HEMISPHERIC LANGUAGE LATERALIZATION
AND
VERBAL ABILITY IN TSONGA CHILDREN

BY

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Submitted in partial fulfilment of the requirements

for the degree of

MASTERS OF ARTS

in

CLINICAL PSYCHOLOGY

in the

DEPARTMENT OF PSYCHOLOGY

of the

RAND AFRIKAANS UNIVERSITY

SUPERVISOR: MRS A.D. STUART

SEPTEMBER 1993

ACKNOWLEDGEMENTS

I wish to express my sincere thanks, respect and my appreciation to:

My supervisor Mrs A.D. Stuart, for involvement, support and for motivating me to empirically investigate an area that needs special attention in the black community.

Mr Johan Etsebeth and Henk, for the interest and their professional expertise in programming the DST tape.

The teachers of Tiakeni Primary School: Mrs. Mabanga (the principal), Mrs. C.M. Mabaso, Mrs. T.M. Mnisi, Mrs M.I. Baloyi, Mrs. M. Phiri, and lastly Miss A. Khoza who made the preparation of the Dichotic Listening Technique possible.

The cooperation and interest of the pupils who sacrificed their learning time to undergo the Dichotic listening test and the verbal test.

The R.A.U. for financial assistance towards this research.

My friend Dazmen Risimati Mavunda for his involvement, interest and patience in discussing interesting issues in the central nervous system and part of the statistics relevant to my research.

My parents, Mr Solomon Shibanda and Mrs Edith Shibanda for their moral support during this research and my studies as a whole.

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SUMMARY

Research on lateralization has been replicated in many countries of Europe, the American states and the Asiatic states. The research findings on language functions verify the occurrence of cerebral dominance or lateralization in these various races. In the South African context, language lateralization has been studied among the whites and the asiatics, but no study to date has been done among the various black population groups. The specific aim of the present study was to fill this void by researching language lateralization in a young mail Tsonga population, ascertaining the effect of the degree of language lateralization on various language abilities (reading, writing, spelling, vocabulary).

It is shown in the literature survey that the left hemisphere has a major role in language functions. Aspects that influence this lateralization of language functions to the left hemisphere are handedness, and footedness, sex, and age. Disorders of language functions are for example aphasia, dyslexia and dysgraphia. Research on these dysfunctions have led to the construction of a model for language pathways which inter alia, explains developmental dyslexia and postulates slow hemispheric lateralization as a possible reason for language dysfunction. This model is investigated in the present research.

A total number of 63 Tsonga-speaking (Shangaan) boys ranging between the ages six to eight were used as respondents. The boys

who participated were all rightfooted and righthanded. Since the literature indicates sexual differences in language functions between boys and girls. It was decided that only boys be selected in the present study.

The dichotic listening technique was used to measure the degree of language lateralization. The dichotic listening technique (DST) involves presenting subjects with two different auditory stimuli simultaneously, one to each ear. The test has been used many times to assess hemispheric dominance. The test also appears to be reliable and valid. Results of the DST were used to divide the boys in to a strong and a weak right ear dominant group. A verbal battery was administered to both groups.

The verbal battery, which consisted of tests of reading fluency, reading comprehension, reading and spelling, handwriting, writing spelling, writing understanding, and vocabulary was used to measure the language abilities of the two groups. Comparative statistics were used to analyze the data.

The results of the study indicated that children who scored high on the DST also scored high on some subtests of the verbal battery and those who scored low on the DST also scored low on the verbal battery. (High scores on the DST indicate strong lateralization or left hemisphere dominance for language. Low scores possibly indicate slow lateralization development).

The study on language lateralization in black children has yielded positive results, but the study utilized a relatively limited sample of children ranging between the ages 6 and 8 years. A recommendation is made that further research in a similar trend be undertaken using a large sample and controlling for variables such as intelligence and socio-cultural background. An older sample should also be investigated. An appropriate standardized verbal battery should be constructed so that the results are more valid and reliable .

CHAPTER 1

1. ORIENTATION, MOTIVATION AND OBJECTIVES

1.1 ORIENTATION

Research findings have indicated that the left hemisphere of the brain in most people is dominant for language. The left and right hemispheres do not completely function independently. One hemisphere is affected by the other one through the corpus callosum. Specific areas of the brain are principally stimulated, but monitored by the total cerebral activity (Gaddes, 1980; Corballis, 1983).

Research has indicated that children as early as age three have their left hemispheres lateralized for verbal processing. Lateralization of function or activity in one side of the organism, is a gradual developmental process evidenced in psychomotor development during infancy as the child replaces bilateral movements with unilateral movement (Millers, 1982).

It has also been indicated that in any damage that may affect the left hemisphere before the age of six , the right hemisphere will, through the corpus callosum, compensate for left hemisphere functioning. On the other hand any damage of the left hemisphere after the age of six may lead to a degree of loss of language functions. Examples are various levels of aphasia, dyslexia, or dysgraphia.

An explanatory model for language pathways is proposed by Mac

Farland (1981) which involves these dysfunctions, presented in various levels. Mc Farland (1981) also postulate maturational lags of language lateralization in some of these language dysfunctions.

1.2 MOTIVATION FOR THE PRESENT RESEARCH

To date no study exists which investigates this latter maturational lag of language lateralization as an explanation for language dysfunction in a normal young black population. The present study was motivated by this obvious need to verify the above model.

1.3 FORMULATION OF RESEARCH PROBLEM AND RESULTANT AIM OF THE INVESTIGATION

The general research problem can be formulated as follows:

Are there differences in language ability between two groups of subjects who have various degrees of left hemisphere language lateralization.

The aim of the research can thus be operationally defined as follows:

Do Tsonga boys (of an age when lateralization should be just completed i.e. 6 to 8 years) who differ in levels of lateralization of language functions, as measured by the dichotic stimulation test of Kimura (1964, in Potter and Graves, 1988, p.88), differ statistically significantly in a series of verbal tests namely:

a. Reading fluency
b. Reading comprehension
c. Reading and oral spelling
d. Handwriting
e. Writing and spelling
f. Writing and comprehension
g. Vocabulary

1.4 IMPLEMENTATION VALUE OF THE PRESENT STUDY

Positive research results will be valuable not only for the clinical psychology practitional purposes. Particularly in the black educational system there is a dire need for greater understanding of the functions of an intact brain, a brain that might be slower to mature in terms of lateralization and the damaged brain resulting from head trauma. The present study also opens a new terrain for researchers in South Africa namely the much needed interest in lateralization of function (handedness, footedness, eyedness, language etc.) in black communities and ethnical differences in this regard with particular reference to children. A greater understanding could enhance education and a resultant entrance to the job market and to job creation.

The first chapter investigating literature on the present topic relates to hemispheric asymmetry with particular reference to the left hemisphere.

CHAPTER 2

2. STRUCTURAL AND CHEMICAL HEMISPHERIC ASYMMETRY, LEFT HEMISPHERE FUNCTIONS AND LATERALIZATION

Chapter two presents research findings pertaining to hemispheric asymmetry and lateralization. Special emphasis is placed on the role of the left hemisphere as it relates to language functioning. The primary goal of studies on brain asymmetry, is the better understanding of cerebral dominance in humans and of mechanisms underlying abnormality of functional lateralization (Geschwind and Galaburda, 1984).

2.1 STRUCTURAL AND CHEMICAL HEMISPHERIC ASYMMETRY

2.1.1 ASYMMETRY OF CORTICAL AND SUBCORTICAL AREAS

Structural asymmetry begins to show itself and become measurable by the 29th week of gestation. The imbalance or asymmetry shows an equal sized or larger planum temporal (temporal plane) on the left than on the right at birth in about 90% of cases. This suggests that structural temporal asymmetry precedes speech and language development. This neonatal asymmetry indicates that the infant is born with a pre-programmed biological capacity to process speech sound (Collinge,1990; Gaddes,1980).

Initial studies of structural asymmetry focused on parameters such as hemisphere weight and volume, proportions of grey and white matter, cortical thickness, and differences in cortical folding on the two sides. Erberstaller and Cunning (in Geschwind and Galaburda, 1984), described asymmetries in the Sylvian fissures, finding a consistent difference in the shape of the posterior ends of the sides. The right fissure tends to curl up posteriorly, whereas the left Sylvian fissure leads to the supposition that the temporal and parietal opercula, which create the floor and roof of the posterior portion of the Sylvian fossa, are larger on the left side.

In a later study involving many autopsy specimens Geschwind and Levitsky (1968, in Geschwind and Galaburda, 1984) found that the planum temporal was larger on the left side in 65% of the brains. This area was approximately of equal size in 24% and larger on the right side in 11% of cases.

The findings of various degrees of structural asymmetry in the language areas may support the claim that these anatomical differences underlie variations in the extent of functional lateralization for language. In Broca's area and Wernicke's area for instance, architectonic hemispheric asymmetries vary markedly. In Broca's area architectonic asymmetries fluctuate between 15% and 25% in favour of the left side. It has been proposed that the region which is dominant for a given left hemisphere function, has larger numbers of connections than the corresponding non-dominant area (Geschwind & Galaburda, 1984; Kolb & Whishaw, 1990).

2.1.2 VASCULAR ASYMMETRIES AND FOSSIL EVIDENCE

There are differences of the position of the blood vessels on the two sides of the brain which reflect morphological asymmetries of the hemispheres. The most striking differences are found in the posterior Sylvian region. There is also commonly more bone on the outer margin of the occipital bone on the left than on the right. In the studies of endocasts of skulls of humans, forward extension of the right hemisphere and posterior extension of the left hemisphere have been found to be the most common pattern of asymmetry (Geschwind & Galaburda, 19984; Kolb, & Whishaw, 1990).

2.1.3 VENTRICULAR ASYMMETRY

Bruijn (1959, in Geschwind and Galaburda, 1984), found the left lateral ventricular to be usually wider than the right. His data (N=163) show the midportion of the body of the lateral ventricle, the cella media, to be wider on the left in 67% of cases, wider on the right in 24% of cases and equal on the two sides in 9% of cases. Asymmetries of ventricular size have also been observed in the cerebral ventricles in postmortem studies of cats. Measurements of 200 brains of individuals between the ages of 20 and 90 years showed the left lateral ventricle to be larger in 15% of cases. Last and Thomsette (1953, in Geschwind and Galaburda, 1984), also showed the left lateral ventricle to be usually larger than the right. Computerized axial tomography (CAT) scan studies also show the tendency of the body of the left lateral ventricle to be slightly larger than that of the right (Geschwind & Galaburda, 1984).

2.1.4 CHEMICAL ASYMMETRY

Asymmetry in the content of several transmitter substances have been demonstrated in the human brain. Oke et al. (1978,in

Geschwind and Galaburda, 1984), showed asymmetry in the content of the norepinephrine in the thalamus. In the pulvinar the left hemisphere contains more norepinephrine, whereas the ventrobasal complex of the right side is richer in this neurotransmitter. Amaduci et al. (1981, in Geschwind and Galaburda, 1984), showed that there is greater choline acetyltransferase activity on the left side, and the degree of asymmetry increases in the posterior portion of the superior temporal gyrus, an area involved in language.

2.1.5 DEVELOPMENT OF CEREBRAL ASYMMETRIES

Brain asymmetry is found to be present early in life and reflects biological characteristics that are at least in part independent of postnatal experience. Asymmetry in the planum has been noted in the brains of infants and fetuses. Research which shows a larger left than right lateral thalamic posterior nucleus includes post mortem analyses of the brains of a 4-month-old female, a 4-year-old female, a 6.5-month-old, and an 11-year-old female. Asymmetry has been also demonstrated in the rates of development of the hemispheres. The emergence of cortical folding of the gyri and sulci apparently occurs earlier in the right hemisphere (Corballis, 1983; Eidelberg, 1982).

The larger adult left-hemisphere cortex surrounding the Sylvian fissure illustrates the principle that slowly developing structures in the brain may ultimately become large and better. Thus, although the language region of the left temporal lobe may develop slowly on average, it ultimately reaches greater size and complexity of organization. The more prolonged growth of this area may, on the other hand make it more vulnerable to developmental dyslexia. Unilateral left-hemisphere cortical malformation originating during the period between the 16th and 20th fetal weeks may be a consequence of this vulnerability (Collinge, 1990; Geschwind, 1984).

2.2 LEFT HEMISPHERE FUNCTIONING

2.2.1 THE LEFT HEMISPHERE: INTRODUCTION

The functions of the left hemisphere are mostly verbal and these include the ability to speak, write, hear, and understand verbal representation of any modality. Traditionally these skills have been classified into two groups namely expressive and receptive skills. Research, however has shown that this oversimplification ignores interactions among all language skills. Patients with dysfunction of the left hemisphere may be unable to understand or articulate speech due to an impaired ability to break words into their basic phonemes (Collinge, 1990; Corballis, 1983; Golden,1978).

The left hemisphere is also involved in spatial behaviour, but the involvement is not the same as the right hemisphere. The right hemisphere is concerned with such basic spatial dimensions as slope or direction and the left hemisphere contributes to the ability to cope with complex figures and spatial relationship, especially where some verbal coding is required by the task. Luria (1966, in Charles, 1978) has described a verbal type of spatial ability which is dependent on the left hemisphere. The left hemisphere is believed to be involved in understanding the meaning of such words as **below** or **above** (Charles, 1978; Collinge, 1990).

Having indicated the major role of the left hemisphere in verbal functions, and its minor role in spatial functions, the functional roles of the left hemisphere lobes will now be discussed.

2.2.1.1 LEFT TEMPORAL LOBE

The left temporal lobe is responsible for the analysis and the integration of speech as well as the decoding of language. The left temporal lobe also plays and important role in the phonemic analysis necessary for reading. It is also involved in verbal memory, recall and the integration of auditory and visual information. This area is also involved in the comprehension of speech (Golden, 1978; Kolb & Whishaw, 1990; Luria, 1987).

Damage to this area may cause deficit in verbal memory, and the processing of speech sound. Patients also have deficits in language comprehension. Damage may further cause an inability to recognize or read letters or words, a condition known as dyslexia (Collinge, 1990; Kolb & Whishaw, 1990; Small, 1980).

2.2.1.2 LEFT PARIETAL LOBE

The parietal lobe has a special role in language processes. It specializes in the processing of symbolic-analytic information. It is also involved with speech and writing (Kolb &

Whishaw,1990).

Damage to this area may cause the patient to suffer from agraphia (inability to write), acalculia (inability to perform mathematical operations), dyslexia (difficulties in reading), or dysphasia (errors in grammar). Damage may further affect the patient's ability to recall (for example a person may forget how to add or use any of the skills learned at school or he may be unable to distinguish and understand speech sounds) (Golden, 1978; Kolb & Whishaw, 1990; Luria 1987).

2.2.1.3 LEFT OCCIPITAL LOBE

Disorders of the left occipital lobe may cause an inability to read or recognize letters or numbers and an inability to remember verbal material presented visually. The patient may be better able to appreciate visual forms but be unable to read because of an inability to match visual and phonemic information (Collinge, 1990; Golden,1978).

2.2.1.4 LEFT FRONTAL LOBE

The primary function of the left frontal lobe is to control movement related to language. It also programs speech and images of the words (Golden, 1978; Kolb, & Whishaw, 1990). Lesions of the left frontal lobe may lead to an inability to control speech or the expression of speech, especially when the damage is severe. Such patients may be unable to produce more than a few words beginning with a given letter. The patient may further be unable to act on instructions especially when the instructions are complex or symbolic. The patient may also show extreme memory deficits, especially for verbal material (Kolb & Whishaw, 1990; Luria, 1987; Meccaci,1979).

2.2.1.5 THE RELATIONSHIP BETWEEN BROCA'S AREA AND WERNICKE'S AREA

Broca's area and Wernicke's area are essential for the production of speech and the reception of language (Hecaen and Albert,1978).

Broca's area is in the left frontal lobe and it lies in front of the motor facial area. This area is involved in the production of speech. Wernicke's area lies posterior to the Sylvian fissure and is responsible for the understanding of speech (Berg, Franzen & Wedding,1987; Gianitrapani,1985; Parker,1990).

Wernicke theorized that Broca's area and Wernicke's area must be connected. Such a connection does in fact exist, in the form of a bundle of subcortical nerve fibres. When a person is instructed to speak a certain word, he hears and interprets it in Wernicke's area and then sends the auditory pattern through the connection to Broca's area, where the necessary cortical adjustments are made to enable the person to speak the word correctly (Berg, Franzen & Wedding,1987; Jordaan & Jordaan,1989).

The following aspect to be discussed, namely lateralization, explains the asymmetrical distribution of function in the two cortical hemispheres. Emphasis will be on the left hemisphere.

2.3 LATERALIZATION

2.3.1 LATERALIZATION OF BRAIN FUNCTION

Lateralization of brain function refers to the asymmetrical distribution of function in the two cortical hemispheres. These functions include handedness and footedness, ear dominance, cognitions and emotions. Lateralization may also be defined as the preponderance of one cerebral hemisphere or the other in processing particular functions. Particular functions utilize reciprocal inter-hemispheric release and inhibition of the opposite hemisphere (probably utilizing the corpus callosum). Cognitive processing involves both cerebral hemispheres. Typical right hemisphere performance tasks (nonverbal holistic organization, visual reasoning) are for example performed with the assistance of left hemisphere function such as verbal signals to the self, reasoning, memory, and planning (Corballis,1983; Gianitrapani, 1985; Parker, 1990).

Input and retrieval of different types of sensory information (for example visual or auditory, or verbal versus spatial processing) make different anatomical demands (Corballis, 1983; Parker, 1990).

Currently there are conflicting theories and hypotheses related not only to cerebral dominance and hemispheric specialization but also regarding the onset, development and maturation of brain lateralization. To date there is no firm conclusion as to the nature and cause of cerebral hemispheric asymmetry (Collinge, 1990; Reynolds & Fletcher-Janzen,1989).

2.3.2 SEX DIFFERENCES IN LATERALITY

Recent evidence from a number of neurological studies suggest that women characteristically are more proficient in functions related to the left hemisphere and men are more proficient in functions related to the right hemisphere. McGlone and her associates at the University of Western Ontario (in Gaddes,1980) have carried out investigations that support sex differences in hemispheric specialization (Corballis,1983; Gaddes,1980).

Cerebral dominance for language is established sooner in girls than in boys. Girls were found to pass through the successive stages faster than boys and boys may experience difficulties more frequently than girls in early stages of learning to read. Girls show superiority in verbal fluency that seem to be present from infancy, earlier speech than boys, better articulation, fewer grammatical errors, and the production of longer and more complex sentences (Corballis,1983; Gaddes,1976; Healy et al.1985).

Later studies have also reported female superiority on measures of oral fluency, written word fluency and rapid automized naming. Investigations of sex differences in learning and memory generally has yielded results that parallel findings in other cognitive abilities, that is, women generally show superior verbal memory and men show superior spatial memory (Corballis, 1983; Davis, et al.,1989).

2.3.3 LATERALITY IN HANDEDNESS

Geschwind (1975, in Gaddes,1980), has reported a difference in the angle of the Sylvian fissure in right and left-handed people (the fissure on the right was angled up more sharply in 67% of right-handed subjects) and in the width of the frontal lobes (the right frontal lobe was wider in 70% of right handed subjects).

An interesting theory linking handedness, cerebral dominance and genetic factors is that of Annett (1964, in Corballis, 1983). She proposes that handedness is genetically determined by a dominant gene, and a recessive gene. Dominant homozygotes, that is children who have inherited dominant handedness genes from both parents, are consistently right-handed, with language dominance in the left hemisphere. Genetically these children are pure right handed except when they suffer traumatic brain damage (Corballis,1983; Gaddes,1980).

Handedness seems to be related to speech. Percy (1964, in Lishman, 1978) found evidence that the incidence of dysphasia in right-handed subjects is 67% when the lesion is in the left hemisphere and only 1% when the lesion is right-sided.

2.3.4 AGE AND LATERALIZATION

The research on handedness and hemispheric language representation indicate that age is a variable to be considered in lateralization. Dichotic listening performance was investigated in 234 children in Grades 2, 4, and 6. Right-ear superiority was found to increase with age in right handers and decrease in age in left handers, reaching significance in Grade 6 (Bryden,1970).

Kimura (in Bryden,1970) studied 120 right-handed children between the ages of 4 and 9 and she found right ear superiority at all ages, suggesting that hemispheric dominance is established as early as age four. For some tasks, strategies seem to change over the childhood years. Particularly in visual spatial tasks, young children may deploy a mixed strategy involving both sides of the brain. Older children rely more exclusively on the right hemisphere for visual spatial tasks (Corballis,1983; Reynolds & Fletcher-Hanzen,1989).

Lateralization of function or activity is a gradual developmental process evidenced in psychomotor development during infancy as the child replaces bilateral movements with unilateral movements.

The developmental trend from ambilaterality to differentiation occurs throughout development, with the period of most rapid lateralization before 5 years of age and possibly extending throughout the entire life span (Corballis,1983; Miller,1982).

2.3.5 FUNCTIONAL DEFICITS OF THE LEFT HEMISPHERE AFTER LESIONS AND LATERALITY SHIFTS

Aphasia, signs indicating dysnomia (inability to name objects), dyslexia (reading impairment), dysgraphia (inability to write), or visual-letter dysgnosia (confusion between numbers and letters) are almost always indicative of left brain injury (Corballis, 1983; Wheeler & Reitan, 1962). Dyscalculia (inability to perform arithmetic operations), central dyarthia (slurring of speech) and right-left disorientation (confusion between right and left) are generally indicative of left brain injury but do occur sometimes with lesions lateralized to the right hemisphere. Poor performance on tests of verbal recall is also an indicator of left brain injury (Charles,1978; Kolb & Whishaw,1990).

Laterality shift can occur in cases where lesions occur at an early age. It is known for example that a child born with a defective left temporal lobe, particularly if the defect affects Wernicke's area, will mostly likely have a shift of the language functions to the right hemisphere. This demonstration of plasticity of brain function has however also been demonstrated in adult subjects. For example one study of 25 right handed adult traumatic aphasics (with left hemisphere damage) showed that as they recovered and improved in language use, cerebral dominance gradually became more firmly established in the right hemisphere. This evidence supports a dynamic concept of brain function (Corballis,1983; Kolb & Whishaw,1990).

2.3.6 INTER-HEMISPHERIC FUNCTION

As briefly indicated in paragraph 2.3.1 the two hemispheres work together, possessing a reciprocal and interacting variety of hemispheric specialization functions (Gaddes,1980). The left and right hemispheres do not function completely independently. In any normal healthy brain whatever occurs in one hemisphere is affected by the other one. This influence is mediated largely through the corpus callosum. Kinsbourne (1974, in Gaddes, 1980) has presented a scholarly discussion of the competitive, compensatory, and collaborative effects of the homologous areas of the two hemispheres. In conceptualizing what may be occurring in a learning disabled child's central nervous system when he is reading, writing, or talking, it is useful to remember that the whole brain is stimulated, and monitored by the total cerebral activity. Any damage to the brain, even when outside the language centres and other highly specialized cortical areas, may modify the delicate balances between the cerebral hemispheres (Corballis,1983; Gaddes,1980; Kolb & Whishaw,1990; Obrzut & Hynd,1986).

2.3.7 CONCLUSION

Chapter 2 discussed the development of asymmetry in infants. The left hemisphere and the right hemisphere differ in their functions and structures as well as in brain size.

Theories of aphasia and other dysfunctions such as dyslexia, and dysgraphia are discussed in chapter three. Aphasia is defined as the impairment of the use or the understanding of language due to some type of brain injury or dysfunction. Aphasia is a broad term. When it affects reading it is called dyslexia, and when it affects writing it is called dysgraphia. Chapter three also includes developmental issues related to language attainment. It include stages of language attainment as well as theories of language attainment.

Whereas chapter two explains the role of the left hemisphere in language functioning, and indicates the specific parts of the left hemisphere responsible for different aspects of language functioning, Chapter three explains in more detail what may happen if any part of the left hemisphere's language area is damaged. This then leads on to a particular model to explain developmental language deficits. This model will be empirically tested using normal subjects.

CHAPTER 3

3. LANGUAGE, READING, AND WRITING DISORDERS; AN ANATOMICAL MODEL FOR SPEECH; AN EXPLANATORY MODEL FOR DEVELOPMENTAL DYSLEXIA.

Various aspects of language dysfunction will be discussed in the following chapter. Deficits in spoken language, reading disabilities and writing disorders will lead onto developmental issues related to language attainment. The research findings presented in chapter two, related to hemispheric asymmetry and lateralization, as well as the findings subsequently presented in chapter three, form the background of a theoretical developmental model which explains language disorders. This model will be tested in the present research.

3.1 APHASIA

Aphasia can be defined as the loss or impairment of the use and/or understanding of language due to some type of brain injury or dysfunction. When it affects spoken language it is medically described as aphasia, when it affects reading it is called dyslexia, and when it affects writing it is called dysgraphia. Aphasic patients will often experience reading difficulties which are part and parcel of their more general language impairments (Ellis,1984; Kolb & Whishaw, 1990; Small, 1980).

Various types of language disorders (aphasia) have been described in the literature. These will now be briefly addressed.

3.1.1 RECEPTIVE (WERNICKE'S) APHASIA

Wernicke's aphasia is also known as fluent aphasia, posterior aphasia, sensory or syntactic aphasia. Receptive aphasic children have difficulty understanding what is said to them or remembering specific words they wish to use. The receptive aphasic speech is fluent and mostly manifests normal grammar and articulation but, it sounds like **double talk.** Very little is communicated and much of it is confused. The condition appears to stem from the inability of the person to mobilize the words he or she needs in the correct order, and to attach the appropriate conceptual meaning to them (Collinge, 1990; Gaddes, 1980; Kolb & Whishaw, 1990).

This disorder is characterized primarily by a disorder in reception and comprehension of words. Spontaneous speech output is fluent, or hyperfluent, with an increased rate of words per minute. Comprehension defect, the hallmark of the syndrome, may vary from mild to total comprehension disorder and is seen for both spoken and written language. Typically there is no motor deficit since the lesion is posterior (superior temporal gyrus) (Parker,1990).

3.1.2 CONDUCTION APHASIA

Conduction aphasia is a paradoxical deficit. People with this disorder can speak easily, but cannot repeat words. This disorder involves fluent output, with substitutions of one sound for another (phoneme). There is relatively normal comprehension and reading, but the person experiences severe disability in repetition. Since it is associated with damage to the arcuate fasciculus connecting the auditory receiving area with the motor area, it is considered to reflect a distinct anatomic separation between high level conversational speech, and more rudimentary verbal skills of repetition. The patient may be unable to respond but will stutter and often give up in despair (Collinge, 1990; Kolb & Whishaw, 1990, Mac Farland, 1981; Parker,1990).

3.1.3 TRANSCORTICAL APHASIA

Transcortical aphasia (also sometimes called isolation syndrome), is a type of aphasia in which an individual can repeat and understand words and name objects but cannot speak spontaneously. For example a person may repeat words said to him without understanding them and suddenly stop until the next auditory input. They are also unable to comprehend words although they can still repeat them. Comprehension could be poor because even though the production of words is normal, words are not associated with other cognitive activities in the brain (Kolb & Whishaw,1990).

3.1.4 ANOMIC APHASIA

People with anomic aphasia (sometimes called amnestic aphasia) comprehend speech but have great difficulty in finding the names of objects, for instance, asking a person to name a watch by pointing at it. A person may say **this is used for counting** instead of saying **this is a watch**. This symptom is most likely to result from a lesion in the angular gyrus. All aphasics have naming difficulties (Collinge,1990; Kolb & Whishaw,1990; Mac

make up another eg

Farland,1981).

3.1.5 NONFLUENT APHASIA ("BROCA'S APHASIA")

In Broca's aphasia a person has difficulties in speaking, although he continues to understand uncomplicated speech. Broca's aphasia is also known as motor, expressive, or non-fluent aphasia. This aphasia features patterns of speech in which a person speaks very slowly, in a deliberate manner with very simple grammatical structure. Thus all the forms of a verb are likely to be reduced to the infinitive or the participle. Nouns are most apt to be expressed only in the singular, and conjunctions, adjectives, adverbs, and articles are very uncommon, only the key words necessary for communication are used. Language is sparse, interrupted, awkwardly expressed, and produced with great effort. Patients with this disorder appear to understand speech with little difficulty, but subtle comprehension deficit can be detected. It is associated with a left posterior frontal cortex lesion (not far from the motor cortex), perhaps extending into the insula white matter, and basal ganglia. It is associated with right motor weaknesses including hemiplegia or hemiparesis of the upper extremity. The lesion is typically, though not exclusively, in the inferior gyrus (Ellis, 1984 Kolb & Whishaw; Parker,1990;).

Broca's aphasics experience language comprehension difficulties whether they are reading or listening to speech. In a sentence like **the cat chased the rat**, a patient may understand the meaning of each separate word, and so know that the sentence is about a cat and a rat, and that one chased the other, but because they cannot utilize word order they cannot say which animal is chasing which (Collinge,1990; Ellis,1984; Friederich,1981; Mac Farland,1981).

3.1.6 GLOBAL APHASIA

Global aphasia is a total loss of all sensory and motor functions of communications by speech or writing (Mac Farland, 1981). With this disorder we find that all aspects of language are severely impaired, with the possible exception of articulating a few words or utterances. There is nonfluent output, a severe comprehension deficit, and little or no ability to repeat words, to read, or to write. Most patients with this disorder are hemiplegic (Collinge,1990; Parker,1990).

3.1.7 SUBCORTICAL OR THALAMIC APHASIA

The symptoms of this disorder include mutism, with little spontaneous speech, hemiplegia, and deficits of comprehension, naming, reading and writing. Repetition is usually intact with a tendency for echolalia (nonsensically repeating what is said). In some cases thalamic lesions impair attention, making the patients distractible, leading to incoherent speech when not forced to pay attention (Parker,1990).

3.1.8 JARGON APHASIA

Jargon aphasia is a variety of speech disturbances in which neologisms occur (that is the introduction of new words as is the case with some schizophrenic patients). Some are similar to the jargon words and some are similar to other words used in a nearby context. Still others are phonologically dissimilar to the target but similar to other neologism, words put together in meaningless sequences, which are entirely irrelevant. These strategies and stereotypes, serve the function of concealing inability to retrieve words one desires. The term **jargon aphasia** is also used when speech is produced freely, and clearly, but with such semantic jumble and misuse of words that meaning cannot be discerned (Lishman,1978; Parker,1990).

The following section deals with a related disorder namely dyslexia. A short description of various types of dyslexia (acquired and developmental dyslexia) will be presented.

3.2 DYSLEXIA

The term **dyslexia** is used to designate those children of average intelligence who have a reading disability not attributed to deprived educational opportunities or to extraneous factors. This disorder is independent of fundamental cognitive disabilities which are frequently of constitutional origin (Gordon, 1980; Naude & Bodibe,no date; Parker, 1990; Rutter & Hersou,1987).

Dyslexia may be developmental (defined as of unknown origin) or acquired. Dyslexia is further subdivided into two parts: Deep dyslexia and surface dyslexia. Deep dyslexia refers to difficulties with phonological processing for example nonsense syllables and/or substitution of related words, with some retention of comprehension. Surface dyslexia refers to intact reading of orthographically regular words, but a deficit in reading words with phonological peculiarities (e.g.**tough**). The reader will break up these words (Parker,1990).

Developmental dyslexia is defined as a disorder manifested by difficulties in learning to read despite conventional instruction, adequate intelligence and socio-cultural opportunity. One theoretical approach to the aetiology of developmental dyslexia states that this disorder is genetically determined. Another theoretical approach emphasizes prenatal and perinatal influences. Children who are brain injured prenatally, at birth or up to about the age of two years, constitute the group of developmental dyslexics. Many studies relate to perinatal events as precursors of learning and reading disabilities. Some neurological function or functions mediate perinatal factors and later reading ability. Abnormal conditions have a long term impairing effect to the extent that they have permanently damaged neurological functioning (Gaddes,1980; Kolb & Whishaw, 1990).

In developmental dyslexia children's difficulties are constitutional and not as the result of some primary handicap of the mind or of the senses, or lack of educational opportunity (Young & Tyre,1983).

Children with developmental dyslexia have never been able to read. These children apparently lack or are slow to develop connections between the visual and language areas. In most children the left hemisphere becomes the dominant hemisphere for language by the time reading is taught, but dyslexic children characteristically display left-right confusion in both reading and writing. These children tend to read from left to write, confusing words like **p** and **q** or **b** and **d**. The observations suggest that hemispheric lateralization is either absent or slow to develop in dyslexics. Some dyslexic children do outgrow the disorder. Maybe for those who do not outgrow it, a critical period for lateralization has passed by the time the visual-language area connections become functional (Mac Farland,1981).

The term acquired dyslexia was first used by the medical profession to describe the reading and spelling difficulties of patients who had suffered a certain sort of brain damage. The brain damage may have been caused by accidents or wars, as the result of tumours, strokes, psychiatric disorders, drugs or the effects of aging. Acquired dyslexia is not a disease, but a term used to describe the symptom of damage to the brain: some patients have difficulties only in reading and spelling long and unusual words: some will have difficulties in reading aloud; others will read aloud but fail to understand what they have read. In short, acquired dyslexia can be defined as loss or impairment of the ability to read as the result of damage to the brain (Young & Tyre,1983).

Dyslexia is a broad field of study and it has been discussed in detail by many authors. A detailed study on dyslexia is beyond the scope of this research, however, a short description of a number of types of dyslexia will be discussed in the following sections.

3.2.1 DEVELOPMENTAL DEEP DYSLEXIA

Developmental deep dyslexics are better at reading concrete words aloud than they will do with abstract words. They are slower in reading non-words. They make semantic errors such as misreading **corn** as **wheat**, **locomotive** as **engine**, and **dog** as **cat**. Visual errors and derivational substitutions occur in developmental deep dyslexia. It is often found that concrete nouns are read better than adjectives, verbs, or abstracts nouns. There is some reliance, according to some researchers, on imageability, concreteness, and word frequency. Finally there is context effect, in that subjects with this syndrome can use context clues as an aid to word recognition (Ellis,1984; Obrzut & Hynd,1986).

3.2.2 DEVELOPMENTAL SURFACE DYSLEXIA

The reading of someone with developmental surface dyslexia is characterized by an intact ability to read phonologically regular words, and even nonwords, but an inability or difficulty reading irregular words. These dyslexics find whole-word recognition essentially unavailable. They have difficulties in comprehension. Understanding can only occur after each word has been phonologically decoded. Developmental surface dyslexics read predominantly phonically, and frequently arrive at a word on the basis of its sound rather than its appearance. Often the phonic form of the word from which its sound is generated is achieved by breaking the form of word from its letters or letter groups, to which analogies or correspondence are then applied. This strategy results in typical errors for example, regularizing **bread** to **breed** and **island** to **izland**, or failing to lengthen the vowel for example **describe** stated as **dicrib**, **check** as **C.H.E.C.H.** (Ellis,1984; Obrzud & Hynd,1986).

3.2.3 DEVELOPMENTAL PHONOLOGICAL DYSLEXIA

This syndrome is characterized by the ability to read familiar words well (essentially nouns) but difficulty with phoneme-grapheme correspondence, that is the application of the phonetic system. These types of dyslexics rely to a very large extent on direct visual word recognition. They read irregular words, but they are very poor at pronouncing unfamiliar words or non-words. Such dyslexic are good at reading irregular words as well as regular words, though they make visual errors (for example **cheery** read as **cherry**, **bouquet** as **boutique**, and **attractive** as **achieve**), and derivational errors (for example **cautious** as **caution**, **appeared** as **appearance** and **smoulder** as **smouldering** (Ellis,1984; Obrzut & Hynd,1986).

3.2.4 DEVELOPMENTAL LETTER-BY-LETTER (SPELLING) DYSLEXIA

The reading of these children is slow and tortuous and they frequently resort to saying the letter names aloud or to themselves before identifying a word. They have either lost access to the visual word recognition system or had lost that system itself and are as a consequence, obliged to read by using a graphemic code to trigger graphemic word production units in the spelling system. They experience great difficulty in forming visual word recognition units. They can recognize few words "by sight" through the triggering of hard-word recognition units (Ellis,1984).

3.2.5 ACQUIRED VISUAL DYSLEXIA

Case studies of acquired visual dyslexia have demonstrated that different patients will make different sorts of visual errors, presumably because different parts of the visual route to word meanings are impaired in these patients. Allport (1977, in Naude and Bodibe, no date) observed how normal subjects will make **visual segmentation errors** when shown two or more words simultaneously but briefly ("for example, reporting **glade** when shown **glove** and **spade**"). Visual dyslexic children also have difficulties in the following areas:

a. translating written letters into sounds.
b. translating visual symbols into meaning.
c. differentiating between two similar written letters for example **b** and **d**.
d. learning to read whole words as well as pronounce letters.
e. omitting letters for example read **mit** for **might** (Naude and Bodibe,no date).

3.2.6 ACQUIRED PHONOLOGICAL DYSLEXIA

Acquired phonological dyslexics have difficulties in reading nonwords rather than real words with ease. They are also very poor at reading familiar words aloud with ease. Their symptoms suggest a substitution loss of the capacity for letter-to-phoneme conversion despite of which they successfully read familiar words aloud. The acquired phonological dyslexic would sometimes misread function words or make derivational errors, such as misreading **applaud** as **applause**, recent as **recently** and **fall** as **failure** (Ellis,1984).

3.2.7 ACQUIRED SURFACE DYSLEXIA

Acquired surface dyslexics often appear not to recognize a word as a whole but resort to a strategy of "sounding out" in order to assemble pronunciation for the word. They are more likely to read aloud regular words than irregular words. For example, a patient reported by Shallice and Warrington (1980, in Ellis 1984) read correctly thirty-six out of thirty-nine regular words. The errors made by surface dyslexics often look like unsuccessful attempts to assemble pronunciation. Sometimes the errors are nonwords as when the patient reads **island** as **izland**, **sugar** as **suger**, **recent** as **rikunt**, or **broad** as **brode**. Sometimes the errors are other real words for example when a patient reads **disease** as **decease**, **guest** as **just**, **phase** as **face**, or **grid** as **grinned.** Patients with this disorder also have problems with irregular words, and problems with homophones (Ellis,1984).

3.2.8 ACQUIRED DEEP DYSLEXIA

Acquired deep dyslexics find concrete words like **baby**, **church**, or **table**, which have concrete, imaginable referents, easier to read than abstract words like **belief**, **truth**, or **justice**. Like the phonological dyslexic, deep dyslexics also find new nonwords virtually impossible to read aloud. They make several types of reading errors. First and most striking are the semantic errors such as misreading **ape** as **monkey**, **forest** as **tree**, or **belief** as **pray**. Secondly there are visual errors reminiscent of those made by visual dyslexic and surface dyslexics (for example reading **soul** as **soup**, or **signal** as **single**), Thirdly there are derivational errors (e.g. **lovely** read as **loving** and **builder** as **building**). Lastly there are function word substitutions (e.g. reading **his** as **in** or **quiet** as **perhaps**). In deep dyslexics the left hemisphere reading processes have been completely destroyed (Ellis,1984; Saffran, 1980).

3.2.9 ACQUIRED AUDITORY DYSLEXIA

Acquired auditory dyslexics have difficulty translating sound into meaning. They cannot discriminate between similar sounds for example **mat** and **rat** when the words are presented orally. They also have difficulties in remembering oral commands and they have difficulties blending letters into whole words. Lastly they lack phonetic skills (Naude and Bodibe, no date).

The next section is about dysgraphia. It explains the issue of language disorder in terms of writing. In this section dysgraphia will be defined and the relationship between psychomotor disorders, ataxia and apraxia will be indicated and finally a short description of the different types of dysgraphia will be given.

3.3 DYSGRAPHIA

3.3.1 DEFINITION OF DYSGRAPHIA

The term **dysgraphia** can be defined as an inability to write properly or to express oneself through writing. The term is reserved for cases brought about through brain damage (Golden,1978; Rebber,1985).

3.3.2 PSYCHOMOTOR DISORDERS AND DYSGRAPHIA

Paralysis of the dominant hand, which may be due to left-hemisphere damage or peripheral injury, forces the child to write with his non-dominant hand. Since control must now travel from the dominant hemisphere through the corpus callosum to the motor strip of the non-dominant hemisphere and then down the pyramidal tracts to the non-dominant hand, writing with this hand usually is less fluent and more awkward. Children forced to write with the non-dominant hand for any reason including paralysis, are likely to be dysgraphic. Those who continue to write with the affected hand, because the paralysis is mild, will likely be dysgraphic because of the minimal motor interference (Gaddes,1980).

3.3.3 THE RELATIONSHIP BETWEEN CEREBRAL ATAXIA AND DYSGRAPHIA

Cerebral ataxia is a condition of neuromuscular coordination that may affect any motor activity, including walking and manipulating small objects. When it affects the hands, the legibility of writing may be impaired, although the spelling and sentence structure may be normal (Gaddes,1980).

3.3.4 DYSGRAPHIA DUE TO MOTOR APRAXIA

This disorder is believed to be due to loss of the kinaesthetic memory patterns necessary for the performance of the skilled act. This form of apraxia usually affects the finer movements of one's upper extremity, movements such as doing up buttons, opening a safety pin or placing a letter in an envelope.

Ideomotor apraxia is a condition in which the patient finds it difficult to carry out an action on verbal command with either hand but may do so automatically. He is usually unable to imitate actions that are demonstrated to him (Walsh,1987).

3.3.5 DYSGRAPHIA DUE TO DELAYED VISUAL FEEDBACK

Delayed visual feedback can produce a transient dysgraphia by introducing an abnormal delay between the act of writing and the appearance of the script (Gaddes,1980).

3.3.6 VARIETIES OF DYSGRAPHIA

3.3.6.1 PHONOLOGICAL DYSGRAPHIA

Shallice (1981, in Ellis, 1984), reported a patient who could spell correctly more than 90% of dictated real words but who could hardly produce plausible spelling for any nonwords. This was not because he could not hear or say the nonword he was asked to spell, since he could repeat spoken nonwords without difficulty. He could also successfully read aloud a fair proportion of written nonwords. The dysgraphia, therefore, was more or less specific to the process of assembling spellings phonically from pronunciations. Shallice calls this **phonological dysgraphia** because of its obvious similarity to phonological dyslexia. Phonological dysgraphics cannot assemble spellings from sounds yet can spell the great majority of words of which spellings had been learned before the stroke or other injury.

Shallice (1981, in Ellis, 1984), argues that phonological dysgraphic patients retain their graphemic word production system though they had lost the capacity to assemble spellings phonically. The fact that they can still spell even highly predictable words like **lunch**, **thing**, and **spent** shows that the graphemic word production system stores all familiar spellings, not just those of irregular or unpredictable words. They have impaired phonic route but can still spell by their direct route (Ellis,1984).

3.3.6.2 DEEP DYSGRAPHIA

Deep dysgraphics are unable to assemble spellings from pronunciations (same as phonological dysgraphia). Here, however the noteworthy is that semantic writing errors are made. They make semantic errors when reading (e.g. reading **gnome** as **pixie**). They also make semantic errors when attempting to spell words for example when asked to write **star** a certain patient wrote **moon** and when asked to write **bun** he then wrote **cake**. These patients are poor on function words and nouns, as well as poor at writing nonwords to dictation. They also make derivational spelling errors (e.g. **tap** spelled as **TAPS**). The inability of deep dyslexics to spell nonwords indicates a loss of the capacity for phonically assembled spelling (Ellis,1984).

3.3.6.3 SURFACE DYSGRAPHIA

Surface dysgraphics make errors when trying to spell real words which would have caused no difficulties before a stroke. Surface dysgraphics appear to have an impaired graphemic word production system and therefore are obliged to use the phoneme to grapheme conversion system. When they try to spell irregular words correctly they may, for example spell **borough** as **purough, sword** as **sward**. They are not always able to retrieve a word spelling in full from their graphemic word production system but they can sometimes retrieve part of its spelling. They also experience impaired direct spelling route and consequently rely heavily on the phonic route (Ellis,1984).

3.3.6.4 AMNESTIC DYSGRAPHIA

Amnestic dysgraphia is when both routes are incapacitated. These patients appear to have lost the ability to convert meanings or sounds into spellings either directly from the graphemic word production system or phonically via pronunciations. Thus they combine the deficits of both surface dysgraphia and phonological dysgraphia. However amnestic dysgraphics still know the shapes of letters and can execute them proficiently (Ellis,1984).

The previous section discussed dysgraphia and how it affects the writing of language. Section 3.4 explicates the development of language attainment. The development of language attainment is appropriate in this study because it explains the development of language under normal circumstances (that is without language impairment such as aphasia, dyslexia, or dysgraphia).

3.4 DEVELOPMENTAL ISSUES IN LANGUAGE ATTAINMENT

Learning a language is one of the most fascinating and significant developmental tasks a child has to master. Infants are able to understand adult's speech even though they cannot talk themselves (the baby can understand language before he is able to speak it). For the first two months of life babies' cries and grunts are common. They can distinguish between voices and other sounds. Cooing begins at about three months of age, babbling emerges at approximately four months of age, and progressively becomes more like human speech. The number of distinct sounds increase and intonation emerges. Children typically say their first words near their first birthdays. In the year that follows the size of their vocabularies increase dramatically (Frazier & De Villiers,1990; Liebert, Wicks-Nelson & Kail,1986; Louw,1991; Mecacci,1979).

Not long after the first birthday, children produce two-word sentences that seem to be formulas for expressing ideas or needs. As children gradually learn rules that govern the use of grammatical morphemes like prepositions, articles, and auxiliary verbs, their sentences become longer and more sophisticated. They first learn simple grammatical morphemes and later more complex forms. Laboratory research has indicated that experience can be an important factor in language learning. Adults speak to children in ways that should help children to learn language. Beginning in the preschool years, children gradually become much more skilled at constructing efficient messages. They are able to consider the needs of listeners. They become skilled in the use of indirect methods of communicating. They become able to determine if a message is vague or ambiguous (Frazier & De Villiers,1990; Liebert, Wicks-Nelson & Kail,1986).

3.4.1 PHASES OF PRE-LINGUISTIC SPEECH AS FORMS OF COMMUNICATION

During the first year and a half to two years of postnatal life, until they have learned enough words to use as a form of communication, babies use four pre-speech forms of communication, namely crying, explosive sounds which soon develop into babbling; gestures; and emotional expressions. Of these four, the second, namely babbling is the most important in speech development because it becomes the basis for real speech (Hurlock,1978; Louw,1991; Mecacci,1979).

The following paragraphs are about the four forms of pre-speech communication, and they will be briefly discussed.

3.4.1.1 CRYING

During this phase the baby uses crying almost exclusively as a signal of his needs. In the early stage of postnatal life, most vocalization consists of crying. Crying is one of the first ways in which the infant is able to communicate with the world at large. Through cries, babies make known their need for someone to relieve their hunger, pain, fatigue, and their unpleasant bodily states and to satisfy their desire for attention. Comprehension of the meaning of cries is aided by the intensity of the cries and by bodily movements that accompany crying. The louder and the more persistent the cry, the stronger the baby's need. A very hungry baby, for example will have a louder and more persistent cry than a baby who is less hungry. This of course, does not imply that anyone who hears the crying will be able to associate each kind of crying with a particular need, but research does indicate that it is the mother particularly who is able to make such distinctions (Erickson,1982; Hurlock,1978; Louw,1991).

3.4.1.2 COOING AND BABBLING

The second pre-speech form of communication is called **cooing** and **babbling**. In addition to cries, babies may make simply sounds during the early months of life, such as grunts of pain or disgust, squeals of delight, yawns, sneezes, sighs, belching, coughing, barking sounds, growls, and cries that sound like the whine of young pig or the bleat of a goat. These are known as cooing. As the baby's neuromuscular mechanisms develop explosive sounds change into babbling. Cooing refers to the squealing-gurgling sounds a baby emits when he is happy, satisfied or even excited. Many of these cooing sounds will disappear, but some will develop into babbling and still later into sounds (Hurlock,1978; Louw,1991).

Babbling refers to the simple repetition of consonant or vowel sounds, for example **da-da-da-da-da** or **ma-ma-ma-ma-ma**. Gradually the number of sounds the baby can produce increases. There is, as well, an increasing definiteness of utterance of various sounds. At first vowels are combined with consonants, for example, **da**, **ma**, **ugh** or **na**. Later with practice, vocal control makes it possible for the baby to repeat these sounds by striking them together as in **ma-ma-ma-ma** or **ugh-ugu-ugh**. This is real **babbling** or **lulling**. The baby repeats sounds and words he has heard. Babbling is a verbal practice that lays the foundations for developing the skilled movements required in speech. Through babbling the baby will eventually learn to speak. Babbling hastens the learning process by providing the basic skills needed to control the vocal mechanism for more highly complicated speech (Erickson,1982; Hurlock,1978; Louw,1991).

3.4.1.3 GESTURES

This third preliminary form of communication consists of movements of the limbs or the body which serve as substitutes for, or supplements to speech. As a substitute, gestures take the place of words; an idea is conveyed to others by meaningful movements of the limbs or some part of the body. As a supplement to speech, gestures emphasize the meaning of spoken words. Unlike babbling, which is fundamentally a form of play, gestures have the serious purpose of communication, just as crying has (Hurlock,1978; Mecacci,1979).

3.4.1.4 EMOTIONAL EXPRESSION

The fourth pre-speech form of communication is the expression of emotions through facial and bodily changes. The pleasant emotions are accompanied by pleasant vocalization in the form of cooing, chuckling sounds, and laughs, while the unpleasant emotions are accompanied by whimpering and crying. When babies are happy for example, they relax their bodies, wave their arms and legs, and smiles appear on their faces. This is accompanied by pleasant vocal sounds. By contrast anger is expressed by tensing their bodies, by slashing movements of the arms and legs, by tense expressions on their faces or by cries of anger. Like gestures, emotional expressions continue to be a useful form ofcommunication even after children have learned to speak (Hurlock,1978).

3.4.2 THE WAY CHILDREN LEARN TO SPEAK

3.4.2.1 METHODS OF LEARNING

Learning to speak is a skill and like all skills, it can be learnt by different methods. Children learn to speak by trial and error or by imitating a model, but learning through training is more effective (Hurlock,1978).

In training children are not given only a good model to imitate but also receive guidance and help in following the model accurately. They are taught how to pronounce as well as on how to associate meaning with words (Frazier & De Villiers, 1990; Hurlock,1978).

3.4.3 FACTORS THAT AFFECT THE LEARNING OF SPEECH

Speech depends on motor and mental development. From 18 months to 4 or 5 years of age, children master the ability to speak but they have much more to learn before they reach adult language competence. Inspite of the fact that children learn to speak in a predictable pattern, there are individual differences in the rate with which they follow this pattern, the size and quality of their vocabularies, and the correctness of pronunciation of their speech.

There are a number of conditions contributing to those variations:

a. Health: healthy children learn to talk sooner than those who are unhealthy because they have a stronger motivation to be members of a social group and to communicate with the members of the group.

b. Intelligence: Children with high I.Qs learn to talk early and show a marked linguistic superiority over those of lower intellectual level.

c. Socioeconomic Status: Children from the higher socioeconomic group learn to talk earlier than those from the lower socioeconomic groups. This is mainly because those from the higher groups are given better encouragement to take more guidance in learning how to do so.

d. Sex: Boys as a group, lag behind girls, as a group, in learning to talk. At every age boys' sentences are shorter and less grammatically correct, their vocabularies , and their pronunciations are less accurate than girls'.

e. Desire to communicate: The stronger the desire to communicate with others, the stronger will there be motivation for the child to spend the time and effort needed for this learning.

f. Stimulation: The more children are stimulated to talk, by being talked to and being encouraged to respond, the earlier they will learn to talk and the better the quality of their speech.

g. Size of family: An only child or a child from a small family usually speaks earlier and better than children from large families because parents can give more time to teaching them to speak.

h. Personality: Well adjusted children tend to speak better, both qualitatively and quantitatively than those who are poorly adjusted (Hurlock,1978; Mecacci,1979).

3.4.4 MAJOR TASKS IN LEARNING TO SPEAK

Learning to speak involves three separate and yet interrelated processes: learning to pronounce words, building a vocabulary and forming sentences. Because these processes are interrelated failure to master one of them will jeopardize the whole speech pattern (Collinge,1978; Hurlock,1978; Mecacci,1979).

3.4.4.1 PRONUNCIATION

The first task in learning to speak is learning to pronounce words. Pronunciation is learned by imitation. At about 8 or 9 months of age infants begin their attempt to imitate the speech sound of others. This is the time when many infants learn to wave and say **bye-bye** in imitation. Their comprehension of language also becomes more readily apparent in that they respond appropriately to specific words or phrases. For example an infant may reach for or look at a **ball** when hearing the word **ball** (Erickson,1982; Frazier & De Villiers, 1990).

3.4.4.2 VOCABULARY BUILDING

The second task in learning to speak is vocabulary building. In vocabulary building, children must learn to associate meaning with sounds. After children enter school, their vocabulary grows rapidly, owing to direct teaching, new experiences, leisure reading, and radio and television listening. It has been estimated that the average first grader knows between 20,000 and 24,000 words, or 5 to 6 percent of the words in a standard dictionary. The six grader knows approximately 50,000 words, and the child entering high school about 80,000 words or 22 percent of the words in a standard dictionary (Hurlock, 1978). Between the ages of 3 and 7 years a child's speech productions increasingly approximate those of adults. By about 8 years of age a child's use of syntax closely matches that of adults and lacks only the nuances of complex sentence production (Erickson,1982; Frazier & De Villiers, 1990; Meccaci,1979).

3.4.4.3 SENTENCE FORMATION

The third task in learning to speak is combining words into sentences that are grammatically correct and can be understood. At first, children use one-word sentences consisting of a noun or verb which, when combined with a gesture, expresses a complete thought. Saying **give** and pointing to a toy means, for example, **give me the toy**. Children use single-word sentences from approximately 12 to 18 months of age. Two-year-olds combine words into short, often incomplete sentences combining one or two nouns, a verb, and occasionally an adjective or adverb. They simply omit prepositions. Typical sentences are nearly complete in that all parts of speech are used. During this stage of sentence formation the baby begins to speak intelligible words; he uses them deliberately to communicate with other people. However his speech is initially holophrastic, that is, single words are used to convey complex ideas (the term **single-word-sentence** is also used in this connection). Thus the single word **mama** can convey various wishes to the mother, for example **I am hungry** or **I want my mama** or **Take me out of my cot** (Collinge,1978; Hurlock,1978; Louw,1991).

Based on existing knowledge of various language deficits as explicated in sections 3.1 to 3.3, Mac Farland (1981) proposes an anatomical model for speech, which will be briefly presented in the next section. This is followed by an explanatory theoretical approach to developmental dyslexia relevant to the present research.

3.5 AN ANATOMICAL MODEL FOR SPEECH

Mac Farland (1981) depicts a simple anatomical model for speech in the left hemisphere, based on similar information as that presented in section 3.1 (APHASIA). (See the next page)

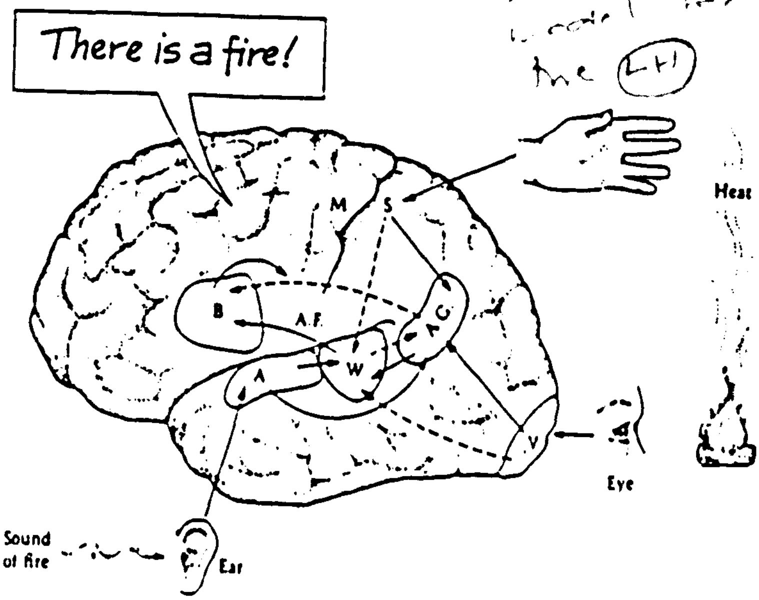

FIGURE 3.1 PATHWAYS FOR LANGUAGE. (Mac Farland,1981,p355) Known (solid lines) and hypothetical (dotted lines) pathways for language are shown. (A = auditory area, V = visual area, S = somatosensory area, M = motor area, AG = angular gyrus, W = Wenrnicke's area, B = Broca's area, af = arcuate fasciculus.)

Figure 3.1 summarizes the known central nervous system (CNS) and pathways responsible for language skills and it also presents educated guesses about the existence and functions of other possible pathways. For example, the figure shows the arcuate fasciculus as essential for repeating words. The figure also shows between Wernicke's and Broca's area a possible alternate pathway whose route and functions have been inferred from the behaviour of conduction aphasics when they attempt the repetition task.

According to the model, the speech process begins with auditory

(A), visual (V), somatosensory (S), gustatory, or olfactory sensation or with an idea or thought that may in turn arouse sensory imagery. Outputs from S, V, and A areas interact in association areas such as the angular gyrus (AG). Mac Farland (1981) thinks that it is in such areas that interactions among sensory inputs arouse neural representations of linguistic units that are associated with sensory inputs.

Mac Farland (1981) further argues that neural output from the AG to Wernicke's area (W) evokes activity in this area, which results in a decision being made as to exactly which of the possible key words or phrases are relevant in the frame of reference in which the stimuli occurred. The neural analogues of these key words and phrases are relayed to Broca's area (B) via the arcuate fasciculus (AF). Neural activity in B leads to the words and phrases being properly ordered, connected and, and embellished with correct syntax. Finaly the ordered neural commands issue from B to motor areas for speech articulation.

Cutting the arcuate fasciculus would break the A-W-AF-B circuit and interfere with repetition. This model postulates an indirect A-W-AG-B connection whereby attempts to repeat a word will result (as in conduction aphasia) in speaking associations of that word with visual or perhaps somatosensory information.

Isolating the A-W-AF-B axis from the rest of the cortex would result in transcortical aphasia in which almost the only remaining language skill is repetition (conduction aphasia and transcortical aphasia was discussed in section 3.1.2 and 3.1.3).

Hypothetical connections S-W and V-W are postulated to explain how visual and somatosensory stimuli can arouse speech even in the absence of the angular gyrus. These inferred pathways are hypothesized to produce insufficient integration of perceptual and ideational information to allow for the rich associations that are essential to talk about stimuli in the abstract (e.g., to assign the correct name to an object independently of talking about its function or appearance).

-Damage to the angular gyrus may cause anomia.
-Damage to Wernicke's area may cause inappropriateness or irrelevant associations.
-Damage to Broca's area can cause articulation difficulty and poor grammar.

3.6 AN EXPLANATORY MODEL FOR DEVELOPMENTAL DYSLEXIA

Based on the above anatomical model for speech, it seems reasonable that reading disorders would relate to minor or major deficits (chemicals or structural) in the V-AG-B loop. Mac Farland (1981) adds an additional explanatory issue to developmental dyslexia namely slow lateralization of brain functions, resulting in the typical left-right confusion of the dyslexic child in reading as well as writing:

As indicated in Chapter two, in most children the left hemisphere becomes the dominant hemisphere for language functions by the time reading is taught, but dyslexic children characteristically display left-right confusion in both reading and writing. They read from right to left as often as from left to right, confusing words like **was**, instead **saw**, **d** instead of **b**, **p** instead of **q**: see section 3.2 (p20). These observations suggest that hemispheric specialization is either absent or slow to develop in dyslexics. (The hemispheres compete with each other, and visuospatial activity, including reading and writing, works as well in either direction).

Mac Farland (1981) expounds on this idea by proposing that lateralization is possibly slow to develop because of the slow maturation of the pathways from the visual to the language area (V-AG-B). He says: "Perhaps neural activity from the visual area is necessary to entrain the left hemisphere language areas and cause them to become dominant. If so, when the pathways finally develop, hemispheric lateralization should occur and the dyslexic symptoms should be alleviated"(p 357-358). It has indeed been shown that some dyslexic children do outgrow their disorder. Mac Farland (1981) maintains that in those who do not outgrow it, a critical period for lateralization has passed by the time the visual-language connections become functional.

3.7 CHAPTER SUMMARY.

In the preceding chapter (Chapter two) it was indicated that there are firm empirical grounds for hemispheric asymmetry, whereafter the left hemisphere's language functions were discussed. Lateralization of brain functions exists but age and gender are variables to be considered. In the light of this information, Chapter three focused on language deficits, leading to a model for speech and an explanatory approach to developmental dyslexia.

The latter explanatory model is a focuspoint of the present study. The empirical procedure will be explicated in Chapter four.

CHAPTER 4

4. EMPIRICAL INVESTIGATION

This chapter focuses on empirical procedures of the study in question. The chapter will explain the reasons behind the investigation. The procedures followed in the selection of subjects will be discussed and the research instruments will be briefly described. The validity and the reliability of the testing instruments will also be described. The main hypothesis and statistical analysis to be used are described.

4.1 GENERAL AIM

In the preceding chapters, mention has been made from time to time of voids in the research literature which lead to the present general research question. Paragraph 2.3.1 for example states that there are conflicting theories and hypotheses related not only to cerebral dominance and hemispheric specialization but also regarding the onset, development and maturation of brain lateralization. Paragraph 2.3.4 points to age as a variable in lateralization, emphasizing that lateralization of function is a gradual developmental process. Paragraph 3.5 explicates a model for speech and paragraph 3.6 explicates a model for dyslexia. The question arises from the model, whether slow and/or incomplete lateralization in **normal** children will also lead to speech, reading and writing deficits. The present study aims to answer this question.

4.2 SPECIFIC AIM

The above general research question can be specified as follows: Do Tsonga boys children (of an age when lateralization should be just completed i.e. 6 to 8 years) who differ in levels of lateralization of language functions, as measured by the Dichotic stimulation test of Kimura (1964, in Potter and Graves, 1988, p,88), differ statistically significantly in a series of verbal tests namely:

a. Reading fluency
b. Reading comprehension
c. Reading and oral spelling
d. Handwriting
e.Writing and spelling
f. Writing and comprehension
g. Vocabulary

The specific aim of the research is to answer this question.

4.3 MOTIVATION FOR INVESTIGATION

Numerous studies in lateralization have been done. These studies included children, adolescents, as well as adults. The dichotic listening technique was predominantly used as testing instrument to measure the degree of language lateralization. Subjects however have been consistently whites and asians. No studies to date exist to verify the findings in black races. Hence this study is directed towards the exploration of language lateralization in black children and recommendations are made for this study to be done in black adolescents and adults.

4.4 SELECTION OF SUBJECTS

Righthanded and rightfooted Tsonga boys aged 6 - 8 years in Sub Standard A and B of a similar socioeconomic background were the target population for the present research. The reason why only boys were selected is that there is literature indicating that cortical maturity in boys and girls present at different ages. Research quoted in the previous chapters has shown that in the first three grades cerebral dominance for language seems to be established sooner in girls than in boys (Gaddes, 1976). A sample of 66 boys was selected from two classes in Sub Standard A and in Sub Standard B.

Only righthanded and rightfooted subjects were selected as a final sample for the investigation of language lateralization in children. The importance of selecting righthanded and rightfooted children is supported by research (Kimura, 1964 in Potter and Graves, 1988). Kimura studied 120 right handed children between the ages 4 and 9. She found a right-ear superiority at all ages, which was the final selection criterium for the present study: The present study planned to divide the subjects into <u>strong</u> versus <u>weak</u> right-ear (i.e left hemisphere) superiority groups. The procedure for the measurement of handedness and footedness was done in the following ways: Each boy was asked to stand in an open space in a class and a tennis ball was thrown towards him to kick. The aim was to find out which leg he prefered to kick the ball with. This exercise was done twice for reliability.

Another exercise was on handedness. With this exercise each boy was given a pencil and a piece of paper to write his name, and this exercise was also done twice. After each boy had completed the exercise he was asked why he preferred a certain hand or leg for writing and kicking. The aim was to eliminate accidental recordings. After everyone had been given a chance to write and kick the ball it was found that 63 boys preferred their right hands and right legs for kicking and writing and only 3 preferred their left legs and their left hands. There were no ambidexterous subjects.

An attempt was also made to select the sample to be similar in socio-economic background. This was done by asking teachers questions about every child in the class. This information was not truly reliable because teachers did not have enough information about the children.

I.Q scores would have been used as additional information in the selection of the subjects. Unfortunately children in that school were never tested for I.Q. No ED. LAB. files exist for these children and practical constraints prohibited additional testing. Kerlinger (1988) emphasizes this control of extraneous variables, which means that the influences of independent variables extraneous to the purpose of the study are minimized, nullified, or isolated.

4.5 SELECTION INSTRUMENT

4.5.1 DICHOTIC LISTENING TECHNIQUE (DST)

The 63 righthanded and rightfooted boys subsequently underwent individual testing by means of Kimura's (1964) Dichotic listening testing in order to ascertain their degree of language lateralization. 29 boys had high DST scores and 34 boys had low DST scores. A discussion of this test follows. The raw data for the DST are reported in Appendix A. An example of a DST scoring sheet is included.

Pupils who scored 24 or above, were regarded as strong left hemisphere language dominant, whereas pupils with scores of below 24, were regarded as weak left hemisphere language dominant. The highest possible score was 40. The mean of the group with high DST scores was 28.868. The mean of the group with low DST scores was 16.2.

The dichotic listening technique is used for the assessment of hemispheric language dominance. This test instrument offers an unprecedented opportunity to study brain-behaviour relationships in neurologically intact listeners and to assess whether various clinical populations deviate from the norm with respect to lateral organization (Niccum and Speaks,1990).

The dichotic listening task involves presenting subjects with two different auditory stimuli simultaneously, one to each ear. Doreen Kimura employed this procedure, using spoken digits as stimuli, with subjects known to have damage to either the left or the right temporal lobe. Each trial consisted of three pairs of dichotic digits presented in rapid succession. Immediately afterwards, subjects were asked to recall as many of the six digits as possible, in any order. Kimura found that patients with lesions in the left temporal lobe identified fewer digits than patients with right temporal lobe lesion. This in itself was not a surprising finding, since considerable clinical evidence has pointed out the role of the left hemisphere in the production and processing of speech in most righthanders. Quite unexpected, however, was the observation that subjects typically reported items presented to the right ear more accurately, regardless of which hemisphere was damaged. Moreover, Kimura demonstrated that this right ear advantage occurred in neurologically normal subjects as well (Springer, 1986).

Kimura noted that when different verbal stimuli were presented simultaneously to the ears, listeners with intact brains were also more accurate at identifying stimuli presented to the right ear. She theorized that the right ear stimuli were perceived more accurately because language processing took place in the left-hemisphere. This was possible since contralateral pathways were functionally stronger than ipsilateral pathways. In support of this theory, Kimura was able to show that a group of listeners who were classified as left-hemisphere dominant for language processing on the basis of sodium amytal tests had a mean right ear advantage on a verbal listening test. Kimura later added further support for the theory when she demonstrated a disassociation between the direction of ear advantage obtained on the verbal test which differentially engaged the left hemisphere processing mechanism, and a dichotic melodies test, which is assumed to engage right hemisphere processing mechanisms. Fifteen of the twenty listeners had high scores of these findings. Kimura concluded that the hemisphere that was dominant for processing a particular class of stimuli was the one contralateral to the ear,presenting with higher score on a dichotic listening test (Springer,1986).

The most direct evidence supporting this model of ear asymmetry, however has come from dichotic testing of the so called **split brain** patients, who have undergone surgery to section all or part of the fibres connecting the two hemispheres as a treatment for epilepsy. In one study two such patients, known to have speech controlled by the left-hemisphere were tested with dichotic consonant vowel syllables presented in single pairs. These stimuli have previously been known to yield a right ear advantage in neurologically normal right handed subjects. The six possible syllables were presented on a card in full view of patients and administered twice, once with left-handed responses and twice with right-handed responses. Patients were able to identify the items presented to the right ear with an overall accuracy of 85 out of 96 (Springer,1986).

Various verbal stimuli can be used in the dichotic presentation. Dichotic digits were the first stimuli to be used. Since they were presented in groups of three pairs, a memory component was introduced into the paradigm. The fact that they were meaningful words yet added another dimension to the task. To isolate what aspect of speech processing per se were lateralized required the use of other stimuli. The investigators at the Haskins laboratories were the first to use syllables consisting of a stop consonant and vowel, for example, pa, ta, da, etc. The consonant portion of the syllable also conveys information present in isolated vowel sounds, with the latter having a steady state character that is more musical in nature. The dichotically presented syllables showed a right ear advantage, while the isolated vowel sounds presented dichotically did not. This finding fits nicely with the idea that speech sounds have to be of a particular type, that is, possess certain acoustic characteristics, to engage a lateralized processor (Springer,1986).

It was Kimura who first introduced the concept of cerebral dominance as a major factor for accounting for lateral asymmetry in the perception of dichotically presented stimuli. Her conclusion is based on the finding of superior recognition of equal verbal material through the right ear by both normal and brain damaged groups. Kimura inferred that the right ear would have the advantageous connection with the left hemisphere which is the dominant hemisphere for language. Kimura's data show that patients with epileptogenic foci in either the left or the right hemisphere reported more verbal material presented to the right ear than the left ear. Following lobectomy of either side, she found that relatively greater loss for the recognition of digits at the side contralateral to the lesion. The overall performance level for the left damaged group was inferior to that of the right damaged group. However when the results of the dichotic experiment were analyzed according to which hemisphere was dominant for language, as determined by the intracarotid injection of sodium amytal, the opposite (dominant) hemisphere was found to have the advantage, whether or not the hemisphere was damaged. With normal subjects many researchers have confirmed Kimura's findings of right ear superiority for reporting dichotically presented digits (Schulhof & Goodglass, 1969).

4.5.2 THE VALIDITY OF THE DST.

The dichotic listening is valid for measuring ear asymmetry. Validity here means the extent to which the ear asymmetry predicts hemispheric asymmetry. Kimura (1961a, in Springer, 1986) herself conducted the first study of validity of dichotic listening by obtaining dichotic listening data on a group of patients tested with the sodium amytal procedure or Wada test. This test in which sodium amytal is injected into the internal carotid artery on one side of the body, temporarily anaesthetizes one hemisphere at a time on separate days before surgery to enable the neurosurgeon to see which side of the brain normally controls speech. In 107 patients shown to have speech controlled by the left-hemisphere, Kimura found the mean left ear correct score with dichotic digits to be 77, while the mean right ear score was 83. In contrast, the 13 subjects shown to have speech controlled by the right hemisphere showed a mean left ear score of 85 and a mean right ear score of 75. The maximum possible score for each ear was 96. The data has provided encouraging evidence of the validity of the dichotic test (Springer,1986).

4.5.3 THE RELIABILITY OF THE DST.

Reliability can be defined as the extent to which measurements are repeatable, in this case by using the same test at different times. The dichotic listening technique appears to be reliable. Blums, Goodglass and Tarter (1975, in Springer,1986) tested right handed subjects on a dichotic test. The test retest reliability coefficient was .74 for an 80 item test. Looking at just the direction of asymmetry, 27 of the 38 subjects, or 70% retained their initial ear preferences (Springer,1986). Many other researchers have since verified the reliability of this instrument.

4.5.4 PREPARATION OF THE DST TAPE

4.5.4.1 PROCEDURE

A major challenge to the present research was to prepare a DST - tape for Tsonga speaking children. The successful creation of this tape for future use by researchers is an important contribution of the present study.

The voice of a Tsonga lady with linguistic experience was recorded on a U-Matic video tape. A lady's voice was chosen because ladies appear to have a clearer tone of voice than males.

In order to make sure that an appropriate sequence of digits could be selected for the subjects, three series of digits were recorded namely: three digits, two digits, and single digits for each series of 20 digits respectively. The final selection for testing was based on two digits (See Appendix B). The selection of two numbers was based on test trials in which it transpired that the best response could be attained this way.

A computer program was written containing various series (eg 593 in the left ear and 462 in the right ear). This program individually presented these digits to the reader (the female voice). All the digits for one ear were first presented followed by the digits for the second ear. The numbers recorded on the computer, were presented on a video monitor, moving slowly across the screen. When a particular digit passed a line on the screen, the reader had to read the digit in an even and unemotional tone into a microphone. The digits that were read out, were recorded on separate U-matic video tapes for the two ears. These two video tapes were synchronized visually on a monitor. The singly synchronized video tape was then transferred to a cassette tape used to test the sample.

The 29 boys with high DST - scores and the 34 boys with low DST-scores now all completed the verbal battery, to be discussed in the next section.

4.6 THE VERBAL BATTERY

4.6.1 PROCEDURE

A suitable selection of verbal tests for sub standard A and sub standard B was devised by the class teachers and the researcher.

The test battery included the following aspects:

a. reading fluency,

b. reading understanding

c. reading spelling,

d. handwriting,

e. writing spelling,

f. writing understanding

g. vocabulary.

Sub A and sub B teachers were consulted to discuss the construction of the verbal battery. Sub A and sub B Tsonga text books were used. The words selected were according to the extent to which the teachers have taught at that period. The purpose of this was to avoid using words that were not taught to pupils and to allow every child to have fair and equal participation. Specific words selected for the construction of the verbal battery are to be found in **Appendix C**.

Reading fluency: children were asked to read a Tsonga paragraph from the textbook. The purpose of this subtest was to see how fluently they can read a paragraph.

Reading understanding: The purpose of this subtest was to see whether children understand the meaning of words they were asked to read.

Reading spelling: the subtest measures the ability of the children about spelling. The researcher read the word and asked the children to spell the words verbally.

Handwriting: the purpose of this subtest was to measure the writing ability of children. A short paragraph was given to children to copy.

Writing spelling : the subtest measures how well children can spell words in writing.

Writing understanding: the subtest measures how well children can follow instructions that has to do with the writing of sets of vowels.

Vocabulary: the subtest measures the ability of children about the meaning of words.

Validity and reliability of the verbal battery

If one is to interpret the score on a given test as an indicator of an individual's ability, that score must be both reliable and valid. These qualities are thus necessary to the interpretation and use of measures of languages abilities, and they are important qualities to be considered in developing and using tests (Bachman, 1990; Vallet,1977).

The validity of the present verbal battery is accepted. It was devised by experienced teachers. The reliability of the battery needs to be established. This was beyond the scope of the present research. However, the tests used in this research were based on work which children had learnt in the course of 5 months and their reliabilities are accepted. Education in South Africa has not contributed to a relevant and reliable verbal battery for Tsonga children between the ages 6 and 8 years old. However recommendations are made in Chapter seven for such studies to be conducted.

4.7 HYPOTHESES

The hypotheses of this study are as follow:

(H.A. = **alternative hypothesis**).

H.A. 1: There will be a statistically significant difference in the vector of averages between the two groups with reference to the total verbal battery.

H.A. 2-8:The two groups will differ statistically significantly in their averages on the:

H.A 2 Reading fluency test
H.A. 3 Reading understanding test
H.A. 4 Reading spelling test
H.A. 5 Handwriting test
H.A. 6 Writing spelling test
H.A. 7 Writing understanding test
H.A. 8 Vocabulary test

4.8 STATISTICAL ANALYSIS

A general MANOVA for only two groups will be performed to establish if the vector of averages for the two groups differs statistically significantly or not (Wilk's Lambda and RAO'S R). A Hotelling T2-test would have been equally appropriate.

If the vector of averages does differ significantly, then Student's t-test will be performed to establish in which of the subscales these differences occur.

4.9 Summary

Chapter 4 explained the empirical investigation. In this chapter the aim and motivation of the research were briefly described. The selection of test instrument was also described, and the procedures for the DST and verbal battery were discussed. Furthermore the hypotheses as well as the statistical analysis were attended to. Chapter 5 reports the test results and the discussion of the results follows in Chapter 6.

CHAPTER 5

5. RESULTS

This Chapter reports the test results, and the next chapter will focus on the discussion of these results. The results are presented in table 5.1

TABLE 5.1
Significance of difference between a group of Tsonga boys with a high versus low DST right ear scores with reference to a verbal test battery.

VERBAL TESTS	GROUP ONE HIGH DST R-EAR SCORES N=29		GROUP TWO LOW DST R-EAR SCORES N=34		2 TAILED T-TEST	P-VALUE
	X	SD	X	SD		
READING FLUENCY	6.517	2.668	4.647	2.616	2.803	.007**
READING UNDERSTANDING	7.414	2.307	6.941	2.51	0.773	.443
READING SPELLING	5.655	3.362	4.618	3.162	1.261	.212
HANDWRITING	3.345	1.01	2.706	0.799	2.803	.007**
WRITING SPELLING	6.551	2.473	5.705	2.444	1.362	.178
WRITING UNDERSTANDING	3.759	1.123	3.353	1.390	1.259	.213
VOCABULARY	17.483	2.246	15.765	3.652	2.202	.031*

** SIGNIFICANT AT 1% LEVEL
* SIGNIFICANT AT 5% LEVEL
WILK'S LAMBA :0.76314
RAO,SR :7.77
P :0.02957*

5.1 TEST RESULTS

Wilk's Lambda and RAO'S R were significant at the 5% level (p=.0295). This means that there were indeed statistically significant differences between the two groups in their verbal performance. H.A. 1 is thus accepted (the null hypothesis is rejected), and Student's t-test was performed. These results are presented in section 5.1.1.

5.1.1 VERBAL TESTS RESULTS

5.1.1.1 READING FLUENCY

The group with high DST scores had an average of 6.157, (SD =2.668), and the Low DST group had an average of 4.647, (SD= 2.616); the 2 tailed t-test was 2.803, with a p-value of .007, The p-value is statistically significant at the 1% level. The null hypothesis is rejected.

5.1.1.2 READING UNDERSTANDING

The group with high DST scores, obtained an average score of 7.414; (SD=2.307), and the Low DST group obtained an average score of 6.941; (SD=2.51); the 2 tailed t-test is .773, with a p-value of .443. The p-value is not statistically significant. The null hypothesis is accepted.

5.1.1.3 READING SPELLING

The group with high DST scores obtained an average score of 5.655; (SD=3.362), and the Low DST group an average score of 4.618; (SD=3.162); the 2 tailed t-test is 1.261, with the p-value of .212. The p-value is not statistically significant. The null hypothesis is accepted.

5.1.1.4 HANDWRITING

The group with high DST scores had a mean of 3.345; (SD= 1.01), and the group with Low DST scores had a mean of 2.706; (SD=.799); the 2 tailed t-test indicates 2.803, with the p-value of .007. The p-value appears to be statistically significant at the 1% level. The null hypothesis is rejected.

5.1.1.5 WRITING SPELLING

The high DST group scored an average of 6.551 (SD=2.473); on the other hand the low DST group scored an average of 5.706; (SD=2.443). The 2 tailed t-test is 1.362, with the p-value of .178; the p-value is not statistically significant. The p-value indicates that the results support the null hypothesis.

5.1.1.6 WRITING UNDERSTANDING

The high DST group had an average score of 3.759 (SD=1.123), and the low DST group had an average score of 3.353; (SD=1.390); the 2 tailed t-test is 1.259, with the p-value of .213. The p-value does not lie near the 5% level or 1% level, therefore it is not statistically significant. Therefore the null hypothesis must be accepted.

5.1.1.7 VOCABULARY

The high DST group obtained a mean of 17.483 (SD=2.246), and the Low DST group had a mean of 15.765 (SD=.651); the 2 tailed t-test is 2.202, with the p-value of .031. The p-value is statistically significant at the 5% level. The null hypothesis is rejected.

This Chapter is concluded by a summarizing statement that the test results agree with the major hypothesis that there will be a statistically significant difference in the vector of averages between the two groups with reference to the total verbal battery. The next chapter discusses the test results (Chapter 6).

CHAPTER 6

6. DISCUSSION OF THE RESULTS, CONCLUSION AND RECOMMENDATIONS

The primary objective of Chapter six is to discuss the saute results, as presented in chapter five, i.e. results will be placed in context. The research is concluded by making recommendations for future researchers.

6.1 DISCUSSION OF THE RESULTS

The primary aim of the present study was to ascertain if children with differential scores on the dichotic stimulation test also differ in terms of various verbal abilities. More specifically, two groups of right handed and right footed Tsonga boys between the ages of 6 and 8 years were selected according to strong left hemisphere language representation (high right ear DST scores 24 and >) and weak left hemisphere language representation (low right ear DST scores 23 and <). A verbal battery consisting of seven subtests, indicating reading fluency, reading understanding, reading spelling, handwriting, writing spelling, writing understanding, and vocabulary was administered.

This primary objective of the research was partly realised. The group with strong left hemisphere language representation obtained higher scores than the group with weak left hemisphere language representation in certain aspects of the verbal battery namely reading, handwriting, and vocabulary. The other four subtests of the verbal battery namely dimensions of comprehension and spelling did not show any statistically significant differences between the two groups. It is interesting to note however, that the group with high DST scores, consistently scored better although not statistically significantly in all the subtests (X=7.4 versus 6.9 for reading understanding, 5.7 versus 4.6 for reading spelling, 6.6 versus 5.7 for writing spelling and 3.7 versus 3.3 for writing understanding). With a larger sample, a standardized verbal battery and greater DST differentiation, future research could possibly also show statistically significant differences between the two groups in terms of these tests.

Realising the primary objective of the present research, also supported the secondary or general objective namely testing the theory that slow or incomplete lateralization in normal children will lead to speech, reading or writing deficits. The results certainly seem to support the Mac Farland (1981) explanatory model for developmental dyslexia, discussed in 3.6. Mac Farland (1981) proposes that lateralization is possibly slow to develop in some children, causing mostly temporary speech and language problems. In those children who do not outgrow it, a critical period for lateralization has passed by the time the visual-language connections, which caused the maturational lag, become functional. According to the pathway for language, depicted in para 3.5, the pathways from the visual to the language area (V-AG-B) is slow to develop causing slow lateralization.

This seems paticulary plausible because it is in the reading and writing terrain where the most significant differences between the two groups occurred.

The above hypotheses, supported by the present research, is substantiated by research done by Wissing and Guse (1991), in which it was found that the more lateralized a brain is, the greater the personal actualization.

6.2 RECOMMENDATIONS AND CONCLUSIONS

The following recommendations are made in connection with the present study:

Uncontrolled variables that could have influenced the results of the present study are education, maturation and socio-cultural factors. The control of these factors can be achieved by assessing teacher competency, teacher efficiency, as well as the environment of the child at home, (e.g. ascertaining whether the child speaks the language that is used as a medium of instruction at school, and whether the child receives informal education from his or her parents).

The final sample used to conduct this study consisted of 63 pupils ranging between the ages of six and eight. For a study on language lateralization to be more meaningful a bigger sample of at least hundred or more children should be selected . Different age levels could be tested and an assessment of adults could also contribute to a verification of the tested model (section 3.5).

The research groups were right ear high DST versus right ear low DST scores. Future researchers may focus on different groups whereby they compare right ear versus left ear, or left ear high DST versus left ear low DST scores etcetera. Lefthanders will be an interesting population, and also girls only or boys versus girls at different ages. A comparison of different ethnical groups would be important too.

The research instruments used for the investigation of lateralization of language was the dichotic listening technique, and the verbal battery. The DST is a valid and a reliable instrument in measuring asymmetry of language. Though valid and reliable, the test has some form of limitations, for example one has to select a number of digits according to the age of the sample being studied and one must also do a pre-test to see if the children can cope with a certain number of digits. This is a difficult thing to determine, because children differ from culture to culture, for example some children may perform well with two digits only and others in other cultures may need three or more digits for the test to be meaningful. Furthermore, digit sounds need to be acoustically clear for the subjects, and the environment from which the test is administered should be a quiet one. Such extraneous variables are also difficult to control. The degree of right ear advantage seems to differ from culture to culture for example the Anglo students reported more syllables from the right ear than the Navajo students. This cross-cultural factor is also not easy to assess and is time consuming. In this regard a suggestion is made for the designing of cross-cultural instruments, as this may bring about equal opportunity for all respondents, i.e utilizing non-meaningful verbal sounds.

The test battery used to assess the language abilities of the two groups was the verbal battery. At present there are no specific verbal tests for black children between 6-8 years. The verbal battery used for this research study was formulated by teachers in sub-standard A and B, and by the researcher. The verbal battery, although measuring what was intended to be measured,was not a standardized instrument. For this reason it is recommended that a standardized verbal test battery for various ethnical groups, for the particular group (6-8 years) be constructed.

In conclusion, a number of important issues relating to cerebral dominance or lateralization have emerged from this research project. Results have indicated that lateralization or left hemisphere dominance for language is a cross-cultural phenomenon in the South African context. It was previously indicated that research on lateralization has been done among the whites and asiatics, but no study of this kind has been done among the blacks. This research study should be regarded as the beginning and an incentive to other researchers interested in this field of study.

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APPENDICES

APPENDIX A: RAW DATA FOR THE DST. AND THE VERBAL BATTERY

NO DST LEVEL	R.FL	R.UN	R.SP	H.WR	WR.SP	WR.PAH	VOC.
1.8\29\1	3	7	3	3	8	4	13
2.3\29\2	5	6	5	3	5	3	18
3.11\24\2	3	7	2	4	8	5	18
4.6\33\1	6	9	3	6	3	4	17
5.7\24\1	2	9	2	3	5	3	20
6.10\29\0	9	8	5	3	7	3	13
7.6\31\3	8	2	3	2	3	1	12
8.5\36\0	9	9	9	3	9	4	19
9.10\28\1	4	8	3	2	5	3	20
10.9\31\0	9	9	10	4	9	5	20
11.8\34\0	8	6	7	4	9	4	16
12.3\28\5	8	6	3	4	9	5	18
13.7\16\2	1	7	1	1	1	1	9
14.4\15\3	4	5	2	2	4	3	9
15.6\24\2	3	6	1	3	4	2	17
16.12\28\0	7	9	9	4	8	4	19
17.7\35\0	9	10	10	4	9	5	20
18.5\37\2	8	10	3	4	8	4	20
19.9\31\0	9	10	10	3	7	3	19
20.8\19\4	5	9	1	3	8	5	16
21.3\17\1	4	3	1	2	4	0	9
22.12\24\3	9	10	7	4	9	4	20
23.12\23\5	9	10	10	3	8	4	19
24.14\27\0	1	7	1	1	2	2	15
25.13\24\5	4	6	4	2	6	3	13

26.16\23\1	7	10	7	3	8	4	20
27.24\9\3	7	10	9	3	8	4	20
28.23\16\0	4	10	9	3	6	3	18
29.6\8\3	1	7	2	1	0	0	17
30.12\6\8	4	6	4	3	8	3	17
31.26\15\2	6	8	4	3	7	5	20
32.15\14\0	1	0	2	1	3	1	10
33.10\14\6	3	4	2	3	5	3	13
34.8\6\6	2	6	1	2	4	4	15
35.13\22\3	2	4	2	2	5	3	12
36.15\19\1	9	9	5	3	7	4	20
37.17\21\3	1	6	1	2	2	2	15
38.16\25\2	8	9	1	4	8	4	20
39.8\24\7	9	7	8	4	8	5	15
40.0\40\0	9	4	2	3	4	4	16
41.9\27\1	7	9	6	4	5	5	17
42.4\35\0	9	10	9	3	10	5	18
43.10\28\0	3	4	2	2	5	3	17
44.6\28\2	9	10	8	5	10	5	20
45.4\36\0	9	5	10	4	10	5	18
46.1\39\0	6	6	4	3	6	4	17
47.11\23\2	4	8	9	3	6	3	19
48.11\27\0	5	8	4	3	6	3	19
49.6\34\0	1	6	1	3	3	2	15
50.6\31\0	8	6	9	4	7	5	16
51.1\4\0	2	3	5	2	3	3	18
52.1\40\0	3	10	0	3	4	2	18
53.12\24\4	3	8	2	3	4	4	15

54.16\23\0	6	10	9	3	5	5	19
55.14\25\2	7	9	10	4	8	5	19
56.15\23\0	4	5	7	3	6	4	15
57.23\17\1	3	4	5	2	2	3	9
58.18\14\5	7	9	9	3	8	4	16
59.16\24\7	3	3	1	2	3	2	11
60.14\24\0	9	5	8	4	10	5	18
61.16\18\1	4	7	5	3	7	4	18
62.16\20\0	7	8	8	3	7	4	16
63.11\24\0	8	10	7	3	8	5	18

APPENDIX B: DST TEST ADMINISTRATION AND THE DST DOUBLE DIGITS

DICHOTIC LISTENING TEST ADMINISTRATION

GOOD MORNING\AFTERNOON

Ndzi ta kunyika tape recorder le yi nga na ti headphones. Xo sungula u ta fanela ku yingisela endzaku u ta ndzi byela tinomboro leti uti tweke. Tinwana tinomboro u ta ti twa kambe tinwana u ta ti rivala kumbe u nga ti twi kahle, kambe sweswo swinga ku vilerisi.

Xo sungula hi ta rhanga hi ku prakatisa leswaku uta tolovela. Endzaku ka ku prakatisa u ta endla hi wexe wa swi twa!.

A hi sunguli

SECOND OR (DOUBLE DIGITS) WERE USED FOR THE DST. AND THEY ARE AS FOLLOW:

NUMBERS FOR THE RIGHT EAR

3 NHARHU 2 MBIRHI

5 NTLHANU 4 MUNE

7 NKOMBO 6 NTSEVU

9 NKAYE 8 NHUNGU

2 MBIRHI 3 NHARHU

4 MUNE 5 NTLHANU

6 NTSEVU 7 NKOMBO

8 NHUNGU 9 NKAYE

3 NHARHU 2 MBIRHI

5 NTLHANU	4 MUNE
7 NKOMBO	6 NTSEVU
9 NKAYE	8 NHUNGU
2 MBIRHI	3 NHARHU
4 MUNE	5 NTLHANU
6 NTSEVU	7 NKOMBO
8 NHUNGU	9 NKAYE
3 NHARHU	2 MBIRHI
5 NTLHANU	4 MUNE
7 NKOMBO	6 NTSEVU
9 NKAYE	8 NHUNGU

DIGITS FOR THE LEFT EAR

4 MUNE	9 NKAYE
6 NTSEVU	8 NHUNGU
5 NTLHANU	3 NHARHU
7 NKOMBO	4 MUNE
2 MBIRHI	5 NTLHANU
3 NHARHU	6 NTSEVU
9 NKAYE	2 MBIRHI
4 MUNE	6 NTSEVU
6 NTSEVU	9 NKAYE
2 MBIRHI	7 NKOMBO
3 NHARHU	5 NTLHANU
4 MUNE	6 NTSEVU
8 NHUNGU	4 MUNE
2 MBIRHI	5 NTLHANU
3 NHARHU	7 NKOMBO

4 MUNE	6 NTSEVU
5 NTLHANU	9 NKAYE
8 NHUNGU	2 MBIRHI
5 NTLHANU	3 NHARHU
2 MBIRHI	4 MUNE

APPENDIX C: VERBAL BATTERY SCORING SHEET AND THE VERBAL BATTERY QUESTION PAPER FOR THE SUB-STANDARD A AND THE SUB-STANDARD B PUPILS

VERBAL BATTERY SCORING SHEET FOR SUB-STANDARD A PUPILS

NAME:...............DATE OF BIRTH:....................

SCHOOL:.............AGE:......STD:....................

TEACHER:......................

1. READING

1.1. FLUENCY (10)

1.2. UNDERSTANDING (10)

A.

B.

C.

D.

E.

1.3. SPELLING (10)

A.

B.

C.

D.

E.

2. WRITING

A. HANDWRITING (5)

B. SPELLING (10)

C. APHASIC TENDENCIES (5)

3. VOCABULARY (20)

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

TOTAL: (70)

VERBAL BATTERY FOR SUB-STANDARD A PUPILS

1. READING

and wa deya.

deya and deya.

and wa mama.

deya wena and. (10)

1.1. READING FLUENCY (10)

1.2. READING UNDERSTANDING (10)

mama

deya

tana

haha

meno

1.3. READING SPELLING (10)

and

mama

deya

tana

wena

2.WRITING (10)

o n i

a u r

c m e

a. Handwriting (5)

b. Spelling (10)

c. Aphasic Tendencies (5)

3.UNDERSTANDING (20)

tana hleka haha yiva famba

deya rila meno mama homu

TOTAL:(70).

VERBAL BATTERY SCORING SHEET FOR SUB-STANDARD B PUPILS

NAME:......................DATE OF BIRTH....................

SCHOOL:....................AGE:....STD:....................

TEACHER....................

1.READING

1.1. READING FLUENCY (10)

1.2. READING UNDERSTANDING (10)

A.

B.

C.

D.

E.

1.3. READING SPELLING (10)

A.

B.

C.

D.

E.

2.WRITING

A.HANDWRITING (5)

B.SPELLING (10)

C.APHASIC TENDENCIES (5)

3.VOCABULARY (20)

A.

B.

C.

D.

E.

F.

G.

H.

I

J.

TOTAL:(70).

VERBAL BATTERY FOR SUB-STANDARD B PUPILS

1.READING

Hi ka wena Dedeya miyela, Kokwana wa vabya. Vona Kokwana u etlele hikuva wa vabya. Swi lo yini namuntlha Kokwana? Ndza vabya n'wana wa n'wananga. Mi karhata hi yini ka Kokwana? Ndzi karhata hi nhloko, ya pandza.

1.1. Reading Fluency (10)

1.2. Reading Understanding (10)

kokwana

N'wana

Ku karhata

Vavbya

Ku pandza hi nhloko

1.3. Spelling (10)

Kokwana

N'wana

Vabya

Deya

Miyela

2. WRITING (dictate a short paragraph)

Kokwana u endzela hahani.

Hahani u ta tsaka ngopfu.

a. Handwriting (5)

b. Spelling (10)

c. Aphasic tendencies (5)

3.VOCABULARY (20)

mbuwetela

miyela

rila

dyana

meno

nghala

timanga

mama

etlela

tsaka

TOTAL: (70)