e., Crager & Spriggs, 1977; Ekstrom et al., 1976; Kaufman & Kaufman, 1983b). Raw scores for the paired-associate task were calculated on the basis of the number of concrete paired- associates correctly recalled from a particular class of associates (e.g., Iconic, Enactive, Functional, Logical). An inter-rater reliability check of the scoring of the TCU Reality Match and Unilateral Concept raw scores yields a significant degree of overall agreement ($r = 0.84$) between the two judges.

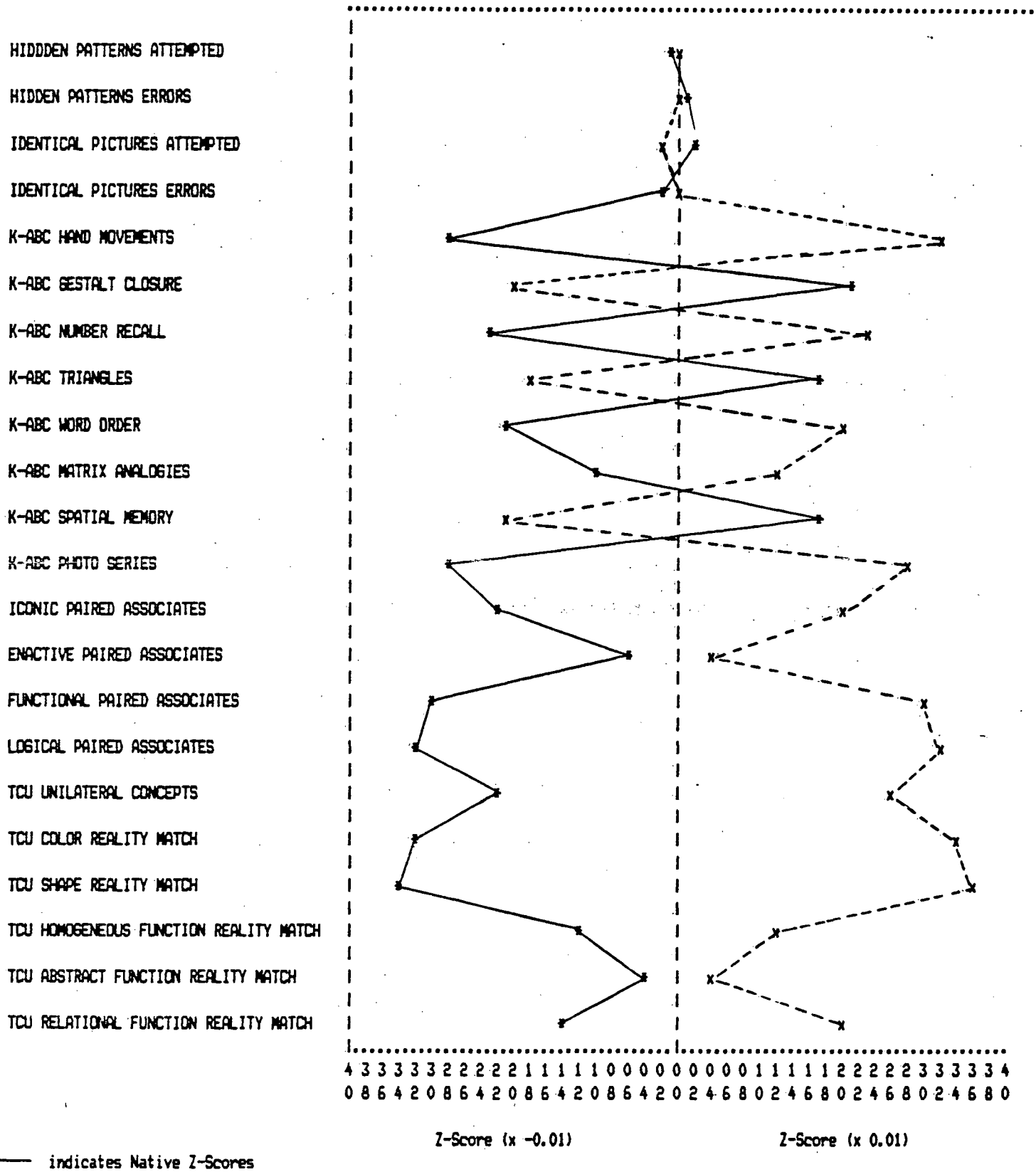
CHAPTER FOUR: RESULTS

DATA REDUCTION PROCEDURES

Each of the twenty-two raw scores calculated has been derived from a single integrated theory of reading, language, and cognition, thus implying that these measures reflect a common theoretical metric. To facilitate comparisons along this metric, each raw score was converted to a "z" score using the BMD:P1S program (Dixon et al., 1983). In order to facilitate comparison of Native and non-Native children's performance on these measures, separate "z" score means for each measure were calculated for both the Native and non-Native groups. These results are graphically presented in Figure 1.

A brief examination of Figure 1 suggests there are sufficient differences between the performance of Native and non-Native children on these various tasks to warrant further data reduction and interpretation. Performance differences were evidenced between populations on a number of--but not all of--the measures. For example, tasks theoretically associated with the attentional control processes appear close together in Figure 1 implying little difference between the two populations. In contrast, there is a large gap between Native and non Native children's performance on coding and planning marker tasks.

FIGURE 1: Z-SCORE COMPARISON OF NATIVE AND NON NATIVE PERFORMANCE ON THE TWENTY-TWO MEASURES



——— indicates Native Z-Scores
- - - - indicates Non Native Z-Scores

Sex and age differences are assumed to have a pronounced effect on the intercorrelations of the various tasks among Native children since the selection of processing is related to the form of mediation provided in the socio-ethnic learning environment, thereby differentially effecting the strength of the theoretical intercorrelations, based on the selection of processing strategies. In the case of Native children, age and sex effects are more frequently reported on academic intelligence tasks such as the Wechsler subtests, implying differences in processing between genders may reflect differences in the style of mediation provided for Native boys and girls. Differences between genders in non Native samples are infrequent, implying a relatively homogeneous learning environment for non Native boys and girls.

Age differences, which significantly effect the intercorrelations of the various subtests, reflect the adoption of differences in processing strategy. Non Native children have not evidenced significant differences in performance on most information processing tasks utilized in this study. Furthermore, age differences in processing do not significantly effect the intercorrelations of the subtests of the K-ABC (Kaufman & Kaufman, 1983a) or the TCU (Crager & Spriggs, 1977). Based on the "cross-over" phenomenon and the increased exposure to the mediational style provided in the formal

academic learning environment, Native children should evidence qualitative and quantitative differences in processing with increasing age.

In order to investigate the effects of age and gender on the qualitative aspects of the various measures, the BMD: P2R program was used to calculate, separately for the two groups, the effects of age and sex, and the combined effects of these parameters on intercorrelations of the twenty-two measures. Table Two summarizes these results.

An examination of Table Two suggests that for Native children, age and gender differences significantly effect the intercorrelations of eight of the measures. Sex differences reflect qualitative differences in performance between Native girls and boys on the HPA, the IPA, the K-ABC Hand Movements, the Word Order, Photo Series, and Functional and Logical paired associate scores. Similarily, age differences reflect qualitative differences in performance on the IPA, the K-ABC Matrix Analogies, the Functional paired-associates and the TCU Relational Reality Match scores with increasing age. Non Native qualitative performance differences associated with gender increasing age were demonstrated on the K-ABC Hand Movements task. Non-Native qualitative performance differences, associated with gender differences, were present the Functional paired associate task.

TABLE 2: SIGNIFICANCE LEVELS FOR AGE, SEX, AND AGE/SEX EFFECTS ON THE INTERCORRELATIONS OF THE TWENTY-TWO MEASURES

	AGE EFFECT NATIVE	SEX EFFECT NATIVE	AGE/SEX EFFECT NATIVE	AGE EFFECT NON NATIVE	SEX EFFECT NON NATIVE	AGE/SEX EFFECT NON NATIVE
HIDDDEN PATTERNS ATTEMPTED	—	0.05	0.05	—	—	—
HIDDEN PATTERNS ERRORS	—	—	—	—	—	—
IDENTICAL PICTURES ATTEMPTED	0.01	0.05	0.05	—	—	—
IDENTICAL PICTURES ERRORS	—	—	—	—	—	—
K-ABC HAND MOVEMENTS	—	0.001	0.001	0.05	—	—
K-ABC GESTALT CLOSURE	—	—	—	—	—	—
K-ABC NUMBER RECALL	—	—	—	—	—	—
K-ABC TRIANGLES	—	—	—	—	—	—
K-ABC WORD ORDER	—	0.005	0.005	—	—	—
K-ABC MATRIX ANALOGIES	0.05	—	0.05	—	—	—
K-ABC SPATIAL MEMORY	—	—	—	—	—	—
K-ABC PHOTO SERIES	—	0.01	0.01	—	—	—
ICONIC PAIRED ASSOCIATES	—	—	—	—	—	—
ENACTIVE PAIRED ASSOCIATES	—	—	—	—	—	—
FUNCTIONAL PAIRED ASSOCIATES	0.05	0.05	0.05	—	0.05	—
LOGICAL PAIRED ASSOCIATES	—	0.05	0.05	—	—	—
TCU UNILATERAL CONCEPTS	—	—	—	—	—	—
TCU COLOR REALITY MATCH	—	—	—	—	—	—
TCU SHAPE REALITY MATCH	—	—	—	—	—	—
TCU HOMOGENEOUS FUNCTION REALITY MATCH	—	—	—	—	—	—
TCU ABSTRACT FUNCTION REALITY MATCH	—	—	—	—	—	—
TCU RELATIONAL FUNCTION REALITY MATCH	0.01	—	0.01	—	—	—

— indicates value is non-significant

The presence of qualitative differences in performance between ages and genders among the Native children is highly intriguing; particularily, in light of the relatively few qualitative differences evidenced by the non Native group. Restrictions in sample size prevent a more detailed investigation of these qualitative differences. Investigation of the causes and the nature of these qualitative differences, while essential, is beyond the scope of the present research. Based on the results summarized in Table Two, further analyses of the intercorrelation of these tasks would be effected by age and sex differences without a clear indication of the nature of these differences. For this reason partial correlation matrices with age, sex, and age/sex effects were utilized in subsequent factor analyses.

Investigating the processing differences between Native and non Native children required constructing a target matrix representative of the theoretical structure outlined in Table Three with each measure being assigned either a 0.0, a 0.5, or a 1.0 loading for each of the seven theoretical factors. The theoretical factor structure is summarized in Table Three.

TABLE 3: TARGET MATRIX LOADINGS FOR ALL TWENTY-TWO TASKS

	BOTTOM-UP ATTENTION	VISUAL TOP-DOWN ATTENTION	VERBAL TOP-DOWN ATTENTION	SIMUL-TANEOUS CODING	SUCCESSIVE CODING	CONCRETE ACTIVE PLANNING	VERBAL LOGICAL PLANNING
HIDDDEN PATTERNS ATTEMPTED	—	0.5	—	0.5	—	—	—
HIDDEN PATTERNS ERRORS	—	1.0	—	—	—	—	—
IDENTICAL PICTURES ATTEMPTED	—	—	0.5	—	0.5	—	—
IDENTICAL PICTURES ERRORS	—	—	1.0	—	—	—	—
K-ABC HAND MOVEMENTS	—	—	—	—	1.0	—	—
K-ABC GESTALT CLOSURE	—	—	—	1.0	—	—	—
K-ABC NUMBER RECALL	—	—	—	—	1.0	—	—
K-ABC TRIANGLES	—	—	—	0.5	—	0.5	—
K-ABC WORD ORDER	—	—	—	—	1.0	—	—
K-ABC MATRIX ANALOGIES	—	—	—	1.0	—	—	—
K-ABC SPATIAL MEMORY	0.5	—	—	0.5	—	—	—
K-ABC PHOTO SERIES	—	—	—	—	—	1.0	—
ICONIC PAIRED ASSOCIATES	—	—	—	1.0	—	—	—
ENACTIVE PAIRED ASSOCIATES	—	—	—	—	—	—	1.0
FUNCTIONAL PAIRED ASSOCIATES	—	—	—	—	—	—	1.0
LOGICAL PAIRED ASSOCIATES	—	—	—	—	—	—	1.0
TCU UNILATERAL CONCEPTS	—	—	—	—	—	—	—
TCU COLOR REALITY MATCH	0.5	—	—	—	—	0.5	—
TCU SHAPE REALITY MATCH	1.0	—	—	—	—	—	—
TCU HOMOGENEOUS FUNCTION REALITY MATCH	—	—	1.0	—	—	—	—
TCU ABSTRACT FUNCTION REALITY MATCH	—	—	1.0	—	—	—	—
TCU RELATIONAL FUNCTION REALITY MATCH	—	—	—	—	1.0	—	—

— indicates an assigned value of 0.0

A comparison of the theoretical factor structure with empirically derived factor structures provides a framework for interpreting the degree of error introduced by the theoretical structure. The nature of the empirically derived factor matrices can be conceptually divided into two classes. The first class of empirical factor structures represents the extraction of the maximum variance from the data set by identifiying seven orthogonal components, in other words seven-factor principal component analyses. The second class of empirical factor structures represents the extraction of theoretical factor structure from a data set by identifying, not only a seven factor solution, but also, by specifying factor loadings in the form of a target matrix, utilizing an orthogonal procrustes factor transformation (Schonemann, 1966).

Principal component analyses with varimax rotations were performed separately for the Native, and non Native groups using the Alberta General Factor Analyses Program-AGFAP (Hakstian & Bay, 1973). Table II.1 summarizes the PCA seven factor solution for non Native children. Similiarily, Table II.2 presents the PCA seven factor solution for the Native data using the same procedures. Orthogonal procrustes factor analyses were carried out on both the partial correlation matrices used in the PCA analysis, with the aid of AGFAP.

Tables II.3 and II.4 summarize the procrustes solutions for non-Natives and Natives respectively. A visual inspection of Tables II.1 and II.2 suggests, for both Native and non Native data a PCA seven factor solution yields seven well defined and internally consistent factors. An inspection of the variances of factors for both groups further supports the adequacy of a seven factor solution. The interpretability of the PCA factors is based on a comparison of the PCA factor loading matrices and the procrustes generated empirical matrices, which are summarized in Tables II.3 and II.4.

An error matrix was generated for both Native and non Native data by subtracting the PCA factor structure from the corresponding procrustes factor structure. The mean error rate generated by this subtraction represents the strength of the association between the seven principal factors and the seven theoretical factors. The higher the error coefficient the weaker the association between the two factor structures. Visual inspection was used to assign corresponding factors by matching the factors in terms of the highest loading tasks. For example, the PCA factor with the highest loading for the Hidden Patterns scores was said to correspond to the procrustes factor with the highest loading for Hidden Patterns scores.

The AGFAP program calculates a second type of error

matrix in producing an orthogonal procrustes solution. This type of error is generated by subtracting the unrotated factor loading matrix from the theoretically transformed factor loading matrix. The mean error rate generated by this type of error matix represents the strength of association between the unrotated empirical factor structure and the procrustes orthogonally rotated factor structure. In this case, the assignment of corresponding factors is based on a transformation matrix. The higher the mean error rate the weaker the association between the two factor structures. Table Four summarizes these two types of errors for the non-Native children's data, while Table Five summarizes these errors for the Native children's data.

A brief overview of Table Four indicates a relatively low error rate when comparing the theoretical loadings of the marker tests. For example, the overall procrustes mean error was 0.19, with a standard deviation of 0.14, while the PCA-generated mean error rate was 0.15 with an associated standard deviation of 0.11. All twenty-two of the marker tasks demonstrated significant loadings (r = 0.35 or above) on their assigned factors. Furthermore, in no case were significant errors (i.e.) + OR - 0.35) demonstrated on a marker-task factor.

TABLE 4: SUMMARY OF ERRORS GENERATED BY THE PROCRUSTES AND PCA SOLUTIONS FOR THE NON NATIVE DATA

	BOTTOM-UP ATTENTION PROC/PCA		VISUAL TOP-DOWN ATTENTION PROC/PCA		VERBAL TOP-DOWN ATTENTION PROC/PCA		SIMUL-TANEOUS CODING PROC/PCA		SUCCESSIVE CODING PROC/PCA		CONCRETE ACTIVE PLANNING PROC/PCA		VERBAL LOGICAL PLANNING PROC/PCA	
HIDDDEN PATTERNS ATTEMPTED	*	*	*	*	*	*	*	*	*	*	*	*	*	*
HIDDEN PATTERNS ERRORS	*	*	*	*	*	*	*	*	*	*	*	*	*	*
IDENTICAL PICTURES ATTEMPTED	*	*	*	*	*	.35	.43	*	*	*	*	*	*	*
IDENTICAL PICTURES ERRORS	*	*	.44	*	*	.39	*	*	*	*	*	*	*	*
K-ABC HAND MOVEMENTS	*	*	*	*	*	*	*	*	*	*	*	*	.37	.62
K-ABC GESTALT CLOSURE	*	*	*	*	*	*	*	*	*	*	*	*	*	*
K-ABC NUMBER RECALL	*	*	*	*	.43	*	*	*	*	*	*	*	*	*
K-ABC TRIANGLES	*	*	*	*	*	*	*	*	*	*	*	*	*	*
K-ABC WORD ORDER	*	*	.37	*	*	*	*	*	.43	*	*	*	*	*
K-ABC MATRIX ANALOGIES	*	*	*	*	*	*	.75	*	.57	*	*	*	*	*
K-ABC SPATIAL MEMORY	*	*	*	*	.45	.43	*	*	*	*	*	*	*	*
K-ABC PHOTO SERIES	*	*	*	*	*	*	.44	*	*	*	.35	*	*	*
ICONIC PAIRED ASSOCIATES	*	*	*	*	*	*	*	*	*	*	*	*	*	*
ENACTIVE PAIRED ASSOCIATES	*	*	*	*	*	*	*	*	*	*	*	*	*	*
FUNCTIONAL PAIRED ASSOCIATES	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LOGICAL PAIRED ASSOCIATES	*	*	*	*	*	*	*	*	*	*	*	*	*	*
TCU UNILATERAL CONCEPTS	.39	*	.48	*	*	*	*	*	*	*	*	*	*	*
TCU COLOR REALITY MATCH	*	.41	*	*	*	*	*	*	*	*	*	.66	*	*
TCU SHAPE REALITY MATCH	*	.61	.37	*	*	.61	*	*	*	*	*	.42	*	*
TCU HOMOGENEOUS FUNCTION REALITY MATCH	.39	.37	*	*	.50	*	*	*	*	*	.48	*	*	*
TCU ABSTRACT FUNCTION REALITY MATCH	*	*	*	*	*	.52	*	*	*	*	*	*	*	*
TCU RELATIONAL FUNCTION REALITY MATCH	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Error values less than 0.35 are replaced by *

A brief review of Table Five indicates a relatively low error rate when comparing the marker-task theoretical loadings. For example, the overall procrustes mean error rate was 0.24 with a standard deviation of 0.18, while the PCA-generated mean error rate was 0.19 with a standard deviation of 0.11. All twenty-two of the marker tasks demonstrated significant loadings (r = 0.35 or above) on their assigned factors. Where error rates above + or - 0.35 are reported on theoretically assigned target factors the error is associated with complex variables or variables with more than one significant loading.

TABLE 5: SUMMARY OF ERRORS GENERATED BY THE PROCRUSTES AND PCA SOLUTIONS FOR THE NATIVE DATA

	BOTTOM-UP ATTENTION PROC/PCA		VISUAL TOP-DOWN ATTENTION PROC/PCA		VERBAL TOP-DOWN ATTENTION PROC/PCA		SIMUL-TANEOUS CODING PROC/PCA		SUCCESSIVE CODING PROC/PCA		CONCRETE ACTIVE PLANNING PROC/PCA		VERBAL LOGICAL PLANNING PROC/PCA	
HIDDEN PATTERNS ATTEMPTED	*	*	*	*	*	*	.60	*	*	*	*	*	*	*
HIDDEN PATTERNS ERRORS	*	*	*	*	*	*	*	*	*	*	*	*	*	*
IDENTICAL PICTURES ATTEMPTED	*	*	*	*	*	*	.59	.51	*	*	*	*	*	*
IDENTICAL PICTURES ERRORS	*	*	*	*	.58	.49	.58	.48	*	*	*	*	.41	*
K-ABC HAND MOVEMENTS	*	*	*	*	.44	*	*	*	.73	*	.75	*	.37	.62
K-ABC GESTALT CLOSURE	.49	.37	*	*	*	*	.43	.53	*	*	*	*	*	*
K-ABC NUMBER RECALL	*	*	*	*	.64	*	.53	.41	.42	*	*	*	*	*
K-ABC TRIANGLES	*	*	*	*	.38	*	*	*	.48	*	.42	*	*	*
K-ABC WORD ORDER	.38	.35	*	*	*	*	*	*	.40	*	*	*	*	*
K-ABC MATRIX ANALOGIES	.43	*	.47	*	*	*	.71	*	*	.48	*	*	*	*
K-ABC SPATIAL MEMORY	*	*	*	*	*	*	*	*	*	*	.42	.37	*	*
K-ABC PHOTO SERIES	*	*	*	*	*	*	.59	*	*	*	.48	.44	*	*
ICONIC PAIRED ASSOCIATES	*	*	*	*	*	*	.68	.38	*	*	.40	*	.66	*
ENACTIVE PAIRED ASSOCIATES	.51	.43	*	*	*	*	*	.75	*	*	*	*	*	.61
FUNCTIONAL PAIRED ASSOCIATES	*	*	*	*	*	*	*	*	*	*	*	*	*	.49
LOGICAL PAIRED ASSOCIATES	*	*	*	*	.40	*	*	*	.43	*	*	*	.48	*
TCU UNILATERAL CONCEPTS	*	*	*	*	.36	*	*	*	.71	.46	*	.69	*	*
TCU COLOR REALITY MATCH	.41	*	*	*	*	*	.46	.36	.60	.56	*	*	*	*
TCU SHAPE REALITY MATCH	*	*	*	*	*	*	*	.57	*	*	*	*	*	*
TCU HOMOGENEOUS FUNCTION REALITY MATCH	*	*	*	*	.66	*	*	*	.62	.49	*	.69	.35	*
TCU ABSTRACT FUNCTION REALITY MATCH	*	*	*	*	*	.63	*	*	.48	.35	*	.59	*	*
TCU RELATIONAL FUNCTION REALITY MATCH	*	*	*	*	*	*	*	*	*	*	*	.50	*	*

Error values less than 0.35 are replaced by *

For example, the IPT error score was assigned a loading of 1.0 on the Top-down Verbal Attentional control factor; however, the empirical data suggests that signifigant loadings occur on both the Top-down verbal factor and on the Simultaneous factor. A similar interpretation could be offered for the K-ABC Gestalt Closure, the Numbers Reversed, and the Iconic paired-associate factor loadings.

While the theoretical assignment of each subtest appears to represent the empirical Native data, there is evidence suggesting that the simultaneous-successive factors are significantly associated with almost half of the tasks performed. This finding implies that the coding of information in terms of these processes is activated by a wider range of task demands than was originally specified in the target matrix. The fact that no such pattern emerged in the non-Native data suggests that Native children may use coding processes on a wider range of tasks than their non-Native counterparts. In other words, while Native children demonstrate similar processing factors to the non-Native sample, the coding factors are associated with performance on a wider variety of tasks.

In summary, there is tentative empirical support for the existence of the seven processing factors across both of the populations. Also, there is evidence that the two

populations differ significantly in their performance levels on some of these tasks. The evidence from the error Tables suggests that the marker tasks behaved relatively as expected for the non Native sample and not quite as expected for the Natives. The major unexpected finding was the increase in complex variable loadings for the Native children most of which involved a dual loading with either simultaneous or successive coding and their assigned target factor. There is a sufficiently close association between the theoretical and the empirically derived factor structures to facilitate further analyses between the Native and non Native theoretically transformed factor matrices.

Orthogonal procrustes transformations were performed separately through AGFAP (Hakstian & Bay, 1973) on the partial correlation matrix of the twenty-two marker tasks with age, sex, and age/sex effects partialled out for the Native and non-Native samples. The target matrix was composed of 1.0, 0.5, and 0.0 loadings for each of the twenty-two variables on each of the seven factors thereby generating a 22 by 7 matrix. Table Six reports the transformed factor loading matrix for both the Native and non-Native samples. The reporting of the two factor matrices side-by-side effectively enhances visual comparisons.

TABLE 6: FACTOR LOADINGS FOR PROCRUSTES TRANSFORMATION WITH ORTHOGONAL ROTATION TO A SEVEN FACTOR TARGET MATRIX FOR NON NATIVE AND NATIVE DATA

	BOTTOM-UP ATTENTION		VISUAL TOP-DOWN ATTENTION		VERBAL TOP-DOWN ATTENTION		SIMUL-TANEOUS CODING		SUCCESSIVE CODING		CONCRETE ACTIVE PLANNING		VERBAL LOGICAL PLANNING	
	N.N.	N	N.N.	N	N.N.	N	N.N.	N	N.N.	N	N.N.	N	N.N.	N
HIDDEN PATTERNS ATTEMPTED	0.0	0.0	0.77	0.83	0.0	0.0	0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HIDDEN PATTERNS ERRORS	0.0	0.0	0.80	0.93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ATTEMPTED	0.0	0.0	0.0	0.0	0.43	0.47	0.43	0.59	0.36	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ERRORS	0.0	0.0	0.44	0.0	0.42	0.42	0.0	0.58	0.0	0.0	0.0	0.0	0.0	-0.41
K-ABC HAND MOVEMENTS	0.0	0.0	0.0	0.0	0.0	0.44	0.0	0.0	0.71	0.0	0.0	0.75	0.37	0.0
K-ABC GESTALT CLOSURE	0.0	-0.49	0.0	0.0	0.0	0.0	0.78	0.57	0.0	0.0	0.0	0.0	0.0	0.0
K-ABC NUMBER RECALL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.53	0.73	0.58	0.0	0.0	0.43	0.0
K-ABC TRIANGLES	0.0	0.0	0.0	0.0	0.0	0.38	0.71	0.46	0.0	0.48	0.44	0.0	0.0	0.0
K-ABC WORD ORDER	0.0	0.38	-0.37	0.0	0.0	0.0	0.0	0.0	0.57	0.60	0.0	0.0	0.0	0.0
K-ABC MATRIX ANALOGIES	0.0	0.43	0.0	-0.47	0.0	0.0	0.0	0.0	0.57	0.0	0.0	0.0	0.0	0.0
K-ABC SPATIAL MEMORY	0.0	0.0	0.0	0.0	0.45	0.0	0.0	0.57	0.0	0.0	0.0	0.42	0.0	0.0
K-ABC PHOTO SERIES	0.0	0.0	0.0	0.0	0.0	0.0	0.44	0.59	0.0	0.0	0.64	0.52	0.0	0.0
ICONIC PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.70	0.0	0.0	0.0	0.0	0.40	0.0	0.66
ENACTIVE PAIRED ASSOCIATES	0.0	0.51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.87	0.69
FUNCTIONAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.80	0.80
LOGICAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.40	0.0	0.0	0.0	-0.43	0.0	0.0	0.81	0.52
TCU UNILATERAL CONCEPTS	-0.39	0.0	-0.48	0.0	0.0	-0.36	0.0	0.0	0.38	-0.71	0.0	0.0	0.0	0.0
TCU COLOR REALITY MATCH	0.51	0.0	0.0	0.0	0.0	0.0	0.0	-0.46	0.0	0.60	0.69	0.39	0.0	0.0
TCU SHAPE REALITY MATCH	0.69	0.71	-0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TCU HOMOGENEOUS FUNCTION REALITY MATCH	-0.39	0.0	0.0	0.0	0.50	0.36	0.0	0.0	0.0	0.62	0.48	0.0	0.0	0.35
TCU ABSTRACT FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	0.81	0.73	0.0	0.0	0.0	0.48	0.0	0.0	0.0	0.0
TCU RELATIONAL FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.80	0.71	0.0	0.0	0.0	0.0
VARIANCE OF FACTORS	1.64	1.91	2.31	2.28	2.10	2.03	2.64	3.10	3.04	3.86	2.02	1.73	2.59	2.50

Values less than 0.35 are replaced by 0.0

In order to facilitate the discussion of the transformed factor loading matrix, the unit of analysis will be the factor of comparison and the comparisons will be made between the two populations in terms of the similarity/dissimilarity of each of the seven factors. Differences in performance levels for each subtest will then be discussed in terms of an interactive pattern of strengths and weaknesses evidenced on each of the seven factors by each population.

The Bottom-up Attentional control factor was defined as, "scanning and focussing of attention on environmental stimuli activated by dominant (i.e., biological essential or culturally relevant) characteristics of the stimuli". Three out of the twenty-two tasks were considered to require predominantly this form of processing (i.e., TCU Shape Reality Match score with a theoretical loading of 1.0, and the Color Reality Match score and K-ABC Spatial Memory both with 0.5 loadings on this factor).

The Bottom-up Attentional control factor for both Native and non-Native samples accounted for a significant amount of the variability in performance evidenced across tasks (eigen values were 1.9 and 1.6, respectively). An examination of the non-Native Bottom-up Attentional control factor loadings suggests significant correspondence on all three marker tasks (i.e., TCU Shape = 0.69, TCU Color = 0.51 and K-ABC

Spatial Memory = 0.55). Native Bottom-up Attentional control factor loadings display correspondence on the highest theoretically loaded marker task (TCU Shape = 0.71) but not on either the TCU Color or K-ABC Spatial Memory tasks (loadings (.35).

A number of tasks, which were not designated as loading on the Bottom-up Attentional control factor in the target matrix, demonstrated significant loadings on the empirical bottom-up attentional factor. Non-Native performance on the TCU Homogeneous Function items and the Unilateral score demonstrated low negative loadings (- 0.39) on the Bottom-up Attentional factor. Native performance on K-ABC Gestalt Closure (- 0.49), Word Order (0.38), Matrix Analogies (0.43) and the Enactive paired associate items (0.51) demonstrated secondary loadings on the bottom-up factor. A secondary loading indicates that a subtest loads significantly on one or more other factors.

Top-down Visual Attentional control has been defined as "scanning and focussing of attention on environmental stimuli under the control of concrete/active planning activated by familiar visual-motor feedback". Only the Hidden Patterns number attempted and error scores were considered to predominantly require this form of processing (i.e., theoretical loadings of 0.5 and 1.0, respectively).

The Top-down Visual Attentional control factor for both the Native and non-Native samples accounted for a significant degree of the variability in performance across tasks (eigen values of 2.3). An examination of the non-Native top-down visual control factor suggests correspondence on both marker scores (number attempted score loading = 0.77 and error score loading = 0.80). The top-down visual marker score loadings were equally high (i.e., number attempted score loading = 0.83 and error score loading = 0.93).

A number of tasks, which were not theoretically assigned to the top-down visual control factor target matrix, demonstrated significant loadings on the empirical top-down visual control factors. Identical Pictures test error score (0.44), TCU Unilateral (- 0.48) and Shape (- 0.37) scores demonstrated significant loadings on the non-Native top-down visual control factor. Significant loadings on the Native top-down visual factor were obtained for the K-ABC Matrix Analogies (- 0.47) and Logical paired associate scores.

The Top-down Verbal Attentional control factor has been defined as "scanning and focussing of attention on environmental stimuli under the control of verbal/logical planning and activated by verbal feedback". Four out of the twenty-two measures were assigned target loadings on the Top-down Verbal Attentional factor. The TCU Homogeneous and Abstract Function

scores and the Identical Picture error score were assigned 1.0 loadings, while the number of Identical Picture attempted score was assigned a 0.5 loading).

The Top-down Visual Attentional control factor for both the Native and non-Native samples accounted for a significant amount of the variability in performance across tasks (i.e., variances of factors of 2.0 and 2.1, respectively). Significant factor loadings on all four of the marker tasks were obtained for both the Native and non-Native top-down visual attentional factors. Native factor loadings for these marker tasks were: TCU Homogeneous Function (0.36), Abstract Function (0.73), Identical Picture error (0.42) and attempted (0.47), while non-Native factor loadings were 0.50, 0.81, 0.42, and 0.43, respectively. A number of tasks, not theoretically assigned loadings on the top-down visual target factor, demonstrated significant loadings on the empirical top-down visual control factor. The K-ABC Triangles and TCU Unilateral scores demonstrate significant but secondary loadings on the Native top-down verbal attentional control factor (i.e., 0.38 and - 0.36, respectively). Non-Native performance on the K-ABC Numbers Reversed, Word Order, and Spatial Memory tasks demonstrated significant loadings on the non-Native top-down visual control factor (i.e., 0.43, 0.38, and 0.45, respectively).

The Simultaneous Coding control factor has been defined

as "synthesis of separate stimuli elements into meaningful wholes in which all the elements are mutually sureveyable and meaning is only accessible from the whole with individual elements lacking meaning". Six out of the twenty-two tasks were assigned significant loadings on the Simultaneous Coding control target factor. The K-ABC Gestalt Closure, and Matrix Analogies tasks were assigned loadings of 1.0 on the Simultaneous target factor. The Iconic paired associate items were also assigned a loading of 1.0 on the Simultaneous factor. Secondary loadings on the Simultaneous coding target factor of 0.50 were assigned to two other K-ABC simultaneous scale subtests (i.e., Triangles and Spatial Memory), as well as the Hidden Patterns attempted score.

The Simultaneous Coding control factors of both the Native and non-Native samples account for a significant amount of the variability in performance evidenced across tasks (i.e., eigen values of 3.1 and 2.6, respectively). Correspondence between the target loadings for the six marker tasks and the empirical Simultaneous factor loadings for these marker tasks is equivocal. For example, of the three tasks assigned 1.0 loadings on the Simultaneous target matrix only Gestalt Closure performance demonstrates a significant loading on both the Native and non-Native simultaneous factors (i.e., 0.57 and 0.78, respectively). Neither group demon-

strated a signifcant loading on the simultaneous factor for their K-ABC Matrix Analogies performance. The Iconic paired associate items demonstrated a significant loading on the non-Native simultaneous factor (0.70), but not on the Native simultaneous factor (i.e., a loading < 0.35).

The factor loadings for the marker tasks with 0.50 or secondary loadings on the Simultaneous Coding control target factor do not demonstrate corresponding loadings on the Native and non-Native simultaneous factors. Both the Hidden Patterns attempted and K-ABC Triangles scores demonstrated significant loadings on the non-Native simultaneous factor (i.e., loadings of 0.40 and 0.71 respectively). The K-ABC Spatial Memory failed to demonstrate a significant loading on the non-Native simultaneous factor. Both the K-ABC and Spatial Memory subtests demonstrated significant loadings on the Native simultaneous factor (i.e., 0.46 and 0.57, respectively). The Hidden Patterns attempted performance of Native children did not load significantly on the Native simultaneous factor (i.e, a loading < 0.35).

A number of tasks, not assigned loadings on the Simultaneous Coding target factor, demonstrated significant loadings on the simultaneous factors of both the Native and non-Native samples. For example, the Identical Picture attempted and K-ABC Photo Series scores demonstrated significant, but

secondary, loadings on the non-Native simultaneous factor (i.e., 0.42 and 0.44, respectively). The Identical Pictures attempted and error scores, as well as the K-ABC Numbers Reversed and Photo Series scores demonstrated significant, but secondary, loadings on the Native simultaneous factor.

The Successive Coding control factor has been defined as, "synthesis of separate stimuli elements into temporal, sequence dependent forms which are surveyable only one at a time and meaning is accessed only from the order". Five out of the twenty-two tasks were assigned significant loadings on the Successive Coding control target factor (i.e. K-ABC Hand Movements, Numbers Reversed, and Word Order, as well as the TCU Relational scores, were assigned loadings of 1.0, while the number of Identical Picture items attempted was assigned a 0.50 loading on the Successive Coding control target factor).

The successive coding control factor for both the Native and non-Native samples accounted for a significant amount of the variability in performance across tasks (i.e., variances of factors of 3.9 and 3.0, respectively). All five of the successive marker tasks demonstrated significant loadings on the non-Native successive factor. Non-Native successive factor loadings for the successive marker tasks are: K-ABC Hand Movements (0.71), Numbers Reversed (0.73) and Word Order

(0.57), TCU Relational Function (0.80) and Identical Pictures attempted (0.36). K-ABC Numbers Reversed (0.58) and Word Order (0.60), as well as, the TCU Relational Function (0.71), demonstrated significant loadings on the Native successive coding control factor. Both the K-ABC Hand Movement and the number of Identical Pictures attempted scores failed to demonstrate loadings greater than 0.35 on the Native successive coding control factor.

A number of the tasks not assigned significant loadings on the Successive Coding control target factor demonstrated significant loadings on the Native and non-Native successive coding control factors. Only the K-ABC Matrix Analogies and TCU Unilateral scores demonstrated significant loadings on the non-Native successive factor (i.e., 0.57 and 0.38, respectively). In contrast, K-ABC Triangles (0.48), Logical paired associate items (- 0.43), TCU Unilateral (- 0.72), Color (0.60), Homogeneous Function (0.62), and Abstract Function (0.48) scores, all demonstrate significant loadings on the Native successive coding control factor.

The Concrete/Active Planning control factor has been defined as "generation, selection and monitoring of goal-directed attentional and coding processes activated by familiar visual-motor feedback". Three out of the twenty-two tasks were assigned significant factor loadings on the Conrete/

Active Planning control target factor (i.e., K-ABC Photo Series which was assigned a loading of 1.0 and K-ABC Triangles and TCU Color Reality Match scores, which were assigned 0.50 or secondary loadings).

The Concrete/Active Planning control factors for both the Native and non-Native samples account for a significant amount of the variability in performance across the tasks (i.e., variances of factors of 1.7 and 2.0, respectively). All three of the marker tasks for the Concrete/Active planning target factor demonstrated significant loadings on the non-Native concrete/active planning control factor. The loadings for these marker tasks on the non-Native concrete/active planning factor were: K-ABC Photo Series (0.65), Triangles (0.43) and TCU Color (0.69). Both K-ABC Photo Series (0.52) and TCU Color (0.39) marker tasks demonstrated significant loadings on the Native concrete/active planning factor, while only the K-ABC Triangles marker task failed to demonstrate a loading of 0.35 or above on the Native concrete/active planning factor.

A number of the tasks, not assigned significant loadings on the Concrete/Active Planning target factor, demonstrated significant loadings on the concrete/active planning factors of both the Native and non-Native samples. Only the TCU Homogeneous Function score demonstrated significant (0.48),

but secondary, loading on the non-Native concrete/active planning factor. K-ABC Hand Movements had a significant (0.75) and primary loading on the Native concrete/active planning factor. K-ABC Spatial Memory and Iconic paired associate items demonstrated significant, but secondary, loading on the Native concrete/active planning factor (i.e., loadings of 0.42 and 0.39, respectively).

The Verbal/Logical planning control factor has been defined as, "generation, selection, and monitoring of goal-directed attentional and coding processes activated by familiar verbal feedback." Three out of the twenty-two tasks were assigned significant loadings on the Verbal/Logical Planning control target factor (i.e., Enactive, Functional, and Logical paired associate items were all assigned 1.0 loadings on the Verbal/Logical target factor).

Both the Native and non-Native verbal/logical planning factors account for a significant amount of the variability in performance demonstrated across tasks (i.e., variances of factors of 2.5 and 2.6, respectively). All three of the marker tasks assigned to the Verbal/Logical Planning target factor demonstrate significant loadings on both the Native and non-Native verbal/logical planning factors. Loadings on the non-Native verbal/logical planning factor were: Enactive (0.87), Functional (0.80), and Logical (0.81), while

loadings on the Native verbal/logical planning factor were: Enactive (0.69), Functional (0.80), and Logical (0.52). All three of the marker tasks had primary loadings, or loadings only on the verbal/logical factor for the non-Native factor. Enactive and Logical paired associate items demonstrated secondary loadings on the Native verbal/logical factor, while Functional paired associate items demonstrated a primary loading on the Native verbal/logical factor.

Only the three verbal/logical marker tasks demonstrated significant loadings on the non-Native verbal/logical factor, while Identical Pictures error scores, Iconic paired associate items and TCU Homogeneous Function scores demonstrated significant but secondary loadings on the Native verbal/logical planning factor (i.e., 0.41, 0.66, and 0.35, respectively).

In summary, the factor loading results seem to demonstrate a satisfactory degree of correspondence between the seven factor structure operationally defined in the 7 by 22 target matrix identified in Table 3 and the empirically determined factor structures of the Native and non-Native groups as reported in Table Six. Note, however, the results are restricted by a number of factors.

First, the small sample size places constraints on the reliablity of this factor structure. Second, the exploratory nature of this study prevented a direct assessment of the

"goodness of fit" between the theoretical and empirical factor structures of the two groups, thereby limiting the precision with which this correspondence can be reported. And finally, the operational definitions of the factors required using tasks which could be associated with more than one type of process, thereby limiting the purity of the factors. Nevertheless, the results seem to support the conceptual definitions of the seven control processes to a degree sufficient for further interpretation of these secondary loadings, as well as differences between the factor loadings of the two groups. Due to the limits imposed on the results further interpretation must remain speculative and be drawn more heavily from the literature reviewed than from the results obtained.

CHAPTER FIVE: DISCUSSION

In order to provide a structure for the discussion section and to facilitate precision in interpreting the results, the seven control processes are redefined in terms of patterns of task characteristics associated with significant loadings on a processing factor. Native empirical processing factors and their associated task characteristics are compared to non-Native performance on these same tasks. Performance strengths and weaknesses are related to the "observational" and "formal academic" learning environments. Finally, instructional implications drawn from the patterning of empirical task characteristics with empirical processing factors are presented.

Note that, the instructional implications drawn are equally applicable to both Native and non-Native children who display similar patterns of empirical processing on these empirical task characteristics. The relative heterogenity of the Native group's performance, as indicated by a number of significant age/sex effects on the intercorrelations of the various tasks, severely limits the determination of a characteristic "Native learning style." However, the specification of relative strengths and weaknesses for Native children is carried out, in order to further specify the instruction implications. The patterning of empirically derived task characteristics and processes in the following Table.

TABLE 7: SUMMARY OF THE TYPES OF KNOWLEDGE BASES ASSOCIATED WITH THE NON NATIVE AND NATIVE PROCRUSTES FACTORS

	HOLISTIC FEATURES	ANALYTIC FEATURES	VISUAL STIMULI	AUDITORY STIMULI	SIMUL-TANEOUS STIMULI	SUCCESIVE STIMULI	VERBAL MEDIATOR	NONVERBAL MEDIATOR	CONCRETE FEEDBACK	VERBAL FEEDBACK
NATIVE BOTTOM-UP ATTENTION	1	3	2	2	2	2	2	2	3	1
NON NATIVE BOTTOM-UP ATTENTION	3	0	3	0	3	0	2	1	1	2
NATIVE TOP-DOWN VISUAL	0	3	2	1	2	1	1	2	2	1
NON NATIVE TOP-DOWN VISUAL	0	3	3	0	2	1	1	2	2	1
NATIVE TOP-DOWN VERBAL	2	3	5	0	5	0	4	1	3	2
NON NATIVE TOP-DOWN VERBAL	3	4	5	2	5	2	5	2	4	3
NATIVE SIMULTANEOUS CODING	2	5	6	1	4	3	3	4	6	1
NON NATIVE SIMULTANEOUS	1	5	5	1	5	1	3	3	6	0
NATIVE SUCCESSIVE CODING	3	4	5	2	5	2	5	2	2	5
NON NATIVE SUCCESSIVE	0	6	4	2	2	4	4	2	4	2
NATIVE CONCRETE/ACTIVE	3	2	4	1	3	2	0	5	5	0
NON NATIVE CONCRETE/ACTIVE	2	2	4	0	4	0	1	3	3	1
NATIVE VERBAL/LOGICAL	2	4	2	4	2	4	6	0	2	4
NON NATIVE VERBAL/LOGICAL	1	2	0	3	0	3	3	0	0	3

Values represent the number of subtests with specified characteristic

Table Seven presents a summary of the empirically derived knowledge base task characteristics for each of the seven processing factors for both Native and non-Native results. Table Seven is based on the Knowledge base task analysis presented in Table One. An examination of Table Seven suggests that Native Bottom-up attentional processing is associated with analytic features. In contrast, non-Native Bottom-up attentional processing is associated with holistic features.

Mediation provided within the observational learning environment emphasizes identification of holistic stimuli characteristics over identification of analytic stimuli characteristics. The prevalence of analytic task characteristics associated with Native Bottom-up attention may not represent stimuli task characteristics, but rather, response characteristics. This implies that analytic stimuli characteristics may not be dominant or discriminant stimuli for Natives to the same degree as they are for non-Natives. Verbal mediation may be a necessary condition for establishing analytic features as discriminant stimuli.

For example, the failure of Native children to perform at the same level on the TCU Shape reality match items relative to their non-Native counterparts may be attributable in part to a Native inability to identify shape as a holistic

stimuli characteristic. The lack of recognition of similar shapes in the stimuli, rather than indicating a deficit in shape recognition, may be the result of shape being only one of several possible response feature similarities. In this way, performance on this task may be related to whether or not shape is treated as a holistic stimuli characteristic, or alternatively as, merely one of many response characteristics. In the former case, the stimuli characteristics are associated with Bottom-up attentional processing, while in the latter case, the multiple response characteristics may somehow prevent shape from assuming its expected dominant stimuli characteristic.

This implies that Native Bottom-up processing may be limited when multiple response options--including analytic response features--are part of the overall task. This interpretation is supported by significant loadings for the K-ABC Word Order and Enactive paired associate tasks on the Native Bottom-up processing factor without similar loadins on the non-Native processing factor. The bottom-up processing factor identified for non-Natives is consistent with the specification of processing of dominant stimuli characteristics without regard to response characteristics, while the tasks loading on the Native bottom-up processing factor are more representative of the response charateristics of the task

and therefore, do not represent bottom-up processing.

The influence of the multiple response characteristics may account, in part for the relatively poor performance on the TCU Shape items by the Native group. In light of the relative Native strength demonstrated on the K-ABC Gestalt Closure task, yielding a negative association. The implication left to be drawn is that holistic features in the form of gestalts are the dominant stimuli characteristics for Native children. The failure to recognize the simiarity in shape between the two objects presented on a TCU Shape item may, in part, be accounted for by a Native proclivity to organize analytic shape characteristics into holistic gestalts in which the stimuli characteristics of shape are ignored in favor of the more dominant response characteristics of relating object gestalts.

One instructional implication which can be drawn from this interpretation of the results is that performance differences on global reading comprehension tasks may reflect the analytic response characteristics associated with having to "sound-out-the-word," rather than an inability to recognize the holistic features of the story. In other words, failure to comprehend a passage may be associated with a lack of "automazation" of the decoding skills (La Berge & Samuels, 1974). The lack of automatic decoding skills may be related

to an emphasis on multiple analytic response features during initial reading instruction (mediation) provided by the instructional prompt to "sound-out-the-word."

Furthermore, the observational learning environment tends to favor the identification of holistic features over analytic features by a mediational emphasis on visual pattern matching, implying that initial reading instruction should focus on holistic features (e.g., words) over analytic features (e.g., letters) for children whose home environment is characteristic of the observational learning environment. Reading programs which emphasize whole word approaches and meaning over phonics are suggested for this group.

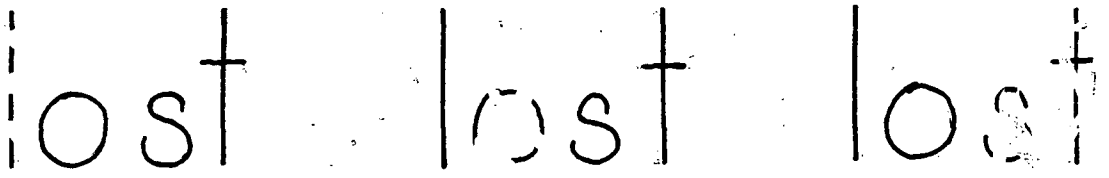
In addition to an emphasis on the meaning-based holistic features (e.g., words) encountered during initial reading instruction, direct instruction in acquiring "automatic" analytic feature identification skills is implied. That is, the 'broad sweeping perception' required within the observational learning environment needs to be adapted to the more analytic response demands of the formal academic learning environment.

This process of adapting an observational attentional style to analytic attentional demands has been a major focus of Feuerstein's (1980) Instrumental Enrichment Program, which is characterized by a provision for mediated learning experi-

ences designed to initially frame analytic response features by treating them as holistic visual stimuli characteristics and later relating them to analytic stimuli features.

Another approach to increasing the saliency of analytic stimuli/response characteristics is the use of partial cloze procedures on the analytic features. The cloze procedure should help to focus attention on the relevant analytic stimuli/response features by ensuring that attention to the analytic feature or detail is associated with the process of forming gestalts. For example, partial clozing of an individual grapheme should ensure that the grapheme is treated as a dominant stimuli by directing attention to the task of forming the gestalt for that graheme (e.g., see Figure Two). Concisely, a gestalt is considered a dominant stimuli, and bottom-up attention is implicated.

FIGURE 2: AN EXAMPLE OF CLOZE PROCEDURE FOR TEACHING VISUAL PHONETIC ANALYSIS



There were no significant differences between Native and non-Native groups in the pattern of task characteristics associated with significant loadings on the Visual Top-down attentional control factor (see Table Seven). Native children evidenced performance equivalent to their non-Native counterparts on all but one of the four tasks loading on this factor (see Figure One).

Interestingly, the only task significantly loading on the Native top-down visual factor, which demonstrated a relative weakness in performance, was the negative loading obtained for K-ABC Matrix Analogies. The relationship between K-ABC Matrix Analogies performance and visual top-down attentional processing by Native children may be interpreted within the context of differences in the factor loadings of a measure of field-independence/dependence which serves as a marker task for visual top-down attention (i.e., Hidden Patterns number attempted and error scores).

Both groups appeared to perform at the same level on the Hidden Pattern items, implying a field-independent cognitive style (Ekstrom, 1973). The performance difference evidenced on the Matrix Analogies task was associated with a difference in the direction of factor loadings between the two groups. This difference in loadings suggests that the use of a field-independent style may be negatively associ-

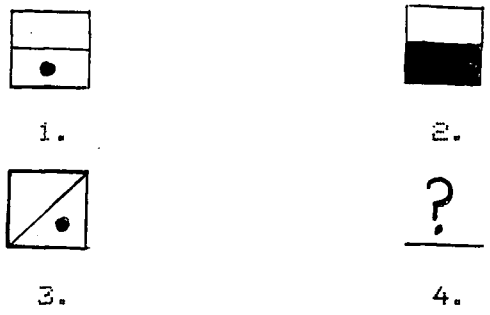
ated with Matrix Analogies performance for Natives and positively associated with task performance for non-Natives.

The Matrix Analogies and Hidden Patterns items present non-meaningful holistic stimuli characteristics. However, the Hidden Patterns items are associated with holistic response characteristics through matching of a visual figure. In contrast, the Matrix Analogies subtest presents analytic response demands in the form of a series of relationships between several stimuli figures. Perhaps the relatively poor performance on the Matrix Analogies subtest by Native children is related to the analytic response characteristics of the task. In other words, poor performance on tasks like Matrix Analogies may be associated with difficulty in identifying the relevant response characteristics.

Suggestive of this difficulty is an error analysis of the performance of Native children on the Matrix Analogies items. The majority of errors committed were in choosing an incorrect response items with similar holistic features to one of the stimulus items, by missing a key analytic feature of the stimulus. For example, Figure Three presents a typical error of the Native group on a Matrix Analogies item. No such pattern of errors was found for the non-Native group.

FIGURE 3: ERROR PATTERNS FOR THE NATIVE AND NON-NATIVE GROUPS ON A SAMPLE MATRIX ANALOGY PROBLEM

Directions: Say, **This** (point to 1) **goes with this** (point to 2) **just as this** (point to 3) **goes with which one of these** (point to A-H responses).



A.	B.	C.	D.
Native 14%*	Native 36%	Native 2%	Native 0%
Non-Native 5%	Non-Native 11%	Non-Native 13%	Non-Native 6%

E.	F.	G.
Native 0%	Native 43%	Native 4%
Non-Native 8%	Non-Native 46%	Non-Native 9%

*Percentage choosing this response.

The type of error illustrated in Figure Three implies a holistic matching style was utilized by the Native group, that is, scanning and focusing on analytic features on the Hidden Patterns task was not considered a response characteristic and consequently this has facilitated performance. In contrast, a holistic matching style on the Matrix Analogies has prevented efficient performance, since analytic features were a relevant response characteristic of the task. In this way, poor performance on Matrix Analogies may be accounted for, in part, by the failure to identify analytic response characteristics.

Several instructional implications can be drawn from the similar performance levels of Native and non-Native children on the tasks loading on the Native top-down visual attentional factor. First, top-down visual attentional control should be considered a relative strength for Native children. This implies that visual meaning can be used to control attention. For example, the use of rebus (pictographs) words should help to focus the Native child's attention on the meaning aspects of reading by providing a visual symbol or frame for the meaning.

A further example of using a Native child's relative strength in top-down visual attentional processing on academic tasks is the use of morphographs to improve spelling. A

morphographic spelling approach links analytic features in the form of grapho-phoneme units with meaning-based units. In this way, visually meaningful analytic features of a word can be coded and retrieved as visually meaningful units, thereby improving both spelling and vocabulary simultaneously.

A second instructional implication to be drawn from Native children's relative strength in top-down visual processing--as evidenced by equivalent Hidden Patterns factor loadings--concerns the use of instructional procedures designed for a field-independent style a construct assumed to be associated with efficient performance (Ekstrom, et al., 1976). For example, it has been suggested that field independence could be related to effective cue-sampling during reading. That is, Native readers who perform well on disemmbedding tasks of cognitive styles (e.g.. Hidden Patterns) should perform effectively in reading tasks requiring the extraction (from a print-stimulus) of salient cues or information, if provided with guides as to "What to look for" or holistic response characteristics. Singer and Donlan (1980) provide several examples of "learning-from-text" guides (see also Davey, 1983, for a more detailed discussion of the relationship between Field-independence and reading instruction).

All of the marker tasks of top-down verbal processing were characterized by pictorial stimuli which required matching on some conceptual dimension (see Table Seven). The response characteristics on these tasks required verbal/-logical labels, which serve as a frame or label for the conceptual equivalence scanning and focusing activity. There were no performance differences, between Native and non-Native children, on any of the marker tasks of the top-down verbal attentional factor (see Figure One & Table Three). There were, however, significant differences in the number of tasks demonstrating significant loadings on this factor between the two groups (see Table Six).

For example, the non-Native sample demonstrated only one significant task loading on the visual top-down factor other than the marker tasks (i.e., K-ABC Spatial Memory). In contrast, Native children demonstrated significant loadings for four additional tasks (i.e., K-ABC Hand Movements & Triangles, Logical paired associates, and a negative loading on the TCU Unilateral Concepts). Interestingly, task performance favored non-Natives over Natives in all cases (see Figure One).

One interpretation of the differences in the additional tasks loading on the top-down verbal factor for the two groups is that verbal/logical response characteristics were associ-

ated with attentional control for the Natives more frequently than for non-Natives accounted for, in part, by differences in the type of mediation provided within the observational learning environment and the formal academic learning environment.

For example, in the "observational" learning environment, a typical learning task associated with top-down verbal attentional control presents a visual/auditory association task with visual response characteristics. Mediation is provided in terms of verbal labels for guiding selection of the correct visual response. In contrast, in the later grades of the "formal academic" learning environment a similar visual/auditory association task linked to top-down verbal attentional control supplies only verbal response characteristics. Note that, the Identical Pictures items are considered representative of the type of top-down verbal processing favored by the "observational" learning environment, while the TCU Homogeneous and Abstract Reality Match items are more characteristic of the type of top-down verbal attentional control favored in the later grades of the "formal academic" learning environment.

The lack of performance differences between Native and non-Native children on the top-down verbal marker tasks may mask significant qualitative differences in the way the con-

ceptual equivalence is identified. Native children, when identifying conceptual equivalence, may use "images" activated by the pictorial stimuli more frequently than their nonNative counterparts. In contrast, non-Native children may determine conceptual equivalence by either verbal/logical or imagery type/logical codes. That is, the type of coding employed as a mediator may account, in part, for performance differences on conceptual equivalence tasks.

Several instructional implications can be drawn from the discussion of the qualitative difference in Native and non-Native childrens' performance on tasks loading on the top-down verbal attentional control factors. First, instructional procedures designed to remediate a generalized Native "verbal deficiency" must be questioned, as no such deficiency was evidenced on the verbal response tasks (e.g., the TCU items) loading on this factor between the two groups.

Second, a relative strength in top-down verbal control was evidenced by Native children when prompts associated with the activation of imagery coding were provided in the form of response pictures (e.g., Identical Pictures). The use of prompts designed to activate images in the absence of actual concrete/active feedback is suggested. As an example, prompts designed to aid coding of sequentially presented material similar to the K-ABC Numbers Reversed

and Word Order stimuli can be provided in the form of "mnemonic" devices (e.g., the peg word method).

Study skill instructional techniques which utilize outlining and diagramming techniques should help to provide the Native child with self-generated prompts to use "imagery" codes for storage and retrieval of conceptual equivalence dimensions. In general, this study skills approach should emphasize the provision of concrete/active feedback for auditory conceptual equivalence tasks. This can be accomplished by providing "metaphors" for the auditory equivalence dimension. For example, the term "attention" can be thought of as a flashlight beam within a darkened room. The scanning and focusing aspects of attention can then be related to the image of the flashlight beam, as well as the verbal definition of attention.

The simultaneous coding control processes of both Native and non-Native children can be characterized by a similar pattern of associated task characteristics (see Table Seven). Performance differences between Native and non-Native children favored Native children on two of the seven tasks that demonstrated significant loadings on the Native simultaneous processing factor (i.e., K-ABC Gestalt Closure and Spatial Memory). These tasks require the formation of a gestalt for matching stimuli and response characteristics. The

stimuli features are analytically presented, while the response features are holistic. The stimuli/response matching is performed by viewing the analytically presented stimuli components as a single holistic feature. A relative strength evidenced on this task may represnt the viewing of the analytic stimuli components "automatically" as a holistic stimuli.

Performance differences on marker tasks loading on the simultaneous factor may be accounted for, in part, by the nature of the features used in matching stimuli/response characteristics within the different learning environments. The observational learning environment favors matching holistic stimuli characteristics to holistic response characteristics, while the formal academic learning environment favors matching analytic stimuli components to holistic response characteristics.

Native children may approach the synthesis of separate stimuli features into meaningful wholes on the basis of simultaneous coding of matching holistic stimuli/response characteristics, while non-Native children may approach the synthesis of separate stimuli features on the basis of successive labelling of analytic stimuli features (which are subsequently related to holistic response categories sharing similar analytic features). Thus for non-Native children,

verbal top-down control of attention may activate successive coding by the identification of a series of separate sequentially related features. For Native children the holistic response features may serve to activate simultaneous synthesis. This is consistent with empirical factor loadings reported in Table Six for these two groups.

One result associated with the simultaneous marker task factor loadings is the significant loading of the Iconic paired associate items for non-Native but interstingly. not for Natives. Non-Natives demonstrated relatively less difficulty in recalling iconic associates comparedf to Natives. This may be related, in part, to a significant negative association between Color Reality Match items and the Native simultaneous factor. Additionally, the Native group demonstrated a relative difficulty in identifying two objects as being similar in color when compared to the non-Native performance.

These quantitative and qualitative differences between tasks associated with Native and non-Native children's simultaneous processing are reflected in differences between the "observational" and "formal academic" learning environments. For example, a strength in simultaneous coding of "interactive images" is anticipated to develop in an environment in which the major form of mediation provided for identifying the

relationship between features and objects is nonverbal modelling (i.e., observational). In contrast, the formal academic learning environment provides verbal mediation for identification of the relationship between features and objects, implying "iconic word associations" are developed.

Quantatative and qualitive performance differences on the TCU Color items may be accounted for, in part, by the nature of the relationship which exists between the analytic stimuli features (e.g., color, shape, etc.,) and the holistic stimuli features of the two objects portrayed. This relationship can be characterized as "iconic" (i.e., adjective-noun).

Performance difficulties on the Iconic associate items and the TCU Shape and Color items may be accounted for, in part, by the difference in the mediation encountered on similar tasks in the two learning environments. It is possible, therefore, that a difficulty in identifying "iconic" relationships on formal academic tasks may be related, in part, to a relatively infrequent exposure to "iconic word associations" and a relatively frequent exposure to "interactive images" associated with the observational learning environment of Natives.

Several instructional implications can be drawn from the qualitative and quantitative differences in simultaneous coding evidenced by Native and non-Native children. Native

children's strength in simultaneous processing can be activated on verbal tasks by providing prompts to create the needed visual stimuli. For example, sentence diagramming techniques provide a visual prompt for identifying the relationships between words. A skimming and scanning study skill strategy based on a diagramming technique would help the child from the observational learning environment to "see" key analytic features of a set of stimuli. Furthermore, we may need to teach children how to activate simultaneous processing strengths, gained in the observational learning environment, by teaching them how to use imagery to explain verbal/logical relationships. That is, they may need to be taught when and how to form "iconic images," rather than "interactive images" on comparison tasks.

The successive processing factor of both Native and non-Native groups are associated with differences in task characteristics. For example, tasks associated with the Native successive processing factor were more likely to involve simultaneous presentation of the stimuli and verbal response characteristics than tasks associated with the non-Native successive processing factor (see Table Seven). Interestingly, only two of the four successive marker tasks demonstrated significant loadings on the Native successive factor (i.e., Number Recall & TCU Relational items). Per-

formance difference between Natives and their counterparts were evidenced on both of these tasks.

The highest loading marker task for both groups of children on the successive processing factors was the TCU Relational Function Reality Match items, which did not demonstrate a significant performance difference between groups. The TCU relational items can be considered to represent "enactive" relationships in which the two objects pictured are related syntagmatically in the form of a predicative statement (e.g., an Apple **grows** on a Tree). Note: the two pictures portraying a relational item are holistic or independently meaningful units (Apple & Tree), which are first identified and then related in an "interactive" or "enactive" relationship (**grows**).

Native children's successive coding control is largely associated with "predicative" relationships. This form of processing was associated with the TCU Homogeneous, Abstract, and Relational Function items. Native children in identifying conceptual equivalence between holistic stimuli features relate these features in an "interactive" or "enactive" manner. For Native children, conceptual equivalence on these types of TCU items is characterized by "syntagmatic" or "predicative" relationships. In contrast, non-Native children seem to determine conceptual equivalence of the TCU Homo-

geneous and Abstract Function items, largely as a result of top-down verbal attentional processing and not on the basis of successive coding control processing. This implies that non-Native children's identification of conceptual equivalence may be in terms of either "paradigmatic" relationships (e.g., TCU Homogeneous & Abstract Fuction items) or "syntagmatic" relationships (e.g., Relational Function items).

A restriction in Native childrens' identification of conceptual equivalence on the TCU Homogeneous and Abstract Function items to "predicative" or "syntagmatic" relationships is assumed to logically follow from the combination of the lack of analytic feature identification, in the form of "iconic" syntagmatic word associations, and the frequent exposure to interactive images or enactive word associations within the "observational" learning environment. In other words, the "observational" learning environment may be said to favor identification of holistic features, whereas the "formal academic" learning environment may be said to favor the identification of analytic features.

The effect of reduced analytic feature identification within the "observational" learning environment should be most pronounced on successive processing marker tasks in which order or sequentially-dependent meaning is a response characteristic. This assumption is supported by the relative

performance weaknesses evidenced by Native children on the K-ABC Numbers Reversed, Word Order, and TCU Color items when compared to their non-Native counterparts.

Differences between Native and non-Native childrens' successive coding processing have been identified in terms of the identification of both stimuli characteristics (i.e., holistic/ analytic) and response characteristics (i.e., syntagmatic/ paradimatic or predicative/nominative). These stimuli and response task characteristics can be identified on both "observational" and "formal academic" learning tasks. Performance differences on tasks loading on the Native successive coding control factor can be interpreted in terms of the occurrence, frequency, patterning, and style of verbal mediation provided by the "observational" learning environment for analytic/holistic feature identification.

The "observational" learning environment can be characterized as providing relatively frequent exposure to visual framing of holistic features, which are associated or related to each other in a predicative manner. In other words, the modelling of a learning task within the "observational" learning environment is usually verbally-mediated by predicative response characteristics (i.e., **Look & Do**), with the relationship between holistic stimuli features mediated by activity or visual/motor directives.

In contrast, within the "formal academic" learning environment, there is frequent exposure to visual framing but, this exposure is "patterned" with verbal labelling that may reflect categorization labels. The verbal labels code both analytic and holistic features into relationships which can be described as having paradigmatic or categorical relationships. For example, a picture of a table and a chair can be related by the sentence "You **sit** on a chair at a table," and in this case, the nature of the relationship between table and chair is syntagmatic (**Sit**). This response would be scored under the TCU Homogeneous Function category. The same stimuli picture of a table and chair could be related by identifying them as both furniture, here table and chair are related to each other paradigmatically or as members of the same class (Furniture), and the response would be scored under the TCU Abstract Function category.

The formal academic learning environment may provide more opportunities for verbal classification tasks, similar to those required in identifying a paradigmatic relationship, relative to the observational learning environment.

This interpretation is supported by an error examination of the TCU Unilateral category, which demonstrates that Native children produced more responses classified as Unilateral Concepts (mean = 8.1, standard deviation = 8.9) than their

nonNative counterparts (mean = 3.1, standard deviation = 3.3). More importantly, the majority of Native Unilateral Concepts reflected separate noun-verb or predicative responses. For example, when presented with a single picture of an eye and a football, which is considered a Shape Reality Match item, Native children typically responded "You **see** with your eye and you **play** with a football."

Results indicating that Native children evidence more significant task loadings on the successive control factor, than their non-Native counterparts (see Table Six), may be related to the recoding of visual stimuli into verbal responses. Classification relationships portrayed visually may activate successive processing due to the Native proclivity to utilize syntagmatic or predicative forms of verbal mediation, resulting from frquency of this form of mediation within the "observational" learning environment.

Syntagmatic relationships have loaded on successive processing factors and paradigmatic relationships have loaded on simultaneous processing factors (e.g., Jarman, 1980); therefore, the increased loadings of tasks associated with verbal response characteristics on the Native Successive processing factor may be accounted for, in part, by Natives' relative familiarity with syntagmatic verbal mediation and their relative unfamiliarity with paradigmatic verbal medi-

ation. This is supported by a relative strength in "enactive" paired associate recall (i.e., syntagmatically related pairs of the noun-verb type) evidenced by Native children when compared to their performance on the functional and logical paired associate recall (i.e., paradigmatically related pairs of the noun-noun type). See Figure One.

One instructional implication which can be drawn from this interpretation is that children whose homes reflect the observational learning environment may require modelling of paradigmatic verbal mediation to a degree not required by those whose homes reflect the formal academic learning environment. Modelling of paradigmatic verbally mediated learning experiences is a major component of the Instrumental Enrichment Program, which is designed to provide a transition from "enactive" mediation to "iconic and paradigmatic" mediation (Feuerstein, 1978, see particularly Chapter Two and the Making Comparisons and Categorization units).

A second instructional implication to be drawn from the qualitive differences in verbal mediation provided by the two learning environments regards the question of whether this qualitative difference generates a deficit, or merely a developmental delay. Like most "either/or" questions, the answer is probably interactive. Reduced exposure to paradigmatic verbal mediation would not only delay the "intern-

alization" of this type of verbal logical planning, but would also reduce the liklihood of its activation by visual stimuli/ response characteristics. The failure to activate verbal/ logical planning may be representative of a "production deficiency" (Flavell, et al., 1977) and instructional planning needs to take this into account (see Brown & French, 1979, for a discussion of this point of view).

Finally, there is a growing body of literature concerning the instructional implications of emphasizing simultaneous/ successive processing by varying academic task demands. The results of this body of research attest to the efficay of such an approach (see Kaufman and Kaufman, 1983, for a review and a preview of new strategies being developed).

Performance differences between the Native children and their counterparts were evidenced on four of the five tasks which loaded significantly on the Native concrete/active planning factor. There were no major differences in terms of the task demands associated with the concrete/active processing factor for the two samples, however, there were differences in terms of the loadings of the various tasks. The factor loading differences on the concrete/active factor appeared to be associated with co-loadings on factors other than the concrete/active factor.

A performance difference on the K-ABC Spatial Memory

task may be interpreted in terms of this task's significant loading on the top-down verbal attention factor for non-Native children. In other words, Spatial Memory performance differences favoring Natives may reflect the limitation placed on non-Native performance by the use of verbal mediation. In contrast, Native children demonstrated that Spatial Memory performance was associated with the Simultaneous factor, implying they may not have attempted to label the objects spontaneously like their non-Native counterparts.

The four concrete/active marker tasks demonstrating performance differences favoring non-Native children share in common analytic response characteristics (i.e., K-ABC Hand Movements, K-ABC Photo Series, Iconic paired associate items, and TCU Color Reality Match items). This implies that performance differences between Native and non-Native children may reflect interactive differences in both attentional and coding processes. This interpretation is supported by the various differences in significant co-loadings demonstrated on these tasks by the two samples (see Table Six).

For example, one explanation of the difficulty Native children experienced on the K-ABC Hand Movements test is that Native children may utilize top-down verbal processing for the task, as demonstrated by a significant loading on this factor. In other words, their attention was directed

to the labelling process, as well as modelling the hand movements. It is possible that these two processes were carried out quite independently, which would be consistent with the form of mediation provided in the observational learning environment--characterized as largely dominated by modelling independent of labelling.

In contrast, non-Native children demonstrated significant co-loadings on the Verbal/logical and Successive factors, which suggests that they utilized a combination of successive processing and verbal/logical planning in meeting the task demands of Hand Movements. In other words, their verbal labelling of the stimuli (i.e., hand moements) was part of a goal-directed and verbally-mediated plan, which allows the successive input of analytic features to be related to the sequential arrival of the features. Successive processing of these tasks is consistent with the "formal academic" learning environment mediation--characterized as largely verbally mediated.

While Native children may experience difficulties on tasks requiring identification of verbal analytic response characteristics, they have demonstrated performance levels equal to their non-Native counterparts on tasks requiring analytic feature identification if these features are highlighted by visual differences. For example, the Identical

Pictures task requires visual comparison of analytic features, and Natives did not evidence a significant difference on this task compared to their counterparts. Native children appear to be able to identify analytic features, but it also appears that they recode these analytic features "automatically" into a single holistic or interactive image. Interactive images or models of what to "look" for in a stimuli provide holistic concrete/active feedback to the Native child which may be used in controlling attention to analytic detail. An interactive image corresponds to a syntagmatic verbal relationship (Reid, 1974).

One instructional implication which can be drawn from this line of interpretation is that Native childrens performance on tasks requiring analytic feature identification may be enhanced by "deautomatizing" the feature identification control processes (ala., La Berge & Samuel, 1974). For example, the use of verbal-mediation on visually presented activities is one method for increasing analytic perception, as employed in Feuerstein's (1978) Instrumental Enrichment Program.

The task characteristics associated with the verbal/logical planning control processing of Native and non-Native children demonstrates no significant pattern of variation, implying that similar task characteristics are associated

with loadings on this factor for the two populations (see Table Seven). Native performance on the three marker tasks of verbal/logical planning suggests that Natives are equal to their non-Native counterparts in the recall of Enactive paired associate items but not in the recall of the Functional or Logical items.

The "observational" learning environment provides frequent mediation for activity based, syntagmatically related, holistic feature identification. The "formal academic" learning environment provides frequent mediation for verbal/logical identification of both holistic and analytic features, which facilitates the development verbal/logical planning control.

One explanation of the difficulty encountered by Native children in recalling Paradigmatic associates is that paradigmatic associate recall is facilitated by the identification of analytic features. In order to utilize a paradigmatic association to recall a word, it is assumed that the pair of words must be broken into two separate words or into a compound image. It is likely that non-Native children process paradigmatic paired associates in this manner, while Native children appear to process these associations as interactive images (see Reese, 1977, for a detailed discussion of the unique organizational properties of these two types of images

for the storage and retrieval of information).

A second interpretation of the relative weakness evidenced by Native children on tasks loading on the verbal/logical factor involves the "level of processing" theory of Craik and Lockhart (1977) which hypothesizes that dual coding (i.e., imagery & verbal coding) increases the depth of processing and therefore the memorability of the information. In this case, superior paradigmatic paired associate recall may reflect dual coding by non-Natives. This is consistent with the lack of performance differences between Native and non-Native children on the Identical Picture-error and TCU Homogeneous Function scores, both of which demonstrated significant loadings on the Native verbal/logical factor. Both interpretations are probably involved in an interactive pattern.

Native children appear to form interactive holistic images for the storage and retrieval of paired associates. Interactive imagery is assumed to be less effective in increasing paired associate recall than dual coding (Reese, 1977). The fact that dual coding is typical of the formal academic learning environment, but not the observational learning environment, implies that the difficulty Native children experience on most vocabulary tests may be related to this paradigmatic recall difficulty.

One instructional implication of performance differences in Verbal/logical planning involves the design of Vocabulary development exercises. The provision for synonyms of new vocabulary terms and/or the categorization of vocabulary through topic-generated lists may be considered a special case of paradigmatic paired associate learning--a relative weakness among Native children. Furthermore, the vocabulary content characteristic of the formal academic learning environment is more abstract than concrete restricting coding to largely verbal codes, which is also a relative weakness for Native children. Finally, the formal academic learning environment emphasizes the use of compound imagery over interactive imagery, as suggested by the frequency of paradigmatic type vocabulary lessons.

Native children demonstrated relative strengths on tasks associated with syntagmatic associations when the relationship between the pair was "predicative". A "predicative" relationship may be considered the verbal equivalent of an interactive image in that both relationships involve one element interacting with another (Reid, 1974). The observational learning environment may favor the development of these Native strengths, thus the vocabulary deficit evidenced by Native children may be characterized as an experiential difference.

The instructional implications for an experiential difference is significantly different than what one would draw from a general verbal deficiency interpretation. For example, a verbal deficiency perspective would suggest the need for increased vocabulary development but without regard to the nature of the tasks demands associated with teaching vocabulary. In contrast, the experiential difference perspective implies that strengths need to be represented in terms of specific task characteristic during the process of vocabulary development.

From the experiential difference perspective, vocabulary development designed to optimize Native strengths should involve the provision of "interactive verbal metaphors" in addition to the typically paradigmatic associations provided. For example, in teaching the term "reptile" the provision of similarities between members of that class should be made in terms of a series of "interactive images" which are generated by prompts concerning similar activities between group members (e.g., "Where do they live?", "What do they eat?", and "How do they reproduce?"). The paradigmatic relationship, for example, between a frog and a reptile can then be recalled in terms of a series of enactive paired associates or interactive images.

In summary, this study provides preliminary evidence regarding quantitative and qualitative differences between Native and non-Native children on the twenty-two marker tasks. The results have been considered suggestive of a unique "learning style" associated with the differences in the form of mediation provided within the observational learning environment of Native children. Further investigation of a "Native learning style" requires addressing a number of methodological and theoretical issues including the following points.

First, identification of the seven control processes needs to be replicated across Native groups and between various non-Native groups. Results of this type of replication would increase confidence in the applicability of these factors within various learning environments. For example, replication of this study comparing groups with sensory impairments would provide further details concerning the nature of the observational environment, as represented by the hearing-impaired population, while details concerning the verbal mediated learning environment could be gained by studying a visually-impaired population.

Second, these factors must be identified using different tasks, including measures more closely related to academic tasks, which could be subsequently tested on the basis of

the empirical task analysis summarized in Table Seven. This type of replication would provide increased confidence in the convergent and discriminant validity of the processing factors. The use of a multi-trait/multi-method matrix research paradigm should prove effective in this style of replication.

Third, differences between Native males and females need to be investigated in terms of the traditional differences in the form of mediation provided to the two groups. For example, the qualitative performance difference evidenced by female Native children compared to male Natives on these seven processing factors may reflect a consistent observational mediation style, which has not changed significantly in generations of Native females. In contrast, the culturally relevant tasks which are required of male Native children have undergone major changes without the necessary changes in mediational style.

Finally, a "Native Learning Style" requires relating learning styles to instructional styles. It is suggested that an interaction between the strengths in processing evidenced by Native children and their performance under certain instuctional conditions (i.e., learning/instructional style matching) is best investigated by an aptitude-treatment interaction paradigm. In fact, an aptitude-treatment inter-

action must be considered as necessary but not sufficient proof of any learning style. Note that, the pronounced heterogenity of learning environments associated with cultural development of various Native and non-Native groups suggests that small sample research designs such as time series designs may be required. In this sense, it is unlikely that one characteristic learning style can be identified for all Natives. Rather, several learning styles maybe involved and represented, in part, by the interaction between the learning environment task characteristics a child is exposed to, and the type of control processes utilized on formal academic tasks.

In conclusion, the precision of language used in interpreting the seven control processes in this paper provides a basis for future operational definitions and investigations of learning style dimensions. Only with precise language and detailed cognitive task analyses, can we hope to begin to design more appropriate instructional procedures for Native children. Many roads and blind alleys must be travelled before the promise of matching instructional style to learning style can be met. This paper is submitted as a signpost.

BIBLIOGRAPHY

Allen, M. (1983). Models of Hemispheric Specialization. Psychological Bulletin, 93, 73 - 104.

Ashman, F., & Das, J.P. (1980). Relation between planning and simultaneous successive processing. Perceptual and Motor Skills. 51, 371 - 382.

Bannatyne, A. (1974). Diagnosis: A note on recategorization of the WISC scaled scores, Journal of Learning Disabili-abilities. New York: Plenum Press.

Belmont, J., & Butterfield, E. (1977). The instructional approach to developmental cognitive research. In R.V. Kail & J. Hagen (Eds.), Perspective on the Development of Memory and Cognition. Hillsdale, New Jersey: Lawrence Erlbaum.

Berliner, D.C. & Cahen, L.S. (1973). Trait-treatment interaction and learning. In F.N. Kerlinger (Ed.), Review of Research in Education. Itasca, Ill.: F.E. Peacock.

Berry, J. (1966). Tenne and Eskimo perceptual skills. International Journal of Psychology, Vol. 1, No. 3, 207 - 229.

Berry, J. (1971). Ecological and cultural factors in spatial perceptual development. Canadian Journal of Behavioral Science, Vol. 3, No. 4, 324 - 336.

Black, M. B. (1973). Ojibwa questioning etiquette and use of ambiguity. Studies in Linguistics, 23, 13 - 29.

Bogen, J. D., DeZure, R., Tenhouten, W.D., et al. (1972). Bulletin of the Los Angeles Neurological Societies, 37, 49 - 61.

Borkowski, J., & Cavanaugh, J. (1978). Maintenance and generalization of skills and strategies by the retarded. In N. Ellis (Eds.), Handbook of Mental Deficiency: Psychological Theory and Research. Second edition. Hillsdale, New Jersey: Lawrence Erlbaum.

Bradshaw, J. L., & Nettleton, N. C. (1981). The nature of hemispheric specialization in man. Behavioral and Brain Sciences, 4, 51 - 91.

Brandt, E. (1984). The cognitive functioning of American Indian children: A critique of McShane and Plas. School Psychology Review, 13, 74 - 82.

Bibliography

Brailsford, A. (1981). Strategy Training and Reading Comprehension. Unpublished doctoral dissertation, University of Alberta.

Brokenleg, M. K., & Bryde, J. F. (1982). Cited in A. S. Kaufman & N. L. Kaufman, K - ABC Interpretive Manual.

Brown, A. L. (1974). The role of strategic behavior in retardate memory. In N. R. Ellis (Ed.), International Review of Research in Mental Retardation (vol. 7). New York: Academic Press.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser (Ed.), Advances in Instructional Psychology (vol. 1), Hillsdale, New Jersey: Lawrence Erlbaum.

Brown, A. L., French, L. A. (1979). The cognitive consequences of education: School experts or general problem solvers? Commentary on "Education and cognitive development. The evidence from experimental research" by Sharp, Cole, & Lave. Monographs of the Society for Research in Child Development. 44, (1 - 2 serial no. 178).

Campione, J. C., & Brown, A. L. (1977). Memory and metamemory development in educable retarded children. In R. V. Kail, & J. W. Hagen (Eds.), Perspectives on the Development of Memory and Cognition, Hillsdale, New Jersey: Lawrence Erlbaum.

Campione, J. C., Brown, A. L., & Ferrara, R. A. (1982). Mental retardation and intelligence. In Sternberg (Ed.), Handbook of Human Intelligence, New York: Cambridge University Press.

Cazden, C. B., & John, V. P. (1971). Learning in American Indian children. In M. L. Wax, S. Diamond, & F. O. Hearing (Eds.), Anthropological Perspectives on Education. New York: Basic Books, Inc..

Cohen, R. (1973). Anthropology and Education: Some issues. In F. A. Ianni & E. Storey (Eds), Cultural Relevance and Educational Issues: Reading in Anthropology and Education. Boston: Little, Brown and Co..

Crager, R. L. & Spriggs, J. C. (1977). Administration Manual: Test of Concept Utilization. Los Angeles: Western Psychological Services.

Bibliography

Craik, F. I. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671 - 684.

Cronbach, L. J. & Snow, R. E. (1977). Aptitudes and Instructional Methods. New York: Irvington.

Cummins, J. P. & Das, J. P. (1977). Cognitive processing and reading difficulties: A framework for research. Alberta Journal of Educational Research, 23, 245 - 256.

Cummins, J. P. & Das, J. P. (1978). Simultaneous and successive syntheses and linguistic processes. International Journal of Psychology, 13, 129 - 138.

Cummins, J. P. & Mulcahy, R. F. (1982). Cited in J. P. Das, R. Mulcahy, & A. R. Wall (Eds.), Theory and Research in Learning Disability, New York: Plenum Press.

Cundlick, B. P. (1970). Measures of intelligence on Southwest Indian students. Journal of Social Psychology, 31, 151 - 156.

Darnell, R. (1979). Reflections on Cree interactional ettiquette: Educational implications. Working Papers in Sociolinguistics, No. 57. Austin, Texas: Southwestern Educational Development Laboratory.

Das, J. P. (1972). Patterns of cognitive ability in non-retarded and retarded children. American Journal of Mental Deficiency, 77, 6 - 12.

Das, J. P. (1973). Structure of cognitive abilities: Evidence for simultaneous and successive processing. Journal of Educational Psychology, 65, 103 - 108.

Das, J. P. (1984a). Intelligence and information integration. In J. R. Kirby (Ed.), Cognitive Strategies and Educational Performance. New York: Academic Press.

Das, J. P. Aspects of Planning. (1984b). In J. R. Kirby (Ed.), Cognitive Strategies and Educational Performance. New York: Academic Press.

Das, J. P. & Jarman, R. F. (1981). Coding and planning processes. In M. P. Friedman, J. P. Das & N. O'Connor (Eds.), Intelligence and Learning. New York: Plenum Press.

Bibliography

Das, J. P., Kirby, J. R., & Jarman, R. F. (1975). Simultaneous and successive syntheses: An alternative model for cognitive abilities. Psychological Bulletin, 82, 87 - 103.

Das, J. P., Kirby, J. R., & Jarman, R. F. (1979). Simultaneous and Successive Cognitive Processes. New York: Academic Press.

Das, J. P., Manos, J., & Kanungo, R. N. (1975). Performance of Canadian native, black and white children on some cognitive and personality tasks. Alberta Journal of Educational Research, 21, 183 - 185.

Davey, B. (1983). Cognitive styles and reading research. Reading Psychology, 4, 65 - 78.

Davidson, G. R. & Klich, L. Z. (1984). Ethnography, cognitive processes, and instructional procedures. In J. R. Kirby (Ed.), Cognitive Strategies and Educational Performance. New York: Academic Press.

Day, M. C. (1975). Developmental trends in visual scanning. In H. W. Reese (Ed.), Advances in Child Development and Behavior (vol. 10). New York: Academic Press.

Dixon, W. J. et al.. (1983). BMDP Statistical Software: 1983 Printing with Additions. Berkeley: University of California Press.

Doehring, D. G., Trites, R. L., Patel, P. G., & Fiedorowicz, C. A. (1981). Reading Disabilities: The interaction of Reading, Language, and Neuropsychological Deficits. New York: Academic Press.

Dumont, R. V. (1972). Learning English and how to be silent: studies in Sioux and Cherokee classrooms. In C. B. Cazden, V. P. John, & D. Hymes (Eds.) Functions of Language in the Classroom. New York: Teachers College Press.

Eells, K., Davis, A., Havighurst, R. J., Herrick, V. E., & Tyler, R. W. (1951). Intelligence and Cultural Differences. Chicago: University of Chicago Press.

Ekstrom, R. B. (1973). Cognitive Factors: Some Recent Literature (Project Report 73 - 30). Princeton, New Jersey: Educational Testing Service.

Bibliography

Ekstrom, R. B., French, J. W., Harman, H. H., & Derman, D. (1976). Manual for Kit of Factor-Referenced Cognitive Tests. Princeton, New Jersey: Educational Testing Service.

Entwistle, D. (1965). Word Associations of Young Children. Baltimore: John Hopkins Press.

Entwistle, D. R., Forsyth, D. F., & Muuss, R. (1964). The syntactic - paradigmatic shift on children's word associations. Journal of Verbal Learning and Verbal Behavior, 3, 19 - 29.

Ervin, S. M. (1961). Changes with age in verbal determinants of word associations. American Journal of Psychology, 74, 361 - 372.

Erickson, F. (1978). The Social Organization of Participation Structures in Two Classrooms of Indian Students. Ontario Department of Indian Affairs and Northern Development, Toronto, Ontario.

Feuerstein, R. (1980). Instrumental enrichment: An intervention program for cognitive modifiability. Baltimore: University Park Press.

Flavell, J. Beech, D., & Chinsky, J. (1966). Spontaneous verbal rehearsal on a memory task as a function of age. Child Development, 37, 283 - 299.

Flavell, J. & Wellman, H. (1977). Metamemory. In R. Kail and J. Hagen (Eds.), Perspectives on the Development of Memory and Cognition. Hillsdale, New Jersey: Lawrence Erlbaum.

Flavell, J., Speer, J. R., Frances, L. and August, D. L. (1981). The development of comprehension monitoring and knowledge about communication. With commentary by GROVER WHITEHURST. Monographs of the Society for Research in Child Development. 16 (5, Serial No. 192).

Goodenough, F. L. (1926). Racial differences in the intelligence of school children. Journal of Experimental Psychology, 9, 388 - 395.

Greenbaum, P. E. & Greenbaum, S. D. (1983). Cultural differences, non verbal regulation, and classroom interaction: Sociolinguistic interference in American Indian education. Peabody Journal of Education, Vol. 61, no. 1, 16 - 83.

Bibliography

Guilmet, G. M. (1981). Oral-linguistic and nonoral-visual styles of attending: Navajo and Caucasian children compared in an urban classroom and on an urban playground. Human Organization, 40, 145 - 150.

Hakstian, A. R. & Kyung, S. B. (1973). User's Manual to Accompany the Alberta General Factor Analysis Program. Division of Educational Research Services, University of Alberta.

Havighurst, R. J. and Janke, L. L. (1944). Relations between ability and social status in a midwestern community. I. Ten-year-old children. Journal of Educational Psychology. 35, 357 - 368.

Havinghurst, R. (1970). Goals of Indian education. The education of Indian children and youth. Summary report and recommendations: National Study of American Indian Education, 1970, IV, (6).

Hickerson, H. (1970). The Chippewa and their neighbors: A Study in Ethnohistory. New York: Holt, Rinehart and Winston.

Hickerson, H. (1971). The Chippewa of the Upper Great Lakes: A study in sociopolitical change. In Leacock & Lurie (Eds.), North American Indians in Historical Perspectives. New York: Random House, 169 - 199.

Hunt, D. E. (1980). Intelligence as an information-processing concept. British Journal of Psychology, 71, 449 - 474.

Hynd, G. W. & Scott, S. A. (1980). Propositional and appositional modes of thought and differential cerebral speech lateralization in Navajo Indian and Anglo children. Child Development, 51, 909 - 911.

Jakobson, R. (1971). Studies on child language and aphasia. The Hague: Mouton.

Jamieson, E. & Sanford, P. (1928). The mental capacity of Southern Ontario Indians. Journal of Educational Psychology, 19, 313 - 328, 536 - 551.

Jarman, R. F. (1975). Intelligence, Modality Matching and Information Processing. Unpublished doctoral dissertation. Department of Educational Psychology, University of Alberta.

Bibliography

Jarman, R. F. (1978). Selection and validation of preschool screening instruments: Confirmatory analyses based on test taxonomy. Paper given at the XIXth International Congress of Applied Psychology, Munich.

Jarman, R. F. (1980). Cognitive processes and syntactical structure: Analyses of paradigmatic and syntagmatic associations. Psychological Review, 41, 153 - 167.

Kane, M. (1984). Cognitive styles of thinking and learning: Part two. Academic Therapy, 20, 83 - 93.

Kaufman, D. (1978). The Relation of Academic Performance to Strategy Training and Remedial Techniques: An Information Processing Approach. Unpublished doctoral dissertation, University of Alberta.

Kaufman, A. S. & Kaufman, N. L. (1983). Kaufman Assessment Battery for Children: Interpretive Manual. Circle Press, Minnesota: American Guidance Service.

Kaulbach, B. (1984). Styles of learning among Native children: A review of research. Canadian Journal of Native Education, Vol. 11, No. 3, 27 - 37.

Kirby, J. R. (1984). Strategies and processes. In J. R. Kirby (Ed.), Cognitive Strategies and Educational Performance. New York: Academic Press.

Kleinfeld, J. (1970). Cognitive Strength of Eskimos and Implications for Education. Institute of Social Economic and Government Research, University of Alaska.

Klesner, M. (1982). Language Arts for Native Indian Students. Victoria: Curriculum Development Branch, Ministry of Education.

Koenig, D. M. (1981). Natives of Northern Canada and Alaska and Implications for Education. Unpublished doctoral dissertation, University of Saskatchewan.

Krywaniuk, L. L. (1974). Patterns of Cognitive Abilities of High and Low Achieving School Children. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

Kuske, I. (1969). Psycholinguistic Abilities of Sioux Indian Children. Unpublished doctoral dissertation, University of South Dakota.

Bibliography

La Berge, D. & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. Cognitive Psychology, 6, 293 - 323.

Laboratory of Comparative Human Cognition. (1982). Culture and intelligence. In R. J. Sternberg (Ed.), Handbook of Human Intelligence. New York: Cambridge University Press.

Leong, C. K. (1974). An Investigation of Spatial-Temporal Information Processing in Children with Specific Reading Disability. Unpublished doctoral dissertation. University of Alberta.

Lombardi, T. (1969). Psycholinguistic Abilities of Papago Indian School Children. Unpublished doctoral dissertation, University of South Dakota.

Lupart, J. & Mulcahy, R. (1984). Some thoughts on research in learning disabilities and attention. In J. R. Kirby (Ed.), Cognitive Strategies and Educational Performance. New York: Academic Press.

Luria, A. R. (1966a). Higher Cortical Functions in Man. New York: Basic Books.

Luria A. R. (1966b). Human and Psychological Processes. New York: Harper Row.

Luria A. R. (1970). The functional organization of the brain. Scientific American, 222, 3, 66 - 78.

Luria A. R. (1973). The frontal lobes and the regulation of behavior. In K. H. Pribram, & A. R. Luria (Eds.), Psychophysiology of the Frontal Lobes. New York: Academic Press.

Mac Arthur, R. (1968). Some cognitive abilities of Eskimo, white and Indian-Metis pupils aged 9-12 yrs. Canadian Journal of Behavioral Science, 1, 50 - 59.

Mac Arthur, R. S. (1978). Ecology, culture and cognitive development: Canadian Native youth. L. Driedger (Ed.), The Canadian Ethnic Mosaic. Toronto: Mc Clelland & Stewart.

Bibliography

Mc Areavey, J. P. (1978). An Analysis of Selected Educationally Handicapped South Dakota Sioux Indian Children's Responses to the Wechsler Intelligence Scale for Children and the Wide Range Achievement Test of Reading. Unpublished doctoral dissertation, University of Colorado.

Mc Keever, W. F. (1981). Note: Evidence against the hypothesis of right hemispheric language dominance in the Native American Navajo. Neuropsychologia, 19, 595 - 598.

Mc Shane D. A. (1982). Otitis media and American Indians: Prevalence, etiology, psychoeducational consequences, prevention and intervention. In S. Manson (Ed.), New Directions in Prevention, among American Indian and Alaskan Native Communities. Portland: Oregon Health Sciences University Press.

Mc Shane D. A., & Plas, J. M. (1984). The cognitive functioning of American Indian children: Moving from the WISC to the WISC-R. School Psychology Review, Vol. 13, No. 1, 61 - 73.

Mc Shane D. A., & Plas, J. M. (1982). The relationship between otitis media frequency to the intellectual and psycholinguistic performances of American Indian children. Psychiatric Prevention, Journal of Preventative Psychiatry, Vol. 1, No. 3, 277 - 292.

Moran, L. J. (1973). Comparative growth of Japenese and North American cognitive dictionaries. Child Development. 44, 862 - 865.

More A. J. (1984a). Quality of Education of Native Indian Students In Canada: A review of research. Paper presented at the annual Conference of the Canadian Society for the Study of Education, Guelph, Ontario.

More A. J. (1984b). Learning Styles and Indian students: A review of Research. A paper presented at the Mokakit Indian Research Conference.

Myers, M., & Paris, S. G. (1978). Children's metacognitive knowledge about reading. Journal of Educational Psychology, 70, 680 - 690.

Naglieri, J. A., Kamphaus, R. W., & Kaufman, A. S. (1983). The Luria-Das successive-simultaneous model applied to WISC-R data. Journal of Psychoeducational Assessment, Vol. 1, no. 1, 25 - 35.

Bibliography

O'Conner, K. and Blower, G. H. (1980). Cognitive style: Set and sorting strategy. British Journal of Psychology. 71, 17 - 22.

Olshavsky, J. E. (1977). Reading as problem solving: An investigation of strategies. Reading Research Quarterly, 12, 654 - 674.

Paivio, A. (1974). Language and knowledge of the world. Educational Researcher, October, Vol. 3, 5 - 122.

Paivio, A. (1975). Imagery in recall and recognition. In J. Brown (Ed.), Recall and Recognition. New York: Wiley.

Palermo, D. S. (1963). Word association and children's verbal behavior. In L. P. Lipsitt & C. C. Spiker (Eds.), Advances in Child Development and Behavior, Vol. 1. New York: Academic Press.

Palermo, D. S. (1971). Characteristics of word association responses obtained from children in grades one through four. Developmental Psychology. 5, 118 - 123.

Patterson, E. P. (1972). The Canadian Indian: A History Since 1500. Toronto: Collier - Macmillan.

Peck, R. L. (1972). A Comparative Analysis of the Performance of Indian and White Children from North Central Montana on the Wechsler Intelligence Scale for Children. Unpublished doctoral dissertation, Montana State University.

Peters, H. (1963). Performance of Hopi children on four intelligence tests. Journal of American Indian Education, 2, 27 - 31.

Phillips, S. W. (1976). Some sources of cultural variability in the regulation of talk. Language in Society, 5, 81 - 95.

Pribram, K. H. (1971). Languages of the Brain. Englewood Cliffs: Prentice-Hall.

Reese, H. W. (1977). Imagery and associative memory. In R. V. Kail and J. W. Hagen (Eds.), Perspectives on the Development of Memory and Cognition. New York: LEA.

Bibliography

Reid, L. S. (1974). Toward a grammar of the image. Psychological Bulletin, 81, 319 - 334.

Reschly, D. J. (1979). Non biased assessment. In G. P. Phye & D. J. Reschly (Eds.), School Psychology: Perspective and Issues. New York: Academic Press.

Ross, A. O. (1976). Psychological Aspects of Learning Disabilities and Reading Disorders. New York: McGraw-Hill.

Sacks, D. A. (1974). The WISC and the Mescalero Apache. JoBoooàlofPsychology, 92, 303 - 304.

Schonemann, P. H. (1966). A generalized solution of the Orthogonal Procrustes problem. Psychometrika, 31, 1 - 10.

Schubert, J. & Cropley, A. J. (1972). Verbal regulation of behavior and I.Q. in Canadian Indian and white children. Developmental Psychology, 7, 295 - 301.

Singer, H. & Donlan, D. (1980). Reading and Learning from Text. Toronto: Little, Brown and Company.

Snart, F. D., O'Grady, M., & Das, J. P. (1982). Cognitive processing by subgroups of moderately mentally retarded children. American Journal of Mental Deficiency, 86, 465 - 472.

Snart, F. D. & Swann, V. (1982). Assessment of intellectually handicapped adults: A cognitive processing model. Applied Research in Mental Retardation, 3, 201 - 212.

St. John, J. & Bauman, E. (1976). Northwestern Ontario Indian children and the WISC. Psychology in the Schools, 13, 407 - 411.

Sternberg, R. J. (1982). Reasoning, problem solving, and intelligence. In R. J. Sternberg (Ed.), Handbook of Human Intelligence. New York: Cambridge University Press.

Sternberg, R. J. & Powell, J. S. (1982). Theories of intelligence. In R. J. Sternberg (Ed.), Handbook of Human Intelligence. New York: Cambridge University Press.

Bibliography

Taylor, L. & Skanes, G. (1975). Psycholinguistic abilities of children in isolated communities in Labrador. Canadian Journal of Behavioural Science, Vol. 7, no. 1, 30 - 39.

Telford, C. W. (1932). Test performance of full and mixed blood North Dakota Indians. Journal of Comparative Psychology, 14, 145 - 157.

Thompson, A. L. & Bogen, J. F. (1976). More on the question of cultural hemisphericity. Bulletin of the Los Angeles Neurological Societies, 41, 93 - 98.

Thurber, S. (1976). Changes in Navajo responses to the Draw-A-Man test. The Journal of Social Psychology, 99, 139-140.

Turner, G. H. & Penfold, D. J. (1952). The scholastic aptitude of Indian children of the Caradoc Reserve. Canadian Journal of Psychology, 6, 31 - 44.

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Cambridge, Mass: Harvard University Press.

Weitz, J.M. (1971). Cultural Change and Field Dependence in Two Native Canadian Linguistic Families. Unpublished doctoral dissertation, University of Ottawa.

Werner, E.E. (1972). Cross-cultural Child Development. Monterey, California: Brooks and Cole.

Witkin, H.A., Dyk, R.B., Faterson, H.F., Goodenough, D.R., & Karp, S.A. (1962). Psychological Differentiation. New York: Wiley.

Zarske, J. A., Moore, C. L., & Peterson, J. D. (1981). WISC-R factor structures for diagnosed learning disabled Navajo and Papago children. Psychology in the Schools, 18, 402 - 407.

Zelniker, T. & Jeffrey, W. E. (1976). Reflective and impulsive children: Strategies of information processing underlying differences in problem solving. Monographs of Society for Research in Child Development, 41, (5, No. 168).

APPENDIX I

PAIRED ASSOCIATES TEST

Directions

"I'm going to read a list of eight pairs of words that go together like salt and pepper. When I'm through reading all eight pairs, I'll read one of the words like salt and you have to tell me what word went with it. Ready? Listen carefully."

Read each pair with a one second pause between pairs. After the last pair, immediately read the first prompt word, then continue reading prompt words at the rate of one per three seconds. Record all answers on the line next to prompt word even if incorrect. Use N.R. for no response, and D.K for don't know responses.

Name_____ Date of Birth_____ Sex: M____ F_____

B[4]	high style	D	happen _____	C[5]	butter melt	E	mother _____
C	corn grow	F	greed _____	A	red blood	H	direction _____
A	hot fireplace	G	circle _____	D	duty calls	B	honest _____
E	door house	C	grow _____	G	ocean sea	F	quality _____
F	greed hatred	A	hot _____	H	position direction	G	ocean _____
D	event happen	H	belief _____	E	mother child	C	melt _____
H	hope belief	B	high _____	F	cost quality	A	red _____
G	circle square	E	house _____	B	honest truth	D	calls _____

D[6]	power shock	F	item _____	E[7]	teacher student	G	money _____
F	item unit	D	shock _____	H	humor joke	E	teacher _____
G	car automobile	H	spirit _____	B	pleasant dream	F	effort _____
C	ship sank	A	old _____	F	outcome effort	H	humor _____
A	old gentleman	B	horrible _____	G	dollar money	C	dance _____
H	soul spirit	G	automobile _____	C	shoes dance	B	pleasant _____
B	horrible fate	E	hospital _____	A	small bird	D	give _____
E	hospital doctor	C	sank _____	D	hint give	A	small _____

F[8]	hearing silence	H	deed _____	G[1]	cat animal	A	green _____
D	heaven help	G	church _____	E	chair table	B	bad _____
H	life deed	E	sky _____	F	answer knowledge	C	flow _____
A	big city	B	strong _____	H	justice law	D	measure _____
B	strong opinion	D	help _____	C	river flow	E	chair _____
G	church building	A	big _____	B	bad attitude	F	knowledge _____
E	star sky	C	cooks _____	D	length measure	G	animal _____
C	meat cooks	F	hearing _____	A	green grass	H	justice _____

H[2]	quantity amount	B	second _____	A[3]	glass bottle	C	kiss _____
G	arm body	C	ride _____	B	proven fact	A	glass _____
E	garden flower	A	sharp _____	C	lip kiss	D	run _____
B	second chance	E	flower _____	D	trouble run	G	boy _____
D	mercy kill	F	hour _____	E	book school	H	thought _____
A	sharp rock	D	kill _____	F	fault excuse	E	book _____
C	horse ride	H	amount _____	G	boy girl	F	excuse _____
F	hour time	G	arm _____	H	idea thought	B	proven _____

APPENDIX II

APPENDIX TABLE II.1: FACTOR LOADINGS FOR PRINCIPAL COMPONENTS ANALYSIS WITH VARIMAX ROTATION OF A SEVEN FACTOR SOLUTION FOR THE NON NATIVE DATA

	BOTTOM-UP ATTENTION	VISUAL TOP-DOWN ATTENTION	VERBAL TOP-DOWN ATTENTION	SIMUL-TANEOUS CODING	SUCCESSIVE CODING	CONCRETE ACTIVE PLANNING	VERBAL LOGICAL PLANNING
HIDDEN PATTERNS ATTEMPTED	0.0	0.89	0.0	0.0	0.0	0.0	0.0
HIDDEN PATTERNS ERRORS	0.0	0.88	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ATTEMPTED	0.0	0.0	0.76	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ERRORS	0.0	0.36	0.42	-0.41	0.0	0.0	0.0
K-ABC HAND MOVEMENTS	0.0	0.0	0.0	0.0	-0.76	0.0	-0.36
K-ABC GESTALT CLOSURE	0.0	0.0	0.0	0.86	0.0	0.0	0.0
K-ABC NUMBER RECALL	0.0	0.0	0.0	0.0	0.82	0.0	0.0
K-ABC TRIANGLES	0.0	0.0	0.0	0.74	0.0	0.0	0.0
K-ABC WORD ORDER	0.0	0.0	0.0	0.0	0.66	0.0	0.0
K-ABC MATRIX ANALOGIES	0.0	0.0	0.0	0.0	0.45	0.0	0.0
K-ABC SPATIAL MEMORY	0.52	0.0	0.58	0.0	0.0	0.0	0.0
K-ABC PHOTO SERIES	0.0	0.0	0.0	0.45	0.0	0.54	0.0
ICONIC PAIRED ASSOCIATES	0.0	0.0	0.0	0.63	0.0	0.0	0.38
ENACTIVE PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.86
FUNCTIONAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.78
LOGICAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.85
TCU UNILATERAL CONCEPTS	-0.54	0.0	0.0	0.0	0.0	0.0	0.0
TCU COLOR REALITY MATCH	0.91	0.0	0.0	0.0	0.0	0.0	0.0
TCU SHAPE REALITY MATCH	0.0	-0.44	0.0	0.0	0.0	-0.65	0.0
TCU HOMOGENEOUS FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	-0.76	0.0	-0.35
TCU ABSTRACT FUNCTION REALITY MATCH	0.0	0.0	0.77	0.0	0.0	0.0	0.0
TCU RELATIONAL FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	0.69	-0.36	0.0
VARIANCE OF FACTORS	1.83	2.38	2.45	2.44	2.92	1.69	2.63

Loading values less than 0.35 are replaced by 0.0

APPENDIX TABLE II.2: FACTOR LOADINGS FOR PRINCIPAL COMPONENTS ANALYSIS WITH VARIMAX ROTATION OF A SEVEN FACTOR SOLUTION FOR THE NATIVE DATA

	BOTTOM-UP ATTENTION	VISUAL TOP-DOWN ATTENTION	VERBAL TOP-DOWN ATTENTION	SIMUL-TANEOUS CODING	SUCCESSIVE CODING	CONCRETE ACTIVE PLANNING	VERBAL LOGICAL PLANNING
HIDDEN PATTERNS ATTEMPTED	0.0	0.81	0.0	0.0	0.0	0.0	0.0
HIDDEN PATTERNS ERRORS	0.0	0.89	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ATTEMPTED	0.0	0.0	0.0	0.0	0.56	0.57	0.0
IDENTICAL PICTURES ERRORS	0.0	0.0	0.0	0.0	0.0	0.91	0.0
K-ABC HAND MOVEMENTS	0.0	0.0	0.54	0.0	0.0	0.0	0.42
K-ABC GESTALT CLOSURE	0.0	0.0	0.0	0.86	0.0	0.0	0.0
K-ABC NUMBER RECALL	0.0	0.0	0.0	0.0	0.80	0.0	0.0
K-ABC TRIANGLES	0.36	0.0	0.38	0.0	0.0	0.0	0.0
K-ABC WORD ORDER	0.0	0.0	0.0	0.0	0.80	0.0	0.0
K-ABC MATRIX ANALOGIES	0.0	-0.37	0.0	0.0	0.72	0.0	0.0
K-ABC SPATIAL MEMORY	0.52	0.0	0.0	0.0	0.41	0.0	0.0
K-ABC PHOTO SERIES	0.0	0.0	0.0	0.0	0.65	0.0	0.0
ICONIC PAIRED ASSOCIATES	0.70	0.0	0.0	0.0	0.0	0.54	0.38
ENACTIVE PAIRED ASSOCIATES	0.86	0.0	0.0	0.0	0.0	0.0	0.0
FUNCTIONAL PAIRED ASSOCIATES	0.53	0.0	0.0	0.0	0.47	-0.40	0.0
LOGICAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.85
TCU UNILATERAL CONCEPTS	0.0	0.0	-0.84	0.0	0.0	0.0	0.0
TCU COLOR REALITY MATCH	0.0	0.39	0.73	0.0	0.0	0.0	0.0
TCU SHAPE REALITY MATCH	0.58	0.0	0.0	-0.45	0.0	0.0	0.0
TCU HOMOGENEOUS FUNCTION REALITY MATCH	0.0	0.0	0.78	0.0	0.0	-0.35	0.0
TCU ABSTRACT FUNCTION REALITY MATCH	0.0	0.0	0.76	0.0	0.0	0.0	0.0
TCU RELATIONAL FUNCTION REALITY MATCH	0.0	0.0	0.62	0.0	0.46	0.0	0.0
VARIANCE OF FACTORS	2.51	2.28	3.67	1.64	3.67	1.94	1.79

Loading values less than 0.35 are replaced by 0.0

APPENDIX TABLE II.3: FACTOR LOADINGS FOR PROCRUSTES TRANSFORMATION WITH ORTHOGONAL ROTATION TO A SEVEN FACTOR TARGET MATRIX FOR THE NON NON NATIVE DATA

	BOTTOM-UP ATTENTION	VISUAL TOP-DOWN ATTENTION	VERBAL TOP-DOWN ATTENTION	SIMUL-TANEOUS CODING	SUCCESSIVE CODING	CONCRETE ACTIVE PLANNING	VERBAL LOGICAL PLANNING
HIDDEN PATTERNS ATTEMPTED	0.0	0.77	0.0	0.40	0.0	0.0	0.0
HIDDEN PATTERNS ERRORS	0.0	0.80	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ATTEMPTED	0.0	0.0	0.43	0.43	0.36	0.0	0.0
IDENTICAL PICTURES ERRORS	0.0	0.44	0.42	0.0	0.0	0.0	0.0
K-ABC HAND MOVEMENTS	0.0	0.0	0.0	0.0	0.71	0.0	0.37
K-ABC GESTALT CLOSURE	0.0	0.0	0.0	0.78	0.0	0.0	0.0
K-ABC NUMBER RECALL	0.0	0.0	0.0	0.0	0.73	0.0	0.43
K-ABC TRIANGLES	0.0	0.0	0.0	0.71	0.0	0.44	0.0
K-ABC WORD ORDER	0.0	-0.37	0.0	0.0	0.57	0.0	0.0
K-ABC MATRIX ANALOGIES	0.0	0.0	0.0	0.0	0.57	0.0	0.0
K-ABC SPATIAL MEMORY	0.55	0.0	0.45	0.0	0.0	0.0	0.0
K-ABC PHOTO SERIES	0.0	0.0	0.0	0.44	0.0	0.64	0.0
ICONIC PAIRED ASSOCIATES	0.0	0.0	0.0	0.70	0.0	0.0	0.0
ENACTIVE PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.87
FUNCTIONAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.80
LOGICAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.81
TCU UNILATERAL CONCEPTS	-0.39	-0.48	0.0	0.0	0.38	0.0	0.0
TCU COLOR REALITY MATCH	0.51	0.0	0.0	0.0	0.0	0.69	0.0
TCU SHAPE REALITY MATCH	0.69	-0.37	0.0	0.0	0.0	0.0	0.0
TCU HOMOGENEOUS FUNCTION REALITY MATCH	-0.39	0.0	0.50	0.0	0.0	0.48	0.0
TCU ABSTRACT FUNCTION REALITY MATCH	0.0	0.0	0.81	0.0	0.0	0.0	0.0
TCU RELATIONAL FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	0.80	0.0	0.0
VARIANCE OF FACTORS	1.64	2.31	2.10	2.64	3.04	2.02	2.59

Loading values less than 0.35 are replaced with 0.0

APPENDIX TABLE II.4: FACTOR LOADINGS FOR PROCRUSTES TRANSFORMATION WITH ORTHOGONAL ROTATION TO A SEVEN FACTOR TARGET MATRIX FOR THE NATIVE DATA

	BOTTOM-UP ATTENTION	VISUAL TOP-DOWN ATTENTION	VERBAL TOP-DOWN ATTENTION	SIMUL-TANEOUS CODING	SUCCESSIVE CODING	CONCRETE ACTIVE PLANNING	VERBAL LOGICAL PLANNING
HIDDEN PATTERNS ATTEMPTED	0.0	0.83	0.0	0.0	0.0	0.0	0.0
HIDDEN PATTERNS ERRORS	0.0	0.93	0.0	0.0	0.0	0.0	0.0
IDENTICAL PICTURES ATTEMPTED	0.0	0.0	0.47	0.0	0.59	0.0	0.0
IDENTICAL PICTURES ERRORS	0.0	0.0	0.42	0.58	0.0	0.0	-0.41
K-ABC HAND MOVEMENTS	0.0	0.0	0.0	0.0	0.0	0.75	0.0
K-ABC GESTALT CLOSURE	-0.49	0.0	0.0	0.57	0.0	0.0	0.0
K-ABC NUMBER RECALL	0.0	0.0	0.0	0.53	0.58	0.0	0.0
K-ABC TRIANGLES	0.0	0.0	0.38	0.46	0.48	0.0	0.0
K-ABC WORD ORDER	0.38	0.0	0.0	0.0	0.60	0.0	0.0
K-ABC MATRIX ANALOGIES	0.43	-0.47	0.0	0.0	0.0	0.0	0.0
K-ABC SPATIAL MEMORY	0.0	0.0	0.0	0.57	0.0	0.42	0.0
K-ABC PHOTO SERIES	0.0	0.0	0.0	0.59	0.0	0.52	0.0
ICONIC PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.40	0.66
ENACTIVE PAIRED ASSOCIATES	0.51	0.0	0.0	0.0	0.0	0.0	0.69
FUNCTIONAL PAIRED ASSOCIATES	0.0	0.0	0.0	0.0	0.0	0.0	0.80
LOGICAL PAIRED ASSOCIATES	0.0	0.0	0.40	0.0	-0.43	0.0	0.52
TCU UNILATERAL CONCEPTS	0.0	0.0	-0.36	0.0	-0.71	0.0	0.0
TCU COLOR REALITY MATCH	0.0	0.0	0.0	-0.46	0.60	0.39	0.0
TCU SHAPE REALITY MATCH	0.71	0.0	0.0	0.0	0.0	0.0	0.0
TCU HOMOGENEOUS FUNCTION REALITY MATCH	0.0	0.0	0.36	0.0	0.62	0.0	0.35
TCU ABSTRACT FUNCTION REALITY MATCH	0.0	0.0	0.73	0.0	0.48	0.0	0.0
TCU RELATIONAL FUNCTION REALITY MATCH	0.0	0.0	0.0	0.0	0.71	0.0	0.0
VARIANCE OF FACTORS	1.91	2.28	2.03	3.10	3.86	1.73	2.50

Loading values less than 0.35 are replaced by 0.0