CHAPTER 2

THEORETICAL ISSUES RELATED TO THINKING SKILLS, LANGUAGE AND COGNITION AND THE INFLUENCE OF CULTURE AND DISADVANTAGE

2.1 INTRODUCTION

The way in which a child answers questions to problems posed, reflects the ability to apply and integrate linguistic and cognitive processes, and thereby represent the child's understanding of the world (Zachman, Jorgenson, Huisingh and Barret, 1984). This understanding depends on the ability to recognize the relations between events that occur. Knowledge of these relations evolves as the child learns to recognize multiple causal relationships at increasingly more complex levels of event organization. It is what enables a child to understand what made the event occur, which in turn allows him/her to anticipate future events, to predict the consequences of behaviour and guide plans of action (van den Broek, 1997).

An attempt to gain a true refection of the child's proficiency in this area, requires that the evaluation must, of necessity, correlate with the child's own language and culture. If such an evaluation involves children from a 'non-mainstream' culture, issues related to 'culture-fair' testing must be addressed. However it is not only for the creation of a 'non-biased test' that the impact of culture must be recognized (Taylor, 1986a). Culture affects every aspect of the development of language and thinking skills, creating a unique context for that culture. Some cultures are also affected by the impact of poverty and disadvantage, which further influence the development of linguistic and cognitive processes.

In studying the explanations about problems of everyday life in children of a rural Zulu culture, the context of how culture and social circumstances influence linguistic and cognitive processes, as well as problem solving skills, must be considered.

Culture and Disadvantage are two of the significant factors that affect the development of language and cognition. Culture is a fundamental factor affecting primary language development, early cognitive development and communication competence, with a particular emphasis being placed on mother-child communication style (Taylor, 1986a). In addition, disadvantage has also been shown to have a particular effect on secondary language development impacting on the development of abstract thinking skills and the acquisition of literacy skills, which contribute to successful education (Blank,1970; Heath, 1992; Macdonald, 1990; Wood, 1992)

The first part of this chapter aims to discuss the relationship between culture and the development of language and cognition, within the context of socialization (Schneider and Watkins, 1996; Vygotsky, 1962) and different cognitive styles (Pitts and Thompson, 1984; Tinajero and Paramo, 1997; Witkin, 1967). Further, oral and literate traditions, and their impact on educational success (Ong, 1982) will be discussed. The inter-relationship between culture, language and learning will then be discussed, and related to Cummins' (1985) concept Cognitive and Academic Language Proficiency (CALP) and the use of decontextualized language (Snow and Dickson, 1991). The effects of disadvantage on the development cognition and language will be outlined (Bernstein, 1970; Blank and Solomon,1968; Blank, 1970; Heath, 1982) with reference to the damaging effects acquired in infancy when minimal cognitive stimulation occurs (Halpern, 2000).

An analysis of causality, reasoning and inferencing, both cognitively and linguistically, has provided much information as to the relationship between thinking skills and language, and their relevance for learning and problem solving (Donaldson, 1986; Kemper and Edwards, 1986; Piaget and Inhelder, 1968; Shiro, 1994; Verzoni and Swan, 1995). Further, while the ability to make inferences, considered to be the essence of reasoning, is a part of children's every day experiences, it is also a central feature of reading competence (Winne, Graham and Prock, 1993). Thus competence in this area has far reaching implications for a child.

The second part of this chapter deals with thinking skills in relation to language and cognition. An analysis of explanation as a means of expressing causality and reasoning is presented, and discussed in relation to a psycholinguistic framework (Donaldson, 1986), a

narrative framework (Johnston, 1982) and a framework for text based inferencing (Winne, Graham and Prock, 1993). Developmental aspects of explanation are discussed with reference to Donaldson (1986), Piaget and Inhelder (1968) and the developmental patterns of event comprehension described by van den Broek (1997). This is followed by the importance of evaluating ability to explain as an expressive language task, particularly when evaluating disadvantaged children (Hertzig, Birch, Thomas and Mendez, 1986), and children in a cross-cultural context (Quay, Mathews and Schwarzmeuller, 1977). The relationship between social or pragmatic reasoning and logico-deductive reasoning is discussed.

The final section of the chapter relates particular thinking skills to the issue of verbal problem solving as a whole, highlighting the complexity of the process that takes place.

2.2 CULTURE, LANGUAGE AND COGNITION

Children are not born with a culture, but rather they are born into a culture (Taylor and Clarke, 1994), which is acquired through the socialization of the child into the values, behaviours, beliefs and institutions which give unique meaning to that culture. Language is the primary means of communication by which this is achieved, and through a process of socialization (Vygotsky, 1962) and exposure to environmental experiences (Piaget and Inhelder, 1968), cognition develops whereby the child learns to represent reality and moves towards an analytical perspective of the world.

In this way, social reasoning can be seen to act as a precursor to intellectual reasoning (Frawley and Lantolf, 1985). A child's cognitive processing acquired within a social context, becomes so well learned and automatic, that it can then be applied to operational thought processes giving rise to logical reasoning and problem solving ability. Vygotsky (1962) refers to this process as the internalization of cultural tools, which includes language, and which then mediates and guides thinking. An analysis of a child's social reasoning proficiency may then act as a predictor of intellectual reasoning.

However, it is the child's culture that provides the overriding framework and limits within which this process may occur (Taylor and Clarke, 1994).

Independent linguistic and cognitive functioning is seen as the goal of socialization i.e. of the adult-child interaction occurring in early childhood (Vygotsky, 1978). Language development refers not only to the acquisition of its syntax and semantics, but also to use of that language to enable that child to conform to the realities and norms of the culture. Reasoning and problem solving form a part of cognitive functions which Vygotsky believes must move from the position of occurring between adult or capable peer and child, to a position of occurring independently within the child, i.e. the self regulating function of cognition and language.

Thus Vygotsky's concept of the child's "zone of proximal development" (1978, p 84) further emphasizes the role of socialization in the ultimate development of language and thinking. The "zone of proximal development" refers to the difference between the child's current level of problem solving, and the potential level of problem solving that may be achieved through adult mediation, that is at a higher level than that of the child functioning on his/her own. It is through the repeated participation in such interactions that the child acquires more advanced problem solving skills. It would reflect the process of internalization giving rise to independent linguistic and cognitive functioning referred to above. It is within the adult child interaction in this problem solving context that culture impacts and gives rise to different cognitive styles (Witkin 1967).

2.3 COGNITIVE STYLE, LANGUAGE AND COGNITION

Lee (1987) has defined cognitive style as the manner in which individuals perceive, organize and process experiences, and transmit them behaviourally (unpublished masters thesis). Language has been identified as a primary tool facilitating this process. Thus analysing the language used when children verbally represent their perceptions of experiences, may give an indication of the cognitive style of the indigenous culture, and not only the individual child's ability. This would give rise to the need to evaluate these responses within the child's cultural context, when quantifying level of skill.

Although Taylor and Clarke (1994) believe that more research is required into cognitive styles and culture, rural Zulu culture, alongside African -American and Hispanic cultures may be aligned with Witkin's concept of a field -dependent cognitive style. This infers a social orientated style, as opposed to an object-orientated style, in which experiences are viewed as part of a relationship or unit. Meaning is dependent on the context in which information is presented. The above three cultures, are considered to belong to a member-member category which tends to concentrate on relationship. This would be in agreement with the concept of "ubuntu" (the people) in Zulu culture, upholding the group rather than the individual (Macdonald, 1990). Witkin's field independent, or a member-object category, to which European and Asian cultures are aligned, are said to be analytical styles which concentrate on attention to detail, acquisition of objects and self gratification, in which individuality is encouraged, and which is the cognitive style related to a western education system.

Witkin (1967), among other prominent researchers (Tinajero and Paramo, 1997), have recognized the relevance of field dependence and field independence for education. The critical question being asked, is whether students who display a field dependent cognitive style, and students who display a field independent cognitive style, are equally well adapted for academic success. Recent formulations of these concepts focus on their impact on 'conduct organization' and the extent to which an individual uses external or internal cues to achieve this (Tinajero and Paramo, 1997, p 199). Field dependent thinkers connect more to external cues, and tend to accept percepts or symbolic representations at face value. Field

independent thinkers connect more to internal cues providing a greater potential for restructuring of percepts and imposing self generated organization on received information (Witkin and Goodenough, 1981). Research in the area of information processing, has revealed differences between the two cognitive styles in the way individuals encode, store and recall information, in attention paid to different aspects of information, and in the general manner of thinking and comprehending.

Such research has challenged Witkin's original beliefs that field dependence and field independence were 'adaptively neutral' (Tinajero and Paramo, 1997, p 200). He believed the greater social skills of field dependence are counterbalanced by the greater restructuring skills in field independence. Similarly, Ong's (1982) proposition that even within the educational context, the distinction between the two cognitive styles does not refer to ability level and performance, but rather to manner of execution, is thus also challenged. Conclusions indicate that the two concepts are not mutually exclusive and that overlap must always be considered in studying the application of cognitive style to intellectual tasks.

Ong (1982) suggests two important points that must be noted in relation to field dependent/independent cognitive styles. One, is that all individuals possess both cognitive styles, but that one predominates. Further, it is extremely rare today to find a culture that has not been exposed to another culture in some way, and this would be true of rural Zulu culture. Thus what we may observe in a rural Zulu-speaking culture is a blending of cognitive styles to some degree.

Cognitive style, originally identified as a perceptual phenomenon, has been related to literacy through the process of 'inferential comprehension', or the ability to make logical judgements about information in text, from a particular perspective (Pitts and Thompson, 1984). The four possible applications of inferential comprehension, viz interpretation of words within context determined meanings; ability to identify anaphoric referents; ability to identify story context; integration of information (Trabasso, 1980), are equally relevant for comprehension of both oral and written material. Cognitive style is said to mediate this comprehension process.

In addition to field dependent/ independent, two other cognitive styles, reflective /impulsive control and flexible/constricted control, are said to have bearing on inferential comprehension, particularly within the context of reading. Pitts and Thompson (1984) report on numerous studies related to these three cognitive style variations.

Field dependent readers reportedly tend to view patterns in text globally, tend to limit their reasoning to real events and tend to over rely on text information rather than use prior knowledge, and therefore reflect constricted control. Field independent readers are more able to find salient features in a complex text, they tend to treat ambiguous material analytically, they tend to consider multiple causes including creative options, and tend to use prior knowledge efficiently, and therefore reflect a flexible style of control. These findings would give support to Tinajero and Paramo (1997) in their conclusion, that field dependent and independent students are not equally equipped for the challenges in education and in literacy in particular.

The reflective/impulsive cognitive style refers to time taken to develop a response. Whereas some individuals respond slowly, but correctly to problem solving, and are therefore reflective, others respond with quick and incorrect responses, and are therefore impulsive. It is impulsive readers who perform poorly on comprehension tasks, through lack of awareness of less obvious, but important cues to meaning in the text.

'Attentional style' has also been shown to differentiate good from poor readers. Readers with 'flexible control' are able to ignore distracting, irrelevant information in a text, whereas a readers with 'constricted control' cannot, and become distracted by less relevant cues (Denny, 1974). When an individual is required to respond to a question, understanding the stimulus is critical, whether it be oral narrative input, reading material or a pictorially represented context, all three cognitive styles can be seen to play a relevant role.

What is said, and how it is said, is thus a product, not only of the context in which language is spoken, but also of the socio-cultural identities, of the individuals speaking (Westby, 1994) including the cognitive style expressed. This influence can be seen to affect both the

development and expression of language and cognition, and would be reflected in answers provided by children when questions are posed. As questions and answers are an integral part of education and literacy, the impact of culture and cognitive style is far reaching. However the way in which children apply their oral language skills to literacy, the de-contextualized language, with which they are faced at school, is influenced by a further factor- the extent to which a culture has a strong oral or literate tradition.

2.4 THE ORAL TRADITION, LANGUAGE AND COGNITION

Despite the fact that in some societies development has taken place from orality to literacy, to secondary orality through telephone radio and TV, and even to electronic media and computers, there are still cultures today for whom literacy is not an embedded way of life (Ong, 1982).

Within rural cultures, such as rural Zulu culture, although there is increasing exposure to secondary orality through radio, and an increasing exposure to television, and thereby other cultures, there is still minimal exposure to literacy-type activities in the early years of development (Liddel, Kvalsvig, Shabalala and Qotyana, 1994). In addition, there is minimal exposure to books outside of the school context as the child grows up (Macdonald 1990; information from the pilot study of this research). African cultures today, are still associated with a predominantly oral tradition as opposed to a literate tradition associated with a middle class western culture (Tannen, 1982). Ong (1982) expresses the strong belief, borne out by experiments performed by A.S. Luria with illiterate speakers, that the tradition to which a speaker belongs, influences how that person thinks and how language is used. Thus in evaluating oral verbal expression of children in an oral tradition, e.g. rural Zulu-speaking children, the effects of belonging to a predominantly oral tradition must be considered in terms of the types of answers presented.

Ong (1982) described a number of characteristics of the language used in the oral tradition when large amounts of information are transferred without access to written prompts, some of

which continue to influence the language of cultures with oral traditions right up to this time. The experiences of the ancient Greeks, which Havelock (1963) describes as taking three hundred years from the advent of the written word to the interiorization of literacy enough to affect a change in thought processes, alerts us to the fact that merely introducing reading and writing skills does not immediately and easily change thought processing. Thus, despite widespread acquisition of functional literacy skills, the characteristics of a predominantly oral tradition may still affect the way in which rural Zulu-speaking children think and answer questions.

In purely oral traditions, absence of written language for reference results in a number of techniques applied, to deal primarily with memorization of material and information.

In the oral tradition, there is a reported tendency to use additive language, rather than subordinate sentences in order to keep thoughts linguistically uncomplicated and linear. Language tends to be aggregative rather than analytical in that there is a reliance on formulas to aid memory, e.g. 'the 4th of July celebrations'. Redundancy in language occurs due to the inability of the speaker to go back to what has been said, thus by moving forward slowly with repetition, the information is retained and has a sense of continuity. Due to the fact that so much effort is focused on remembering the content, there is little remaining potential for intellectual reformulation at the moment of delivery. Written language frees the mind from conserving and retaining knowledge, thereby creating the possibility for new and creative thoughts. Further, the focus on the present and human events makes language of the oral tradition contextualized and field dependent, with an emphasis on homeostasis- word definition in terms of present context, rather than having an abstracted generalized meaning.

In conclusion Ong (1982) points out two significant factors related to the oral tradition. Firstly, the effects of oralism do not make the language simplistic or illogical - it is merely language that is not analytically sequential. Secondly, many of the current tests, including language tests, so often used to condemn a student, are constructed for a certain kind of mind and intellectual tradition. When testing children from a predominantly oral tradition through a

traditional questioning mode, this factor must be noted and may be justified in terms of the fact, that at the basis of all learning, are questions and answers.

Acknowledging that culture and tradition influence how children think and learn, we must also consider what it is that children do need linguistically and cognitively in order to learn. Although it would be ideal to adapt the school to the child to achieve success (Cazden, 1970), the western educational tradition continues to be the model into which all children must fit.

2.5 LEARNING, LANGUAGE AND COGNITION

The child in the primary school phase is required to participate in literacy-based activities, which aside from the new visual, auditory and motor skills being learnt, places new demands on the child's oral language and cognitive skills. The language demands further increase as students move beyond the primary grade levels, and they study subjects in which language becomes increasingly technical and less related to the language of everyday communication.

Noted developments in language occur during this phase, in that children are required not only to use language as a representational tool, but also as a tool for referring to and extending the references made (Westby, 1994). The ability to use reformulations, indicative of metalinguistic skill at approximately 7 years, enables the child to create more accurate referential meaning (Wood, 1992). However, the most significant developments during these years are the achievement of narrative skills (Kemper and Edwards, 1986) and the ability to reason and explain (Donaldson, 1986; Wood, 1992).

At a cognitive level, the emergence and development of these skills coincides with Piaget's concept of concrete operations. At this time the processes of decentration- the ability to hold more than one thought in one's mind, reversibility of thought - the ability to move back and forth between different aspects of the narrative, and ability to categorize hierarchically,

become evident. These skills form the foundation of the ability to answer questions through reasoning, understanding cause and effect, and making inferences.

The role of prior knowledge of the world in problem solving and learning is also stressed. Blachowicz (1994), states that essentially all learning is an attempt to make meaning through a process of problem solving based on prior knowledge of the world. It is the attempt to reconcile something new with something known. This requires skills to formulate what is already known, to hypothesize about various possibilities, and to collect, integrate and evaluate the new knowledge. This process is the result of a number of questions and answer processes, which may be self formulated and initiated, or posed by an outside agent.

The importance of life experiences has also been stressed in the area of reading comprehension and text analysis. Pitts and Thompson (1984), refer to cognitive theory and the concept of 'schemata', which are structures for representing concepts (based on life experience) in memory, and which are said to be the key units of the comprehension process. Inferences about portions of a text that are not explicitly presented, are derived from these schemata to access full meaning. If a child possesses sufficient schemata that are easily accessible, cognitive processes such as inferencing are easily achieved. Inferencing enables a child to derive meaning from text by adding personal information in the form of schemata to textual information, thereby creating new meaning and comprehension (Shiro, 1994).

At the core of the learning process is ability to encode new meaning that is created and answer questions effectively. This is based on accurate comprehension of the question itself, as well the implicit and explicit information presented, irrespective of whether the problem is concrete, such as solving physical problems in the world, pragmatic such as solving social problems, or decontextualized such as comprehension in reading.

Decontextualized language is essential for academic success. Evidence suggests that skill in the use of decontextualized language such as recounting personal narratives, planning future events and explaining ideas and reasoning, is a better predictor of literacy and school achievement than skill at other challenging language tasks (Snow and Dickson, 1991).

Decontextualized language embodies three dimensions, which, once achieved are manifest in all aspects of language. Thus the ability to engage in discourse: in the absence of an interactive conversational partner; in the absence of presumed shared knowledge with the listener; and where the message is complex, ensures a level of school achievement and an ability to engage effectively with literacy. Research is demonstrating, that for children from disadvantaged backgrounds, even exposure to cognitive stimulation in high quality pre-schools, i.e. from 3-4 year, is not facilitating the development of decontextualized language (Dickson and Snow, 1987). This places more emphasis on the importance of early language stimulation in particular in the home and preschool environments, and the influence of early stimulation and environment on language development as a whole.

Cummins' (1985) concept of 'cognitive and academic language proficiency', CALP, highlights the role of language in thinking, learning and literacy. Out of the social aspect of 'basic interpersonal communication skills', (BICS), externalized in the form of pronunciation, grammar and vocabulary, the ideational aspect of language, CALP, emerges which is a covert function, resulting from the "manipulation of language in decontextualized academic situations." (Cummins, 1985, p 212) The ability to manipulate language is strongly connected to the development of metalinguistic skills, eg understanding whether a question demands an answer related to cause or an effect, which are externalized, when a child consciously performs a linguistic manipulation required by a given task. Cummins also refers to a strong association between metalinguistic skills and cognitive development. He further believes that the significant factor facilitating the development of BICS to CALP, is an active engagement with literacy and the type of tasks emerging from that context. The critical factor here is the extent to which a child acquires skilled use of decontextualized language, both receptively and expressively.

In the attempt to understand thinking skills and their application to problem solving, CALP and its associated metaliguistic skills may be targeted in the form of the child performing linguistic manipulations by answering the specific questions posed, e.g. cause and effect and inferencing. Considering that learning and acquiring the skills to answer questions is primarily related to the child's prior knowledge about the world (Blachovicz, 1994), it is important to understand the context in which this prior knowledge is acquired. For some

children, the context is physically enriching and interpersonally promotive of the thinking skills required for schooling. When this is not so, the difficulties that a child may face with formal learning, can be said to be related to such disadvantage, with a specific impact on language for literacy, learning and problem solving.

Although it is extremely difficult to separate ethnicity and social class when considering children who are at risk for school failure (Hertzig, Birch, Thomas and Mendez, 1986) the following section will attempt to focus on the effects of poverty and disadvantage.

2.6 DISADVANTAGE, LANGUAGE AND COGNITION

A definition of disadvantage, within an educational context, refers to a relatively enduring condition of life within certain social groups, working class or poor among them, which contribute, not only to poor academic achievement in the short term, but also to more limited opportunities for success in the greater society (Edwards, 1979), hence the perpetuation of the cycle of poverty (Williams, 1970). This definition is extended to a concept of a disadvantaged culture, referring to groups of individuals, whose backgrounds, attitudes, and general capabilities have failed to equip them adequately for a life of opportunities (Williams, 1970). These opportunities are the ones most often associated with educational qualification and economic advancement.

Whereas the 60's and early 70's produced support for a 'deviance theory' in relation to the effects of disadvantage on language (Bernstein, 1970), the 80's firmly established the concept of 'difference' (Labov, 1970). The deviance theory stated that language of the disadvantaged was deviant or deficient in relation to that of the middle class in the areas of language usage and accent or dialect. The difference theory highlighted the fact that skills can only be considered deficient in relation to the child's own culture, language or social group. As disadvantage is seen in relation to the effects of environment, it implies that one can only consider a child to be deviant if s/he does not perform optimally in relation to the limits of

'own environment'. This does not preclude the child's need to develop cognitive and linguistic skills of another environment, if that child is to cope adequately at school.

Examining the language used by disadvantaged children, has demonstrated that both syntactically and lexically (Bernstein, 1970), conceptually (Blank, 1970) and in continuous language (Edwards, 1979), disadvantaged or working class children perform differently to their middle class peers (Heath, 1992).

Whereas Cummins (1985) refers to BICS and CALP in relation to language and literacy, and the ability to deal with contextualized and decontextualized language, Bernstein (1959) had developed earlier concepts of public language and formal language. In defining these, he had specified the syntactic and lexical ways in which language of the disadvantaged differed from that of the middle class (see Table 2.1). These concepts emerge from his theory of restricted and elaborated codes and closed and open role systems, which closely connects the cultural and social class influences. It is interesting to note the relationship between use of a restricted code and public language, which could also refer to BICS, as existing within a closed role system. In such a system there is a high level of fixed and formal definition of roles, ways of conducting discourse between adult and child and procedures for decision making. This implies that the more a social group lives within a closed role system, the more likely it is to use public language and BICS.

In his criticism of Bernstein's theory, Trudgill (1975) refers to evidence for the fact that disadvantaged children do use elaborated codes in spontaneous language, but not when attempts are made to elicit it formally. Further findings have indicated that disadvantaged children have been shown to possess elaborated language skills which they are unable to use effectively when demonstrating cognitive ability (Hertzig, Birch,Thomas and Mendez, 1986). This highlights the distinction, which needs to be made between the possession of language, even if it is at a fairly complex level, and the use to which it is put in response to demands for cognitive performance. It also gives weight to Bernstein's belief that these concepts are related to language at a performance and not at a competence level.

Labov (1970) has also criticized Bernstein's early theory of deviance by demonstrating the importance of the manner in which language is elicited from a non-mainstream child, which had not previously been considered. Reports of black American pre-schoolers, being able to communicate only in single word utterances and simple sentences, have been disproved by Labov (1970). He demonstrated an increased verbal output, when language samples were elicited by individuals of the same culture as the child, and within a context and setting familiar to the child. Labov's important contribution in demonstrating that non-mainstream English, e.g. Black American English, is rule governed and structurally capable of expressing complex ideas and opinions does not account for the fact that cognitively, children developing in socially disadvantaged environments do not acquire adequate language skills necessary for successful learning.

Table 2.1

Bernstein: Public and Formal Language (adapted from Edwards 1979 p 34)

Public Language	**Formal Language**
short, simple, often unfinished sentences, with poor syntax	Grammatical and syntactic accuracy
simple and repetitive use of co-ordinating conjunctions	sentence complexity via the use of subordinate conjunctions and clauses
frequent use of commands and questions	frequent use of prepositions to indicate logical, temporal, spatial relationships
rigid and limited use of adjectives and adverbs	a range of adjectives and adverbs
infrequent use of pronouns as subjects	frequent use of pronouns referentially
reasons and conclusions not expanded, but confounded to produce a categoric statement	expansion of reasons and conclusions indicating logical thought processes
frequent use of idiomatic phrases indicating a high level of pre-supposition	use of language to contextualize the discourse
low-order symbolism	use of expressive symbolism
much of the meaning is implicit	much of the meaning is explicit

In his later work, Bernstein moved away from the interpretation of deviance toward the concept of difference in the language of non-mainstream speakers.

Whereas Bernstein's theory emphasized the effect of disadvantage on the primary acquisition of language, Blank (1970) related this to its impact on cognition. She stated that disadvantaged children often lacked the ability to use more complex verbal structures, which resulted in problems with causal thinking, conditional statements, achieving deductions and retrieving past events. These are the areas she attempted to develop in her language programmes for disadvantaged pre-schoolers. It is these aspects which require investigation in attempting to assess the relationship between cognitive and linguistic ability and poor academic achievement of rural African primary school children.

Recognition of poor cognitive and language development occuring prior to formal schooling, with the consequent negative impact on academic achievement for disadvantaged children, prompted a surge of interest in the field of early childhood intervention in the USA during the past 30 years. This resulted in the initiation of numerous intensive, and very costly early intervention programmes aimed at cognitive development which have been longitudinally evaluated and reported on in much detail.

The three basic assumptions underlying this new concept of early childhood intervention (Shonkoff and Meisels, 2000) need to be given strong consideration within the South African context. The first is that a child's developmental potential is not fixed by genetic factors or the passing of critical periods of development, but rather that the child remains responsive to new environmental realities. The second is that the development of a young child must be seen in a broad ecological context, set within the family, the community, and the broader social, economic and political environment. The third is that, due to the complex nature of child development, the range of services and supports required for intervention is extensive.

Despite the fact that the multi-sited programmes initiated, attempted to embrace all thee principles, long term outcomes have been uniformly disappointing. Halpern (2000) noted that there seemed to be a consistent pattern of short to medium term benefits, demonstrated using regular formal tests for the two and three year old children. This tended to taper off by five years and by 8 years there was no discernable difference in the academic performance of children who has participated in the programmes and the control group children.

Such facts do not bode well for poor, rural children in South Africa, when additionally placed within the context of recent brain research. This research is demonstrating with conviction, that early experiences in infancy influence the actual growth and development of neural pathways. It is maintained that synaptic connections between brain cells that are stimulated are reinforced, whereas unstimulated connections are eliminated. Furthermore it has been reported that the part of the brain critical to language development and the processes facilitating logical thought is particularly sensitive during early childhood. This reinforces the notion of the critical importance of the quality of the environment in which children grow up, in laying the foundations for later learning (Nelson, 2000).

This environment does not only refer to disadvantaged social circumstances, and minimal early stimulation, it includes the of the type of codes used by rural Zulu speakers and the extent to which closed social systems still operate in different geographical areas. In addition, little is known of how these factors affect the learning process for rural African children. We must, therefore start at a basic level of investigation and try to find out just how rural African children do think when placed in an educational framework.

2.7 EXPLANATIONS, LANGUAGE AND COGNITION

This section analyses thinking skills in the context of explanations in which linguistic and cognitive aspects, such as, comprehension, inferencing, and decontextualized language, are integrated and encoded.

2.7.1 Thinking skills and explanation

Thinking skills are those skills, that emerge in an individual as a result of the development of language, of cognition, of socialization, and the integration of cultural norms and life experiences. They are the skills that a child calls upon in attempting to represent and explain events in the world. The ultimate goal is the ability to think in a logico-deductive manner, yet social or pragmatic reasoning may play a significant role in achieving this.

Explanation is essential to education. On one hand a child takes in explanations offered by others, and on the other, presents explanations to convey the ability to reason and solve problems i.e. thinking skills. Hence, we explain to demonstrate our understanding, or to convey our knowledge. Within an educational context, ability to explain is the primary means by which a child's knowledge is assessed. By evaluating children's ability to explain we may gain an understanding of thinking skills and how they impact on school achievement. Evaluating this within a rural African context will add to such a body of knowledge.

At the core of explanation is the integration of language and cognition. Explaining cannot occur without language, and in addition it pre-supposes a number of cognitive skills, some of which are the ability to distinguish between a cause and an effect, a reason and a result and evidence and a conclusion. It is the speaker's linguistic resources that enable him/her not only to string single words together, but to sequence and organize clauses, and with the aid of causal connectives to produce new and complex messages. Thus the ability to explain and the ability to use causal connectives are closely inter-related. When working in a cross-cultural and cross linguistic context focus on linguistic units is extremely problematic. However through accurate translation of material, semantic units may be effectively studied.

2.7.2 A psycholinguistic framework for understanding explanations

In formulating a psycholinguistic analysis of children's explanations, Donaldson (1986) provides a theoretical framework for analysis of questions and answers based on the integration of language and cognition. Thus in combining different clauses, a number of explanations may occur, having both linguistic and cognitive origins and implications.

Three of the different types of explanations she identifies are relevant to an understanding of thinking skills . Explanation of an *event* (why did the car break down?), would result in an empirical answer (what happened to cause such an event?). Explanation of an *action* (why did you hit the boy?) would result in an intentional answer (for what purpose or reason?). Explanation of a *conclusion* (how do you know they are at a wedding?) would result in a deductive answer (how do you know?). Procedural explanations (how do you bake a cake?) were omitted.

Related to event, action and conclusion are three content categories of explanations related to type of causality. *Physical causality* relates to an empirical answer based on the event. *Psychological causality* relates to a motivation for action or reason for action. *Logical causality* relates to a deductive answer, which may be based on an inference, leading to a conclusion. The linguistic formulation of each of these requires cognitive skill in specific areas.

An empirical explanation (what happened to cause?) requires the ability to deal with temporally sequential events in which the explanation relates to a prior event, which must have occurred. Linguistically, this would be expressed using 'because'. An intentional explanation (for what purpose or reason?) requires an answer related to a purposive, goal directed aim or behavioural intent. Linguistically this would be expressed as 'want to, is going to, would, could'. A deductive explanation (how do you know that?) relates to a concept, idea, judgement, inference or conclusion, i.e. a mental act. This is a situation in which one mental act requires justification in terms of another mental act, rule or observable evidence. Linguistically this would be expressed as 'can tell that, know that, must' Thus whereas an empirical explanation can be considered to require concrete thinking skills, intentional and deductive explanations require abstract thinking.

The issue of the role of language in thought, and vice versa, is clarified by considering the distinction drawn by Donaldson, between content and mode of explanations.

> *Content* refers to the type of relations which holds between events, states, actions or mental acts, which are referred to in an explanation. These relations are independent of language, but may also be expressed in linguistically. This may also be referred to as the level of competence.

> *Mode* refers to how the speaker's own view of the task affects the type of relation, which he/she expresses in the explanation. These relations are dependent on the use of language, and must be expressed linguistically. This may be referred to as the level of performance.

Explanation, therefore, exists in the complex relationship between content and mode, facilitated by the use of causal connectives, resulting in an overlap between semantics, syntax and pragmatics. Such an analysis may form the basis of a criterion referenced scoring system to be useful in research into children's ability to explain. (Table 2.2)

Table 2.2

Summary of Donaldson's (1986) content/ mode, and relationships expressed as a reference for a criterion based scoring system

Content/Mode	**Relationships Expressed**
Physical / Empirical	Cause and effect between 2 events
Psychological / Intentional	Cause and effect between 2 actions OR Cause and effect between 1 action + 1 intention
Logical / Deductive	A relationship between 2 ideas or judgements OR A relationship between a judgement and proof of its logical antecedent

2.7.3 A narrative framework for understanding explanation:

Explanations, like narratives, relate to language beyond a focus on basic rules of sentence formation and simple relational or naming vocabulary. In both instances there is a need to draw on information and knowledge (cognition) outside the scope of the sentences that are produced (linguistics). Thus explanations may also be related to the theoretical frameworks which have emerged from the study of narratives. Johnston (1982) refers to four different perspectives, which may be applied to narrative analysis which have application for analysis of explanations and reasoning. The *story grammar approach* (Stein and Glen, 1979) identifies a number of story components, which relate to concepts of explanation and reasoning.

Empirical explanations (Donaldson, 1986) may be associated with the child's ability to identify and comprehend the *physical setting* component of the story grammar approach, involving main characters and locations. Thus an answer in response to 'what happened to cause.....` is based on a firm understanding of the physical reality presenting at that moment, and reflects the cause and effect between two events already present. This would make possible an explanation based on physical causality emerging from what is evident, giving rise to a concrete answer.

Intentional explanations (Donaldson, 1986) may be associated with the *initiating event and the response components. The initiating event* may be a *natural occurrence* unrelated to an action of a character, or *an action*, which stimulates a response. It may be *an internal event,* which refers to the way a character perceives an internal or external event or changes in a character's internal state, e.g. pain/sadness/hunger or it may be *a verbalization* which is an initiating event expressed in dialogue. *The response* relates to the psychological state of the character in response to the initiating event, and may be *affective* or emotional, *a goal* in terms of the character's desires or intentions or *a cognitive response* referring to the characters thought about the initiating event. All these initiating events and responses relate to information and effects not directly accessible merely from understanding the setting and identifying the characters, and are therefore more abstract in nature. The initiating event gives rise to a response resulting in psychological causality due to cause and effect between two actions or between an action and an intention, and results in an abstract answer.

Deductive explanations (Donaldson, 1986) may be related to *the plan, the attempt and the consequences. The plan* refers to strategy for achieving the goal, *the attempt* to the actual overt actions and the *consequences* to the effect of the plan and the attempt. They will result from the relationship between two ideas or judgements, or a relationship between an idea or judgement and logical proof of its correctness. Inferencing about the issue forms an active component of this process. This aspect will result in logical causality giving rise to a deductive answer also abstract in nature. The episodic nature of true narratives (Applebee, 1978) also requires logical deductive reasoning.

Johnston's second perspective relates to narratives as *scripts* which may be related to the role of socio-cultural environment (Taylor, 1986a) (see 2.2, p 12), early socialization (Vygotsky 1962) (see 2.2, p 12) and world knowledge (Blachowicz, 1994) (see 2.5, p 19), previously referred to. Scripts refer to each individual's expectations about particular events which are derived from prior experience, and which provide the individual with a structure for imposing order on experiences by categorizing them and may also be referred to as schemata. Thus a particular script may be retrieved from long term memory and consciously activated in an appropriate verbal or situational context. The context may be that of a narrative or explanation and the relevance of scripts would apply equally to both.

Texts are the third perspective from narratives, which may relate to explanations, and refer to the linguistic devices, primarily conjunctions, which serve to create cohesive text. Conjunctions enable us to reformulate and reorganize sentences to create new meaning. It is the flexibility of the way in which sentences are linked that enables us to formulate explanations related to the specific formulation of the question.

Johnston's final perspective relates to narratives as *communication acts,* told at a particular time for a particular audience, which require the speaker to apply skills outside of the actual story content. These skills enable the speaker to alter the narrative according to the age, situation and social relationship with the listener. Similarly, explanations require the application of such skills, which would be most significant in the presentation of explanations

in a learning context, where passing and failing depend on the ability to adequately explain in a formal school setting.

It is no co-incidence that success at the primary school level is closely related to both the ability to reason and explain (Donaldson, 1986; Wood, 1992), and the ability to tell stories (Kemper and Edwards, 1986), as both are directly related to the ability to integrate cognitive and linguistic skills. Both narratives and explanations, can be verbally produced in order to be effectively studied by researchers.

This enables us to identify developmental stages in explanations that are indicative of the development of abstract reasoning.

2.7.4 Developmental aspect of explanation

Developmentally, Donaldson's research (1986) revealed that by 7 years, children have acquired a number of skills in relation to their ability to explain. Piaget also described developmental stages in relation to cognitive processes and problem solving behaviour (Ginsberg and Opper, 1969). Van den Broek's (1997) overview of developmental patterns in event comprehension completes this section giving a comprehensive analysis of different ways of speculating about development of thinking skills.

Donaldson stated that by 7 years, children are able to distinguish between cause and effect. They are able to distinguish between physical, psychological and logical relations. They can produce well-formed causal sentences. Their ability to explain includes the empirical and intentional modes. They know an action can be explained in terms of the agent's intention to achieve a particular result. It is also the age at which true narratives, containing all story grammar components begin to appear (Applebee, 1978), reinforcing the relationship between logical thinking and narratives.

Donaldson's research further revealed that 10 year olds performed better than 5 and 8 year olds on tasks requiring understanding of temporal relationships in relation to 'because' and

'so' ('because' states a reason for an event which has already occurred / 'so' states effect to follow). There was greater improvement in performance between 5 and 8 year olds for 'because' items, or stating the cause, and greater improvement in performance between 8 and 10 years for 'so' items, or stating the effect. Thus the ability to explain the effects of actions or intentions, based on an inference, shows significant development between 8 and 10 years. In addition, there is sequential improvement in performance for deductive items from 5, to 8, to 10 year olds. This correlates with narrative development. By 9 years children who have been exposed to a field independent cognitive style within a literate society, have established the skill to tell an original story with all story grammar components present. They are thus equipped cognitively and linguistically to enter the senior primary school phase in which there is a growing emphasis on using language for learning at both a comprehension and production level. This is also the time when the foundations for the development of logico-deductive thinking are laid down.

At a cognitive level, Piaget identified three interdependent components of thought that show developmental sequence, viz centration/decentation of thought, static/dynamic reality and irreversibility/reversibility of thought. Development occurs through the pre-operational stage (5-7 years), the concrete operational stage (7-11 years) and formal operational stage (12 years +) (Ginsberg and Opper, 1969). Although Piaget derived these concepts in relation to the child's demonstration of thinking skills through interacting with physical challenges in the environment, they are equally applicable to the way in which children offer explanations about social realities.

Whereas the pre-operational child shows irreversability of thought, and is attentive to limited amounts of information, which are of a particularly static or concrete nature, the concrete operational child shows reversibility of thought, can focus on several aspects of a situation simultaneously, and is therefore sensitive to dynamic aspects of reality. The inter-dependence of these skills is emphasized. Further they have a direct influence upon the manner in which children at different stages approach a problem-solving task. Pre-operational children are said to approach a task in a haphazard way, reporting results in terms of expectations not observations and drawing faulty conclusions based on unrelated evidence. Concrete operational children are said to investigate a number of possibilities, but show limited skill in

designing an experimental process, resulting in the process of analysis being unsystematic. Children who achieve formal operations are said to be able to plan, test possibilities and design experiments well. They observe results accurately and draw proper logical conclusions. They should, therefore possess all the skills necessary to analyse and explain social problems proficiently.

Finally, it is the study of the development of the ability to detect causal relations between events that gives rise to an understanding of the developmental aspects of event comprehension. It is assumed that like all other language activity, comprehension must precede expression of such causal relations.

Event comprehension is related to three main skills, viz the emergence of the ability to recognize multiple causation; to do this at increasingly more complex levels of event organization; and to relate increasingly to internal psychological causes. The different types of events and relations described by van den Broek (1997) show close correlation with types of causal relationships described by Donaldson (1986) above (2.7.3).

He describes observable events as actions and physical events, and non-observable events as goals and intentions, which may include different types of relations such as motivations, enablements, necessary and/or sufficient causal relations, with one or more human protagonist.

His analysis of causality incorporates two important dimensions. One is that causal relations differ in terms of the kind of events they connect, and two is that causal relations differ in their strengths. Thus physical causality refers to relations between two physical events, motivational causality refers to relations between intentions and consequences, psychological causality refers to the effects of events on internal states such as emotions, feelings, intentions. Strength of causal relation refers to whether an antecedent is necessary and sufficient for a consequence to occur, or whether it is necessary but not sufficient and therefore prevents enablement as a consequence. In addition, because events may be caused

by multiple antecedents, multiple consequences are possible. Thus explanations may be offered at multiple levels involving a complex of integrated skills.

In the construction of developmental stages for event comprehension, van den Broek (1997) analysed research which attempted to answer the question: Do causal relations between events, affect children's ability to comprehend and recall the events ?

A number of age related trends emerged (see Table2.3 for summary). Children as young as 4 years consistently recognized causal relations between concrete and observable events such as physical events and actions, but had difficulty with goals and motivations. At 6 years it was noted that the level of coherence in a narrative (measured by no of coherence markers) did not influence the level of recall of causal relations and there continued to be a focus on concrete observable events. This trend appears to continue till 7 years, when children demonstrated some understanding of goals and actions, and a weak understanding of motivation. By 8 years children continue to focus strongly on directly observable events in answering questions, but they do start to recognize the causal relations between goals, intentions and other events. This occurs only within the same episode. 10 year olds demonstrated that level of coherence did improve recall of causal relations, as did events with multiple causality. By 10 –11 years children demonstrate an understanding of all causal relations both within and between episodes and can therefore give an answer reflecting the global structure of the events. The final stage in integrating and interconnecting events, which occurs in adolescence, lies in the ability to identify themes or topics that connect events into a cohesive whole, which ultimately lead to the ability to make inferences about more complex concepts such as morals and values. It is also the time at which children enter Piaget's period of formal operations when logico-deductive reasoning increases.

In attempting to explain why event comprehension changes over time, van den Broek considered two possibilities. Firstly, the very process of identifying causal relations may challenge attentional and working memory capacities of young children, and may correlate well with Piaget's concepts of reversibility of thought and an understanding of static/dynamic reality in the pre-operational child. The second is in explanation of why children overcome

difficulty developing causal relations relating to internal states. As internal states are not observable, they must be inferred. It may be that as children mature, they become cognitively more practised at inferencing, and can therefore access internal states. Another explanation relates to life experience and the creating of schemata (Pitts and Thompson, 1984) or scripts (Johnston, 1982). As children become aware of their own internal states and store them in memory, such events can be retrieved for inferences related to internal states in episodes and events.

Table 2.3

Developmental trends in the comprehension of complex events (van den Broek, 1997, p 335)

Observed ages in Text and Television research					
Developmental Trend	4	6	8	10-11	14-Adult
Increasing centrality of causal structure	Some effect of causal connections	Stronger effect of causal connections		Very strong effects of causal connections	
Shift from focus on within-episode connections only to focus on between episode connections to focus on themes	Within episodes	Within episodes	Within episodes when cognitive demandsare low Between episodes when cognitive demands are low	Within episode; between episodes	Within episodes; Between episodes; themes
Shift from focus on observable, concrete actions to focus on internal states (goals, motivations)	Focus on actions	Focus on actions	Some focus on goals, but actions still prominant	Strong focus on goals	
Note: Ages provided for relative rather than absolute comparison					

In conclusion van den Broek recognizes the many unanswered questions in relation to development of event comprehension and suggests a possible way to explore further is to look

at the product of comprehension in the form of questions and the encoded answers produced, as has been attempted in this research.

2.7.5 Explanation as a production exercise

There is support for the study of explanation and causality as a production exercise rather than a comprehension exercise for a number of reasons. Primarily, the goal of education is to facilitate the development of thinking skills in children, which are demonstrated by them first through oral verbal expression and then through written verbal expression as the children enter higher classes. Thus mode, modality and content becomes relevant in revealing to us a child's ability to express thoughts and ideas, and why from a cognitive-linguistic point of view, s/he may be unable to achieve these goals of education.

However, production experiments are also of particular value when working in a cross cultural context. The main difference between production and comprehension lies in the balance between choice and control that exists between the child and the investigator. In a comprehension study, control rests with the experimenter in that a particular target, decided upon by the experimenter, is present or absent in the child. Failure in this context may not be due to the child's incompetence, but due to the investigator's assumptions, which may not be consistent with child's cultural context. In a production study, control lies with the child who presents a response borne of the child's own mode of explaining and avoids presupposition about the child's cognitive processes. It has further been shown that when children themselves have selected the events for event comprehension tasks, level of performance has been achieved at an earlier age (Trabasso and Nickels, 1992). Thus locus of control can affect test outcome. This is of particular value cross-culturally in the South African context, as so little in known of thinking skills in rural African children.

However, even in a production study, children may not have full control of what they will say, in that specific questions are posed. Yet the mode of explanation that they use is free, and it is particularly in the evaluation of the responses, that great emphasis is placed upon ensuring criteria are culturally appropriate.

Production studies also have been shown to be more reliable when working across socio-economic boundaries. This was demonstrated by one particular study, which aimed at studying the communicative accuracy of middle socio-economic status (SES) white children, lower SES white children and lower SES black children in the USA (Quay, Mathews and Schwarzmueller, 1977). It was found that whereas there was no difference in performance for decoding information between the three groups of children, there was a difference in encoding information between the middle SES group and the lower SES group irrespective of race. A test that evaluates production ensures that reliability at this level has been accounted for.

Finally, production studies of narratives have been shown to be the more accurate diagnostic measure, in the identification of learning disability in students (Feagens and Short 1984). Whereas 6-7 year old normal ability and learning disabled children performed equally well when enacting a story told to them, there was a significant disparity between the two groups on a variety of verbal production measures. The disparity between the comprehension and production scores is explained in terms the learning disabled child possessing adequate narrative competence but inadequate production strategies for expressing this knowledge in a linguistically appropriate manner. This is a similar conclusion to that reached about disadvantaged children, in the belief that disadvantaged children possess elaborated codes, which they are unable to use effectively when demonstrating cognitive ability (Hertzig, Birch, Thomas and Mendez, 1986).

2.7.6 Pragmatic versus logico-deductive explanation

The final issue to consider in this section is the relationship between social or pragmatic reasoning, and logico-deductive reasoning in which an individual develops context-free syntactic rules of logic (Verzoni and Swan, 1995). Although Pretorious (1994) refutes the idea that the reasoning achieved in relation to everyday life is equal to formal reasoning, it may be a precursor and facilitate it. This notion is reinforced by the outcome of a training programme for 14 year olds in which pragmatic reasoning schemas presented, assisted the students in bridging the gap between concrete and formal thought (Verzoni and Swan, 1995).

These positive effects are explained by the belief that the adolescents studied, used memory of domain-specific (contextualized) inferential rules, to assist them with achieving proficiency with decontextualized reasoning. The pragmatic reasoning schemas facilitate the development of inferential rules from experiences occurring in everyday life. Thus understanding how rural African children reason within a pragmatic context may have important implications for intervention programmes, resulting in more positive educational outcomes through better event comprehension and inferencing in literacy.

2.8 VERBAL PROBLEM SOLVING SKILLS AND THEIR RELATIONSHIP TO THINKING

The ability to engage in verbal problem solving, which would enable a child to be academically successful, is based on cognitive and language skills accumulated well before entering school. Yet it is only once at school, that poor skills may be identified and remediated. It must be stressed that in order to identify problems with confidence, appropriate tools must be used. This is proving to be extremely challenging in cross-cultural settings.

Some of the specific language based thinking skills which may be identified as indicators of verbal problem solving ability are (Zachman, Jorgenson, Huisingh and Barret, 1984):

- The ability to determine causes of a problem
- The ability to determine solutions for a problem
- The ability to explain inferences about the problem
- The ability to identify ways of avoiding problems
- The ability to reason in relation to a negative why question.

These abilities would place both linguistic and cognitive demands on the child. They require that the child is able, not only to understand the immediate problem, but to draw on world knowledge and past experience, as well as the ability to produce new creative imaginitive

options. An understanding of the role of inferencing in formulation of answers to questions gives insight into how this may occur.

An inference may be referred to as an assumption of truth derived from the interaction between linguistic structure and non-linguistic information (Shiro, 1994). If we accept that intentional communication is more than the linguistic units decoded and encoded, then all communication is inferentially enriched. Due to the abstract nature of inferencing, a speaker cannot necessarily differentiate between what is explicitly stated or read and what is added to this to create new meaning. This process may only reach consciousness when there is awareness, that appropriate meaning is not being automatically derived from the explicit information presented and effort must be made to achieve this. Whereas explicit information is closely related to the propositional content of an utterance, implicit information is not confined by it.

The extent to which information in a particular text or communication is explicit or implicit is fixed. What does change is the individual's ability to derive meaning from these different forms of information, and will directly impact on the response presented. In most educational contexts, this response is in the form of answers to questions posed.

The source of the non-linguistic features necessary for inferencing, derived from world knowledge (Blachowicz, 1994), schemata (Pitts and Thompson, 1984) or scripts (Johnston, 1982) are intrinsic to an individual and are used by children regularly in their non-school lives. When they are applied to text, e.g. a reading comprehension, they are said to be 'schemata-based' inferences. Some inferences may be made in the absence of prior knowledge about a topic, and require procedural knowlegdge of how to apply inferencing to components in the text. This is referred to as 'text-based' inference, and is critical to the learning process and dealing with new information (Winne, Graham, and Prock, 1993). Thus an answer may consist of a blend of external and internal processes, or it may be the product of procedural knowledge on two or more external components.

Irrespective of the type of inferencing applied, there are three fundamental steps essential to effective. inferencing. A student must be able to identify and access the information pertaining to the 'rule' or the context of the information. S/he must be able to identify and access the 'critical fact' or the specific aspect that is being targeted which may be encoded in the linguistic structure of the question asked. Finally, a cognitive process must be executed, whereby the critical fact must be fitted to the rule in order to draw the appropriate inference. All three conditions must be met- all are necessary and all must be sufficient.

There is a positive consequence to understanding the process of inferencing. Despite the fact that there appears to be a lack of awareness amongst teachers that inferencing skills can be taught, gains have been noted when such programmes have been initiated. The outcome has been increased inferencing for reading and ultimately therefore, better academic achievement (Hansen and Pearson, 1983; Winne, Graham and Prock, 1993).

It has been shown that disadvantaged rural South African children have not had adequate pre-school stimulation and exposure to literacy based activities, which would ensure the development of the above inferencing and reasoning skills. The consequences in terms of poor academic achievement have also been documented (MacDonald, 1990) Finding a means of evaluating and tracking the development of inferencing and reasoning skills, would provide a means of addressing this problem.

The Test of Problem Solving (TOPS) (Zachman, Jorgenson, Huisingh and Barret, 1984) is an example of a test that targets children's verbal problem solving ability through analysing the five thinking skills outlined above. Tables 2.4 – 2.8, attempt to relate these thinking skills to the education process, and to demonstrate the role each one plays in ensuring academic success.

The tables identify :

- each thinking skill
- the type of question used to elicit this skill
- the cognitive skills required in order to answer the question
- the linguistic skill required to demonstrate ability to apply the thinking skill
- the mode of explaining
- and the problems with learning, that may result for the child due to the lack of that particular skill.

Analysing each thinking skill in terms of the exact structure of the question that elicits the appropriate response, is critical to the reliability of the test. An understanding of the cognitive skills involved provides a basis for criterion-based evaluation. Analysing the relevant linguistic skills to be applied, provides a structural format for analysing thinking skills and for remediating deficiencies. Understanding the mode of response required to answer a particular thinking skill, identifies its level of complexity and is important for a developmental analysis of thinking skills. Identifying the problems that may result due to a lack of that particular thinking skill alerts educationists and researchers as to how the problem will manifest academically. Failure in these academic areas may then be remediated through the development of abstract thinking skills.

Table 2.4

Explaining Inferences: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skill	Linguistic Skill	Mode Empirical/ Intentional/ Deductive	Problems due to Lack of Skill
1. Explaining Inferences	How do we know.....	Must understand intention of the question. Must sort relevant from irrelevant information. Must critically evaluate the illustration Must identify specific feature related to question	Encode for syntax and semantics	Deductive thinking mode	Difficulty comprehending questions. Unable to determine most critical factor. May lack syntax or semantics

Table 2.5

Determining Causes: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical Intentional Logical	Problems due to lack of Skill
2 Determining Cause	Why - for what reason? How - how did it come to pass?	Must understand the intention of the question Temporal sequence must be analysed Backtracking/ reversibility of thought must take place to determine a likely cause Cause must be evaluated Must draw on life experience	Must encode correct linguistic form- use 'because' Must select accurate lexical items	Empirical mode	Difficulty with sequencing of events Difficulty with comprehending science experiments Difficulty with predicting outcomes Difficulty explaining own behaviour

Table 2.6

Negative Why: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skill	Linguistic Skill	Mode Empirical Intentional Logical	Problems due to lack of skill
3 Negative Why Question	Why..... .not? Why would you not behave in a particular way OR carry out a particular action?	Must understand the intention of the question Must note the negative component in the question Must understand the meaning of the question and how the neg influences the answer Must understand the type of information required Must identify the appropriate answer	Encode the correct linguistic form	Concrete Intentional Logical	Difficulty with problem solving Difficulty following instructions

Table 2.7

Determining Solutions: An analysis of linguistic and cognitive skill

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical/ Intentional/ Logical	Problems due to lack of Skill
4 Deter-mining Solutions	What should/ could they do?	Must understand the intention of the question Child must place self in position of other Must consider various possibilities Must identify the critical one Must rely on past experience	Encode correct syntactic form 'should have / could have'	Concrete Intentional Logical	Problems with reading studies Problems with maths Problems with story sums difficulty planning ahead

Table 2.8

Avoiding the Problem: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical /Intentional /Logical	Problem due to Lack of Skill
5 Avoiding Problems	What could be done so that .....would not occur?	Must understand the intention of the question Must understand the problem at hand Must have reversibility of thought Must identify possible causes Must identify problem to be avoided Must match the problem with the solution	Encode appropriate linguistic structure 'should have/ could have' Establish correct tenses	Empirical Logical	Cannot backtrack in time Poor comprehension of complex linguistic structure Difficulty with cause/effect

These five tables highlight the complex nature of an apparently straightforward task-answering a basic question.

2.9 SUMMARY

In the first part of this chapter an in-depth discussion was presented on language, cognition and thinking skills, and the impact of social and cultural factors on their development. Types and influence of different cognitive styles as well as originating from an oral or literate tradition, raised questions as to problems of certain cognitive styles and traditions for academic success.

The importance of skilled use of decontextualized language as well as cognitive and academic language proficiency, highlight the relevance of language skills in the development of cognitive processes. These aspects were also reviewed in terms of their impact on learning.

Bernstein's deviance theory of the impact of disadvantage on cognitive and linguistic development was critically reviewed in terms of the currently accepted difference theory. Recent outcomes of early intervention programmes and findings related to the long-term impact, as well as research on brain development, paint a bleak picture for disadvantaged children of Africa in terms of addressing academic issues affected by disadvantage.

Two theoretical frameworks for the understanding of explanations were discussed. Donaldson's (1986) psycholinguistic framework was related to a narrative framework proposed by Johnston (1982). The three developmental aspects of explanation discussed, offer a model for a criterion-based reference system for analysing thinking skills in non-mainstream children

The relevance of using the production mode, for the assessment of ability to explain particularly in a cross-cultural setting and with disadvantaged children, was described. The importance of social or pragmatic reasoning in the development of logical reasoning was emphasized, in light of the benefits of training pupils to develop 'domain-specific' inferential rules.

Finally, verbal problem solving skills relevant to five categories of thinking skills applied in this research were described and analyzed, highlighting the complexity of the process of answering a question. The role of inferencing was discussed in understanding how an answer is derived from a question.